A Benefits Document Supporting the Continued Registration of Flubendiamide (Belt® SC)

Data Requirements
None

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Information claimed confidential on the basis of its falling within the scope of FIFRA, Section 10(d),1(A), (B), or (C) has been removed throughout the document to a Confidential Business Information Appendix and replaced with a numerically sequenced placeholder sentence, “CBIx text located in the Confidential Business Information Appendix”.

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Bayer CropScience AG

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This document is informational, and is not the result of a study as defined by 40 CFR 160.3. Since the document does not report a study, no GLP (40 CFR 160 *or* Current OECD Principles of Good Laboratory Practices) statement is required as per PR Notice 2011-3 (VI)(C)(3), p. 11.

Study Director: There is no study director for this document

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Notes to Reviewer

Note to Reviewer: Confidential Business Information (CBI) has been removed to a Confidential Appendix F, and replaced throughout the document with a numerically sequenced placeholder sentence, "CBIx text located in the Confidential Business Information Appendix". In the Confidential Business Information Appendix, the CBI text can be found in numerical sequence corresponding to the placeholder sentence noted above.

Note to Reviewer: This document is best read using Adobe.

Note to Reviewer: The following pesticide names may be used interchangeably.

TABLE 1. Pesticide, Seed Brand and Trait Names Referenced in this Document.

Common Name	Product Name (EPA Reg. No.)
---	Bollgard®II[1] Insect Protected Cotton
Abamectin	Agri-Mek®[2], Numerous brands (numerous)
Acephate	Orthene®[3] , Numerous brands (numerous)
Acetamiprid	Assail®[4] (8033-36-70506)
Alpha-cypermethrin	Fastac™ [5] (7969-298)
Bifenthrin	Brigade®[6] , Capture®[7] , Numerous brands (numerous)
Buprofezin + flubendiamide	Tourismo[8] (71711-33) Vetica[9] (71711-32)
Chlorantraniliprole	Altacor®[10] (352-730) Coragen®[11] (352-729) Prevathon®[12] (352-844)
Clorantraniliprole + lambda-cyhalothrin	Voliam Xpress®[13] (100-1320)
Clofentezine	Apollo®[14] (66222-47)
Cyantranilipriole	Exirel®[15] (352-859) Verimark®[16] (352-860)
Cyfluthrin	Baythroid®[17] (264-840)
Cypermethrin	Ammo®[18] (279-3027-5905)
Deltamethrin	Delta Gold®[19](264-1011-1381)
Dicofol	Dicofol 4E® (66222-56)
Diflubenzuron	Dimilin®[20] (400-461)
Esfenvalerate	Asana XL®[21] (59639-209)
Fenpropathrin	Danitol®[22] (59639-35)
Flubendiamide	Belt®[23] SC (264-1025)
Gamma-cyhalothrin	Declare®[24] (67760-96)
Gamma-cyhalothrin + spinosyn	Consero®[25](34704-953)
Hexythiazox	Savey®[26] (10163-250)
Imidacloprid	Admire® Pro[27](264-827)
Indoxacarb	Avaunt®[28] (352-597)

Common Name	Product Name (EPA Reg. No.)
	Steward EC[29] (352-638)
Lambda-cyhalothrin	Karate®[30] (100-1097) Warrior®[31] (100-1295)
Lambda-cyhalothrin + thiamethoxam	Voliam Flexi®[32](100-1319)
Methomyl	Lannate LV ®[33] (352-384)
Methoxyfenozide	Intrepid®[34] (62719-442)
Methoxyfenozide + spinetoram	Intrepid Edge™[35] (62719-666)
Novaluron	Rimon 0.83®[36] (66222-35-400)
Permethrin	Numerous brands (numerous)
Phosmet	Imidan®[37] (10163-169)
Pyrethrins	Numerous brands (numerous)
Spinetoram	Delegate®[38] (62719-541) Radiant®[39] (62719-545)
Spinosad or spinosyn	SpinTor®[40] (62719-294) Success®[41] (62719-292) Tracer®[42] (62719-267) Blackhawk®[43] (62719-523) Entrust®[44] (62719-621) Conserve SC®[45] (62719-291)
Thiodicarb	Larvin 3.2®[46] (264-379)
Zeta-cypermethrin	Mustang®[47] (279-3426)

Note to Reviewer: The following insect names may be used interchangeably in this document.

TABLE 2. Common and Scientific Names of Insects Referenced in this Document.

Insects	
Common Name	**Scientific Name**
Ants	Various species
Aphid	Various species
Alfalfa looper	*Autographa californica*
Eurpopean Apple Saw Fly	*Hoplocampa testudinea*
Apple maggot	*Rhagoletis pomonella*
Armyworms	*Various species*
Beet armyworm	*Spodoptera exigua*
Bertha armyworm	*Mamestra configurata*
Black cutworm	*Agrotis ipsilon*
Braconid wasp	Various species
Bumblebee	*Bombus spp.*
Cabbage looper	*Trichoplusia ni*
Cabbage maggot	*Hylemya brassicae*
Cherry fruit fly	*Rhagoletis cingulata*
Codling moth	*Cydia pomonella*
Corn earworm	*Helicoverpa zea*
Cotton bollworm	*Helicoverpa zea*
Cotton leaf perforator	*Bucculatrix thurberiella*
Cotton leafworm	*Spodoptera littoralis*
Cutworms	*Agrotis spp.*
Diamondback moth	*Plutella xylostella*
European corn borer	*Ostrinia nubilalis*
Eyespotted bud moth	*Spilonota ocellana*
Fall armyworm	*Spodoptera frugiperda*
Fall webworm	*Hyphantria cunea*
Fireants	*Solenopsis invicta*
Fleabeetles	*Epitrix spp.*, others
Flies	Various species
Grape leaffolder	*Desmia funeralis*
Grapeleaf skeletonizer	*Harrisinia americana*
Green fruitworm	*Lithophane antennata*
Green lacewing	*Various species*
Hickory shuckworm	*Cydia caryana*
Honeybee	*Apis mellifera*
Horn-faced bee	*Osmia cornifrons*
Hornworms	*Manduca spp.*
Imported cabbageworm	*Pieris rapae*

Insects	
Common Name	**Scientific Name**
Katydids	*Tettigoniidae spp.*
Laconobia fruitworm	*Lacanobia subjuncta*
Lady beetle	*Harmonia axyridis and Coccinella septempunctata*
Liriomyza leafminers	*Liriomyza trifolii, L. huidobrensis, L. sativae*
Leafrollers	*Choristoneura spp., Pandemis spp., Archips spp.*, others
Lepidoptera leafminers	Various species
Lesser appleworm	*Grapholita prunivora*
Loopers	*Trichoplusia spp.*, others
Lygus bug	*Lygus spp.*
Melonworm	*Diaphania hyalinata*
Mites	Various species
Navel orangeworm	*Ameylois transitella*
Obliquebanded leafroller	*Choristoneura rosaceana*
Omnivorous leafroller	*Platynota stultana*
Orange tortrix	*Argyrotaenia citrana*
Oriental fruit moth	*Grapholita molesta*
Paper wasp	*Polistes spp. and others*
Parasitic wasp	*Encarsia formosa, Aphidius colemani, Cotesia glomerata, Campoletis sonorensis, Goniozus legneri,* and *Pentalitomatix plecthricus*
Peachtree borer	*Synanthedon exitiosa*
Peach twig borer	*Anarsia lineatella*
Pear psylla	*Cacopsylla pyricola*
Pecan nut casebearer	*Acrobasis nuxvorella*
Pecan weevil	*Curculio caryae*
Pickleworm	*Diaphania nitidalis*
Plum curculio	*Conotrachelus nenuphar*
Predatory bug	*Orius spp.*
Predatory midge	*Aphidoletes aphidimyza*
Predatory mite	*Amblyseius cucumeris* and *Phytoseiulus persimilis*
Redbanded leafroller	*Argyrotaenia velutinana*
Redheaded pine sawfly	*Neodiprion lecontei*
Redhumped caterpillar	*Schizura concinna*
Rindworms	Various species
Saltmarsh caterpillar	*Estigmene acrea*
San Jose scale	*Quadraspidiotus perniciosus*
Sawflies	Various species
Scales	Various species
Serpentine leafminer	*Liriomyza brassicae*

Insects	
Common Name	**Scientific Name**
Silkworm	*Bombyx mori*
Southern armyworm	*Spodoptera eridania*
Southwestern corn borer	*Diatraea grandiosella*
Spider	*Pardosa pseudoannulata* and *Misumenops tricuspidatus*
Spined stiltbug	*Jalysus spinosus*
Spotted tentiform leafminer	*Phyllonorycter blancardella*
Stilt bug	*Jalysus wickhami*
Stinkbug	*Various species*
Tachinid fly	*Various species*
Tent caterpillar	*Malacosoma spp.*
Thrips	*Frankliniella spp, Thrips spp,* others
Tobacco budworm	*Heliothis virescens*
Tomato fruitworm	*Helicoverpa zea*
Tomato pinworm	*Keiferia lycopersicella*
Tufted apple budmoth	*Platynota idaeusalis*
Tussock moths	*Orgyia spp.*
Variegated leafroller	*Platynota flavendana*
Walnut caterpillar	*Datana integerrima*
Walnut husk fly	*Rhagoletis completa*
Western bean cutworm	*Richia albicosta*
Western cherry fruit fly	*Rhagoletis indifferens*
Western flower thrips	*Frankliniella occidentalis*
Western raspberry fruitworm	*Byturus bakeri*
Western tussock moth	*Orgyia vetusta*
Western Yellowstriped armyworm	*Spodopera praefica*
Whiteflies	*Trialeurodes vaporariorum* and others
Worms	Various species
Yellowstriped armyworm	*Spodoptera ornithogalli*

Note to Reviewer: The following definitions are implied in this document:

Bayer CropScience (BCS): Bayer CropScience LP.

Crop Safety: The ability of a crop to recover from inadvertent or accidental exposure to a pesticide.

Crop Tolerance: The ability of a crop to tolerate or withstand the action of an applied pesticide.

Driver Insect Pests: Difficult to control economically important insect species. Growers generally focus insect control practice decisions on management of driver insect species. Driver insects include beet armyworm, navel orangeworm, soybean looper, corn earworm and tobacco budworm.

Economic Threshold: In general terms an economic threshold would be considered as the cost-benefit relationship of treating a crop in this case with an insecticide. This economic threshold varies based on the specific crop and pest as well as the potential injury at various stages of development, varying climatic conditions, nutritional stresses, varietal differences, the purpose for which the crop is grown as well as fluctuating market values.

Genetically Engineered (GE) Crop: The group of applied techniques of genetics and biotechnology used to cut up and join together genetic material and especially DNA from one or more species and to introduce the result into an organism in order to change one or more of its characteristics.

Integrated Pest Management (IPM) Friendly Insecticides: Insecticides with limited to no effects on beneficial arthropods, does not flare secondary pests, compatible with IPM programs. Examples include flubendiamide, chlorantraniliprole, diflubenzuron, indoxacarb and methoxyfenozide.

IPM Disruptive Insecticides: Significant to severe effects on beneficial arthropods, may or routinely flares secondary pests, limited incompatibility to incompatible with IPM programs. Examples include: bifenthrin, cyfluthrin, cypermethrin, lambda-cyhalothrin and methomyl.

Insecticide Resistant (IR) Insect: An insecticide resistant insect is a member of a population within a species that has an inherited ability to survive and reproduce following exposure to a dose of insecticide normally lethal to susceptible populations of the species. Through repeated insecticide selection, the resistant population becomes dominant in a given area.

Mode of Action (MOA): The mode of action is the overall manner in which an insecticide affects an insect at the tissue or cellular level.

LIST of TABLES

Table 50: Relative Performance Rankings, Based on Research Plot Studies, by Southern University Entomologists of Insecticides Used to Control Lepidopteran Pests in Soybeans (1-10 scale with 10 being the highest).

Table 50. Relative Performance Rankings by Southern University Entomologists of Insecticides Used for Control of Lepidoptera Pests in Cotton (1-10 scale with 10 being the highest).

LIST OF FIGURES

1. Executive Summary

Bayer CropScience (BCS) provides this Benefits Document as evidence and documentation to support our position that the continued registration of flubendiamide for crop use is in the public interest. A thorough examination of the information and data provided in this document will support this decision.

Flubendiamide is a foliar applied selective insecticide, formulated as a water-based suspension concentrate (SC) containing 4 pounds active ingredient per gallon, known in the marketplace as Belt® SC Insecticide. Chemically, flubendiamide is a phthalic acid diamide and is listed in Group 28 as a Ryanodine Receptor Modulator. Flubendiamide offers producers a valuable tool for use in IPM and IRM programs. The benefits that strongly support the continued registration of flubendiamide are summarized in Table 3.

TABLE 3: Benefits that flubendiamide offers to growers.

Benefits
1.1. Flubendiamide offers unique attributes which make it compatible with and easily integrated into IPM and IRM programs in over 200 crops, providing broad-spectrum control of over 95 lepidopteran insect pests, including driver species like beet armyworm, navel orangeworm, soybean looper, corn earworm and tobacco budworm. a. Non-systemicity of flubendiamide is a benefit for IPM and IRM in many crops. b. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems. c. The economic and performance value of flubendiamide promotes its use over inexpensive “IPM disruptive” insecticides.
1.2. Flubendiamide offers a mode of action with no known cross resistance to alternative modes of action for management of resistant lepidopteran pests in over 200 crops.
1.3. Flubendiamide offers superior length of control compared to pyrethroid insecticides.
1.4. Flubendiamide has low acute toxicity, a short REI/PHI and a favorable environmental risk profile which ensures minimal impact on applicators, field workers and the environment.

1.1. Flubendiamide offers unique attributes making it compatible with and easily integrated into IPM and IRM programs. These attributes are:

a. Non-systemicity of flubendiamide is a benefit for Integrated Pest Management (IPM) and Insecticide Resistance Management (IRM) in many crops.

The non-systemicity of flubendiamide gives growers the option to apply a treatment window approach to insecticide resistance management. Treatment windows are described in IRAC documents as a method for controlling the exposure of an insect population to a specific mode of action by alternating chemistries in a pattern to minimize extended periods of exposure to one mode of action.

b. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems.

Unlike pyrethroids, flubendiamide does not harm predatory mites in various crops and, as a result, does not flare mites. Flubendiamide has been tested under semi-field and field conditions for its selectivity against key beneficial arthropods and has been found to be harmless to slightly harmful on the relevant beneficial insects, based on the International Organization for Biological and Integrated Control (IOBC) classification. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems.

c. The economic and performance value of flubendiamide promotes its use over inexpensive "IPM disruptive" insecticides.

As an economical, high performance, IPM friendly insecticide, flubendiamide's low relative cost promotes its use in IPM systems, especially in broad acre crops like alfalfa, peanuts and soybeans. Based on market research data, variable region to region, inexpensive pyrethroids comprise the majority of "IPM disruptive" insecticides. Flubendiamide is among the least expensive "IPM friendly" insecticides, and is less than half the average cost of chlorantraniliprole, its major phthalic diamide competitor. The loss of flubendiamide would likely result in a significant increase in pyrethroid use in alfalfa, peanuts and soybeans. > CBI1 text located in the Confidential Business Information Appendix <

1.2. Flubendiamide offers a mode of action with no known cross resistance to alternative modes of action for management of IR lepidopteran insect pests in over 200 crops.

Flubendiamide is greatly needed to help manage insect resistance because it brings broad spectrum Lepidoptera control; a Group 28 Ryanodine Receptor Modulator MOA; and proven performance for the control of driver IR insects in alfalfa, almond, peanuts, soybeans, tobacco and over 200 other crops. Insect resistance is spreading rapidly; many insecticides are no longer providing consistent control. Insecticides like flubendiamide, offering a unique MOA, are desperately needed by growers.

1.3. Flubendiamide offers superior length of control compared to pyrethroid insecticides.

Flubendiamide works by ingestion, and when used according to label directions, poses minimal risk to beneficial arthropods while providing long residual control of target insects. Flubendiamide is an “IPM friendly”, high performance product that promotes reduced overall insecticide use by negating any short-term need for repeated insecticide applications.
Pyrethroids have contact activity, comparatively short residual activity, and are highly disruptive to beneficial populations. As a result, pyrethroids provide a relatively short length of control of target pests.

1.4. Flubendiamide has low acute toxicity, a short REI/PHI and a favorable human health and environmental risk profile which ensures minimal impact on applicators, field workers and the environment.

With a “Caution” signal word, 12 hour REI, favorable PHI’s, and high IPM and IRM compatibility, flubendiamide offers safety, flexibility, and low bee toxicity equal to chlorantraniliprole and methoxyfenozide, and superior to the other commercial standards. Methomyl has a “Danger” signal word, while bifenthrin, cyfluthrin and lambda-cyhalothrin have “Warning” signal words and are classified as Restricted Use pesticides due to risks they pose to fish and aquatic organisms.

Crop Specific benefits are described in the following paragraphs:

Benefits of flubendiamide to Soybean Growers:

Based on current use patterns and the significant pricing difference between flubendiamide and other IPM-friendly competitors, we believe removal of flubendiamide from the soybean marketplace will result in an increase in IPM-disruptive pyrethroids.

Benefits of flubendiamide to Tree Nut Growers:

It is anticipated that the removal of flubendiamide from the tree nut sector, specifically almond, would increase the use of pyrethroids specifically targeting peach twig borer. This increase in the use of pyrethroids would disrupt beneficials used in IPM and would likely flare mite populations, leading to increased usage of miticides and increasing overall environmental loading.

Benefits of flubendiamide to Peanut Growers:

We believe if flubendiamide is removed from the peanut marketplace growers will switch to using IPM-disruptive insecticides resulting in secondary pest infestations and a greater amount of insecticide being applied season-long or increase their use of diflubenzuron or methoxyfenozide, increasing the selection pressure on these chemistries and promoting the development of insecticide resistance. The current product availability in peanuts provides an ideal portfolio of choices for growers with the options to rotate insecticide mode of action, retaining the utility of a variety of tools to control caterpillar pests.

Benefits of flubendiamide to Tobacco Growers:

Based on current use patterns and input from University stakeholder, such as Dr. Hannah Burrack, we believe the removal of flubendiamide from the market would likely result in increased reliance on IPM-disruptive chemistries such as acephate and pyrethroids. This would have negative environmental and human safety impacts in tobacco production.

Benefits of flubendiamide to Alfalfa Growers:

Based on the current insecticide use patterns in alfalfa, and the relatively high price of leading IPM-friendly competitors, we believe if flubendiamide is removed from the marketplace, growers are likely to increase their use of IPM disruptive pyrethroid insecticides. The use of pyrethroids will likely increase the amount of insecticide applications made during the season and cause secondary pest outbreaks such as aphids - typically suppressed by parasitoids.

Benefits of flubenidamide to Cotton Growers:

If flubendiamide is removed from the cotton marketplace, we believe it will increase use of pyrethroids. This assertion is based on the current reliance on pyrethroid chemistries to control caterpillars in cotton grown in the southeast. In the case of growers who prefer to use IPM-friendly products, growers will likely increase their reliance on novaluron and spinetoram, increasing the selection pressure on these chemistries and potentially decreasing their life-span as a valuable tool for growers to manage insecticide resistance.

Benefits of flubendiamide to Tomato Growers:

Flubendiamide offers growers the opportunity to apply a treatment window approach to pest management.The narrow spectrum of activity of flubendiamide minimizes the risk of resistance developing in other insect pests present in the crop, such as leafminers. In Florida, resistance in leafminers to chlorantraniliprole has been documented. The excellent price point of flubendiamide makes it a more economic choice for growers who want to apply a product that only controls caterpillars and provides rapid feeding cessation to prevent injury to fruit. If flubendiamide is removed from the market it is likely the use of spinetoram, chlorantraniliprole and methoxyfenozide will increase, placing more selection pressure on these chemistries.

Benefits of flubendiamide to Pepper Growers:

If flubendiamide is removed from the market, it is likely the use of spinetoram, spinosyn, chlorantraniliprole and methoxyfenozide will increase, placing more selection pressure on these chemistries. This also creates a greater risk for resistance development in leafminers, a group of insects which historically develop resistance very quickly.

Benefits of flubendiamide to Grape Growers:

If flubendiamide is removed from the market, it is likely the use of methoxyfenozide, spinetoram, and chlorantraniliprole will increase placing more selection pressure on these chemistries. The use of flubendiamide when necessary for caterpillar control allows growers to be extremely selective in their control of caterpillar pests in grapes and presents no risk to resistance development in other groups of insects that may coexist with caterpillars.

Benefits of flubendiamide to Watermelon Growers:

If flubendiamide is removed from the market, it is likely one of two things could happen: growers will switch to chlorantraniliprole or the use of pyrethroids will increase. Either option has a downside. If growers switch to chlorantraniliprole, their lepidopteran pest control costs will increase significantly and growers extend the exposure period of their target insect population to the group 28 mode of action, increasing selection pressure. If growers switch to pyrethroids, they will disrupt the IPM balance of the watermelon field with subsequent increases in secondary pest problems, such as mite flares.

Benefits of flubendiamide to Broccoli Growers:

If flubendiamide is removed from the marketplace, we expect to see increased use of spinetoram and chlorantraniliprole. A reliance on spinetoram will likely result in increased insecticide use during the season due to the short window of residual activity. Increased reliance on chlorantraniliprole will place more pressure on group 28 chemistries because of the extended exposure this product presents to diamond back moth species. Both scenarios would diminish a grower's ability to effectively manage this pest over the long term.

Benefits of flubendiamide to Lettuce Growers:

If flubendiamide is removed from the market, growers will likely continue with their current use patterns of insecticides, with a majority relying on IPM-disruptive pyrethroids. The continued registration of flubendiamide in the lettuce markets, provides an economic and efficacious alternative to pyrethroids, encouraging growers to adopt IPM practices.

Benefits of flubendiamide to Snap Bean Growers:

If flubendiamide is removed from the legume vegetable market, we believe the use of IPM disruptive pyrethroids will increase. This is based on the low adoption of IPM friendly products in this market. Increased use of pyrethroids will cause more secondary pest problems, such as flares of mites. It will likely increase the insecticide use season-long.

Benefits of flubendiamide to Strawberry Growers:

If flubendiamide is removed from the strawberry market, growers are likely to either increase the use of other IPM-friendly products or increase use of pyrethroids. If they increase the use of other IPM-friendly products, they may increase their total amount of product used season-long because of the short window of control provided by the top three most used products. Alternatively, if they switch to pyrethroids, they will likely encounter secondary pest problems, such as spider mites, a major pest problem on strawberries grown in California.

Stewardship comment:

BCS has implemented product stewardship measures to avoid the development of insect resistance and ensure the efficient, effective, and safe use of flubendiamide through implementation of sound Integrated Resistance Management (IRM) programs. Product Stewardship is the responsible and ethical management of a product throughout its life-cycle, from its invention, through to its ultimate use and beyond.

If BELT is removed from the marketplace:

The removal of BELT from the market increases the risk of growers returning to IPM-disruptive chemistries - such as organophosphates and pyrethroids - which pose environmental risk and human safety issues.

2. Introduction

2.1. Purpose of Analysis

This document is designed to provide specific evidence and documentation to support the position that the continued registration of flubendiamide for crop use is in the public interest. Bayer CropScience (BCS) is confident that a thorough examination of the information and data provided in this document will support this decision.

2.2. Scope and Limitations of Assessment

> CBI2 text located in the Confidential Business Information Appendix < Flubendiamide is also registered for use on a wide array of crop groupings containing numerous minor-use crops. The benefits of flubendiamide relative to alternative chemical control products used in these crops will be presented. The assessment was conducted using information from BCS, GfK Kynetec, published literature, letters of support from various University IPM Specialists, and Crop Profiles available from The National Information Center for the Regional IPM Centers.

3. Product Profile

Today, flubendiamide is authorized by Regulators in over 35 countries for use in over 200 crops, including the United States, Australia, Brazil, Canada, China, and India. Flubendiamide has excellent activity against a broad spectrum of lepidopteran insect pests such as armyworms, corn borers, loopers, bollworms, cutworms, fruitworms and diamondback moth (See Efficacy Data in Appendix B). The human hazard and exposure profile of flubendiamide is well understood and presented in “NNI-0001 (Flubendiamide): Human Health Risk Assessment for Use on Corn, Cotton, Tobacco, Tree Fruit, Tree Nut, Vine Crops and Vegetable Crops”, MRID 46817252. The environmental/ecological hazard and exposure profile of flubendiamide is also well understood and presented in “Environmental fate and ecological risk assessment for NNI-0001”, (MRID 46817251), and recent water/sediment study results and aquatic risk evaluations (MRID 49415301, 49415302, 49415303, Report No. US0485/M-517598-01-1). The mammalian toxicology and residue data indicate that risks to consumers and workers are acceptable and meet EPA criteria of reasonable certainty of no harm to human health. Similarly the environmental and ecological exposure and risk assessments demonstrate that the use of flubendiamide will result in no unreasonable risk to the environment.

Flubendiamide is a foliar applied selective insecticide, formulated as a water-based suspension concentrate (SC) containing 480 grams of flubendiamide per liter (4 pounds ai per gallon), known in the marketplace as Belt® SC Insecticide. Flubendiamide provides reliable, cost effective, and environmentally sound control of over 95 commercially important lepidopteran pests in over 200 crops, including many minor-use crops. Chemically, flubendiamide is a phthalic acid diamide and is listed in MOA Group 28 as a Ryanodine Receptor Modulator (IRAC mode of action classification system). Flubendiamide is an activator of ryanodine-sensitive calcium release channels (ryanodine receptors, RyRS), which invokes or “locks” the ryanodine receptors into an open state, evoking a massive calcium release from intracellular stores and causing muscle contraction. This causes rapid cessation of feeding, followed by paralysis and larval death. The most typical visual symptom of treatment occurs one to two hours after application. The treated larvae contract to half the size of untreated larvae. Belt shows a slight ovi-larvicidal effect on eggs. At hatching, larvae begin to chew through the chorion. Some larvae die within the egg before hatching. Other larvae get stuck in the chorion and die. Still others manage to hatch, but show characteristic poisoning symptoms (constriction) and die very soon after emergence. Rapid feeding cessation will keep caterpillars from causing additional damage to crops.

Flubendiamide offers unique attributes which make it compatible with and easily integrated into Integrated Pest Management (IPM) and Insecticide Resistance Management (IRM) programs. Flubendiamide is an economical, high performance, “IPM friendly” insecticide. Flubendiamide is a highly selective product with excellent control of lepidopteran pests. Flubendiamide has been tested for selectivity against key beneficial arthropods and has been found to be harmless to slightly harmful to relevant beneficial insects based on the International Organization for Biological and Integrated Control classification. Unlike pyrethroids, flubendiamide does not harm predatory mites, and as a result, does not flare phytophagous mites. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems. It offers superior rainfastness and length of control, reducing the need for repeat applications. Flubendiamide is among the least expensive “IPM friendly” insecticides and costs less than half as much as chlorantraniliprole, its major phthalic diamide competitor. The low relative cost of flubendiamide promotes its use over inexpensive “IPM disruptive” insecticides. With a “Caution” signal word, 12 hour REI, favorable day PHI, and high IPM/IRM compatibility, flubendiamide offers unsurpassed safety and flexibility (Table 4 & 8).

TABLE 4. Comparative Toxicity of Flubendiamide and Competitive Standards to Applicators, Field Workers, and Beneficial Populations and their Potential to Flare Secondary Insect Pest Populations.

Crop / Pests	Flubendiamide	Bifenthrin	Chlorantraniliprole	Cyfluthrin	Lambda-Cyhalothrin	Indoxacarb	Methomyl	Methoxyfenozide	Spinetoram
Label Signal Word	Caution*	Warning Restricted Use	Caution	Warning Restricted Use	Warning Restricted Use	Caution	Danger Restricted Use	Caution	Caution
Re-Entry Interval (REI)	12 hours	12 hours	4 hours	12 hours	24 hours	12 hours	2-4 days	4 hours	4 hours
Beneficial Insect Toxicity	Low	High	Low	High	High	Low	High	Low	Moderate
Bee Toxicity	Low	High	Low	High	High	High	Moderate	Low	High
Secondary Pest Flaring (mites, etc)	Low	High	Low	High	High	Low	Moderate	Low	Moderate
IPM Compatibility	High	Low	High	Low	Low	High	Low	High	Moderate
IRM Compatibility	High	Low (pyrethroid resistance)	High	Low (pyrethroid resistance)	Low (pyrethroid resistance)	Moderate	Low	High	Low (spinosad cross-resistance)
Feeding Cessation	<1-2 hours	>4 hours	<1-2 hours	>4 hours	>4 hours	2-4 hours	2-4 hours	>4 hours	<1-2 hours
Residual Activity on Lepidopteran Pests	Long	Short	Long	Short	Short	Short	Moderate	Moderate	Moderate
Residual Activity on Beneficials	Short	Long	Short	Moderate	Moderate	Moderate	Moderate	None	Moderate
Primary Activity	Ingestion	Contact	Ingestion	Contact	Contact	Ingestion	Contact	Ingestion	Ingestion

Source: Product labels.
*Attributes rating scale:
Green Consistently meets or exceeds customer expectations; limited to no effects on beneficial arthropods, does not flare secondary pests, compatible with IPM programs
Yellow Sometimes meets customer expectations; significant effects on beneficial arthropods, may flare secondary pests, limited compatibility with IPM programs.
Red Does not meet customer expectations; severe effects on most beneficial arthropods, routinely flares secondary pests, not compatible with IPM programs.

4. Benefits Claimed

When used at label rates, flubendiamide is an effective and proven high-performance, flexible, economical, and environmentally sound insecticide offering many benefits over alternatives. It is essential growers retain the use of flubendiamide and other effective insecticide tools in comprehensive IPM and IRM programs to manage insect resistance. Flubendiamide provides the following benefits that strongly support its continued registration.

TABLE 5. Benefits that flubendiamide offers to growers.

Benefits
4.1. Flubendiamide offers unique attributes which make it compatible with and easily integrated into IPM and IRM programs in over 200 crops, providing broad-spectrum control of over 95 lepidopteran insect pests, including driver species like beet armyworm, navel orangeworm, soybean looper, corn earworm and tobacco budworm. a. Non-systemicity of flubendiamide is a benefit for IPM and IRM in many crops. b. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems. c. The economic and performance value of flubendiamide promotes its use over inexpensive "IPM disruptive" insecticides.
4.2. Flubendiamide offers a mode of action with no known cross resistance to alternative modes of action for management of resistant lepidopteran pests in over 200 crops.
4.3. Flubendiamide offers superior length of control compared to pyrethroid insecticides.
4.4. Flubendiamide has low acute toxicity, a short REI/PHI and a favorable environmental risk profile which ensures minimal impact on applicators, field workers and the environment.

Each benefit is detailed in the following sections.

4.1 Flubendiamide offers unique attributes which make it compatible with and easily integrated into IPM and IRM programs in over 200 crops, providing broad spectrum control of over 95 lepidopteran pests, including driver species like beet armyworm, navel orangeworm, soybean looper, corn earworm and tobacco budworm.

Flubendiamide has the broadest crop and lepidopteran pest registration, rivaled only by chlorantraniliprole and lambda-cyhalothrin, giving flexibility to growers who produce a variety of crops. Flubendiamide is registered for use in over 200 crops, including numerous crop groupings containing important minor use crops, for control of over 95 lepidopteran pests including driver species (economically important and difficult to control) like beet armyworm, navel orangeworm, soybean looper, corn earworm and tobacco budworm. Within this document, we detail the benefits that flubendiamide brings to farmers who produce soybeans, almond, pistachio, peanuts, tobacco, alfalfa, cotton, tomatoes, peppers, grape, watermelons, lettuce, snap beans and strawberries. Many of these crops are representatives of minor use crop groupings. Bayer supported the residue studies necessary to offer use of flubendiamide to minor use growers. Tables 48-49 in Appendix D list the labeled lepidopteran pests and crops for flubendiamide and alternative insecticides.

Flubendiamide is biologically active against the larval stages of a broad spectrum of phytophagous lepidopteran insects (butterflies and moths), many of which are driver pests in agricultural crops, including:

- **Diamondback moths** - including but not limited to: diamondback moth;
- **Gelechìids** - including but not limited to: peach twig borer;
- **Leafrollers** - including but not limited to: eye-spotted bud moth, hickory shuckworm, obliquebanded leafroller, omnivorous leafroller, orange tortrix, redbanded leafroller, and variegated leafroller;
- **Noctuids/cutworms/armyworms/under-wings** - including but not limited to: black cutworm, beet armyworm, cabbage looper, corn earworm/tomato fruitworm/cotton bollworm, fall armyworm, green fruitworm, Lacanobia fruitworm, true armyworm, variegated cutworm, walnut caterpillar, western bean cutworm, and yellowstriped armyworm;
- **Olithrids** - including but not limited to: codling moth, grape berry moth, lesser appleworm, and Oriental fruit moth;
- **Pyralids or snout moths** - including but not limited to: European corn borer, grape leaffolder, melonworm, naval orangeworm, pecan nut casebearer, pickleworm, and southwestern corn borer;
- **Smoky moths** - including but not limited to: grape leaf skeletonizer;
- **Sphinx or hawk moths** - including but not limited to: tomato hornworm and tobacco hornworm;
- **Tiger moths and footman moths** - including but not limited to: salt-marsh caterpillar and fall webworm;
- **Whites, sulphurs and orange tips** - including but not limited to: imported cabbageworm.

Superior or equivalent control of susceptible lepidopteran pests, including IR biotypes, has been observed in field trials at recommended use rates. The performance of flubendiamide has been extensively evaluated in field trials in major almond, pistachio, peanut, tobacco, alfalfa, cotton, tomato, pepper, grape, watermelon, broccoli, lettuce, snap bean, and strawberry producing states, in soybeans in the southeastern U.S., and in other U.S. production areas for other labeled crops. Representative trial results are presented in Appendix B. Relative performance rankings by Southern University entomologists demonstrate the strength of flubendiamide performance on lepidopteran pests in soybeans and cotton (Tables 50 and 51 in Appendix E).

Following is a case study demonstrating the value of flubendiamide's broad-spectrum lepidopteran control as part of an IPM program to control lepidopteran pests in peanuts.

CASE STUDY: Beat Back Peanut Pests with Belt Insecticide Provides Peace of Mind

Insect pressures and species in peanuts vary greatly from year to year. Collectively, armyworms, tobacco budworms, velvetbean caterpillar and other hungry worms cause loss that university entomologists measure in millions of dollars. Based in southwest Georgia, Extension agent Paul Wigley works within two hours of about half the peanuts grown in the U.S. and serves 24,000 acres in Calhoun County alone. According to Wigley, as many as six major worm pest species can affect a peanut crop in a single season. Often, he says, one species can dominate and inflict the most damage.

"One year it may have been armyworms; one year, velvetbean caterpillar," Wigley says, "Another year it was (soybean) loopers in peanuts, which we'd never seen. It can differ from year to year." Managing such a broad spectrum of worm pests can be difficult. But now, peanut growers have an additional control option with the expanded label of Belt insecticide from Bayer CropScience. Belt is active on most worm pests, including resistant species and late-stage larvae. "*It doesn't matter what year or what worm, a product like Belt targets it," Wigley says. "One product takes care of our needs, and that's a huge advantage."*

According to product manager Lee Hall, Belt is a highly selective insecticide that targets many economically significant worm species. "Worms stop feeding minutes after application, and the ensuing residual control can last two weeks or more with minimal risk to beneficial insects and without flaring mites," he says. "Plus, in this crop, Belt features a mode of action with no known cross-resistance to insecticides from other chemical classes."

Wigley has two years of experience with Belt through grower trials and has been pleased with both its knockdown power and residual control. *"It meets or exceeds expectations," he says. "Belt is one of just two products I have tested that will control almost any foliage-feeding caterpillar. Belt stops the feeding in just a few hours, does not seem to flare other insect problems and provides weeks of residual benefits."*

Scouting and Spraying

Mark Mitchell of Mitchell Ag Consulting, Inc., in Bainbridge, Ga., services a wide array of crops in southwest Georgia, including thousands of peanut acres. For his growers, common insect threats include cutworm and tobacco budworm most years. *"We also face corn earworm, fall armyworm, beet armyworm, velvetbean caterpillar, even soybean looper most years."* Both Mitchell and Wigley stress the importance of scouting, as well as wise application choices. While most general threshold guidelines call for treatment at four or more worms per foot of row, many growers will wait and base the spray decision on foliage damage.

"You can sustain damage to foliage without economic impact," says Mitchell. Wigley estimates around one-third of the foliage can be damaged without causing significant yield loss. Once-a-week scouting from about 4 weeks after planting to digging usually allows growers to stay on top of damage estimates and insect lifecycles. Heavy pressure can warrant an increase in scouting. Wigley recalls a trial situation with about eight to 12 worms per foot of row and considerable feeding. In the untreated check, the worms had increased in just one day, and doubled in one week, he says. “When we waited one week, we went from eight to 10 percent foliage loss to 25 to 30 percent loss,” says Wigley. “We had to spray.” Mitchell also references a lesson learned.

Three years ago, he was in a field of peanuts about 60 days old when he found several foliage feeders, namely tobacco budworm. “The numbers were at threshold, but the damage not great. They were mostly hatching,” he explains. “Working with the grower, we both agreed to let them ride for a week. Some years the beneficials can take them out.” Five days later, the grower realized there was not a bloom in sight on those 180 acres, but the foliage damage still was not great. It wasn’t until Mitchell looked at other fields with similar symptoms that he determined tobacco budworms were feeding almost exclusively on and removing blooms, something he had not seen before in peanuts. “Now it’s the No.1 thing I look at,” Mitchell says. “It impacts yield more than we realized 10 years ago.”

According to Mitchell, the field never really recovered, even though it did bloom after being sprayed. It yielded 3,629 lbs/A, when other nearby fields averaged about 5,000 lbs/A. “Since that incident, we now treat foliage feeders, primarily tobacco budworm, before foliage loss occurs if worm counts are there. There is no doubt that those foliage-and-bloom feeders can have a major negative impact on peanut yield potential.”

Benefits of Belt

Mitchell sees Belt as a viable choice in peanuts. “Belt is a new option, and a good one, based on information I have and data I’ve seen.” A Heliothine complex study by Ames Herbert of Virginia Tech University in 2010 showed Belt leading the pack in peanuts. Belt chalked up a nearly 90 percent efficacy, beating out both similar products and products from other classes of peanut insecticides. Additionally, Belt has a proven track record of residual control up to, and even greater than, two weeks in other registered crops.

Hall explains that Belt insecticide offers excellent worm control because it has a powerful, unique mode of action. It works by activating worms’ ryanodine receptors. Ryanodine receptors are intracellular calcium channels that are specialized for rapid and massive release of calcium. Belt causes the receptors to stay open and release all available calcium. “When all of that calcium is released all at once, it triggers massive muscle contractions,” Hall says. “This stops worm feeding almost immediately and later causes paralysis and larval death.” “Because it is highly selective on worm pests, Belt has minimal impact on parasitoids, syrphid flies, lacewings, predatory bugs, predatory mites, or adult and larval ladybird beetles,” Hall adds.

Source: Southeast Farm Press, June 13, 2011

a. Non-systemicity of flubendiamide is a benefit for Integrated Pest Management (IPM) and Insecticide Resistance Management (IRM) in many crops.

Flubendiamide moves translaminarly from the top to the bottom of the leaf, but it does not have systemic activity. While the lack of systemicity can be seen as a detriment relative to other members of the diamide chemical class, it is actually a very positive attribute of flubendiamide. As Dr. Eric Natwick, University of California Cooperative Extension Service, stated in a letter to Carmen Rodia, EPA Registration Division, on April 17, 2015:

"Flubendiamide is somewhat unique among the recent development and/or registration of diamide chemistries in that it has a narrower spectrum of activity than chlorantraniliprole, cyantraniliprole or cyclaniliprole and unlike its sister chemical compounds, flubendiamide is not systemic via root uptake and transport via the xylem within plants. These unique characteristics may be viewed by some as a detriment for flubendiamide, but actually, the narrower spectrum and non-systemic activity are of benefit for inclusion of Belt in integrated pest management (IPM) and insecticide resistance management (IRM). Although flubendiamide has good residual activity when applied as a foliar spray to vegetable crops or to alfalfa, the residual activity is short enough to not span the lifecycle of most, if not all lepidopteran pests; unlike the extended activity of the soil applied, systemic diamide insecticides. When there is extended residual activity of a specific insecticide or insecticide class, such as the diamides, due to the systemic activity, the target pest exposure can easily span two or possibly more generations of a pest insect multiplying the risk for selection of individuals within the pest population that have one or more alleles that allow escape of intoxication or to overcome/detoxify the insecticide's toxic effects allowing development of insecticide resistance within the pest population. Because flubendiamide is not systemic via soil application and root uptake, it has a better fit into IPM schemes than do the diamide compounds that are systemic."

The non-systemic activity of flubendiamide allows users to apply a treatment window approach to insecticide resistance management. This preserves the utility of this chemistry, but also provides additional protection for all modes of action that are used in the rotational program.

b. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems

Integrated pest management (IPM) is a process growers use to solve pest problems while minimizing risks to people and the environment. IPM principles and practices are combined to create IPM programs. The five following major components are common to all IPM programs:

- Pest identification
- Monitoring and assessing pest numbers and damage
- Guidelines for when management action is needed
- Preventing pest problems
- Using a combination of biological, cultural, physical/mechanical and chemical management tools

Biological control is an important component of IPM programs. Biological control is the use of natural enemies—predators, parasites, pathogens, and competitors—to control pests and their damage. Invertebrates, plant pathogens, nematodes, weeds, and vertebrates have many natural enemies. Some insecticides are very toxic to predators and parasitoids. Destroying these natural enemies often results in target pest resurgence or secondary pest outbreaks. Some pesticides have a greater impact on the natural enemies than the target pest. **Target pest resurgence** can result when the unfavorable ratio of pests to natural enemies permits a rapid increase or resurgence of the pest population. A **secondary pest outbreak** occurs when a pesticide that was applied to control one pest kills the natural enemies that were keeping a second pest population in check. Another reason is a phenomenon known as **hormoligosis**, the insecticide actually causes the spider mites to reproduce faster.

Many of the IPM-disruptive insecticides commonly used to control lepidopteran pests can cause a specific secondary pest outbreak - a flare of spider mites. Foliar sprays of acephate or carbaryl are especially likely to flare mites. Most of the pyrethroid insecticides (permethrin, cyfluthrin, lambda-cyhalothrin, etc.) also flare mites. This is a common challenge for almond, soybean, peanut, cotton, grape, tomato and strawberry growers. Flubendiamide has been tested under semi-field and field conditions for its selectivity against key beneficial arthropods and has been found to be harmless to slightly harmful on the relevant beneficial insects, based on the International Organization for Biological and Integrated Control (IOBC) classification. Unlike pyrethroids, flubendiamide does also not harm predatory mites in various crops and, as a result, does not flare mites. Results of studies conducted to determine the toxicity of flubendiamide to beneficial arthropods are shown in Figures 1-9 and are summarized in Table 6. Primary competitors in the IPM-friendly market that have a similar favorable beneficial insect profile are chlorantraniliprole, indoxacarb and methoxyfenozide whereas spinetoram only has a moderate beneficial insect safety profile. Safety to predatory mites and other beneficial arthropods favors flubendiamide use in IPM systems.

Below are some comments from Dr. Jeff Gore, Research and Extension Entomologist at Mississippi State University, on the benefit that the flubendiamide brings to peanut growers – particularly with respect to preserving natural enemies to manage spider mite infestations.

"There are several insecticides labeled for control of caterpillars in peanut, but most of them only control one or two species. Insecticides in the diamide class of insecticides provide good control of all of the caterpillar pests. Similar to soybean, we are also concerned with the disruption of natural enemy complexes with alternative insecticides. In particular, spider mites can be one of the most devastating arthropod pests of peanut and they occur almost exclusively in fields that have received a spray with a broad spectrum insecticide. We rarely see spider mites in peanut fields where natural enemy complexes have not been disturbed. This is especially important because there are currently no miticides labeled in peanut that will effectively manage a spider mite infestation. The only miticide labeled in peanut is propargite (Comite II, Chemtura Corp.), but we have not recommended it in any of the crops it is labeled for because of resistance. In experiments I conducted here in Stoneville, MS, two sequential applications of propargite provided less than 50% control of twospotted spider mite. With their reproductive capacity, the mites rebounded to damaging levels within 7-10 days and significant yield losses

were observed. Because of that, prevention of spider mite infestations is the best management strategy and an insecticide such as flubendiamide is an ideal insecticide to fit into that plan to manage other pests." – Dr. Jeff Gore, Mississippi State University

The excellent safety profile of flubendiamide when compared to IPM-disruptive chemistries makes it an excellent fit for growers who adopt IPM strategies to control lepidopteran pests. When compared to other IPM-friendly chemistries, flubendiamide has one of the most favorable profiles, ranking similarly to chlorantraniliprole, indoxacarb and methoxyfenozide. Table 4 details the comparative toxicity of flubendiamide competitors. The favorable profile and competitive price point of flubendiamide make it an easy choice for growers who want effective lepidopteran control while protecting beneficial insects in their production field.

TABLE 6. Summary of the Selectivity of Flubendiamide on Beneficial Arthropods.

Crop	Beneficial	Stage	Species	Dose range	IOBC* Classification+
Apple; peach; plum; vine (bean)	Predatory mite	Mixed	Typhlodromus pyri, Kampimodromus aberrans; Amblyseius andersoni; Neoseiulus californicus; Phytoseiulus persimilis	48-72-(96-144)**; 0.0075% to 0.015%***	Harmless to slightly harmful
Apple	Parasitoid	Hatching and parasitization	Aphelinus mali	72*; 0.01%**	Harmless
Apple	Ladybird beetle	Not identified	Stethorus punctillum	48-72****	Harmless
Pear; Apple	Predatory bug	Mixed	Anthocoris nemoralis; Orius sp	48-72*; 0.0048%-0.072%**	Harmless
Barley; cabbage; roses	Parasitoids	Hatching and parasitization	Aphidius ervi and colemani	0.015%**	Harmless
Citrus	Parasitoids	Adults	Trichogramma cryptophlebiae	0.01%**	Harmless
			Coccidoxenoides perminutus		
			Aphytis lingnanensis		Slightly harmful
	Ladybird beetle	Adults+larva	Chilocorus nigritus		Harmless
Bean; potatoes; apple (field)	Ladybird beetle	Larva	Coccinella septempunctata	48-72***	Harmless
				100-150***	Harmless to modeately harmful
Rice	Spiders	Mixed	Lycosa pseudoannulata	150***	Slightly to moderately harmful
Cotton	Spiders	Mixed	Not identified	48***	Harmless
	Predatory bugs	Mixed	Orius sp	48-(96)***	Harmless
			Nabis sp	48***	Harmless

Crop	Beneficial	Stage	Species	Dose range	IOBC* Classification+
	Lacewing	Larva	Chrysopa sp.		Slightly harmful
	Ladybird beetle	Mixed	Coccinella		Harmless
	Earwig	Mixed	Doru luteipes		Slightly harmful
Barley; maize; cabbage	Predatory midge	Larva	Aphidoletes aphidimyza	0.02%**	Harmless to moderately harmful
Barley; cabbage; roses	Predatory midge	Larva	Feltiella acarisuga	0.015%**	Harmful
Roses	Predatory midge	Larva	Episyrphus balteatus	0.015%**	Harmless
Maize	Parasitoids	Parasitization of aphids	Not identified	60***	Harmless
	Ladybird	Adults	Not identified		Harmless
Tomato	Predatory bugs	Mixed	Macrolophus caliginosus	36-60***	Harmless

Source: Bayer CropScience.
* International Organization for Biological and Integrated Control
** g a.s./m (grams active substance/meter
*** % a.s.(active substance)
**** g a.s./ha meter canopy height (grams a.s./hectare/meter of canopy height)

Figure 1. Selectivity of Flubendiamide on Ladybird Beetles, Soldier Beetles, Ear Wigs and Mirid Beetles.

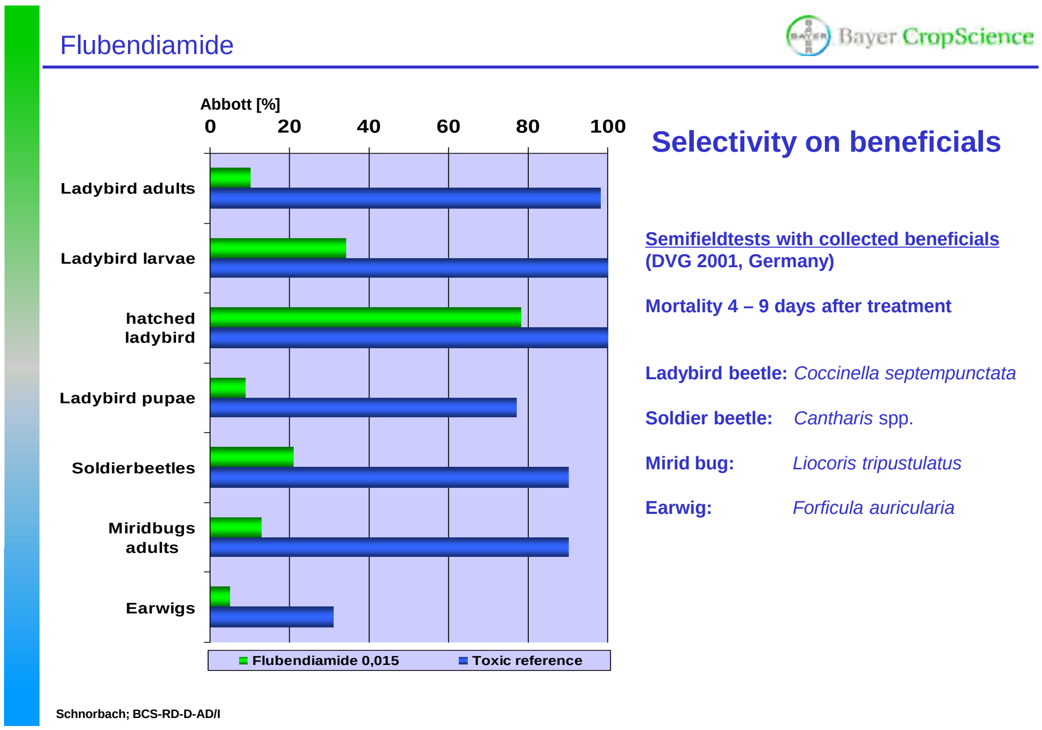


Figure 2. Selectivity of Flubendiamide on Predatory Mites

Flubendiamide

Selectivity to predatory mites in various crops
(Summary of field trial results)

Crop	Species	No of Application	No of field trial results	Mean effect [% Abbott]	Classification
Apple	*Typhlodromus pyri*	1 to 3 post-flower	47	19.4	harmless
Apple	*Amblyseius andersoni*	1 to 2 pre+post-flower	11	14.5	harmless
Apple	*Phytoseiulus persimilis*	1 to 4 post-flower	19	26.5	harmless to slightly harmful
Plum	*Amblyseius sp.*	3 post-flower	2	0	harmless
Peach	*Amblyseius andersoni*	2 post-flower	2	18	harmless
Vine	*Typhlodromus pyri*	3 1 pre-flower 2 post-flower	6	0	harmless
Vine	*Amblyseius aberrans*	1 post-flower	2	16.5	harmless
Citrus	*Euseius citri*	Residual efficacy on leaves	1	0 adults 55 larvae	harmless to slightly harmful
French bean	*Phytoseiulus persimilis*	1	2*	10.5	harmless

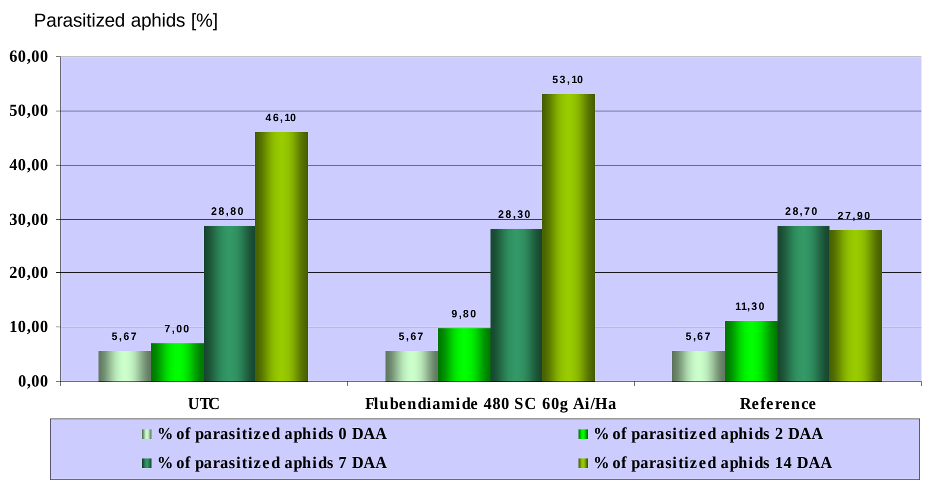
* Greenhouse results

Schnorbach; BCS-RD-D-AD/I

Figure 3. Selectivity of Flubendiamide on Beneficials in Corn.

Flubendiamide

Selectivity on aphid parasitoids on corn



Results: no influence of flubendiamide on parasitization of aphids

(IA04VSFM01JM25, France)

Schnorbach; BCS-RD-D-AD/I

Figure 4. Selectivity of Flubendiamide on Beneficials in Tomato.

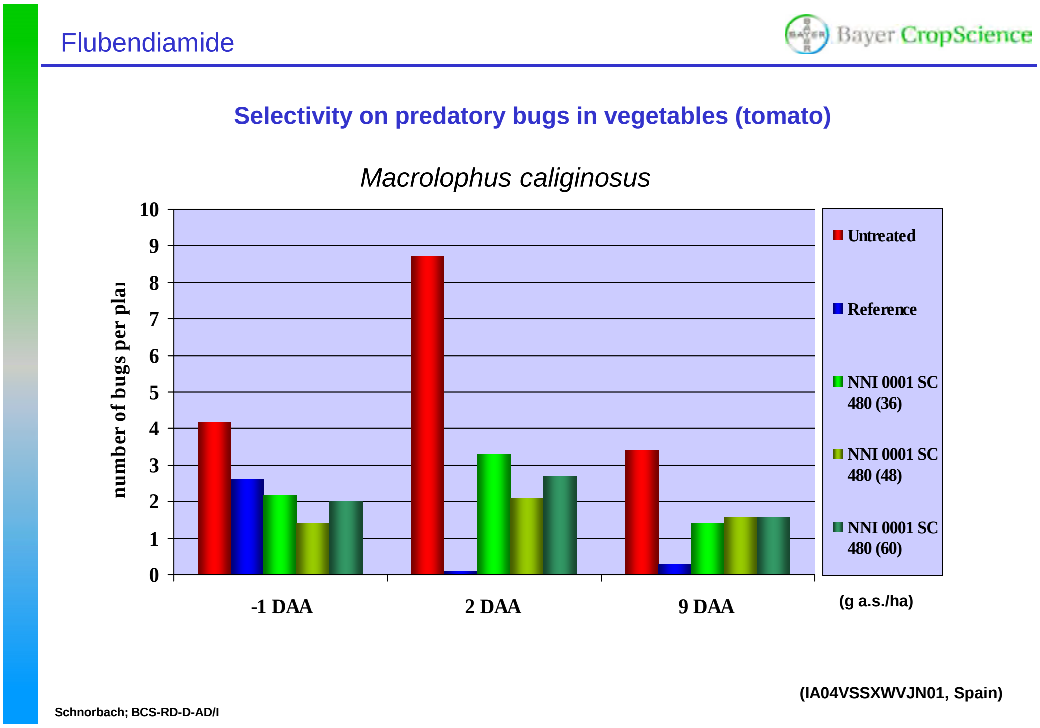


Figure 5. Selectivity of Flubendiamide on Beneficials in Tomato – Prey / Predator Ratio.

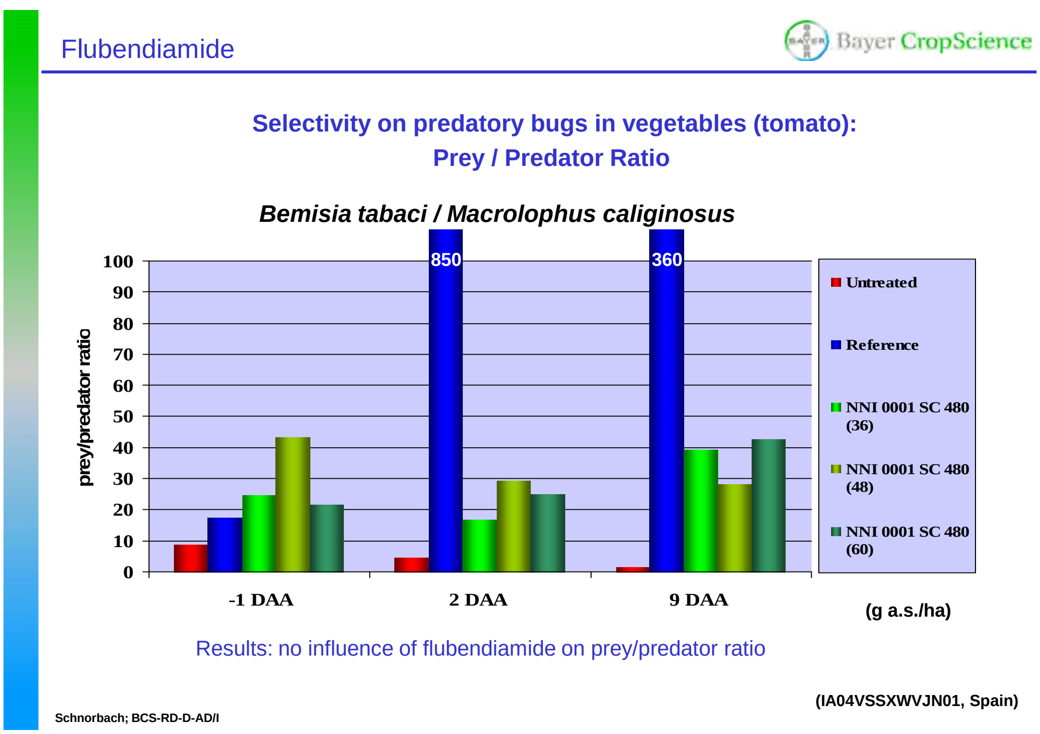


Figure 6. Selectivity of Flubendiamide on Beneficials in Apples.

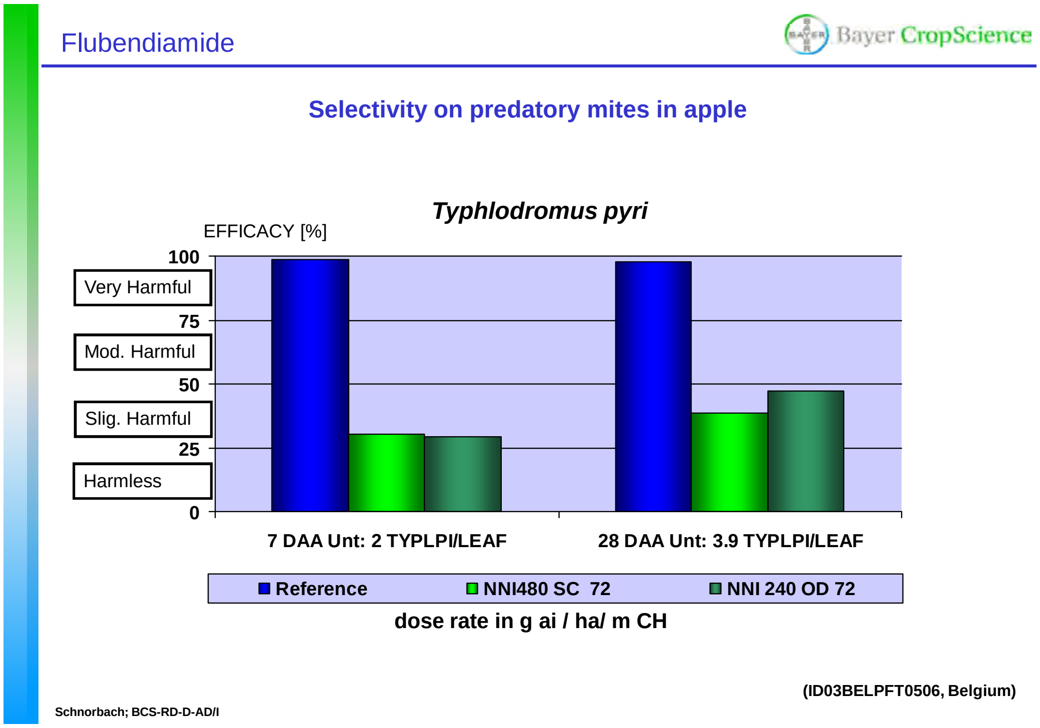


Figure 7. Selectivity of Flubendiamide on Earwigs in Pears.

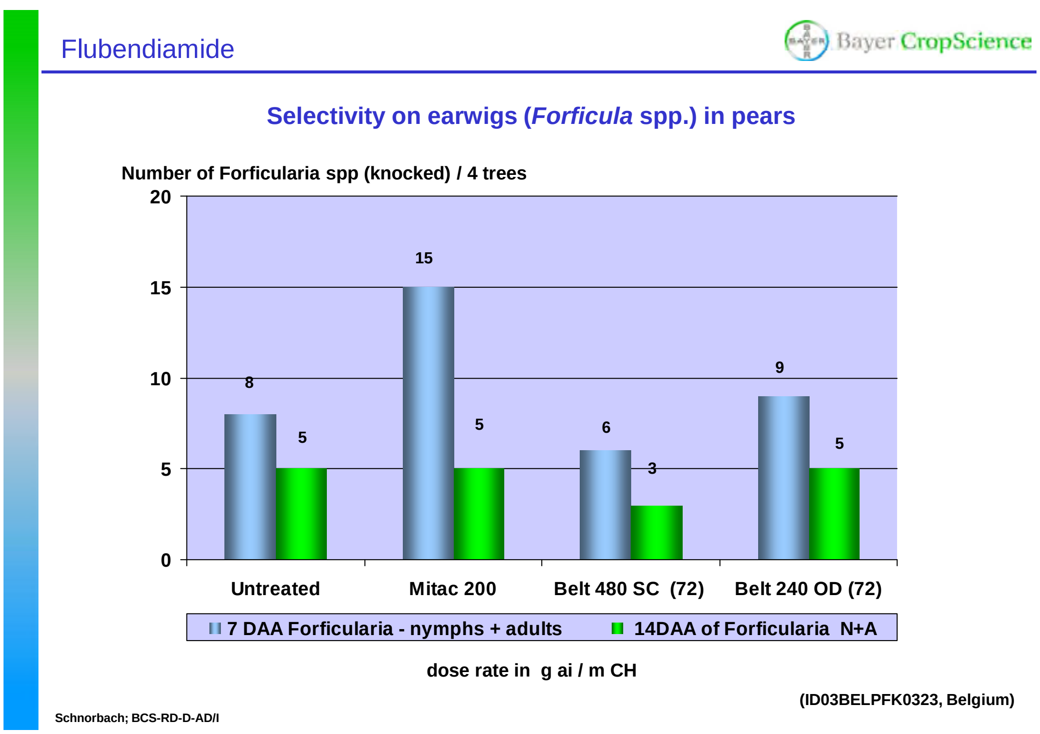


Figure 8. Selectivity of Flubendiamide on Predatory Bugs in Pears.

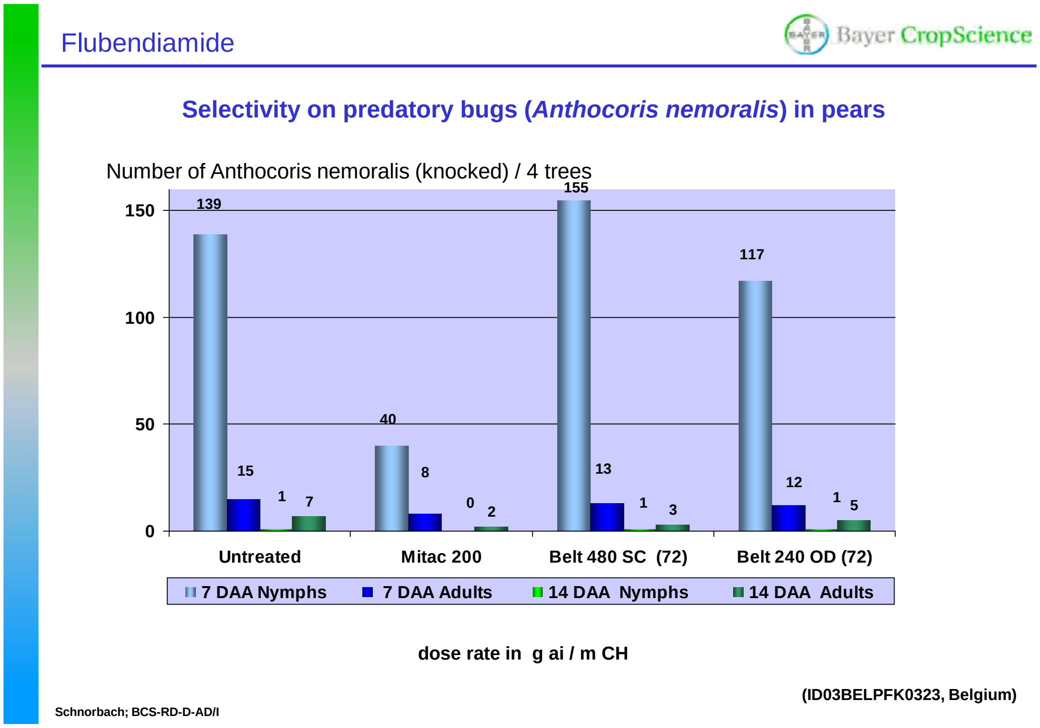
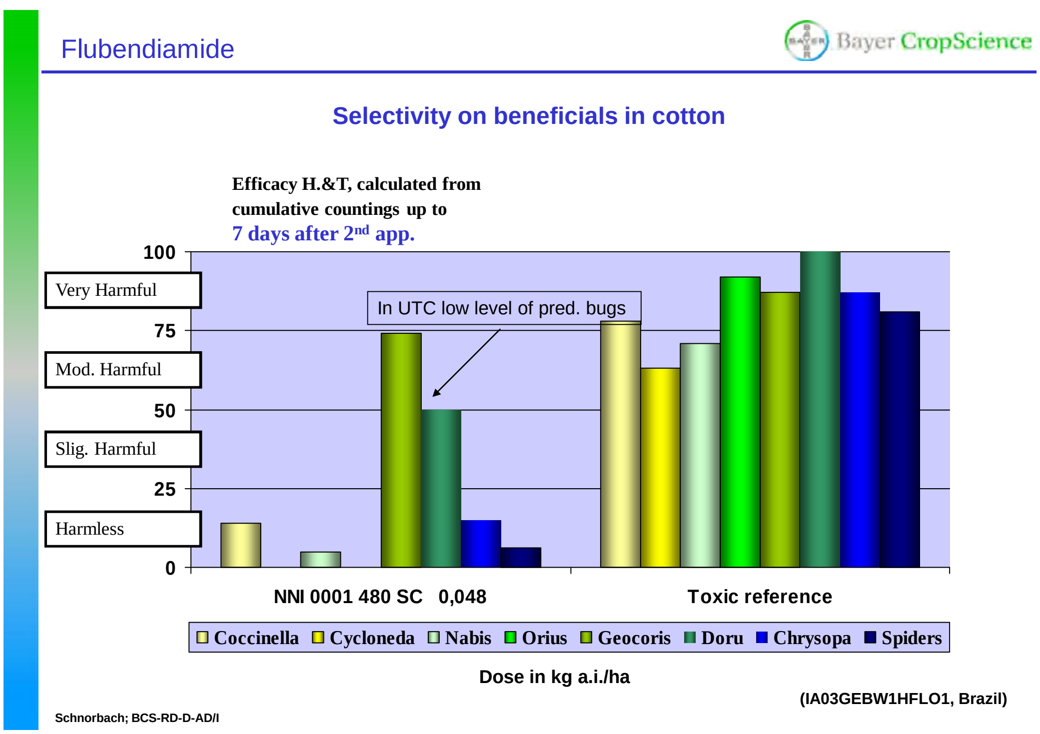


Figure 9. Selectivity of Flubendiamide on Beneficials in Cotton.



Following is a case study demonstrating the value of flubendiamide's low beneficial toxicity to support insect management as part of an IPM program to control lepidopteran pests in alfalfa.

CASE STUDY: Belt – The Insecticide that Fits Alfalfa Production

Sometimes, things just fit. A broken-in pair of gloves. A round peg in a round hole. And tried and true Belt®, an insecticide with proven effectiveness on more than 200 crops, including alfalfa. For Geoff Bitle, a pest control adviser (PCA) with Colusa County Farm Supply in California, Belt has fit the needs of his alfalfa production customers during each of the three seasons he has recommended it. "In my area, alfalfa caterpillars come on in late July and last through August and into September. I've been very happy with the control during this period," said Bitle. "Belt provides good residual control versus the cheaper competition. It gets us through a whole cutting, so a lot of times we don't have to go back in and spray."

Belt provides this strong residual control without flaring up secondary pests like aphids, an added bonus for Bitle. The control and residual of Belt in alfalfa have not been a surprise for Bitle, as he had previously seen similar results with Belt on almonds. "The chemistry of Belt rolled over well into alfalfa," Bitle said. "I had prior experience with Belt on almonds and it performed really well in alfalfa field trials, so I have a lot of confidence in it."

In Arizona, production challenges are different. The frequent rains during Arizona's monsoon season create unique pest situations and the need for a product that is rainfast with a short pre-harvest interval (PHI). Once again, Belt is a perfect fit, providing growers with complete flexibility. "Belt is a really good fit as far as controlling our major pests — alfalfa caterpillars, armyworms and cutworms — in summer production of alfalfa," said Ken Narramore.

Narramore is an independent PCA with Verde Agricultural Service LLC in Arizona. *"Peak pressure time coincides with our monsoon season when we get regular storms. Belt is rainfast quickly, and the zero-day PHI is very attractive with our weather. Growers don't have to work around a seven-day PHI."* Between periods of rain in Arizona, it is a very dry climate, forcing many growers to install drip irrigation equipment. Without the right insecticide, this dilemma of too much or not enough water can make cutworm control more difficult. *"The staying power of Belt will give longer control of cutworm pests, and in a lot of our production, effective cutworm control is a real challenge," Narramore said. "It is important to get long-term control and Belt certainly delivers in that scenario."*

Like Bitle, Narramore sees it as an advantage that Belt does not flair up secondary pests. Narramore noted that using a product other than Belt early in the cut cycle may reduce beneficials, forcing another insecticide treatment for worm pests. Belt's strong reputation preceded it with Narramore as well. "During product development, I was aware of results generated by Belt during the testing phase. Obviously, it had a very impressive performance." In addition to alfalfa, the results generated by Belt go above and beyond in soybeans, corn, cotton, pistachios, peanuts and sorghum.

Belt helps preserve yield potential by combining rapid knockdown and long-lasting residual. Worms stop feeding within minutes, and residual activity can last two weeks or more, without flaring mites. Belt is rainfast after dry on leaf surfaces. In addition to being fast-acting and long-lasting, Belt is an ideal integrated pest management tool, providing minimal risk to beneficial insects and maximum resistance.

For Bitle, the benefits of Belt for his area can be summed up in one word — value. Just because a product is cheaper at the start doesn't mean it costs less in the long run. "The value of Belt is tremendous," Bitle said. "There are certainly cheaper products that will perform alright, but with those products, we often have to respray and there is a lot of labor involved with rechecking."

Source: http://www.agrinews-pubs.com/Content/Default/Homepage-Rotating-Story/Article/Eliminating-insects-in-alfalfa-production-/-3/23/10453

c. The low relative cost of flubendiamide promotes its use over inexpensive "IPM disruptive" insecticides

Flubendiamide is an economical, high performance, IPM friendly insecticide. Its low relative cost is critical to promote the use of IPM friendly insecticides, especially in low-value crops such as alfalfa, peanuts and soybeans. Table 7 presents the average cost per acre for major foliar lepidopteran insecticides used in alfalfa, almonds, peanuts, soybeans and tobacco. Cost is a major factor affecting insecticide selection in low value crops like alfalfa, peanuts and soybeans, but is less impactful for higher value crops like almonds and tobacco. > CBI3 text located in the Confidential Business Information Appendix <

The loss of flubendiamide would likely result in a significant increase in pyrethroid use in alfalfa, peanuts, and soybeans. > CBI4 text located in the Confidential Business Information Appendix < The increased use of pyrethroids may have unintended consequences including an overall increase in insecticide use because of inferior rainfastness and residual control compared to flubendiamide and the disruption of beneficial populations and flaring of mites that accompany pyrethroid use. Growers need access to economical, high performance, IPM friendly insecticides like flubendiamide that promote IPM practices and reduce overall insecticide use.

> CBI5 text located in the Confidential Business Information Appendix .<

4.2 Flubendiamide offers a mode of action with no known cross resistance to alternative modes of action for management of resistant lepidopteran insect pests in over 200 crops.

Cross-resistance to flubendiamide has not been observed in lepidopteran populations that are resistant to chlorinated hydrocarbons (i.e. dicofol), avermectins (abamectin) and growth regulators (hexythiazox, clofentezine), or to neonicotinoid insecticides (acetamiprid, imidacloprid). Consequently, flubendiamide controls pests that have developed resistance to organophosphates, carbamates, pyrethroids, or neonicotinoid based pesticides. Insecticide MOA rotation helps to prevent or delay the onset of new cases of resistance when used as part of a comprehensive IRM program. Broad labeling of flubendiamide in over 200 crops and broad spectrum control of lepidopteran pests allows growers to use flubendiamide on multiple crops simplifying insecticide MOA rotation. Because of its unique mode of action (a Group 28 Ryanodine Receptor Modulator) and a lack of cross-resistance with other insecticide MOAs, flubendiamide enables farmers to manage insecticide resistance to the older chlorinated hydrocarbons, organophosphate, carbamate, pyrethroid and neonicotinoid pesticides, and reduce the selection pressure for resistance to other insecticide MOAs.

Flubendiamide has provided growers with a valuable tool to manage lepidopteran pests resistant to other classes of pesticides, while benefiting from its reduced acute toxicity, its reduced impact on biological control agents and its relatively short re-entry period. Insect resistance will continue to grow for the foreseeable future and many producers have included flubendiamide as a tool in their IPM and IRM programs, as evidenced in market research data. Effective insecticides represent a finite resource that must be conserved and protected. Growers need as many tools available as possible to simplify IRM program implementation and help sustain the activity of all insecticides. Restricting access to effective, broad spectrum, low-cost, low-risk tools like flubendiamide only complicates IRM and increases the risk of resistance development.

Following is a case study demonstrating the value of flubendiamide's alternative MOA, length of control, and safety to beneficial populations when used as part of an IPM program to control lepidopteran pests in soybeans and tobacco.

CASE STUDY: Smart Selections and Strategy Keep Family Farm for Future: Tobacco pro chooses 'pros' of Belt insecticide.

Outside of the weather, insects often have the most direct impact on a tobacco crop as they literally eat away yield. Several worm species spread the risk of yield loss throughout the season, making the challenge of control even greater. Lifelong tobacco farmer, Clay Strickland of Salemburg, N.C., does not wish to control the weather. "If I did, I'm sure I'd mess up something bigger," he says. But he does understand the need to protect his livelihood from pests.

Strickland runs the family operation with his cousin Sherrill, managing 1,800 acres of tobacco, corn and soybeans, along with raising hogs and turkeys. Heading into the farm's fourth generation, it is important to Strickland to keep the operation viable and successful. "We want to preserve this option for our kids," says Strickland, who came back to the farm himself years ago. "There's something about the smell of the earth at the end of a long work day."

The Stricklands work hard to grow great crops and keep the land productive. In addition to attentive management, they also look for products that live up to promises. *"Belt insecticide worked exactly as we expected it to," says Strickland. "Belt insecticide is a highly selective insecticide that targets many economically significant worm species,"* says Lee Hall, product manager, Bayer CropScience. "It is an ideal choice to eliminate worms, combining rapid feeding cessation with a long-lasting residual of two weeks or more. What's more, Belt controls a broad spectrum of worm larvae without disrupting beneficials or flaring mites."

In his third season using the product, Strickland calls it "an all-around good product," checking off its attributes from his "needs" list. *"Effective, easy and efficient to use, and easy on our land. It controls up front with residual and protects the beneficials. We are very satisfied."*

A Tale Of Two Threats

In Strickland's area, two of the primary yield-robbing insects scouted and targeted are tobacco budworm and hornworm. "They go neck and neck as far as economic threat," he says. The tobacco budworm is known to feed in the buds of young plants, damaging the small developing leaves, but often the plants recover without major threats to final yield and quality. However, budworms also can top the plants, prematurely promoting early sucker growth that may stunt the plants.

According to the North Carolina State University (NCSU) Tobacco Growers Information Portal, this damage is of greater economic concern than when the budworm chews into developing leaves because it potentially increases labor costs for sucker control. The damage of a budworm infestation can impact yield both indirectly and directly, but after buttoning, Strickland turns his attention to the hornworm. The tobacco hornworm is one of the most common and also one of the most destructive insects on tobacco. Additionally, hornworms present on plants at harvest will continue to feed on wilting and curing tobacco. It takes just two hornworm larvae to completely defoliate a tobacco plant, and moderate populations in a field can result in significant damage, according to the NC State Portal.

Scouting & Spray Strategy

Strickland believes in rigorous scouting and prompt reaction to thresholds. He said they inspect an individual field every five days or so, and as insects become threats at different stages, they may check two or three times per week to stay on top of things. Bayer CropScience also promotes proper scouting for best management and economic strategy.

"Belt provides very high protection against plant and fruit damage, especially when applied in conjunction with careful scouting and appropriate thresholds for the region," says Hall. *"Belt is effective against early and late instars, and it also works well in an Integrated Pest Management (IPM) program."* For Strickland, Belt is part of his IPM plan. *"Belt does what you need it to do, and it gives us another chemistry to avoid resistance, now and down the road."*

Reaping Residual Rewards

Strickland enjoys the flexibility Belt gives his operation. *In his experience, Belt controls his targeted pests at least two weeks and up to three weeks at a time, which can greatly reduce the need for additional sprays.* A 2010 Virginia Tech study showed exceptional residual control of Belt. Additionally, 2008 data from NCSU showed similar results over multiple sites.

“When you put it out there, it’s ready to go,” Strickland says of control at application. “Plus, a great benefit is the residual activity that comes with Belt. Not having to spray once a week or even every 10 days like before allows our beneficials to build up.” It also means more efficient use of time, fewer trips across the field and ability to focus on other scouting and needs, he explains. “Belt fits our operation and our needs.”

How it Works: Belt Tightens Security of Your Crop without Sacrifice
Belt insecticide offers excellent worm control because it has a powerful, unique mode of action. It works by activating worms’ ryanodine receptors. Ryanodine receptors are intracellular calcium channels that are specialized for rapid and massive release of calcium. Belt causes the receptors to stay open and release all available calcium. While that may sound complex, the bottom line is quite simple, explains Ralph Bagwell, Bayer CropScience product development manager.

“When all of that calcium is released all at once, it triggers massive muscle contractions,” Bagwell says. “This stops worm feeding almost immediately and later causes paralysis and larval death.” *And because it is highly selective to worm pests, Belt poses minimal risk to beneficial insects such as parasitoids, syrphid flies, lacewings, predatory bugs, predatory mites, or adult and larval ladybird beetles when used according to label directions.* Belt features fast action and extended residual control to help preserve yield potential in a variety of crops. It is now registered for use in peanuts, as well as cotton, corn, soybeans, tobacco and other southern crops. “This allows growers engaged in most rotations to maintain full crop flexibility,” adds Bagwell.

Source: Southeast Farm Press, May 16, 2011

4.3 Flubendiamide offers superior length of control compared to pyrethroid insecticides.

Belt has a long residual window of activity and protects treated surfaces for as long as two weeks, depending on the application rate. It is also rainfast once the spray deposit has dried on leaf surfaces; subsequent rainfall will have little or no effect on residual performance. BELT is recommended to be used when scouting indicates caterpillar populations have exceeded economic thresholds. This allows growers to apply sound IPM and/or economic practices. As a result, fewer foliar applications are needed to control these caterpillars throughout long growing seasons.

Residual insecticides remain effective for varying lengths of time after application. The length of time depends on the insecticide active ingredient, formulation (dust, liquid, etc.), the type of surface (soil, foliage, etc.), rainfall amounts and intensity, sunlight intensity, temperature, and the condition of the surface (wet, dry, dusty, etc.). Short residual insecticides have limited residual activity and most are contact insecticides. They work now, then they are gone within a fairly short time. Safety to beneficial populations also affects the length on control. A product that decreases the beneficial insect population will often result in a quick rebound in the pest population. Alternatively, products that do not negatively impact beneficial population densities allow them to continue to control the pest population, augmenting the control that is provided by the insecticide.

Pyrethroids have contact action, comparatively short residual activity, and are highly disruptive to beneficial populations (see Section 4.1.b). As a result, pyrethroids provide a relatively short length of control of target pests. Flubendiamide, on the other hand, works by ingestion, and when used according to label directions, poses minimal risk to beneficial arthropods, thereby providing IPM friendly, long residual control of target insects.

Below are comments from University IPM Specialists and an Independent crop consultant on the value flubendiamide provides as an insecticide providing residual activity to protect the crop and as part of an insecticide resistance management program.

"*Over the last several years we have been able to successfully incorporate Belt into our IPM programs. The residual activity and safety profile on beneficial insects it provides often displaces multiple applications with harder chemistries therefore solidifying its place in our IPM toolbox in Mississippi."* – Dr. Angus Catchot, Mississippi State University

"*The extended residual control of this selected group of pests functionally limits the number of applications because of the effectiveness. In other words, we use fewer applications of diamides, such as Belt, because they are so effective. This is good for the environment in at least a couple of ways. First of all, it reduces the amount of active ingredient released into the environment. Secondly, it cuts down on other application inputs and use of natural resources, such as fuel for spray equipment."* – Dr. Jeremy Greene and Dr. Francis Reay-Jones, Clemson University

As an example of the relative length of control, flubendiamide and cyfluthrin were applied to sugarcane on mixed populations of Mexican rice borer and sugarcane borer (Figures 10 and 11). Flubendiamide provided superior control 37-40 days after application compared to cyfluthrin, regardless of the rate of flubendiamide applied. Flubendiamide is a high performance product that can reduce overall insecticide use by providing long residual control thereby reducing the need for repeat insecticide applications.

Figure 10. Percent Sugarcane Stalks with Borer Damage 37 to 40 Days After Flubendiamide and Cyfluthrin Application

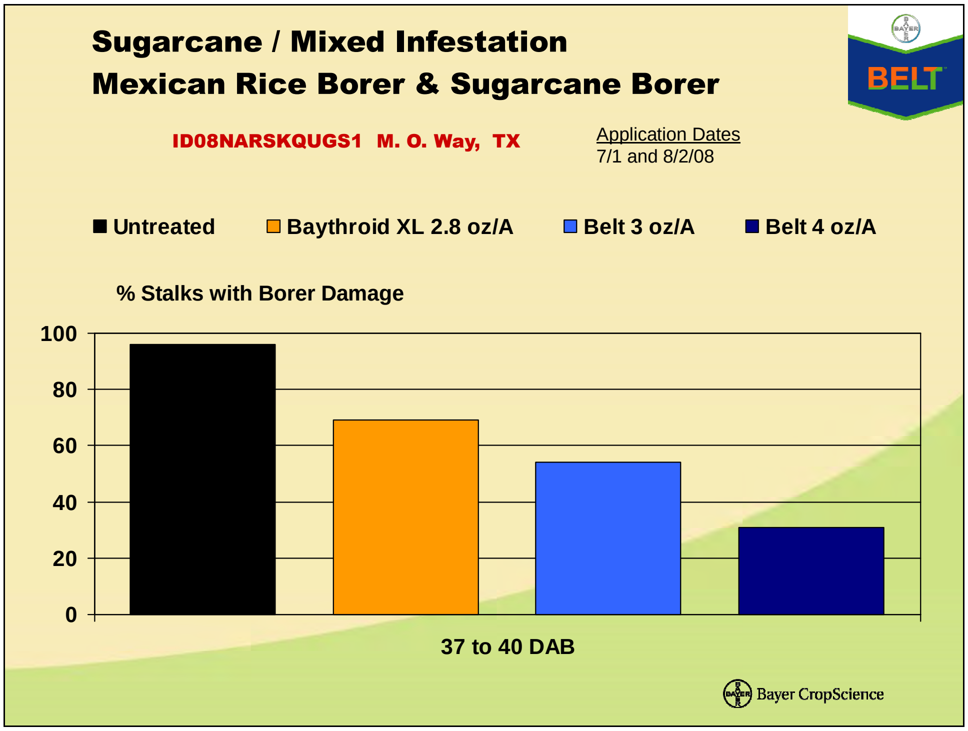
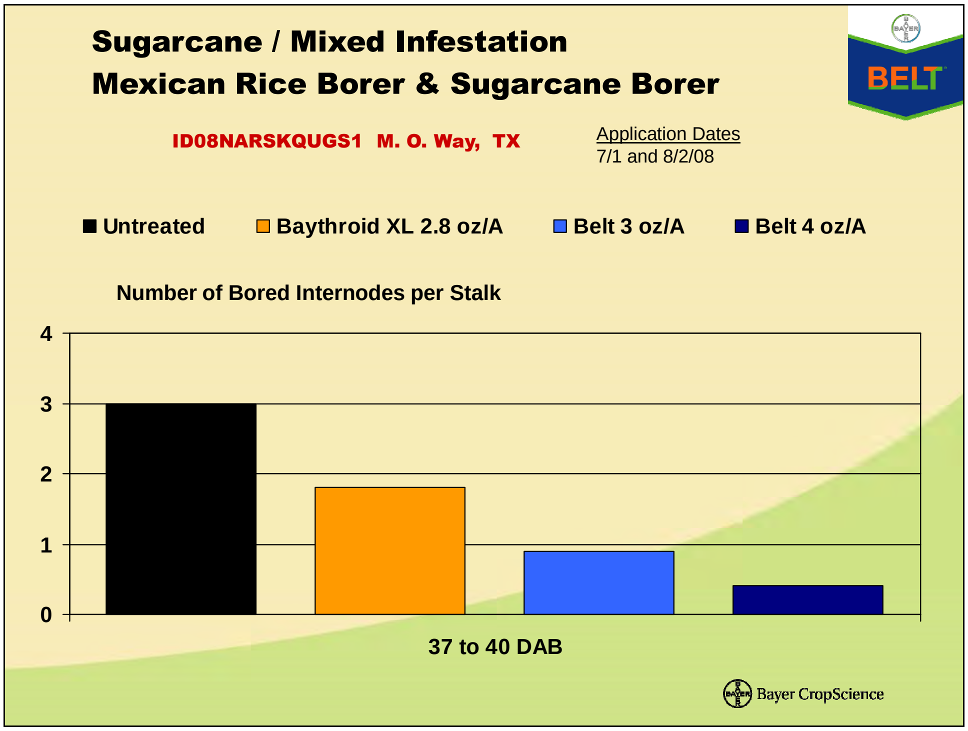


Figure 11. Number of Bored Sugarcane Internodes per Stalk 37 to 40 Days After Flubendiamide and Cyfluthrin Application.



Following is a case study demonstrating the value of flubendiamide's length of control and alternative MOA when used as part of an IPM program to control lepidopteran pests in soybeans.

CASE STUDY: No Regrets with Residual: Tighten Control of Worms with Belt Insecticide in Soybeans

As the southern row crop landscape adjusts to reflect the market, Delta farmers face many challenges – from cropping system shifts to resistance concerns to high pest populations. The broader spectrum of crops planted means there also is a broader spectrum of pests to control, and farmers can't necessarily rely on insecticides they used previously. Edward Whatley of Whatley Agricultural Consultants, Inc., in Clarksdale, Miss., works with cotton, corn and soybean acres. The latter is a current crop of concern, with heavy pressure from yield-robbing insects, including stinkbugs, loopers, beanleaf beetles and, the most concerning – bollworm/earworm.

According to Mississippi State University Extension, Mississippi farmers treated 1,800 acres for bollworm/earworm in 2006. By 2010, 450,000 acres were sprayed for bollworms/earworms and 750,000 acres in 2011. *Whatley said that insect lifecycles, pyrethroid resistance and cropping changes all play a part in the dramatic increase in the pests. "We are seeing resistance,"* he said. "But the main change is in cropping situations. We have less cotton and are shifting to more soybeans and corn."

Dr. Angus Catchot, Mississippi State Extension entomologist, documented this shift in a July 2011 article. The region's growers traditionally planted Group IV soybeans early, which helped them miss bollworm/earworm flights in the past, he explained. "As grain prices have increased, we are planting more wheat beans and more maturity Group V soybeans later to manage around harvest of corn," said Catchot. "We have essentially exposed a large portion of the crop to a time of the year where the highest bollworm/earworm numbers are present. "In past years, bollworms/earworms were extremely easy to control in soybeans, and even the low rates of pyrethroids were providing excellent control," Catchot said. *"In the last couple of years, we have been seeing declining efficacy with pyrethroids in all crops on bollworms/earworms."*

Whatley's 30-mile radius service area is somewhat typical of the bollworm/earworm challenge. He and his customers choose to meet the challenge head on with Belt® insecticide. "Belt is my primary worm control method in soybeans," Whatley said. "The No. 1 reason is excellent control, the best. Residual is the second reason. It has lasting power – two, three weeks, maybe a month."

When applied at early stages of pest infestation, Belt insecticide provides long-lasting worm control of all soybean worm pests, even resistant populations and late-stage larvae, said Lee Hall, Belt product manager, Bayer CropScience. "Belt helps preserve your yield potential," Hall said. "Its powerful activity stops worm feeding within minutes and can last two weeks or more with minimal risk to beneficials. "Plus, Belt is registered for use in soybeans, sugarcane, cotton, corn, peanuts, sorghum and tobacco, providing a critical IPM and resistance management tool with no known cross-resistance to any insecticide currently available on the market."

Whatley and his growers agree that Belt is a key to a productive season. In fact, Belt was applied to 100 percent of the soybean acres Whatley influenced in 2011. *"There are no failures, no slippage with Belt," he said. "The residual is outstanding. You pay a little more but you're getting your money's worth." One shot with Belt is cost-comparable to two passes of pyrethroid, said Whatley. It could actually be less when you factor in one less field trip and more peace of mind, he added.*

Scotty Fraiser, sales representative with Farmer Supply in Marvell, Ark., attests to the performance of Belt. "No doubt we deal with worms and stink bugs," he said. "The worm problem is increasing, mainly bollworm/earworm. There seem to be more and more every year." He admits he was initially skeptical to use Belt due to perceived cost, so he first tried it on a few fields. "I put my foot in my mouth," he said. "It's top-notch. Forget about the price and focus on the great control." Fraiser said his Belt customers are pleased with the return on investment. They saw that it brought excellent control and kept the threshold down longer than other products. *"We get 3 to 4 weeks with Belt," he said. "Pyrethroids do not provide enough residual. Ten days to 2 weeks later, [the field is] back at threshold. With Belt, it's clean as a pin."*

Bollworm/earworm pressure was so great in 2011, Fraiser said it wasn't unusual to lose 10 bu/A on untreated, irrigated ground. Not treating isn't an option, he said, and pyrethroids do not have the residual to handle the population boom. *"Two applications of Belt equal four applications of a cheaper product,"* he said. While he always leaves the door open for that second application, it's not always needed. *"That's why we recommend growers use Belt as their first spray of the season," Hall said. "Belt delivers longer residual and is quickly rainfast, so it lasts longer on the first try. You may not need the second spray, and Belt doesn't expose farmers to pyrethroid resistance issues. Even better is it doesn't kill beneficials that can help fight lateseason pests."*

Scouting before the first spray and throughout the season is critical. Both Whatley and Fraiser recommend frequent, regular scouting and following university threshold recommendations — 9 worms per 25 sweeps. Fraiser scouts twice each week to keep an accurate eye on the populations. "They can go from 9 to 30 before you know it." Whatley added,"Our farmers are aggressive. They are looking for new products to keep them ahead of the curve. They've seen and understand resistance, whether it be in weeds or insects. They are educated, driven and know we need these tools to be successful."

Application

- Belt is typically applied midseason or late season when worm pests approach economic threshold. Belt is tankmix compatible with many other crop inputs labeled for similar timing.
- Scout fields regularly and talk with your consultant, Extension agent or Bayer CropScience representative for advice on spray timing and tankmix options.

Beneficials

- When used according to label directions, Belt poses minimal risk to beneficial arthropods.

- Belt has a minimal impact on parasitoids, syrphid flies, lacewings, predatory bugs, predatory mites, or adult and larval ladybird beetles.

Environmental

- Belt is rainfast after it has dried on leaf surfaces for powerful, lasting control from the start.
- Belt has fast-action performance that combines with long-lasting residual control. Its powerful activity stops worm feeding within minutes and can last up to two weeks or more, without flaring mites.

Source: Delta Farm Press, May 30, 2012

4.4 Flubendiamide has low acute toxicity, a short REI/PHI and a favorable environmental risk profile which ensures minimal impact on applicators, field workers and the environment

With a “Caution” signal word, 12 hour REI, 0-14 day PHI, and high IPM and IRM compatibility, flubendiamide offers safety and flexibility equal to chlorantraniliprole and methoxyfenozide, and superior to the other commercial standards (Table 8). Methomyl has a “Danger” signal word, while bifenthrin, cyfluthrin and lambda-cyhalothrin have “Warning” signal words and are Restricted Use pesticides due to their toxicity to fish and aquatic organisms. Bifenthrin, cyfluthrin, lambda-cyhalothrin and methomyl are highly toxic to beneficial populations, while indoxacarb and spinetoram have comparatively low to moderate beneficial population toxicity. However, all of the insecticides are moderately to highly toxic to bees except flubendiamide, chlorantraniliprole and methoxyfenozide, which have low bee toxicity.

Below are comments from Dr. Hannah Burrack, Professor at North Carolina State University, explaining the unique benefit the human safety of flubendiamide brings to tobacco workers:
“North Carolina is the largest flue cured tobacco producing state, and this crop is grown on over 180,000 acres annually. Tobacco is a hand labor-intensive crop, relative to other agronomic crops. Workers may come into direct contact with plants several times during the growing season. These times include mid summer, when plants are topped (the apical meristem is removed) and suckered (axial meristems are removed). While some topping and suckering is mechanized, follow up hand removal is often necessary. Topping and suckering also coincide with the periods of activity of key foliar tobacco pests, including tobacco budworm and hornworms. Because of the continued reliance on hand labor in tobacco, mammalian toxicity of insecticides is an important consideration for worker protection.” – Dr. Hannah Burrack, North Carolina State University

TABLE 8. Comparative Safety and REI/PHI of Flubendiamide and Primary Competitors

Crop	Flubendiamide	Bifenthrin	Chlorantraniliprole	Cyfluthrin	Lambda-Cyhalothrin	Indoxacarb	Methomyl	Methoxyfenozide	Spinetoram
Label Signal Word	Caution*	Warning Restricted Use	Caution	Warning Restricted Use	Warning Restricted Use	Caution	Danger Restricted Use	Caution	Caution
Re-Entry Interval (REI)	12 hours	12 hours	4 hours	12 hours	24 hours	12 hours	2-4 days	4 hours	4 hours
Pre-Harvest Interval (PHI) Alfalfa	0 day	Not labeled	0 day	7 days	1 day forage, 7 days hay	7 days	7 days	0 day forage, 7 days hay	Not labeled
Pre-Harvest Interval (PHI) Almonds	14 days	7 days	10 days	14 days	14 days	Not labeled	Not labeled	14 days	1 day
Pre-Harvest Interval (PHI) Peanuts	3 days	14 days	1 day	14 days	14 days	14 days	21 days	7 days	3 days
Pre-Harvest Interval (PHI) Soybeans	14 days	18 days	21 days	21 days	30 days	21 days	14 days	14 days	28 days
Pre-Harvest Interval (PHI) Tobacco	14 days	1-day (transplant water application at planting)	1 day	Not labeled	40 days	Not labeled	5 flue cured, 14 air or fire cured	Not labeled	Not labeled
Pre-Harvest Interval (PHI) Cotton	28 days	14 days	21 days	0 day	21 days	Not labeled	15 days	14 days	28 days

Crop	Flubendiamide	Bifenthrin	Chlorantraniliprole	Cyfluthrin	Lambda-Cyhalothrin	Indoxacarb	Methomyl	Methoxyfenozide	Spinetoram
Pre-Harvest Interval (PHI) Brassica Vegetables	8 days	7 days	3 days	0 day	1 day	3 days	1-10 days	1 day	1 day
Pre-Harvest Interval (PHI) Cucurbit Vegetables	1 day	3 days	1 day	0 day	1 day	3 days	1-3 days	3 days	1-3 days
Pre-Harvest Interval (PHI) Fruiting Vegetables	1 day	1-7 days	1 day	0-7 days	5 days	3 days	1-5 days	1 day	1 day
Pre-Harvest Interval (PHI) Grape	7 days	30 days	1 day	3 days	Not labeled	7 days	Not labeled	30 days	7 days (grape only)
Pre-Harvest Interval (PHI) Leafy Vegetables	1 day	7 days-Lettuce; 40 days-Spinach	1 day	0 day	1 day	3 days	7-10 days	1 day	1 day
Pre-Harvest Interval (PHI) Legume Vegetables (Dry)	14 days	14 days	1 day	7 days	21 days	7 days (Southern pea only)	14 days	7 days	28 days
Pre-Harvest Interval (PHI) Strawberry	8 days	0 day	Not labeled	Not labeled	Not labeled	Not labeled	Not labeled	3 days	1 day

Source: Product labels.
*Attributes rating scale (excluding PHI):
Green – Consistently meets or exceeds customer expectations; limited to no effects on beneficial arthropods, does not flare secondary pests, compatible with IPM programs
Yellow – Sometimes meets customer expectations; significant effects on beneficial arthropods, may flare secondary pests, limited compatibility with IPM programs.
Red – Does not meet customer expectations; severe effects on most beneficial arthropods, routinely flares secondary pests, not compatible with IPM programs.
PHI rating scale:
Green – <7 days
Yellow – 7-14 days
Red – >14 days (may not necessarily be a detriment, dependent upon crop)
Orange – Not registered

5. Justification of the Need for Flubendiamide for Reliable, Cost Effective and Environmentally Sound Control of Commercially Important Lepidopteran Pests

5.1 Historical Use of Flubendiamide

Flubendiamide has been widely embraced by growers because of its many attributes versus insecticide alternatives:

- Broad-spectrum Lepidoptera-specific pest control, including control of driver species
- Unique Group 28 Ryanodine Receptor Modulator mode of action
- Low cost “IPM friendly” insecticide option
- Low use rate
- Low toxicity **–** “Caution” signal word, short REI/PHI
- Long lasting residual control
- Superior selectivity and safety to beneficial populations
- Easily integrated into Integrated Pest (IPM) and Insecticide Resistance Management (IRM) programs.
- Favorable environmental risk profile.

Flubendiamide use for 2012-2014 is summarized in Figure 12 and Table 9. > CBI6 text located in the Confidential Business Information Appendix <

Dr. Angus Catchot, Professor at Mississippi State University writes on the benefits BELT provides to Mississippi row crop farmers:

“Belt was the first chemistry to receive section 3 status in the state of Mississippi in the diamide class of chemistry. Belt and the diamide chemistry has become critically important to the producers in the state of Mississippi to manage caterpillar pests in Cotton, Soybean, Corn, Grain Sorghum, and Peanuts. When the first large scale field trials began to go out with Belt, growers were extremely pleased with the results and the long residual. Our university testing also has shown superior control and residual compared to any products registered or tested previously. Although Belt cost more, producers quickly adopted this product because of its benefits and safety profile.” - Dr. Angus Catchot, Mississippi State University

The following sections of the Benefits document detail the use scenario in the majority of the crops present on the flubendiamide label. These are listed in order of use based on % treated acres - from highest to lowest. Key examples of critical benefits of flubendiamide in minor use crops are also highlighted and organized by crop group.

> CBI7 text located in the Confidential Business Information Appendix **<**

5.2 Flubendiamide Use in Soybeans

> CBI8 text located in the Confidential Business Information Appendix < Major lepidopteran pests that infest soybeans include soybean looper, tobacco budworm, fall armyworm, beet armyworm, green cloverworm and velvetbean caterpillar.

>CBI9 text located in the Confidential Business Information Appendix <

Table 12 presents the total percent acres treated with insecticides used for control of lepidopteran pests in soybeans in 2012-2014. > CBI10 text located in the Confidential Business Information Appendix <

Based on these current use patterns and the significant pricing difference between flubendiamide and other IPM-friendly competitors, we believe removal of flubendiamide from the soybean marketplace will result in an increase in IPM-disruptive pyrethroids. This has many downsides including disruption of natural enemies which will likely result in increased insecticide use for the duration of the production season. The efficacy of flubendiamide in soybeans has been proven by multiple trials conducted by university IPM practitioners. See soybean Arthropod Management Test efficacy reports in Appendix B for trial results. Additionally, Table 14 lists the advantages of flubendiamide over each of the major alternative insecticides for lepidopteran pest control in soybeans.

TABLE 14. The Advantages of Flubendiamide Over Alternative Foliar Lepidopteran Insecticides in Soybeans.

<table>
<tr><th>Advantages of Flubendiamide Over Alternative Insecticides</th><th>Available Alternatives to Flubendiamide</th></tr>
<tr><td rowspan="6">IPM friendly, Controls pyrethroid resistant soybean lepidopteran pests, Superior length of control and rainfastness = reduced number of sprays</td><td>BIFENTHRIN</td></tr>
<tr><td>CYHALOTHRIN-LAMBDA</td></tr>
<tr><td>CYFLUTHRIN</td></tr>
<tr><td>CYHALOTHRIN-GAMMA</td></tr>
<tr><td>ZETA-CYPERMETHRIN</td></tr>
<tr><td>CYHALOTHRIN-LAMBDA – THIAMETHOXAM</td></tr>
<tr><td>IPM friendly, Controls pyrethroid resistant soybean lepidopteran pests</td><td>CHLORANTRANILIPROLE – CYHALOTHRIN-LAMBDA</td></tr>
<tr><td>Narrow spectrum of activity. Only controls caterpillar pests. Quicker cessation of feeding.</td><td>DIFLUBENZURON</td></tr>
<tr><td>Much lower cost/acre</td><td>CHLORANTRANILIPROLE</td></tr>
</table>

University faculty and an independent crop consultant comment on the benefit flubendiamide brings to soybean growers in the southeastern United States:

"As an agricultural consultant advising 100 + growers annually, I need products which work and are cost effective. Belt has proven itself on both counts. We use Belt for corn earworm and soybean looper control in soybeans. At 2-2.5 oz/acre we get excellent control and have never needed a second treatment for escapes or later hatching larvae. Cost is in the $10-12.50/acre,

which is an affordable price range for our growers." – Stan Winslow, President – Tidewater Agronomics, Inc.

"While organophosphates and pyrethroids are broad-spectrum insecticides, the selectivity of flubendiamide helps conserve species of predaceous and parasitic arthropods that aid in regulating populations of pest insects."
– Dr. Jeremy Greene and Dr. Francis Reay-Jones, Clemson University

"The commercial introduction of this compound occurred almost simultaneously with the onset of pyrethroid tolerant/resistant corn earworm in the Midsouth region. There was numerous request by grower groups for us to push the companies for development and implementation of the use of B.t. soybeans in response to these issues. Although Belt cost more, producers quickly adopted this product because of its benefits and safety profile. Belt and the diamide class of chemistry have become so important to our overall caterpillar management program that it has now been said that we still need the introduction of B.t soybeans to take the pressure off this chemistry to delay resistance with this compound well into the future. Over the last several years we have been able to successfully incorporate Belt into our IPM programs. The residual activity and safety profile on beneficial insects it provides often displaces multiple applications with harder chemistries therefore solidifying its place in our IPM toolbox in Mississippi" – Dr. Angus Catchot, Mississippi State University

"From a soybean standpoint, the corn earworm has become our most important insect pest in Mississippi and other areas of the Mid-South. This has been compounded by the fact that pyrethroids no longer provide adequate control of this pest. Even if pyrethroids were effective, we would still recommend the use of flubendiamide in most situations. We have multiple yield limiting insect pests of soybean in the Mid-South. However, many of those insect pests are maintained below the current economic thresholds unless natural enemy complexes are disrupted by foliar insecticide sprays. Corn earworm applications generally occur during the early flowering and pod setting stages in soybean (R2-R4). When we make an application with a broad spectrum insecticide, such as a pyrethroid, during those stages, we generally have to follow that application with additional applications from R5 to R6 to manage other pests such as soybean looper. In contrast, we rarely have to make an application for soybean looper during the later stages of soybean development when a flubendiamide application is made during the R2-R4 growth stages. Because of that, flubendiamide has been an integral component of our overall soybean IPM program in Mississippi." – Dr. Jeff Gore, Mississippi State University

"In field trials conducted at the Edisto Research and Education Center near Blackville, SC, flubendiamide has demonstrated excellent selective activity on immature lepidopteran pests (larvae/caterpillar insect pests) of cotton and soybeans. I (J. Greene) have tested flubendiamide in various trials since 2009 and have noted very good residual control of lepidopterans in both crops. In soybeans, flubendiamide provides good control of the aforementioned species in addition to velvetbean caterpillar, Antcarsia gemmatalis, green cloverworm, Hypena scabra, and other minor caterpillar pests. Many of the species mentioned above are resistant to older classes of insecticide chemistry, such as the organophosphates and the pyrethroids, so the diamide class of chemistry is an essential tool for pest managers." – Dr. Jeremy Greene, Clemson University

Growers trust BELT to stop feeding and provide residual protection. Removal of flubendiamide from soybean production would likely result in increased reliance on pyrethroids early in the crop cycle, which disrupts natural enemy complexes, triggering more insecticide use later in the season.

5.3 Flubendiamide Use in Tree Nut Crops and Pistachio, Crop Group 14

This crop grouping includes Almond, Beech Nut, Brazil Nut, Butternut, Cashew, Chestnut, Chinquapin, Filbert (hazelnut), Hickory Nut, Macadamia Nut, Pecan, Pistachio, Walnut (black and English). The predominant usage of flubendiamide within the tree nut grouping is on almond. In this section, we also describe the benefits that flubendiamide provides to pistachio growers as a representation of the benefits this product provides to minor crop growers.

Almonds:

A variety of insect pests and diseases attack almonds in California and the crop is treated with insecticides on a frequent basis. > CBI11 text located in the Confidential Business Information Appendix <

> CBI12 text located in the Confidential Business Information Appendix<

Table 16 presents the insecticides used for control of lepidopteran pests in almonds in 2012-2014. >CBI13 text located in the Confidential Business Information Appendix <

>CBI14 text located in the Confidential Business Information Appendix <

TABLE 17. The Advantages of Flubendiamide Over Alternative Foliar Lepidopteran Insecticides in Almonds.

Advantages of Flubendiamide Over Alternative Insecticides	Available Alternatives to Flubendiamide
Very Similar, Some advantages for control of NOW and PTB*	METHOXYFENOZIDE
Much lower cost/acre	CHLORANTRANILIPROLE
Superior activity on almond lepidopteran pests = NOW, PTB	DIFLUBENZURON
	ACETAMIPRID
	INDOXACARB
IPM friendly, Does not flare mites, Superior length of control = reduced number of sprays	BIFENTHRIN
	CYHALOTHRIN-LAMBDA

*NOW = Navel Orange Worm, PTB = Peach Twig Borer

Flubendiamide provides superior NOW control when compared to methoxyfenozide (trade name Intrepid). According to Dr. Frank Zalom, Distinguished Professor at University of California -

Davis,*“Where Belt differs from Intrepid in our suggested IPM Program is when peach twig borer is also a target pest. Intrepid does not provide satisfactory control of peach twig borer while diamide insecticides such a Belt provide excellent control – even better than the pyrethroids.”* The efficacy of flubendiamide in almonds has been proven by multiple trials conducted by university IPM practitioners. See almond Arthropod Management Test efficacy reports in Appendix B for trial results. When compared to chlorantraniliprole, flubendiamide is non-systemic, applying a treatment window approach for IPM. Flubendiamide also has an extremely competitive price point, making it easier for growers to remain committed to an IPM program with use of this IPM-friendly insecticide.

It is anticipated the removal of flubendiamide from the tree nut sector, specifically almond, would increase the use of pyrethroids specifically targeting peach twig borer. This increase in the use of pyrethroids would disrupt beneficials used in IPM and would likely flare mite populations, leading to increased usage of miticides and increasing overall environmental loading.

Pistachio

A variety of insect pests and diseases attack pistachios in California and the crop is treated with insecticides on a frequent basis. > CBI15 text located in the Confidential Business Information Appendix <

>CBI16 text located in the Confidential Business Information Appendix <

Table 19 presents the insecticides used for control of lepidopteran pests in pistachio from 2012-2014. > CBI17 text located in the Confidential Business Information Appendix.<

>CBI18 text located in the Confidential Business Information Appendix <

The efficacy of flubendiamide in pistachios has been proven by multiple trials conducted by university IPM practitioners. See pistachio Arthropod Management Test efficacy Flubendiamide provides superior NOW control when compared to methoxyfenozide (trade name Intrepid). When compared to chlorantraniliprole, flubendiamide has an extremely competitive price point and also provides control of PTB, making it easier for growers to choose this IPM-friendly insecticide and maintain an IPM program.

Below are comments from the American Pistachio Growers Association supporting the benefits of BELT to California Pistachio growers:

“The U.S. pistachio industry, along with other tree nut crops, have found Belt, produced by Bayer CropScience, to be a useful tool in our arsenal against pest diseases particularly the navel orangeworm, which are not beneficial. In 2014, the U.S. pistachio industry treated approximately 10,000 acres with Belt to combat navel orangeworm, a pest that causes pistachios to be susceptible to contamination that results in aflatoxin. Aflatoxin contamination is detrimental to our industry; therefore, we must protect our crop from the navel orangeworm in order to prevent aflatoxin contamination. Aflatoxin causes significant problems for U.S. pistachio exports. All of our export markets follow Codex maximum standards for aflatoxin.

Pistachios that test above the Codex standard are subject to be destroyed, returned to the U.S. or shipped to another country. Belt has shown its ability to minimize the occurrence of naval orangeworm and other hard to manage caterpillar pests." – Richard Matoian, Executive Director, American Pistachio Growers Association.

We believe the removal of flubendiamide from the pistachio marketplace could result in an increased use of IPM-disruptive chemistries. IPM-disruptive chemistries hold the majority of the marketplace at this time. The likelihood of growers switching to chlorantraniliprole – the diamide competitor – is low because of the significantly higher cost of this product when compared to flubendiamide and methoxyfenozide. An increase in the use of IPM-disruptive chemistries will likely result in increased secondary pests problems, such as mite flares, and result in an overall increase in insecticide use.

Our perspective is reinforced by this statement from Dr. Frank Zalom, *"With the restrictions on organophosphate use and the loss of some registrations (e.g. Guthion), growers turned to other insecticides, most notably pyrethroids which those of us at the University have long recommended against due to their potential side-effects. Indeed, the widespread use of pyrethroids for navel orangeworm control has destroyed our nonchemical mite management programs in some growing regions. Instead, we encourage growers to use less disruptive insecticides during the season when necessary including certain insect growth regulators such as Intrepid (methoxyfenozide) and the diamides."*

5.4 Flubendiamide Use in Peanut

>CBI19 text located in the Confidential Business Information Appendix <. < A variety of lepidopteran pests attack peanuts, including corn earworm/cotton bollworm, fall armyworm, beet armyworm, soybean looper, and velvetbean caterpillar.

>CBI20 text located in the Confidential Business Information Appendix<

Table 21 presents the insecticides used for control of lepidopteran pests in peanut in 2012-2014. >CBI21 text located in the Confidential Business Information Appendix < <

>CBI22 text located in the Confidential Business Information Appendix<

TABLE 22. The Advantages of Flubendiamide Over Alternative Foliar Lepidopteran Insecticides in Peanut.

Advantages of Flubendiamide Over Alternatives	Available Alternatives to Flubendiamide
Superior activity on peanut lepidopteran pests, Rainfastness = reduced number of sprays	DIFLUBENZURON
	METHOXYFENOZIDE
	NOVALURON
	SPINOSYN
IPM friendly, Does not flare mites, Superior length of	BIFENTHRIN

control and rainfastness = reduced number of sprays, Compatibility with fungicides commonly sprayed at the same time	CYHALOTHRIN-LAMBDA
	CYFLUTHRIN
	ZETA-CYPERMETHRIN
Narrow spectrum of activity, only controlling caterpillar pests.	INDOXACARB

The efficacy of flubendiamide in peanuts has been proven by multiple trials conducted by university IPM practitioners. See peanut Arthropod Management Test efficacy reports in Appendix B for trial results. When compared to pyrethroid chemistries, flubendiamide has a much more favorable profile for preserving beneficial insects, such as predatory mites that control spider mites (Figure 2). Additionally, when compared to the other IPM-friendly insecticides (diflubenzuron and methoxyfenozide), flubendiamide provides superior control of lepidopteran pests and is also rainfast. Rainfastness is of particular importance in the southeast region U.S. where the majority of peanuts are grown and rainstorms are a common occurrence during the production season. The product attributes of flubendiamide combined with its efficacy fill an important niche in southeastern US peanut production.

Research and Extension faculty at the University of Georgia and Mississippi State University comment on the benefits of flubendiamide to peanut growers:

"Georgia growers produce nearly 50% of the US peanut crop annually, and insect pests can result in significant economic loss. Foliage feeding caterpillars are probably the most commonly treated pest group in peanut. Broad spectrum pyrethroid insecticides have been the standard for caterpillar control for many years, and this class of chemistry is still widely utilized. Nevertheless, problems associated with pyrethroid use in peanut are significant, and the availability of alternate chemistries like flubendiamide is important. Resistance development in tobacco budworm, Heliothis virescens, and fall armyworm, Spodoptera frugiperda, has rendered pyrethroids ineffective against these key pests. The efficacy of pyrethroids is also limited against other economically important species such as soybean looper, Chrysodeixis includens, and velvetbean caterpillar, Anticorsio gemmotolis. Another major concern associated with the use of pyrethroids and other broad spectrum insecticides is the risk of flaring secondary pests such as two spotted spider mite, Tetranychus urticae." – Dr. Mark Abney, University of Georgia

"In peanut, we see a similar situation. There is a large complex of caterpillar pests that infest peanut simultaneously in Mississippi. Some of the more important ones include corn earworm, tobacco budworm, granulate cutworm, fall armyworm, and several looper species. It is rare to find only one or two species in a field at any particular time. Flubendiamide provides excellent control of all of these pests in peanut. Additionally, many of these pests are no longer effectively managed with pyrethroids. There are several insecticides labeled for control of caterpillars in peanut, but most of them only control one or two species. Insecticides in the diamide class of insecticides provide good control of all of the caterpillar pests. Similar to soybean, we are also concerned with the disruption of natural enemy complexes with alternative insecticides. In particular, spider mites can be one of the most devastating arthropod pests of peanut and they occur almost exclusively in fields that have received a spray with a broad spectrum insecticide. We rarely see spider mites in peanut fields where natural enemy complexes have not been

disturbed. This is especially important because there are currently no miticides labeled in peanut that will effectively manage a spider mite infestation. The only miticide labeled in peanut is propargite (Comite II, Chemtura Corp.), but we have not recommended it in any of the crops it is labeled for because of resistance. In experiments I conducted here in Stoneville, MS, two sequential applications of propargite provided less than 50% control of twospotted spider mite. With their reproductive capacity, the mites rebounded to damaging levels within 7-10 days and significant yield losses were observed. Because of that, prevention of spider mite infestations is the best management strategy and an insecticide such as flubendiamide is an ideal insecticide to fit into that plan to manage other pests." – Dr. Jeff Gore, Mississippi State University

"Flubendiamide is commonly used by peanut producers in Georgia as it provides good efficacy and residual activity against a broad range of foliage feeding caterpillars. ln short, Belt fits very well into an integrated pest management program in peanut with low risk to beneficial insects and humans, good efficacy against target pests, and an alternative MOA compared to other insecticides commonly used in the crop."- Dr. Mark Abney, University of Georgia

We believe if flubendiamide is removed from the peanut marketplace it is likely one of two things may happen. In the first scenario, growers switch to using IPM-disruptive insecticides resulting in secondary pest infestations and a greater amount of insecticide being applied season-long. In a second scenario, growers increase their use of diflubenzuron or methoxyfenozide, increasing the selection pressure on these chemistries and accelerating the development of insecticide resistance. The current product availability in peanuts provides an ideal portfolio of choices for growers with the options to rotate insecticide mode of action, retaining the utility of a variety of tools to control caterpillar pests.

5.5 Flubendiamide Use in Tobacco

A variety of insects and disease attack US grown tobacco. >CBI23 text located in the Confidential Business Information Appendix< A variety of lepidopteran pests are treated on a frequent basis in tobacco including tobacco budworm, tobacco/tomato hornworms, cutworm and splitworm.

>CBI24 text located in the Confidential Business Information Appendix<

Table 24 presents the insecticides used for control of lepidopteran pests in tobacco in 2012-2014. >CBI25 text located in the Confidential Business Information Appendix<

>CBI26 text located in the Confidential Business Information Appendix<

Flubendiamide differs from chlorantraniliprole in tobacco in two key ways. It is highly selective, only providing control of caterpillar pests and it is non-systemic, allowing the application of a treatment window approach for insecticide resistance management. Furthermore, as detailed in the comments below from Dr. Hannah Burrack, Associate Professor and Extension Entomologist at North Carolina State University, the use patterns of diamide chemistries vary across the US. In Dr. Burrack's experience, flubendiamide is the preferred diamide chemistry in North Carolina tobacco production (Table 26). Dr. Burrack attributes the reduction in acephate use to increased adoption of flubendiamide and not chlorantraniliprole. It is likely the competitive pricing of flubendiamide has encouraged the adoption of this chemistry over other, more expensive, IPM-friendly alternatives.

TABLE 25. The Advantages of Flubendiamide Over Alternative Foliar Lepidopteran Insecticides in Tobacco.

Advantages of Flubendiamide Over Alternative Insecticides	Available Alternatives to Flubendiamide
Superior length of control = reduced number of sprays	SPINOSYN
Much lower cost/A	CHLORANTRANILIPROLE
IPM friendly, Superior residual control = reduced number of sprays	METHOMYL
IPM friendly, Superior length of control = reduced number of sprays, Application flexibility (PHI)	BIFENTHRIN
	CYHALOTHRIN-LAMBDA
	CHLORANTRANILIPROLE - CYHALOTHRIN-LAMBDA

The efficacy of flubendiamide in tobacco has been proven by multiple trials conducted by university IPM practitioners. See tobacco Arthropod Management Test efficacy reports in Appendix B for trial results.

Below are some specific comments from Dr. Burrack on her research around adoption of flubendiamide by North Carolina tobacco farmers:

"Since BELT's registration in tobacco, I have recommended it for use against our key caterpillar pests, tobacco budworm and tobacco/tomato hornworms. These two pests together account for virtually all foliar insecticide treatments in tobacco, and between 2-4 foliar treatments are made per growing season, dependent upon pest pressure. In addition to BELT, I also recommend the use of Coragen (DuPont Crop Protection) and spinosad (formerly labeled as Tracer in tobacco, now labeled as Blackhawk; Dow AgroSciences). I recommend the use of BELT for several reasons. First, it is effective. Second, I have fewer concerns about worker exposure with BELT as compared to acephate (Orthene, among other trade names), which was a commonly used standard before the registration of BELT. Third, BELT is narrower spectrum than the other materials I recommend for tobacco budworm and hornworms. Because BELT targets only caterpillar pests, I have fewer concerns about impacts on beneficial insects or non target pests. This is a particular concern for spinosad because it is very toxic to bees and wasps if they are contacted. Parasitism rates in budworms and hornworms can be as high as 70-80% (which include three different wasp species) and these beneficial insects provide an important measure of population reduction, reducing the number of foliar sprays that may be needed. Finally, BELT provides a different mode of action, which is important for resistance management. Tobacco budworm in particular has a history of developing resistance to insecticides when a single mode of action is overused."

"BELT has become a very important tool for North Carolina tobacco growers and has positively impacted the sustainability of our pest management programs."

"The average percentage acres treated with at least one application of acephate for the three years prior the registration of BELT was 61.9%, and after the registration of BELT was 44.8%. Similarly, the area treated with spinosad averaged 36.1% prior to BELT's registration and 20.9% after. I believe, based on these data and conversations with growers, that the decrease in the use of both these materials is due to a shift to BELT, and to a much lesser extent Coragen, which was registered around the same time period. If this assertion is correct, then BELT's availably in tobacco has contributed to a reduction in both the use of an organophosphate insecticide (acephate) and the use of a broader spectrum insecticide (spinosad)." – Dr. Hannah Burrack, North Carolina State University

TABLE 26. Percent of North Carolina Tobacco Acreage Treated With Various Lepidopteran Insecticides Prior To and Following Flubendiamide Registration.

		Reported percentage of acres treated					
Trade name	**Active ingredient**	**2005**	**2006**	**2007**	**2012**	**2013**	**2014**
Orthene	Acephate	60.25	58.41	67.14	56.42	34.97	43
Tracer and/or Blackhawk	Spinosad	26.71	37.41	44.11	33.08	13.59	16
Belt	Flubendiamide	NA	NA	NA	53.8	19.4	43.4

Source: Survey of North Carolina State University Extension Agents

Dr. Francis-Reay Jones, Associate Professor at Clemson University, also has extensive experience with flubendiamide use in South Carolina tobacco production. "*Trials in tobacco with flubendiamide since 2008 also at the Pee Dee REC have shown that Belt provides good control of tobacco budworm and excellent control of tobacco hornworm, Manduca sexta."* Dr. Francis-Reay Jones, Clemson University

Based on current use patterns and input from University stakeholders, such as Drs. Burrack and Reay-Jones, we believe the removal of flubendiamide from the market would likely result in increased reliance on IPM-disruptive chemistries such as acephate and pyrethroids. This would have negative environmental and human safety impacts in tobacco production. As noted in more detail in Benefits Claimed Section 4, caterpillars are controlled during the tobacco production cycle at the time when laborers have frequent contact with the plant, increasing their risk of exposure to chemistry. The favorable acute toxicity profile of flubendiamide and narrow spectrum of control to caterpillars only enables IPM adoption and an ideal solution for tobacco farmers.

5.6 Flubendiamide Use in Alfalfa

>CBI27 text located in the Confidential Business Information Appendix < A variety of insect pests attack alfalfa in the western region of the US, primarily in California. The crop is treated with insecticides on a frequent basis. > CBI28 text located in the Confidential Business Information Appendix <

>CBI29 text located in the Confidential Business Information Appendix<

Table 28 presents the insecticides used for control of lepidopteran pests in alfalfa in 2012-2014. > CBI30 text located in the Confidential Business Information Appendix <

>CBI31 text located in the Confidential Business Information Appendix<

TABLE 29. The Advantages of Flubendiamide Over Alternative Foliar Lepidopteran Insecticides in Alfalfa.

<table>
<tr><th>Advantages of Flubendiamide Over Alternative Insecticides</th><th>Available Alternatives to Flubendiamide</th></tr>
<tr><td rowspan="2">Superior activity on alfalfa lepidopteran pests, Superior length of control = reduced number of sprays</td><td>INDOXACARB</td></tr>
<tr><td>METHOXYFENOZIDE</td></tr>
<tr><td>Much lower cost/acre</td><td>CHLORANTRANILIPROLE</td></tr>
<tr><td rowspan="7">IPM friendly, Does not flare mites, Superior leaf cutter bee safety, Superior length of control = reduced number of sprays</td><td>BIFENTHRIN</td></tr>
<tr><td>CYFLUTHRIN</td></tr>
<tr><td>CYHALOTHRIN-GAMMA</td></tr>
<tr><td>CYHALOTHRIN-LAMBDA</td></tr>
<tr><td>ALPHA-CYPERMETHRIN</td></tr>
<tr><td>ZETA-CYPERMETHRIN</td></tr>
<tr><td>METHOMYL</td></tr>
<tr><td>IPM friendly, Does not flare mites, Superior leaf cutter bee safety, Superior activity on alfalfa lepidopteran pests, Superior length of control = reduced number of sprays</td><td>PERMETHRIN</td></tr>
</table>

The efficacy of flubendiamide in alfalfa has been proven by multiple trials conducted by university IPM practitioners. See alfalfa Arthropod Management Test efficacy reports in Appendix B for trial results. When compared to indoxacarb, flubendiamide provides growers with superior efficacy against target pests and extended residual on the leaf surface, decreasing the need for repeated insecticide applications and decreasing the amount of product used during the season. In comparison to chlorantraniliprole, flubendiamide has a narrow spectrum of activity allowing growers to selectively control caterpillars. The non-systemic nature of flubendiamide allows growers to apply a treatment window approach for insecticide resistance management.

Below are statements from Dr. Eric Natwick, Extension Specialist at the University of California Cooperative Extension Service and Jane Townsend, Executive Director of the California Alfalfa and Forage Association. Both of these individuals have considerable experience with flubendiamide and the benefits provided to alfalfa growers.

"My past experience with flubendiamide, trade name Belt, was that is has excellent activity against lepidopteran pests while showing a minimal impact on beneficial insects, including pollinators." – Dr. Eric Natwick, University of California Cooperative Extension

"Since 2008, when Belt was made available to growers, it has provided a reliable option for control of a variety of pests. In addition to being an important pest management tool for caterpillar pests, Belt has proven to be an excellent fit into integrated pest management (IPM)

systems, which the alfalfa industry employs to protect our crop and the environment. Belt is a selective insecticide that has minimal impact on beneficial insects. In fact, at registration, the conclusion from the EPA after evaluating all of the available data for Belt was that "significant side effects to bumblebees and honey bees are NOT expected". – Jane Townsend, Executive Director, California Alfalfa and Forage Association

Based on the current insecticide use patterns in alfalfa, and the relatively high price of leading IPM-friendly competitors, we believe if flubendiamide is removed from the marketplace, growers are likely to increase their use of IPM disruptive pyrethroid insecticides. The use of pyrethroids will likely increase the amount of insecticide applications made during the season and cause secondary pest outbreaks such as aphids - typically suppressed by parasitoids. Flubendiamide has a very favorable beneficial insect profile, allowing aphid parasitoids to thrive and retaining IPM balance in the crop system.

5.7 Flubendiamide Use in Cotton

A variety of insects and disease attack US grown cotton. >CBI32 text located in the Confidential Business Information Appendix < A variety of lepidopteran pests are treated on a frequent basis in cotton including bollworm, tobacco budworm, fall armyworm, beet armyworm, and soybean looper.

>CBI33 text located in the Confidential Business Information Appendix<

Table 31 presents the insecticides used for control of lepidopteran pests in cotton grown in the southeastern region of the US (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, South Carolina and Virginia) in 2012-2014. > CBI34 text located in the Confidential Business Information Appendix <

>CBI35 text located in the Confidential Business Information Appendix<

The efficacy of flubendiamide in cotton has been proven by multiple trials conducted by university IPM practitioners. See cotton Arthropod Management Test efficacy reports in Appendix B for trial results. When compared to both novaluron and spinetoram, flubendiamide has superior rainfastness, extended residual activity and superior efficacy.

Below are comments on the benefit flubendiamide offers to cotton growers provided by Dr. Jeremy Greene, Professor at Clemson University and Dr. Don Parker, Manager, IPM at the National Cotton Council.

"In field trials conducted at the Edisto Research and Education Center near Blackville, SC, flubendiamide has demonstrated excellent selective activity on immature lepidopteran pests (larvae/caterpillar insect pests) of cotton and soybeans. I (J. Greene) have tested flubendiamide in various trials since 2009 and have noted very good residual control of lepidopterans in both crops. In cotton not expressing toxins from Bacillus thuringiensis (Bt) (i.e. non-Bt cotton), flubendiamide provides excellent control of bollworm, Helicoverpa zea, tobacco budworm, Heliothis virescens, fall armyworm, Spodoptera frugiperda, beet armyworm, Spodoptera exigua,

soybean looper, Pseudoplusia includens, and numerous other caterpillar pests.” – Dr. Jeremy Greene, Clemson University

“*BELT SC insecticide has been in the market since 2008 and has provided growers with a reliable option for control of a variety of pest control, including the difficult to manage caterpillar pest. Even with transgenic Bt crops included, the summary of 5.damaging insect pests for the US in 2014 ranked the caterpillar pest as the fourth most damaging pest. In addition, Belt has proven to be an excellent fit with integrated pest management systems and resistance management practices. Belt provides highly effective control of the caterpillar pest while minimizing impacts on beneficial insects and does not “flare” outbreaks of mite pests. Belt is an excellent tool for resistance management without known cross-resistance to conventional insecticides. The availability of multiple Modes of Action (MOA) for rotation in resistance management plan is critical to maintaining effective pest control without over-reliance on single or few MOAs. EPA has previously acknowledged that Belt was not expected to have significant side effects on bumblebees or honey bees.”* – Dr. Don Parker, Manager, IPM, National Cotton Council

If flubendiamide is removed from the cotton marketplace, we believe it will result in increased use of pyrethroids. This assertion is based on the current reliance on pyrethroid chemistries to control caterpillars in cotton grown in the southeast. In the case of growers who prefer to use IPM-friendly products, growers will likely increase their reliance on novaluron and spinetoram, increasing the selection pressure on these chemistries and potentially decreasing their life-span as a valuable tool for growers to manage insecticide resistance.

5.8 Flubendiamide Use in Fruiting Vegetables and Okra, Crop Group 8

This crop grouping contains Eggplant, Groundcherry, Okra, Pepino, Pepper (includes: bell pepper, chili pepper, cooking pepper, pimento, sweet pepper), Tomatillo, and Tomato.

Tomato

A variety of insect pests and diseases attack tomato grown in the US. > CBI36 text located in the Confidential Business Information Appendix <

>CBI37 text located in the Confidential Business Information Appendix<

Table 33 presents the insecticides used for control of lepidopteran pests in tomato in 2012-2014. >CBI38 text located in the Confidential Business Information<

The efficacy of flubendiamide in tomato has been proven by multiple trials conducted by university IPM practitioners. See tomato Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide is superior to spinetoram and methoxyfenozide because it is rainfast and provides superior efficacy with an extended period of residual control. When compared to chlorantraniliprole, which is systemic, flubendiamide offers growers the opportunity to apply a treatment window approach to pest management.The narrow spectrum of activity of flubendiamide minimizes the risk of resistance developing in other insect pests present in the crop, such as leafminers. In Florida, resistance in leafminers to chlorantraniliprole has been documented ("Insect Resistance Action Committee- US Diamide Working Group Agenda and Minutes". October 10, 2012, Gulf Coast AREC, Wimauma, FL, USA). The excellent price point of flubendiamide makes it a more economic choice for growers who want to apply a product that only controls caterpillars and provides rapid feeding cessation to prevent injury to fruit.

Below are comments provided by The Morning Star Company - the world's leading tomato ingredient processor, serving food processors throughout the world. Plant operations are located in the heart of California's tomato production in the communities of Williams and Los Banos.

"BELT is a key insecticide is our own farming operations and well as over half of our contracted growers IPM programs that it specifically targets armyworms and fruit worms. These worms are key pests of the tomato industry and are difficult to control. High worm damage leads to secondary problems such as mold. Deformed fruit is not acceptable for dice products such as salsa's and mold can causes problems in the production of our paste if the amounts are too high. Logistically we may have to stop harvest in a field if mold or worm damage is too high or bypass the field in its entirety. Another benefit of BELT is as a safer alternative to replace your former product methamidophos, Brand name of Monitor, which was pulled from our approved list of products a grower can use because of customer pressure long before the EPA tolerances expired due to its chemistry.

Please consider these key Points about BELT:

- *BELT is an important and outstanding pest management tool for caterpillar pests.*
- *BELT is a selective insecticide that has minimal impact on beneficial insects and fits into current IPM programs and does not flare mites.*
- *IPM programs are key to the success of USA farming, specifically California due to limited chemical options, BELT is a product that keeps IPM programs intact.*
- *At registration the conclusion from the US EPA after evaluating all of the available data for BELT was that "Significant side effects to bumblebees and honey bees are NOT expected".*
- *BELT is a key insect resistant management tool with no known cross-resistance to conventional insecticides."*

– Renee T. Rianda, Regulatory and Sustainable Compliance Officer, The Morningstar Company – World's leading tomato ingredient processor.

"Effective insecticides are critical to the production of mid and late season processing tomatoes in California. Flubendiamide is considered of primary importance as both as a key larvicide and as a resistance management tool. Flubendiamide is a selective insecticide that has minimal impact on beneficial insects and fits into University of California IPM programs. With low worker re-entry and PHI requirements it is a flexible and valuable production tool. It has gained widespread reliance among advisors and growers." – Charles Rivara, Director, California Tomato Research Institute and Mike Montna, President California Tomato Growers Association.

If flubendiamide is removed from the tomato market it is likely the use of spinetoram, chlorantraniliprole and methoxyfenozide will increase, placing more selection pressure on these chemistries. This also creates a greater risk for resistance development in leafminers, a group of insects which historically develop resistance very quickly. The use of flubendiamide, when necessary for caterpillar control, presents no risk to resistance development in leafminers. Providing growers with the option to rotate chemistries to flubendiamide when needed for economic and efficacious control of caterpillar pests in tomatoes is an excellent way to encourage the adoption of IPM practices.

Pepper

>CBI39 text located in the Confidential Business Information < A variety of insect pests and diseases attack pepper across the US and the majority of this discussion will focus on California production. >CBI40 text located in the Confidential Business Information <

Table 35 presents the insecticides used for control of lepidopteran pests in pepper in 2012-2014. >CBI41 text located in the Confidential Business Information <

The efficacy of flubendiamide in pepper has been proven by multiple trials conducted by university IPM practitioners. See pepper Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide is superior to spinetoram, spinosyn and methoxyfenozide because it is rainfast and provides superior efficacy with an extended period of residual control.When compared to chlorantraniliprole, which is systemic, flubendiamide offers growers the opportunity to apply a treatment window approach to pest management. The narrow spectrum of activity of flubendiamide minimizes the risk of resistance developing in other insect pests present in the crop, such as leafminers.

If flubendiamide is removed from the pepper market it is likely the use of spinetoram, spinosyn, chlorantraniliprole and methoxyfenozide will increase, placing more selection pressure on these chemistries. This also creates a greater risk for resistance development in leafminers, a group of insects which historically develop resistance very quickly. The use of flubendiamide, when necessary for caterpillar control, presents no risk to resistance development in leafminers. Providing growers with the option to rotate chemistries to flubendiamide when needed for economic and efficacious control of caterpillar pests in peppers is an excellent way to encourage the adoption of IPM practices.

5.9 Flubendiamide Use in Grape and Small Fruit Vine Climbing Subgroup (except Fuzzy Kiwifruit), Crop Subgroup 13-07F

This crop grouping contains Armur river grape, Gooseberry, Grape, Kiwifruit (hardy), Maypop, and Schisandra berry.

Grape

A variety of insect pests and diseases attack grape grown across the US. >CBI42 text located in the Confidential Business Information <

Table 37 presents the insecticides used for control of lepidopteran pests in grape in 2012-2014.

>CBI43 text located in the Confidential Business Information <

The efficacy of flubendiamide in grapes has been proven by multiple trials conducted by university IPM practitioners. See grape Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide is superior to methoxyfenozide and spinetoram because it is rain-fast and provides superior efficacy with an extended period of residual control. Although, when compared to chlorantraniliprole, which is systemic, flubendiamide offers growers the opportunity to apply a treatment window approach to pest management.

Below is a quote from Christopher Valadez, Director of Environmental and Regulatory Affairs, California Fresh Fruit Association on the benefits flubendiamide provides to grape growers:

"BELT is ground applied for the control of various moth, caterpillar and leafroller species in table grapes and peach twig borer, fruitworm, leafroller, and moth species in stone fruit. Within an IPM program, the material is selectively applied through well-timed treatments around bloom time, which is often times the preferred treatment time because of its impact on target pests as well as its reduced impact onto beneficials and non-target organisms." – Christopher Valadez, Director, Environmental and Regulatory Affairs, California Fresh Fruit Association.

If flubendiamide is removed from the grape market it is likely the use of methoxyfenozide, spinetoram, and chlorantraniliprole will increase placing more selection pressure on these chemistries. The use of flubendiamide when necessary for caterpillar control allows growers to be extremely selective in their control of caterpillar pests in grapes and presents no risk to resistance development in other groups of insects that may co-exist with caterpillars. Providing growers with the option to rotate chemistries to flubendiamide when needed for economic and efficacious control of caterpillar pests in grapes is an excellent way to encourage the adoption of IPM practices.

5.10 Flubendiamide Use in Cucurbit Vegetables, Crop Group 9

This crop grouping contains Chayote (fruit), Chinese waxgourd (Chinese preserving melon), Citron melon, Cucumber, Gherkin, Edible gourd (includes hyotan, cucuzza, hechima, Chinese okra), Momordica spp. (includes balsam apple, balsam pear, bitter melon, Chinese cucumber), Muskmelon [hybrids and/or cultivars of Cucumis melon (includes true cantaloupe, cantaloupe, casaba, crenshaw melon, golden pershaw melon, honeydew melon, honey balls, mango melon, Persian melon, pineapple melon, Santa Claus melon, snake melon)], Pumpkin, Squash [summer squash (includes crookneck squash, scallop squash, straightneck squash, vegetable marrow, zucchini); winter squash (includes acorn squash, butternut squash, calabaza, hubbard squash, spaghetti squash)], and Watermelon.

Watermelon

A variety of insect pests and diseases attack watermelon grown in the US. >CBI44 text located in the Confidential Business Information <

Table 39 presents the insecticides used for control of lepidopteran pests in watermelon in 2012-2014. > CBI45 text located in the Confidential Business Information <

The efficacy of flubendiamide in watermelon has been proven by multiple trials conducted by university IPM practitioners. Flubendiamide differentiates from chlorantraniliprole because it has a narrow spectrum of activity, only controlling caterpillar pests and is also non-systemic allowing for a treatment window approach to insecticide resistance management. Of the IPM-disruptive products applied in watermelon, pyrethroids represent the most common products used. Pyrethroids present many downsides when compared to flubendiamide. The first being a negative impact on beneficial insects, such as predatory mites that can result in a flare of spider mites. Secondly, they have a very short window of efficacy which often results in more insecticide use season-long. These downsides would increase environmental loading due to additional pesticide applications, increase bottom-line costs of the grower, and increase soil compaction from increased trips across the field.

If flubendiamide is removed from the cucurbit vegetable market, it is likely that one of two things could happen: growers will switch to chlorantraniliprole or the use of pyrethroids will increase. Either option has downsides for specific reasons. If growers switch to chlorantraniliprole, their lepidopteran pest control costs will increase significantly and they will also extend the exposure period of their target insect population to the group 28 mode of action, thus increasing selection pressure. If growers switch to pyrethroids, they will disrupt the IPM balance of the field with subsequent increases in secondary pest problems, such as mite flares. They will also likely use more insecticides season-long due to the short window of efficacy provided by pyrethroids. Flubendiamide offers growers a unique ability to control caterpillar pests in watermelon and other curcurbit vegetables with trusted residual performance, ability to apply a treatment window approach to insecticide resistance management and preserve biological control systems.

5.11 Flubendiamide Use in Brassica (Cole) Leafy Vegetables, Crop Group 5

This crop grouping includes Broccoli, Broccoli raab (rapini), Brussels sprouts, Cabbage, Cauliflower, Cavalo broccolo, Chinese broccoli (gai lon), Chinese cabbage (bok choy), Chinese cabbage (napa), Chinese mustard cabbage (gai choy),Collards, Kale, Kohlrabi, Mizuna, Mustard greens, Mustard spinach, Rape greens, Turnip greens.

Broccoli

A variety of insect pests and diseases attack broccoli grown in the US. >CBI46 text located in the Confidential Business Information < According to University of California IPM, a variety of lepidopteran pests are treated on a frequent basis in broccoli including diamondback moth, beet armyworm, cabbage looper, cutworms, imported cabbageworm (source University of California IPM - http://www.ipm.ucdavis.edu/PMG/selectnewpest.cole-crops.html).

>CBI47 text located in the Confidential Business Information<

Table 41 presents the insecticides used for control of lepidopteran pests in broccoli in 2012-2014. >CBI48 text located in the Confidential Business Information<

The efficacy of flubendiamide in broccoli has been proven by multiple trials conducted by university IPM practitioners. See broccoli Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide is superior to spinetoram in providing extended residual activity, but interestingly, it has a benefit over chlorantraniliprole that is systemic in the plant. The residual activity of flubendiamide in broccoli typically varies from 2 to 4 weeks. This provides growers with security of knowing that their crop will be protected, but also gives them the flexibility to limit the exposure of target species to the chemistry. Chlorantraniliprole, on the other hand, is typically applied as a transplant drench or drip application and having systemic activity in the plant, causes extended exposure of the target species to the chemistry thereby increasing the probability of resistance. In fact, resistance to group 28 Diamide chemistries has been reported in diamondback moth population in cole crops in Mississippi and South Carolina. The first report of resistance occurred in Mississippi in 2013 ("*Plutella xylostella* Resistance Alert!" 2014. IRAC eConnection Pest Alert), followed by a report in South Carolina in January of 2015 (recently reported to the EPA as a 6.a.2.). In response to these reports, BCS encourages growers to become more vigilant in rotating mode of action to extend the life span of a particular mode of action group.

If flubendiamide is removed from the marketplace, we expect to see increased use of spinetoram and chlorantraniliprole. Reliance on spinetoram will likely result in increased insecticide use during the season due to the short window of residual activity. Alternatively, increased reliance on chlorantraniliprole will place more pressure on group 28 chemistries because of the extended exposure that this product presents to diamondback moth species. Both scenarios would diminish a grower's ability to effectively manage this pest over the long term.

5.12 Flubendiamide Use in Leafy Vegetables (except Brassica Vegetables), Crop Group 4

This crop grouping contains Amaranth (leafy amaranth, Chinese spinach, tampala), Arugula (roquette), Cardoon, Celery, Celtuce, Chervil, Chinese celery, Chrysanthemum (edible-leaved and garland), Corn salad, Cress (garden), Cress (upland, yellow rocket, winter cress) , Dandelion, Dock (sorrel), Endive (escarole), Florence fennel (finocchio), Lettuce (head and leaf), Orach, Parsley, Purslane (garden and winter), Radicchio (red chicory), Rhubarb, Spinach [including New Zealand and vine (Malabar spinach, Indian spinach)], and Swiss chard.

Lettuce

A variety of insect pests and diseases attack lettuce grown in the US. >CBI49 text located in the Confidential Business Information <

Table 43 presents the insecticides used for control of lepidopteran pests in lettuce in 2012-2014. > CBI50 text located in the Confidential Business Information <

The efficacy of flubendiamide in lettuce has been proven by multiple trials conducted by university IPM practitioners. See lettuce Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide is superior to these chemistries because it is more efficacious in controlling lepidopteran pests and provides residual control. When compared to chlorantraniliprole, flubendiamide offers a competitive price point and also the non-systemicity of flubendiamide allows growers the option to apply a treatment window approach to IRM.

If flubendiamide is removed from the market, growers will likely continue with their current use patterns of insecticides, with a majority relying on IPM-disruptive pyrethroids. The continued registration of flubendiamide in the lettuce market, provides an economic and efficacious alternative to pyrethroids, encouraging growers to adopt IPM practices.

5.13 Flubendiamide Use in Legume Vegetables, Crop Group 6&7

This crop group contains Bean (Lupinus spp., includes grain lupin, sweet lupin, white lupin, white sweet lupin); Bean (Phaseolus spp., includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); Bean (Vigna spp., includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, Crowder pea, moth bean, mung bean, rice bean, Southern pea, Urd bean, yardlong bean); Pea (Pisum spp., includes dwarf pea, edible-pod pea, English pea, field pea, garden pea, green pea, snow pea, sugar snap pea); Other Peas and Beans: Broad bean (fava bean), chickpea (garbanzo bean), guar, jackbean, lablab bean (hyacinth bean), lentil, pigeon pea, sword bean.

Snap Bean

A variety of insect pests and diseases attack legume crops grown in the US. >CBI51 text located in the Confidential Business Information <

The efficacy of flubendiamide in snap bean has been proven by multiple trials conducted by university IPM practitioners. See snap bean Arthropod Management Test efficacy reports in Appendix B for trial results. Flubendiamide differentiates from chlorantraniliprole because it has a narrow spectrum of activity, only controlling caterpillar pests and is also non-systemic allowing for a treatment window approach to insecticide resistance management. Of the IPM-disruptive products applied in snap beans, pyrethroids represent the most common products used. Pyrethroids present many downsides when compared to flubendiamide. The first being a negative impact on beneficial insects, such as predatory mites that can result in a flare of spider mites. Secondly, they have a very short window of efficacy which often results in more insecticide use season-long.

If flubendiamide is removed from the legume vegetable market, we believe that it is likely that the use of IPM disruptive pyrethroids will increase. This is based on the low adoption of IPM friendly products in this market. Increased use of pyrethroids will cause more secondary pest problems, such as flares of mites. It will also likely increase the insecticide use season-long. Flubendiamide offers an economic price point when compared to chlorantraniliprole and also gives growers the option to selectively control caterpillar pests while applying a treatment window approach to resistance management.

5.14 Flubendiamide Use in Strawberry and Low Growing Berry Subgroup (except cranberry), Crop Subgroup 13-07G

This crop subgroup contains Bearberry, Bilberry, Blueberry (lowbush), Cloudberry, Lingonberry, Muntries, Partridgeberry, Strawberry, plus cultivars, varieties and/or hybrids of these

Strawberry

A variety of insect pests and diseases attack strawberry grown in the US. >CBI52 text located in the Confidential Business Information

Table 47 presents the insecticides used for control of lepidopteran pests in strawberry in 2012-2014. > CBI53 text located in the Confidential Business Information<

The efficacy of flubendiamide in strawberry has been proven by multiple trials conducted by university IPM practitioners. Flubendiamide is superior to novaluron and spinetoram because it provides superior caterpillar control and extended residual activity, decreasing the insecticide load season-long.

If flubendiamide is removed from the strawberry market, growers are likely to either increase the use of other IPM-friendly products or pyrethroids. If they increase the use of other IPM-friendly products, they may increase their total amount of product used season-long because of the short window of control provided by the top three most used products. Alternatively, if they switch to pyrethroids, they will likely encounter secondary pest problems, such as spider mites, a major pest problem on strawberry grown in California. Flubendiamide offers strawberry growers an economic, IPM friendly and efficacious option to control caterpillar pests.

6. Product Stewardship

BCS has implemented product stewardship measures to avoid the development of insect resistance and ensure the efficient, effective, and safe use of flubendiamide through implementation of sound Integrated Resistance Management (IRM) programs. Product Stewardship is the responsible and ethical management of a product throughout its life-cycle, from its invention, through to its ultimate use and beyond. Product Stewardship has the following main objectives:

- To ensure best practices and maximize the benefits from product use,
- To provide beneficial, quality products that gain consumer and stakeholder confidence, and,
- To minimize potential risks to human health and the environment.

BCS recommends a program approach that includes insect scouting and treating when the economic threshold is detected, cultural practices to decrease insect pressure, and mode of action rotation during the production season and from crop to crop to reduce the selection pressure of a single MOA. Rotating insecticides from multiple MOA groups is a sound IRM practice to help reduce the selection intensity for resistance to a particular active ingredient of an insecticide.

BCS also offers regular classroom training and conference call sessions for distributors, retailers and producers that include flubendiamide stewardship and resistance management.

- Publications – BCS provides educational resources to customers, including brochures, meeting handouts and other materials on the appropriate use of flubendiamide and rotation of mode of action in a management program.
- Computer-Based Training – BCS provides updated training modules for sales reps, distributions, retailers, and growers.

6.1 Mode of action labeling

A foundation component of sound IRM is to clearly display the product mode of action (MOA) and resistance management information on all product labels. BCS includes the following IRM language on the BELT SC label:

"BELT SC Insecticide contains an active ingredient with a mode of action classified as a Group 28 insecticide – ryanodine receptor modulators. Studies to determine cross-resistance of Group 28 insecticides with other chemical classes have demonstrated no cross-resistance. However, repeated use of any crop protection product may increase the development of resistant strains of insects. Rotation to another product with a different mode of action is recommended. Contact your local extension specialist, certified crop advisor and/or Bayer CropScience representative for additional resistance management or IPM recommendations. Also, for more information on Insect Resistance Management (IRM), visit the Insecticide Resistance Action Committee (IRAC) on the web at http://www.irac-online.org."

6.2 Promoting a culture of stewardship.

Perhaps more than any other factor, BCS has promoted a culture of stewardship not only with flubendiamide, but also with all of its chemistry. BCS believes the following factors are critical in promoting that company vision.

- Promote the personal relationship between BCS and Customers – BCS has shown a high level of commitment to its distributors, dealers, and customers. This on-going presence of well-trained, knowledgeable, and tenured BCS sales and field development representatives promotes one-on-one relationships with the channel and customers that are used to enhance the stewardship of flubendiamide.
- BCS's Strict Distribution System – BCS has a contractual obligation with re-sellers to represent strict BCS product stewardship. Strict distribution allows for consistent product stewardship and enables BCS to promote and support IRM programs throughout the US.
- 24-Hour Customer Information Center Support – BCS staffs a 7-day-a-week, 24-hour-a-day hotline where product-related, stewardship-related, or emergency-type questions can be asked. When an individual places a call to this number, they are routed to the appropriate person within BCS that can best address their question or situation.
- Staffing to Support Flubendiamide Stewardship – BCS's flubendiamide sales force consists of over 200 sales representatives and technical support staff.
- Resistance Management Research – BCS invests heavily in resistance research including understanding the mechanisms of resistance, research and development of new MOAs and traits, and research of alternative or complimentary insect control methods.

- Insecticide Resistance Monitoring – through its membership in IRAC-US – BCS supports monitoring of insect population tolerance to Diamide chemistries.
- Active Member of the Insecticide Resistance Action Committee (IRAC) - BCS is a member of the IRAC and is also a member of the IRAC-US Diamide Working Group. The task of the Working Group is to develop coordinated stewardship practices and consistent IRM language on all Diamide chemistry product labels. The coordination of these efforts results in a single message going to growers about the importance of rotating insecticide mode of action groups to prevent onset of resistance and retain the utility of a particular mode of action.
- BCS Membership in State Retailer Associations – BCS representatives are very active in the professional community and state retailers associations, BCS provides financial support and leadership to these organizations and helps them establish and achieve their goals.
- Seminars with Academics – BCS, in cooperation with Monsanto, hosts an annual Southern Pest Management Seminar to develop BMPs, understand the current state of pest control across the US, particularly in row crops, and ensure a consistent IRM message is communicated throughout BCS and key influencers.

7. Summary and concluding remarks

Flubendiamide is a broad spectrum lepidopteran insecticide with a unique MOA that offers effective control of most driver lepidopteran insects, including resistant biotypes, in over 200 crops. The use of flubendiamide improves and enhances IPM and IRM systems by providing a unique MOA, proven performance for control of a broad spectrum of lepidopteran pests, safety to beneficials and low toxicity. The diversity of insecticide MOAs that can be applied in a comprehensive IRM program, coupled with cultural approaches to insect management, is expected to provide robust resistance management and help insure long term viability of all insecticides, including flubendiamide. Flubendiamide offers producers a valuable tool for use in IPM and IRM programs because of the following characteristics:

- Broad-spectrum Lepidoptera-specific pest control, including control of driver species
- Unique Group 28 Ryanodine Receptor Modulator mode of action
- Low cost “IPM friendly” insecticide option
- Low use rate
- Low toxicity – “Caution” signal word, short REI/PHI
- Long lasting residual control
- Superior selectivity and safety to beneficial populations
- Easily integrated into Integrated Pest (IPM) and Insecticide Resistance Management (IRM) programs.
- Favorable environmental risk profile.

The unique benefits that flubendiamide provides to growers include:

1. Compatible with **IPM** programs based on its unique characteristics
2. Provides **broad spectrum lep control** on a wide range of crops
3. No observed **cross-resistance**

4 Superior **length of control** compared to pyrethroids

If BELT is removed from the marketplace:

The removal of BELT from the market increases the risk of growers returning to IPM-disruptive chemistries - such as organophosphates and pyrethroids - which pose environmental risk and human safety issues.

"Beat back peanut pests with BELT Insecticide provides peace of mind." Southeast Farm Press, June 13, 2011

"BELT, the insecticide that fits alfalfa production." http://www.agrinews-pubs.com/Content/Default/Homepage-Rotating-Story/Article/Eliminating-insects-in-alfalfa-production-/-3/23/10453

IRAC Lepidoptera Working Group. 2013. http://www.irac-online.org/content/uploads/plutella_poster_v3.1_15Feb13.pdf

"Smart selections and strategy keep family farm for future: tobacco pro chooses "pros" of Belt insecticides." Southeast Farm Press, May 16, 2011

"No regrets with residual: tighten control of worms with Belt insecticide in soybeans." Delta Farm Press, May 30, 2012

46817252 NNI-0001 (Flubendiamide): Human Health Risk Assessment for Use on Corn, Cotton, Tobacco, Tree Fruit, Tree Nut, Vine Crops and Vegetable Crops

49415301 Ovilla, P. (2014) Aquatic Exposure Assessment for Flubendiamide and its Metabolite Des-Iodo Flubendiamide Based on a 3-Year Monitoring Study. Project Number: M/505460/01/1, US0454, MEAM6026. Unpublished study prepared by Bayer CropScience. 98p.

49415302 Hall, A; Dyer, D. (2014) Flubendiamide Aquatic Risk - Summary of Su rface Water Monitoring and Toxicity Testing. Project Number: M/505462/01/1, US0453, MEAMP011. Unpublished study prepared by Bayer CropScience. 16p.

49415303 Tianbo, X. (2014) Monitoring for Flubendiamide and its Metabolite Des-Iodo Flubendiamide in Sediment and Surface Water. Project Number: M/505453/01/1, MEAMP011, MEAM6034. Unpublished study prepared by Bayer CropScience. 518p.

Dyer, D.G., Xu, T., Perez-Ovilla, O., Coody, P.N., Hall, A.T. (2015) Flubendiamide Water Monitoring Update and Exposure Modelling Evaluation. Report Number: US0485, M-517598-01-1. Unpublished. Bayer CropScience 66p.

Endnotes

[1] Bollgard is a registered trademark of Monsanto Company.

[2] Agri-Mek is a registered trademark of Syngenta Crop Protection.

[3] Orthene is a registered trademark of Valent BioSciences Corporation.

[4] Assail is a registered trademark of Cerexagri Inc.

[5] Fastac is a trademark of BASF Corporation.

[6] Brigade is a registered trademark of FMC Corporation.

[7] Capture is a registered trademark of FMC Corporation.

[8] Tourismo is a registered trademark of Nichino America, Inc.

[9] Vetica is a registered trademark of Nichino America, Inc.

[10] Altacor is a registered trademark of E.I. DuPont de Nemours and Company.

[11] Coragen is a registered trademark of E.I. DuPont de Nemours and Company.

[12] Prevathon is a registered trademark of E.I. DuPont de Nemours and Company.

[13] Voliam Xpress is a registered trademark of Syngenta Crop Protection.

[14] Apollo is a registered trademark of Irvita Plant Protection N.V.

[15] Exirel is a registered trademark of E.I. DuPont de Nemours and Company.

[16] Verimark is a registered trademark of E.I. DuPont de Nemours and Company.

[17] Baythroid is a registered trademark of Bayer CropScience.

[18] Ammo is a registered trademark of FMC Corporation.

[19] Delta Gold is a registered trademark of Winfield Solutions, LLC.

[20] Dimilin is a registered trademark of Chemtura Corp.

[21] Asana is a registered trademark of E.I. DuPont de Nemours and Company.

[22] Danitol is a registered trademark of Sumitomo Chemical Company, Ltd.

[23] Belt is a registered trademark of Bayer CropScience.

[24] Declare is a registered trademark of Cheminova, Inc.

[25] Consero is a registered trademark of Loveland Products, Inc.

[26] Savey is a registered trademark of Nippon Soda

[27] Admire is a registered trademark of Bayer.

[28] Avaunt is a registered trademark of E.I. DuPont de Nemours and Company.

[29] Steward is a registered trademark of E.I. DuPont de Nemours and Company.

[30] Karate is a registered trademark of Syngenta Crop Protection.

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[31] Warrior is a registered trademark of Syngenta Crop Protection.

[32] Voliam Flexi is a registered trademark of a Syngenta Group Company.

[33] Lannate is a registered trademark of E.I. DuPont de Nemours and Company.

[34] Intrepid is a registered trademark of Dow AgroSciences LLC.

[35] Intrepid Edge is a registered trademark of Dow AgroSciences LLC.

[36] Rimon is a registered trademark of Chemtura Corp.

[37] Imidan is a registered trademark of Gowan.

[38] Delegate is a registered trademark of Dow AgroSciences LLC.

[39] Radiant is a registered trademark of Dow AgroSciences LLC.

[40] SpinTor is a registered trademark of Dow AgroSciences LLC.

[41] Success is a registered trademark of Dow AgroSciences LLC.

[42] Tracer is a registered trademark of Dow AgroSciences LLC.

[43] Blackhawk is a trademark of Dow AgroSciences LLC.

[44] Entrust is a registered trademark of Dow AgroSciences LLC.

[45] Conserve is a registered trademark of Dow AgroSciences LLC.

[46] Larvin is a registered trademark of Bayer CropScience.

[47] Mustang is a registered trademark of FMC Corporation.

GROUP	28	INSECTICIDE

BELT® SC Insecticide

ACTIVE INGREDIENT:
Flubendiamide (N^2-[1,1-dimethyl-2-(methylsulfonyl)ethyl]-3-iodo-N^1-[2-methyl-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl]-1,2-benzenedicarboxamide).. **39%**

OTHER INGREDIENTS: **61%**

BELT SC Insecticide contains 4 pounds of flubendiamide per US gallon (480 grams per liter). **TOTAL:**............ **100%**

EPA Reg. No. 264-1025 **EPA Est. No.**

STOP - Read the label before use
KEEP OUT OF REACH OF CHILDREN
CAUTION

For MEDICAL And TRANSPORTATION Emergencies ONLY Call 24 Hours A Day 1-800-334-7577
For PRODUCT USE Information Call 1-866-99BAYER (1-866-992-2937)

FIRST AID

IF ON SKIN OR CLOTHING:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
IF SWALLOWED:	• Call a poison control center or doctor immediately for treatment advice. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Have person sip a glass of water if able to swallow. • Do not give anything by mouth to an unconscious person.
Have the product container or label with you when calling a poison control center or doctor or going for treatment. **For medical emergencies, health concerns, or pesticide incidents, you may call the Bayer CropScience Emergency Response toll free number 24 hours a day at 1-800-334-7577.**	
NOTE TO PHYSICIAN: No specific antidote is known. Treat symptomatically.	

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS AND DOMESTIC ANIMALS
CAUTION

Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as Natural Rubber). If you want more options, follow the instructions for Category A on the EPA chemical-resistance category selection chart.
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them.

ENGINEERING CONTROLS STATEMENT

When handlers use closed systems or enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands thoroughly before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove Personal Protective Equipment immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to aquatic invertebrates. For terrestrial uses: Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

Ground Water Advisory

Flubendiamide and its degradate NNI-0001-des-iodo have properties and characteristics associated with chemicals detected in ground water. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow.

Surface Water Advisory

Flubendiamide and its degradate NNI-0001-des-iodo may also impact surface water quality due to runoff of rain water. This is especially true for poorly draining soils and soils with shallow ground water. These chemicals are classified as having a medium potential for reaching both surface water and aquatic sediment via runoff several months or more after application. A well maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams and springs, as required under the Directions for Use, will reduce the potential for loading of flubendiamide and its degradate NNI-0001-des-iodo from run-off and sediment. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read entire label before using this product.

USE RESTRICTIONS

- Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the treated area during application.
- For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.
- The following use restrictions are required to permit use of BELT® SC Insecticide in the State of New York:
  - Not for sale, use, and distribution in Nassau and Suffolk Counties of New York State.
  - Aerial application of this product is prohibited in New York State.
  - This product cannot be applied within 100 ft of a water body (i.e., lake, pond, river, stream, wetland, or drainage ditch).

BUFFER ZONES

Vegetative Buffer Strip

Construct and maintain a minimum 15-foot wide vegetative filter strip of grass or other permanent vegetation between field edge and down gradient aquatic habitat (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or natural ponds; estuaries; and commercial fish farm ponds).

Only apply products containing flubendiamide onto fields where a maintained vegetative buffer strip of at least 15 feet exists between the field edge and down gradient aquatic habitat.

For guidance, refer to the following publication for information on constructing and maintaining effective buffers: *Conservation Buffers to Reduce Pesticide Losses. Natural Resources Conservation Services.* USDA, 2000. Fort Worth, Texas. 21 pp. http://www.in.nrcs.usda.gov/technical/agronomy/newconbuf.pdf.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted entry intervals. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours following application.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated such as plants, soil or water, is: coveralls, chemical-resistant gloves such as barrier laminate, butyl rubber, nitrile rubber, or viton, and shoes plus socks.

GENERAL INFORMATION

BELT® SC Insecticide is a Suspension Concentrate formulation. The active ingredient contained in BELT SC Insecticide is active by insect larval ingestion leading to a rapid cessation of feeding followed by death of the insect. Application should be timed to coincide with early threshold level in a developing larval population. Thorough coverage of all plant parts is required for optimum performance.

Use in enclosed structures, such as greenhouses or planthouses, is not permitted unless specified otherwise by state-specific supplemental labeling.

INSECT RESISTANCE STATEMENT

BELT SC Insecticide contains an active ingredient with a mode of action classified as a Group 28 insecticide – ryanodine receptor modulators. Studies to determine cross-resistance of Group 28 insecticides with other chemical classes have demonstrated no cross-resistance. However, repeated use of any crop protection product may increase the development of resistant strains of insects. Rotation to another product with a different mode of action is recommended. Contact your local extension specialist, certified crop advisor and/or Bayer CropScience representative for additional resistance management or IPM recommendations. Also, for more information on Insect Resistance Management (IRM), visit the Insecticide Resistance Action Committee (IRAC) on the web at http://www.irac-online.org.

APPLICATION GUIDELINES

For all insects, timing of application should be based on careful scouting and local thresholds.

Foliar Spray Applications

Ground applications: A minimum of 10.0 gallons of diluted product/A.

Aerial applications: A minimum of 2.0 gallons of diluted product/A. Aerial applications made to dense canopies may not provide sufficient coverage of lower leaves to provide acceptable pest control. Under these conditions, the higher rate of BELT SC Insecticide specified in the crop/pest specific tables within the Directions for Use section of this label may be necessary for optimum pest control.

Chemigation applications (see use in Chemigation Systems directions below) should be made as concentrated as possible. For best results apply at 100% input/travel speed, for center pivots or 0.10 inch (2,716 gallons) up to 0.15 inch (4,073 gallons) of water/A, for other systems. Higher labeled rates of BELT SC Insecticide may be necessary for chemigation applications.

CHEMIGATION SYSTEMS

BELT SC Insecticide may be applied through irrigation systems only on those crops listed under Recommended Applications where application through irrigation systems is recommended.

Types of Irrigation Systems: Apply BELT SC Insecticide only through sprinkler, including center pivot, lateral move, side roll, or overhead solid set irrigation systems. Do not apply BELT SC Insecticide through any other type of irrigation system.

GENERAL DIRECTIONS FOR ALL RECOMMENDED TYPES OF IRRIGATION SYSTEMS

Uniform Water Distribution and System Calibration: The irrigation system must provide uniform distribution of treated water. Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from non-uniform distribution of treated water. The system must be calibrated to uniformly apply the rates specified. If you have questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts.

Chemigation Monitoring: A person knowledgeable of the chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise.

Drift: Do not apply when wind speed favors drift beyond the area intended for treatment.

Required System Safety Devices: The system must contain a functional check valve, vacuum relief valve, and low-pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from backflow. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump. The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops. The irrigation line or water pump must include a functional pressure switch that will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected. Systems must use a metering pump; such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock.

Using Water from Public Water Systems: Public water system means a system for the provision to the public of piped water for human consumption if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. Chemigation systems connected to public water systems must contain a functional, reduced-pressure zone (RPZ), back flow preventer or the functional equivalent in the water supply line upstream from the point of pesticide introduction. As an option to the RPZ, the water from the public water system should be discharged into a reservoir tank prior to pesticide introduction. There shall be a complete physical break (air gap) between the flow outlet end of the fill pipe and the top or overflow rim of the reservoir tank of at least twice the inside diameter of the fill pipe. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection. The pesticide injection pipeline must contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops, or in cases where there is no water pump, when the water pressure decreases to the point where pesticide distribution is adversely affected. Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock.

Cleaning the Chemical Injection System: In order to accurately apply pesticides, the chemical injection system must be kept clean; free of chemical or fertilizer residues and sediments. Refer to your owner's manual or ask your equipment supplier for the cleaning procedure for your injection system.

Flushing the Irrigation System: At the end of the application period, allow time for all lines to flush the pesticide through all nozzles before turning off irrigation water. To ensure the lines are flushed and free of pesticides, a dye indicator may be injected into the lines to mark the end of the application period.

Equipment Area Contamination Prevention: It is recommended that nozzles in the immediate area of control panels, chemical supply tanks, pumps and system safety devices be plugged to prevent chemical contamination of these areas.

Center-Pivot and Automatic-Move Linear Systems: Inject the specified dosage per acre continuously for one complete revolution (center pivot) or move of the system. The system should be run at maximum speed. It is recommended that nozzles in the immediate area of control panels, chemical supply tanks, pumps and system safety devices be plugged to prevent chemical contamination of these areas. The use of END GUNS is NOT RECOMMENDED. End guns that provide uneven distribution of treated water can result in lack of effectiveness or illegal pesticide residues in or on the crop.

Solid Set and Manually Controlled Linear Systems: Injection should be during the last 30 to 60 minutes of regular irrigation period or as a separate 30 to 60 minute application not associated with a regular irrigation. Adjust end guns to keep treated water on the treated area in a uniform manner.

SPRAY DRIFT REDUCTION MANAGEMENT

Do not apply when wind speed favors drift beyond the area intended for treatment. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator is responsible for considering all of these factors when making application decisions. Avoiding spray drift is the responsibility of the applicator.

Importance of Droplet Size:

An important factor influencing drift is droplet size. Small droplets (<150 - 200 microns) drift to a greater extent than large droplets. Within typical equipment specifications, applications should be made to deliver the largest droplet spectrum that provides sufficient control and coverage. Use only Medium or coarser spray nozzles (for ground and non-ULV aerial application) according to ASAE (S572) definition for standard nozzles. In conditions of low humidity and high temperatures, applicators should use a coarser droplet size.

Ground Applications:

Wind speed must be measured adjacent to the application site on the upwind side, immediately prior to application. For ground boom applications, apply using a nozzle height of no more than 4 feet above the ground or crop canopy. For airblast applications, turn off outward pointing nozzles at row ends and when spraying the outer two (2) rows. To minimize spray loss over the top in orchard applications, spray must be directed into the canopy.

Aerial Applications:

The spray boom should be mounted on the aircraft so as to minimize drift caused by wing tip vortices. The minimum practical boom length should be used, and must not exceed 75% of the wing span or 80% rotor diameter. Flight speed and nozzle orientation must be considered in determining droplet size. Spray must be released at the lowest height consistent with pest control and flight safety. Do not release spray at a height greater than 10 feet above the crop canopy unless a greater height is required for aircraft safety. When applications are made with a cross-wind, the swath will be displaced downwind. The applicator must compensate for this displacement at the downwind edge of the application area by adjusting the path of the aircraft upwind. Making applications at the lowest height that is safe reduces the exposure of the droplets to evaporation and wind.

Wind Speed Restrictions:

Drift potential increases at wind velocities of less than 3 mph (due to inversion potential) or more than 10 mph. However, many factors, including droplet size, canopy and equipment specifications determine drift potential at any given wind speed. Only apply this product if the wind direction favors on-target deposition. Do not apply when wind velocity exceeds 15 mph and avoid gusty and windless conditions. Risk of exposure to sensitive aquatic areas can be reduced by avoiding applications when wind direction is toward the aquatic area.

Restrictions During Temperature Inversions:

Do not make ground applications during temperature inversions. Drift potential is high during temperature inversions. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain close to the ground and move laterally in a concentrated cloud. Temperature inversions are characterized by stable air and increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by mist or ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source. Smoke that layers and moves laterally near the ground surface in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical mixing.

MIXING INSTRUCTIONS

COMPATIBILITY

BELT SC Insecticide is physically and biologically compatible with many registered pesticides and fertilizers or micronutrients. When considering mixing BELT SC Insecticide with other pesticides, or other additives, first contact your supplier for advice. For further information, contact your local Bayer Representative. If you have no experience with the combination you are considering, you should conduct a test to determine physical compatibility. To determine physical compatibility, add the recommended proportions of each chemical with the same proportion of water, as will be present in the chemical supply tank, into a suitable container, mix thoroughly and allow to stand for five minutes. If the combination remains mixed, or can be readily re-mixed, the mixture is considered physically compatible.

ORDER-OF-MIXING

BELT SC Insecticide may be used with other recommended pesticides, fertilizers and micronutrients. The proper mixing procedure for BELT SC Insecticide alone or in tank mix combinations with other pesticides is:

1) Fill the spray tank 1/4 to 1/3 full with clean water;
2) While recirculating and with the agitator running, add any products in PVA bags **(See Note)**. Allow time for thorough mixing;
3) Continue to fill spray tank with water until 1/2 full;
4) Add any other wettable powder (WP) or water dispersible granule (WG) products;
5) Add the required amount of BELT SC Insecticide, and any other “flowable” (FL or SC) type products;
6) Allow enough time for thorough mixing of each product added to tank;
7) If applicable, add any remaining tank mix components: emulsifiable concentrates (EC), fertilizers and micronutrients.
8) Fill spray tank to desired level and maintain constant agitation to ensure uniformity of spray mixture.

NOTE: Do not use PVA packets in a tank mix with products that contain boron or release free chlorine. The resultant reaction of PVA and boron or free chlorine is a plastic that is not soluble in water or solvents.

ROTATIONAL CROP STATEMENT

Treated areas may be replanted with any crop specified on this label as soon as practical following the last application.

ROTATIONAL PLANT-BACK INTERVALS[1]

Immediate plant-back: Alfalfa, Brassica (Cole) Leafy Vegetables, Corn (Field, Pop, and Sweet), Cotton, Cucurbit Vegetables, Fruiting Vegetables, Globe Artichoke, Leafy Vegetables (except Brassica), Legume Vegetables, Okra, Peanut, Safflower, Soybeans, Strawberries, Sorghum, Sunflower, Sugarcane, Tobacco, Turnip Greens.

30-Day plant-back: Barley, Buckwheat, Clover, Grasses, Millet (pearl), Millet (proso), Oats, Rice, Root Crops (Root, Tuber, and Bulb Vegetables), Rye, Teosinte, Triticale, Wheat

9-Month plant-back: All other crops

[1] Cover Crops for soil building or erosion control may be planted at any time, but do not graze or harvest for food or feed.

USES

Recommended Applications: Apply specified dosage of BELT SC Insecticide as needed for control. For best results, treatment should be made when insect populations begin to build and before a damaging population becomes established. Rate selected for use should depend on stage of pest development at application, pest infestation level, plant size and density of plant foliage. Thorough coverage of plant foliage is recommended for optimum product performance. BELT SC Insecticide may be applied by air, ground equipment or through overhead irrigation systems as designated in the CHEMIGATION SYSTEMS statement in the *Application Guidelines* section of this label. Please contact your local Bayer CropScience representative or Pest Control Advisor for specific recommendations by crop.

ALFALFA

PESTS CONTROLLED	RATE PER APPLICATION fluid oz/Acre
Alfalfa caterpillar Armyworm Army cutworm Alfalfa looper Alfalfa webworm Beet armyworm Corn earworm Cutworms Fall armyworm Green cloverworm Loopers Velvetbean caterpillar Yellowstriped armyworm	2.0 – 4.0

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): Forage and hay – **0 days**.

Retreatment Interval - **21 days**.

Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per cutting**.

Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per year.**

Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application

See CHEMIGATION statement in *Application Guidelines* section of this label.

BRASSICA (COLE) LEAFY VEGETABLES and TURNIP GREENS **Crops of Crop Group 5 and Turnip Greens including:** Broccoli, Broccoli raab (rapini), Brussels sprouts, Cabbage, Cauliflower, Cavalo broccolo, Chinese broccoli (gai lon), Chinese cabbage (bok choy), Chinese cabbage (napa), Chinese mustard cabbage (gai choy),Collards, Kale, Kohlrabi, Mizuna, Mustard greens, Mustard spinach, Rape greens, Turnip greens.	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Alfalfa looper Alfalfa caterpillar Armyworms Beet armyworm Cabbage looper Cabbage webworm Corn earworm Cross-striped cabbageworm Cutworm species Diamondback moth Fall armyworm Garden webworm Imported cabbage worm Saltmarsh caterpillar Southern armyworm Southern cabbageworm Tobacco budworm True armyworm Yellowstriped armyworm	2.0 – 2.4
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **8 day**. Do not apply more than **2.4 fl oz per acre (0.075 lb ai/A) per 5-day interval.** Do not apply more than **7.2 fl oz per acre (0.225 lb ai/A) per crop season.** Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application. See CHEMIGATION statement in *Application Guidelines* section of the label.	

CHRISTMAS TREE	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Bagworm Fall webworm Gypsy moth Hemlock looper Jackpine budworm Pine tip moth Redhumped caterpillar Spruce budworm Tent caterpillar Tussock moths	3.0 – 5.0

Notes and Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Do not apply more than **5.0 fl oz per acre (0.156 lb ai/A) per 7 day interval**.

Do not apply more than **10.0 fl oz per acre (0.312 lb ai/A) per crop season**.

Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit.

Minimum application volume: 20.0 GPA – ground; 5.0 GPA – aerial application

CORN (FIELD CORN, POP CORN, SWEET CORN, and CORN GROWN FOR SEED)	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Armyworm Army cutworm Beet armyworm Black cutworm Common stalk borer Corn earworm European corn borer Fall armyworm Green cloverworm Southern armyworm Southwestern corn borer Western bean cutworm Yellowstriped armyworm	2.0 - 3.0

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): Green forage and silage - **1 day**; Sweet corn – **1 day;** Grain or stover – **28 days**.

Do not apply more than **3.0 fl oz per acre (0.094 lb ai/A) per 3-day interval**.

Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**.

Do not apply more than 4 times per crop season.

Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial applications.

See CHEMIGATION statement in *Application Guidelines* section of this label.

COTTON	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Beet armyworm Cabbage looper Cotton bollworm Cotton leafworm Cotton leaf perforator Cutworm species European corn borer Fall armyworm Omnivorous leafroller Saltmarsh caterpillar Soybean looper Tobacco budworm Yellowstriped armyworm	2.0 - 3.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **28 days.** Do not apply more than **3.0 fl oz per acre (0.094 lb ai/A) per 5-day interval**. Do not apply more than **9.0 fl oz per acre (0.282 lb ai/A) per crop season**. Do not apply more than 3 times per crop season. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial applications. See CHEMIGATION statement in *Application Guidelines* section of this label.	

CUCURBIT VEGETABLES

Crops of Crop Group 9 including: Chayote (fruit), Chinese waxgourd (Chinese preserving melon), Citron melon, Cucumber, Gherkin, Edible gourd (includes hyotan, cucuzza, hechima, Chinese okra), Momordica spp. (includes balsam apple, balsam pear, bitter melon, Chinese cucumber), Muskmelon [hybrids and/or cultivars of *Cucumis melon* (includes true cantaloupe, cantaloupe, casaba, crenshaw melon, golden pershaw melon, honeydew melon, honey balls, mango melon, Persian melon, pineapple melon, Santa Claus melon, snake melon)], Pumpkin, Squash [summer squash (includes crookneck squash, scallop squash, straightneck squash, vegetable marrow, zucchini); winter squash (includes acorn squash, butternut squash, calabaza, hubbard squash, spagetti squash)], Watermelon (includes hybrids and/or varieties of *Citrullus lanatus).*

PESTS CONTROLLED	RATE PER APPLICATION fluid oz/Acre
Armyworms Beet armyworm Cabbage looper Corn earworm Cutworm species Fall armyworm Melonworm Pickleworm Rindworm species Squash vine borer Tobacco budworm True armyworm Yellowstriped armyworm	1.5

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): **1 day**.

Do not apply more than **1.5 fl oz per acre (0.047 lb ai/A) per 7-day interval**.

Do not apply more than **4.5 fl oz per acre (0.141 lb ai/A) per crop season.**

Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application.

See CHEMIGATION statement in *Application Guidelines* section of the label.

FRUITING VEGETABLES (Except Cucurbits) and OKRA **Crops of Crop Group 8 plus Okra including:** Eggplant, Groundcherry, Okra, Pepino, Pepper (includes: bell pepper, chili pepper, cooking pepper, pimento, sweet pepper), Tomatillo, Tomato.	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Armyworms Beet armyworm Cabbage looper Celery leaftier Cutworm species Diamondback moth European corn borer Fall armyworm Garden webworm Melonworm Pickleworm Rindworm species Saltmarsh caterpillar Southern armyworm Southwestern corn borer Tobacco budworm Tobacco hornworm Tomato fruitworm Tomato hornworm Tomato pinworm True armyworm Western yellowstriped armyworm Yellowstriped armyworm	1.5
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **1 day**. Do not apply more than **1.5 fl oz per acre (0.047 lb ai/A) per 3-day interval**. Do not apply more than **4.5 fl oz per acre (0.141 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application. See CHEMIGATION statement in *Application Guidelines* section of the label.	

GLOBE ARTICHOKE	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Artichoke plume moth Cutworms Painted lady butterfly Saltmarsh caterpillar	2.0 – 2.4
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **8 day**. Do not apply more than **2.4 fl oz per acre (0.075 lb ai/A) per 3-day interval**. Do not apply more than **7.2 fl oz per acre (0.225 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application. See CHEMIGATION statement in *Application Guidelines* section of this label.	

GRAPE and SMALL FRUIT VINE CLIMBING SUBGROUP (Except Fuzzy Kiwifruit) **Crops of Crop Subgroup 13-07F including:** Armur river grape, Gooseberry, Grape, Kiwifruit (hardy), Maypop, Schisandra berry	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Cutworm European grapevine moth Grape berry moth Grape leaf folder Grape leaf skeletonizer Obliquebanded leafroller Omnivorous leafroller Orange tortrix Raisin moth Redbanded leafroller	3.0 - 4.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **7 days**. Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 5-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit. Aerial application is prohibited.	

LEAFY VEGETABLES (Except BRASSICA VEGETABLES)

Crops of Crop Group 4 including: Amaranth (leafy amaranth, Chinese spinach, tampala), Arugula (roquette), Cardoon, Celery, Celtuce, Chervil, Chinese celery, Chrysanthemum (edible-leaved and garland), Corn salad, Cress (garden), Cress (upland, yellow rocket, winter cress) , Dandelion, Dock (sorrel), Endive (escarole), Florence fennel (finocchio), Lettuce (head and leaf), Orach, Parsley, Purslane (garden and winter), Radicchio (red chicory), Rhubarb, Spinach [including New Zealand and vine (Malabar spinach, Indian spinach)], Swiss chard.

PESTS CONTROLLED	RATE PER APPLICATION fluid oz/Acre
Alfalfa looper Armyworms Beet armyworm Corn earworm Cutworm species Diamondback moth European corn borer Fall armyworm Green cloverworm Imported cabbage worm Saltmarsh caterpillar Tobacco budworm Tomato hormworm True armyworm Yellowstriped armyworm	1.5

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): **1 day**.

Do not apply more than **1.5 fl oz per acre (0.047 lb ai/A) per 3-day interval**.

Do not apply more than **4.5 fl oz per acre (0.141 lb ai/A) per crop season**.

Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application.

See CHEMIGATION statement in *Application Guidelines* section of the label.

LEGUME VEGETABLES Except SOYBEAN

Crops of Crop Groups 6 and 7 including Edible-podded and Succulent Shelled Pea and Bean, Dried Shelled Pea and Bean and Foliage of Legume Vegetables:
Bean (*Lupinus* spp., includes grain lupin, sweet lupin, white lupin, white sweet lupin)
Bean (*Phaseolus* spp., includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean)
Bean (*Vigna* spp., includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, Crowder pea, moth bean, mung bean, rice bean, Southern pea, Urd bean, yardlong bean)
Pea (Pisum spp., includes dwarf pea, edible-pod pea, English pea, field pea, garden pea, green pea, snow pea, sugar snap pea)
Other Peas and Beans: Broad bean (fava bean), chickpea (garbanzo bean), guar, jackbean, lablab bean (hyacinth bean), lentil, pigeon pea, sword bean

PESTS CONTROLLED		RATE PER APPLICATION fluid oz/Acre
Alfalfa caterpillar	Lesser cornstalk borer	2.0 - 3.0
Alfalfa looper	Painted lady (thistle) caterpillar	
Armyworm	Saltmarsh caterpillar	
Beet armyworm	Silverspotted skipper	
Cabbage looper	Southern armyworm	
Celery looper	Southwestern corn borer	
Corn earworm	Soybean looper	
Cutworm species	Tobacco budworm	
European corn borer	Velvetbean caterpillar	
Fall armyworm	Webworm species	
Green cloverworm	Western bean cutworm	
Imported cabbageworm	Wollybear caterpillar	
Leaf skeletonizer species	Yellowstriped armyworm	
Leaftier species	Western yellowstriped armyworm	

Notes and Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): **Edible podded and succulent shelled peas and beans - 1 day; Dry peas and beans – 14 days; Forage, hay and vines – 3 days**.

Do not apply more than **3.0 fl oz per acre (0.094 lb ai/A) per 5 day interval**.

Do not apply more than **6.0 fl oz per acre (0.188 lb ai/A) per crop season**.

Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit.

Minimum application volume: 10.0 GPA – ground;   2.0 GPA – aerial application

See CHEMIGATION statement in *Application Guidelines* section of this label.

PEANUT	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Armyworm Beet armyworm Corn earworm Cutworms Green cloverworm Fall armyworm Loopers Rednecked peanutworm Southern armyworm Velvetbean caterpillar	2.0 – 4.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **3 days**. Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application See CHEMIGATION statement in *Application Guidelines* section of this label.	

POME FRUIT **Crops of Crop Groups 11 including:** Apple, Crabapple, Loquat, Mayhaw, Oriental pear, Pear, Quince	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Codling moth (West of the Rockies) *For use against low to moderate infestations in conjunction with alternate control measures such as in established mating disruption blocks.*	5.0
Codling moth (East of the Rockies) Eyespotted bud moth Fall webworm Fruittree leafroller Green fruitworm Lacanobia fruitworm Lesser appleworm Obliquebanded leafroller Oriental fruit moth Pandemis leafroller Redbanded leafroller Spotted tentiform leafminer Tufted apple bud moth Variegated leafroller Western tentiform leafminer	3.0 - 5.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **14 days**. Do not apply more than **5.0 fl oz per acre (0.156 lb ai/A) per 7-day interval**. Do not apply more than **15.0 fl oz per acre (0.468 lb ai/A) per crop season**. Do not apply more than 3 times per crop season. Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit. Aerial application is prohibited.	

SOYBEAN	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Alfalfa caterpillar Armyworm Beet armyworm Cabbage looper Corn earworm Cutworm species European corn borer Fall armyworm Green cloverworm Imported cabbageworm Leaf skeletonizer species Lesser cornstalk borer Painted lady (thistle) caterpillar Saltmarsh caterpillar Silverspotted skipper Southern armyworm Soybean looper Tobacco budworm Tobacco hornworm Tomato hornworm Velvetbean caterpillar Webworm species Wollybear caterpillar Yellowstriped armyworm	2.0 - 3.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): Immature seed – **1 day**; Dry seed - **14 days**; Forage and hay – **3 days**. Do not apply more than **3.0 fl oz per acre (0.094 lb ai/A) per 5-day interval**. Do not apply more than **6.0 fl oz per acre (0.188 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application See CHEMIGATION statement in *Application Guidelines* section of this label.	

SORGHUM **Crops including: sorghum grain, sudangrass (seed crop), and hybrids of these grown for its seed; sorghum forage; sorghum stover; sudangrass, and hybrids of these grown for forage and/or stover; milo**	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Armyworm Beet armyworm Cutworms European corn borer Fall armyworm Mexican rice borer Sorghum headworm Sorghum webworm Southern armyworm Southwestern corn borer Stalk borer Sugarcane borer Webworms Yellowstriped armyworm	2.0 – 4.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): Forage – **3 days;** grain and stover – **14 days**. Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application See CHEMIGATION statement in *Application Guidelines* section of this label.	

STRAWBERRY and LOW GROWING BERRY SUBGROUP (except cranberry) Crops of Crop Subgroup 13-07G (except cranberry) including: Bearberry, Bilberry, Blueberry (lowbush), Cloudberry, Lingonberry, Muntries, Partridgeberry, Strawberry, plus cultivars, varieties and/or hybrids of these	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Armyworm Corn earworm Cutworm Lesser cornstalk borer Omnivorous leaftier Strawberry leafroller	2.0 – 2.4
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **8 day**. Do not apply more than **2.4 fl oz per acre (0.075 lb ai/A) per 3-day interval**. Do not apply more than **7.2 fl oz per acre (0.225 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground, 2.0 GPA – aerial application. See CHEMIGATION statement in *Application Guidelines* section of this label.	

STONE FRUIT **Crops of Crop Group 12 including:** Apricot, Cherry [sweet and tart], Nectarine, Peach, Plum [includes Chickasaw plum, Damson plum, and Japanese plum], Plumcot, Prune (fresh)	
PESTS CONTROLLED	**RATE PER APPLICATION** **fluid oz/Acre**
Codling moth Cherry fruitworm Eyespotted bud moth Fruittree leafroller Green fruitworm Lesser appleworm Obliquebanded leafroller Omnivorous leafroller Oriental fruit moth Pandemis leafroller Peach twig borer Redbanded leafroller Redhumped caterpillar Spotted tentiform leafminer Threelined leafroller Tufted apple bud moth Variegated leafroller	3.0 - 4.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **7 days**. Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Do not apply more than 3 times per crop season. Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit. Aerial application is prohibited.	

SUGARCANE	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Sugarcane borer Mexican rice borer	3.0 – 4.0

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): **14 days**.

Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**.

Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**.

Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application

See CHEMIGATION statement in *Application Guidelines* section of this label.

SUNFLOWER and SAFFLOWER	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Banded sunflower moth Cutworms Sunflower bud moth Sunflower moth Thistle caterpillar	2.0 – 4.0
Notes and Use Restrictions Do not allow grazing or feed forage to livestock. Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **14 days**. Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application	

TOBACCO	
PESTS CONTROLLED	**RATE PER APPLICATION fluid oz/Acre**
Armyworm Beet armyworm Cabbage looper Corn earworm Cutworm species Fall armyworm Saltmarsh caterpillar Southern armyworm Tobacco budworm Tobacco hornworm Tobacco splitworm Tomato hornworm Webworm species Yellowstriped armyworm	2.0 - 3.0
Notes and Use Restrictions Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours. Pre-harvest Interval (PHI): **14 days**. Do not apply more than **3.0 fl oz per acre (0.094 lb ai/A) per 5-day interval**. Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**. Do not apply more than 4 times per crop season. Minimum application volume: 10.0 GPA – ground; 2.0 GPA – aerial application See CHEMIGATION statement in *Application Guidelines* section of this label.	

TREE NUT CROPS

Crops of Crop Group 14 and Pistachio including: Almond, Beech Nut, Brazil Nut, Butternut, Cashew, Chestnut, Chinquapin, Filbert (hazelnut), Hickory Nut, Macadamia Nut, Pecan, Pistachio , Walnut (black and English)

PESTS CONTROLLED	RATE PER APPLICATION fluid oz/Acre
Codling moth Fall webworm Filbertworm Fruittree leafroller Hickory shuckworm Naval orangeworm Obliquebanded leafroller Omnivorous leafroller Peach twig borer Pecan nut casebearer Redhumped caterpillar Walnut caterpillar	3.0 - 4.0

Notes and Use Restrictions

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 12 hours.

Pre-harvest Interval (PHI): **14 days**.

Do not apply more than **4.0 fl oz per acre (0.125 lb ai/A) per 7-day interval**.

Do not apply more than **12.0 fl oz per acre (0.375 lb ai/A) per crop season**.

Apply BELT SC Insecticide in sufficient water volume that provides thorough coverage of plant foliage and fruit.

Aerial application is prohibited.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE

Do not store for more than 30 consecutive days at an average daily temperature exceeding 100º F. If allowed to freeze, shake well to ensure the product is homogenous before use. Store in original container and out of the reach of children, preferable in a locked storage area. Avoid cross contamination with other pesticides.

PESTICIDE DISPOSAL

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Non-refillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times, then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Bayer CropScience. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BAYER CROPSCIENCE MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer CropScience is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BAYER CROPSCIENCE DISCLAIMS ANY LIABILITY WHATSOEVER FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

LIMITATIONS OF LIABILITY: TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT BAYER CROPSCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

NET CONTENTS:

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PRODUCED FOR

Bayer CropScience

Bayer CropScience LP
P.O. Box 12014, 2 T.W. Alexander Drive
Research Triangle Park, North Carolina 27709
1-866-99BAYER (1-866-992-2937)

11/14/2012AV2

Bayer CropScience

Safety Data Sheet

BELT® SC INSECTICIDE

SDS Number: 102000018618
SDS Version 1.2
Revision Date: 06/29/2012
Print Date: 06/29/2012

SECTION 1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Product name	BELT® SC INSECTICIDE
SDS Number	102000018618
Product code (UVP)	79244029
EPA Registration No.	264-1025
Product Use	Insecticide

Bayer CropScience
2 T.W. Alexander Drive
Research Triangle PK, NC 27709
USA

For MEDICAL, TRANSPORTATION or other EMERGENCY call: 1-800-334-7577 (24 hours/day)
For Product Information call: 1-866-99BAYER (1-866-992-2937)

SECTION 2. HAZARDS IDENTIFICATION

NOTE: Please refer to Section 11 for detailed toxicological information.

Emergency Overview	Caution! Harmful if swallowed or absorbed through skin. Moderate eye irritation. Avoid contact with skin, eyes and clothing. Wash thoroughly with soap and water after handling.
Physical State	liquid
Odor	weak aromatic
Appearance	white to light beige
Exposure routes	Ingestion, Skin Absorption, Eye contact
Immediate Effects	
Eye	Moderate eye irritation. Avoid contact with eyes.
Skin	Harmful if absorbed through skin. Avoid contact with skin and clothing.
Ingestion	Harmful if swallowed. Do not take internally.
Inhalation	Avoid inhalation of vapour or mist.
Chronic or Delayed Long-Term	This product or its components may have target organ effects.

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Potential Environmental Effect Toxic to aquatic invertebrates.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Component Name	CAS-No.	Average % by Weight
Flubendiamide	272451-65-7	39.00
Glycerine	56-81-5	10.00

SECTION 4. FIRST AID MEASURES

General When possible, have the product container or label with you when calling a poison control center or doctor or going for treatment.

Eye Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a physician or poison control center immediately.

Skin Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water for at least 15 minutes. Call a physician or poison control center immediately.

Ingestion Call a physician or poison control center immediately. Rinse out mouth and give water in small sips to drink. DO NOT induce vomiting unless directed to do so by a physician or poison control center. Never give anything by mouth to an unconscious person. Do not leave victim unattended.

Inhalation Move to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a physician or poison control center immediately.

Notes to physician

Treatment Appropriate supportive and symptomatic treatment as indicated by the patient's condition is recommended. There is no specific antidote.

SECTION 5. FIRE FIGHTING MEASURES

Flash point No flash point - Determination conducted up to the boiling point.

Autoignition temperature 435 °C / 815 °F

Lower Flammability Limit no data available

Upper Flammability Limit no data available

Explosiveness	no data available
Suitable extinguishing media	Water, Foam, Carbon dioxide (CO_2), Dry chemical
Fire Fighting Instructions	Keep out of smoke. Fight fire from upwind position. Cool closed containers exposed to fire with water spray. Do not allow run-off from fire fighting to enter drains or water courses. Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions	Keep unauthorized people away. Isolate hazard area. Avoid contact with spilled product or contaminated surfaces.
Methods for cleaning up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Collect and transfer the product into a properly labelled and tightly closed container. Clean contaminated floors and objects thoroughly, observing environmental regulations.
Additional advice	Use personal protective equipment. Do not allow to enter soil, waterways or waste water canal.

SECTION 7. HANDLING AND STORAGE

Handling procedures	Maintain exposure levels below the exposure limit through the use of general and local exhaust ventilation.
Storing Procedures	Store in a cool, dry place and in such a manner as to prevent cross contamination with other crop protection products, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area.
Work/Hygienic Procedures	Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, using the toilet or applying cosmetics. Remove Personal Protective Equipment (PPE) immediately after handling this product. Before removing gloves clean them with soap and water. Remove soiled clothing immediately and clean thoroughly before using again. Wash thoroughly and put on clean clothing.

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SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

General Protection Follow all label instructions. Train employees in safe use of the product.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and warm/tepid water. Keep and wash PPE separately from other laundry.

Eye/Face Protection Safety glasses with side-shields

Hand protection Chemical-resistant gloves (barrier laminate, butyl rubber, nitrile rubber or Viton)

Body Protection Wear long-sleeved shirt and long pants and shoes plus socks.

Respiratory protection When respirators are required, select NIOSH approved equipment based on actual or potential airborne concentrations and in accordance with the appropriate regulatory standards and/or industry recommendations.

Exposure Limits

Flubendiamide	272451-65-7	OES BCS*	TWA	0.5 mg/m3
Glycerine	56-81-5	ACGIH	TWA	10 mg/m3
		OSHA Z1	PEL	15 mg/m3
		OSHA Z1	PEL	5 mg/m3
		OSHA Z1A	TWA	5 mg/m3
		OSHA Z1A	TWA	10 mg/m3
		TX ESL	ST ESL	1000 ug/m3
		TX ESL	ST ESL	50 ug/m3
		TX ESL	AN ESL	5 ug/m3
		TX ESL	AN ESL	100 ug/m3
		TN OEL	TWA	10 mg/m3
		TN OEL	TWA	5 mg/m3

*OES BCS: Internal Bayer CropScience "Occupational Exposure Standard"

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance white to light beige

Physical State liquid

Odor weak aromatic

pH 7.0 (100 %)

Vapor Pressure no data available

Vapor Density (Air = 1)	no data available
Density	ca. 1.23 g/cm³ at 20 °C
Evaporation rate	no data available
Boiling Point	no data available
Melting / Freezing Point	no data available
Water solubility	miscible
Minimum Ignition Energy	no data available
Decomposition temperature	no data available
Partition coefficient: n-octanol/water	no data available
Viscosity	800 - 1,400 mPa.s

SECTION 10. STABILITY AND REACTIVITY

Conditions to avoid	Elevated temperatures
Incompatibility	no data available
Hazardous Decomposition Products	no data available
Hazardous reactions	No dangerous reaction known under conditions of normal use.
Chemical Stability	Stable under normal conditions.

SECTION 11. TOXICOLOGICAL INFORMATION

Only acute toxicity studies have been performed on the formulated product. The non-acute information pertains to the technical-grade active ingredient, flubendiamide.

Acute oral toxicity	female rat: LD50: > 2,000 mg/kg
Acute dermal toxicity	rat: LD50: > 4,000 mg/kg

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Acute inhalation toxicity	rat: LC50: > 2.6 mg/l Exposure time: 4 h Determined in the form of liquid aerosol. Highest attainable concentration. No deaths rat: LC50: > 10.4 mg/l Exposure time: 1 h Determined in the form of liquid aerosol. Extrapolated from the 4 hr LC50.
Skin irritation	rabbit: No skin irritation
Eye irritation	rabbit: No eye irritation
Sensitisation	guinea pig: Non-sensitizing.
Chronic toxicity	Flubendiamide did not cause specific target organ toxicity in experimental animal studies.

Assessment Carcinogenicity

Flubendiamide was not carcinogenic in lifetime feeding studies in rats and mice.

ACGIH
None.
NTP
None.
IARC
None.
OSHA
None.

Reproductive toxicity	Flubendiamide did not cause reproductive toxicity in a two-generation study in rats.
Developmental Toxicity	Flubendiamide did not cause developmental toxicity in rats and rabbits.
Mutagenicity	Flubendiamide was not mutagenic or genotoxic in a battery of in vitro and in vivo tests.

SECTION 12. ECOLOGICAL INFORMATION

Environmental precautions	Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate surface or ground water by cleaning equipment or disposal of wastes, including equipment wash water. Do not apply when weather conditions favor runoff or drift. Apply this product as specified on the label.

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SECTION 13. DISPOSAL CONSIDERATIONS

General Disposal Guidance — Pesticide, spray mixture or rinse water that cannot be used according to label instructions may be disposed of on site or at an approved waste disposal facility.

Container Disposal — Do not re-use empty containers. Triple rinse containers. Empty residue into application equipment. Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill or incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke. Follow advice on product label and/or leaflet.

RCRA Information — Characterization and proper disposal of this material as a special or hazardous waste is dependent upon Federal, State and local laws and are the user's responsibility. RCRA classification may apply.

SECTION 14. TRANSPORT INFORMATION

According to national and international transport regulations this material is not classified as dangerous goods / hazardous material.

Freight Classification: INSECTICIDES OR FUNGICIDES, N.O.I., OTHER THAN POISON

SECTION 15. REGULATORY INFORMATION

EPA Registration No. 264-1025

US Federal Regulations

TSCA list

Glycerine 56-81-5

US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)

None.

SARA Title III - Section 302 - Notification and Information

None.

SARA Title III - Section 313 - Toxic Chemical Release Reporting

None.

US States Regulatory Reporting

CA Prop65

This product does not contain any substances known to the State of California to cause cancer.

This product does not contain any substances known to the State of California to cause reproductive harm.

US State Right-To-Know Ingredients

Glycerine 56-81-5 IL, MN, RI

Canadian Regulations

Canadian Domestic Substance List

Glycerine	56-81-5

Environmental

CERCLA

None.

Clean Water Section 307 Priority Pollutants

None.

Safe Drinking Water Act Maximum Contaminant Levels

None.

International Regulations

European Inventory of Existing Commercial Substances (EINECS)

Glycerine	56-81-5

SECTION 16. OTHER INFORMATION

NFPA 704 (National Fire Protection Association):

Health - 1	Flammability - 0	Instability - 0	Others - none

HMIS (Hazardous Materials Identification System, based on the Third Edition Ratings Guide)

Health - 1	Flammability - 0	Physical Hazard - 0	PPE -

0 = minimal hazard, 1 = slight hazard, 2 = moderate hazard, 3 = severe hazard, 4 = extreme hazard

Reason for Revision: Reviewed and updated for general editorial purposes. The following sections have been revised: Section 3: Composition / Information on Ingredients. Section 8: Exposure Controls / Personal Protection.

Revision Date: 06/29/2012

This information is provided in good faith but without express or implied warranty. The customer assumes all responsibility for safety and use not in accordance with label instructions. The product names are registered trademarks of Bayer.

Arthropod Management Tests 2011, Vol. 36 doi: 10.4182/amt.2011.F1

F1

ALFALFA: *Medicago sativa* L

EFFECT OF SELECTED INSECTICIDES ON CORN EARWORM AND BEET ARMYWORM IN ALFALFA, 2008

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)
Beet armyworm (BAW): *Spodoptera exigua* (Hübner)

Two pyrethroid insecticides were evaluated for control of CEW and BAW in a commercial alfalfa field in Pecos County, TX. Plots, 10 x 40 ft, were arranged in a randomized block design with four blocks and eight treatments. Pesticide applications were made using a CO2 backpack sprayer calibrated to deliver 10 gpa @ 40 psi using 110010VS flat-fan nozzles on a 4 ft boom with 19 inch spacing between the nozzles. Each sample consisted of 10 consecutive sweeps using a standard sweep net, and samples were taken at 0, 3, 7, and 13 DAT. Sweep samples were taken only from the center 5 ft of each plot to help avoid overspray from adjacent treated plots. Samples were taken from a different 10 ft section each sample date to avoid resampling. Sweep samples from each plot were placed into plastic bags, labeled, taken to the laboratory and frozen until samples could be sorted and data recorded. All data were subjected to ANOVA and treatment means separated using Fisher's protected LSD, P=0.05.

Differences among CEW and BAW population densities across treated and untreated check plots were not significant prior to treatment application (Table 1). However, CEW population densities decreased considerably in the check plots during the course of this trial. All tested insecticides effectively suppressed CEW relative to the untreated check plots at 3 and 7 DAT. Corn earworm population densities were too low at 13 DAT for meaningful analysis. All tested insecticides except Baythroid and Warrior significantly or numerically reduced BAW population densities relative to the untreated check. Baythroid and Warrior are pyrethroid insecticides and were not effective against BAW; Tracer, Belt at both rates, and Intrepid all significantly reduced BAW compared to the check at 7 DAT, but no treatment was different from the check for this species at 13 DAT.

Table 1.

		Mean CEW/10 sweeps				Mean BAW/10 sweeps			
Treatment	Rate, lbs ai/acre	0 DA [a]	3 DAT	7 DAT	13 DAT	0 DAT	3 DAT	7 DAT	13 DAT
Check	-	37.0a	13.7a	7.5a	1.5a	1.5a	3.2a	3.7ab	3.2ab
Baythroid	0.02	26.2a	1.2c	0.7b	0.5a	1.7a	3.0a	5.7a	5.5a
Warrior	0.03	20.7a	0.5c	0.5b	0.5a	1.2a	2.7ab	2.5abc	2.0ab
Tracer	0.06	32.2a	0.0c	0.2b	1.0a	0.7a	0.0b	0.2c	0.5b
Belt	0.07	32.0a	0.5c	0.0b	0.2a	1.7a	0.0b	0.0c	0.2b
Belt	0.11	30.0a	0.0c	0.2b	0.0a	1.2a	0.5ab	0.0c	0.2b
Intrepid	0.38	25.0	5.7b	1.7b	0.5a	0.5a	0.0b	0.5bc	1.0b
LSD (P=0.05)		19.0	2.6	2.5	1.6	2.0	2.8	3.3	4.2
P>F		NS[b]	<0.0001	<0.0001	NS	NS	NS	0.0096	NS

Means within a column followed by the same letter are not significantly different (P=0.05: LSD).
[a] DAT=days after treatment
[b]NS=not significant

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(F3)

ALFALFA: *Medicago sativa* L. 'CUF-101'

EFFICACY OF INSECTICIDES FOR WORM PEST CONTROL IN SUMMER ALFALFA, 2008.

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Beet armyworm (BAW), *Spodoptera exigua* (Hübner)
Alfalfa caterpillar (AC) *Colias eurytheme* Boisduval
Alfalfa webworm (AWW) *Loxostege cereralis* (Zeller)

The objective of the study was to evaluate the efficacy of the new and older insecticidal compounds used against larvae of lepidopterous pests (BAW, AC and AWW) on alfalfa grown for hay production under desert growing conditions. The trial was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was RCB using four replicates with eight insecticide treatments and an untreated check. Plots were 25 ft wide by 50 ft long. test materials were applied on 5 Aug 2008 through 12 TJ-60 11003VS nozzles using a Lee Spider Spray Trac operated at 40 psi delivering 38 gpa. An adjuvant, Penetrator Plus (Helena Chemical Co.), was applied at 0.1% v/v with all treatments. Pretreatment (PT) evaluations of insect populations in each plot were conducted on 5 Aug. Post treatment evaluations were made on 8, 12, 19 & 26 Aug or 3, 7, 14 and 21 DAT. During each evaluation, ten sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of BAW, AC, and AWW larvae (Tables 1 - 3). Treatment means were analyzed using 2-way ANOVA and means separated by a protected LSD (P=0.05).

Pretreatment numbers of BAW larvae were similar (P=0.05) among treatments (Table 1). Beet armyworm means for all insecticide treatments were significantly lower (P=0.05) than the untreated check 3 and 7 DAT. All insecticide treatments, except Intrepid (6 fl oz) and Baythroid, had significantly lower beet armyworm means than the untreated check 14 DAT, and only the three rates of Belt 480 SC had means significantly lower than the untreated check 21 DAT. Beet armyworm post treatments averages for all treatments but Baythroid were lower than the check. Alfalfa caterpillar means were significantly lower (P=0.05) in all insecticide treatments compared to the untreated control 3 DAT and 7 DAT (Table 2). All insecticide treatments, except Intrepid (6 fl oz), had significantly lower alfalfa caterpillar means than the untreated check 14 DAT. None of the insecticide treatments had means for alfalfa caterpillar that were significantly lower than the mean for the untreated check 21DAT. All insecticide treatments had post treatment averages for alfalfa cater pillar that were significantly lower than the check. None of the insecticide treatments had alfalfa webworm means that were significantly lower (P=0.05) than the untreated check until 7 DAT when all but Lorsban Advanced were lower than the check (Table 3). All insecticide treatments alfalfa webworm means significantly lower than the untreated check 14 DAT. None of the insecticide treatments had means that were significantly lower than the mean for the untreated check 21 DAT, but all insecticide treatments had post treatment averages that were significantly lower than the check. Belt 480 SC provided superior alfalfa worm pest control, but is not currently registered for this use. Baythroid did not perform well against beet armyworm.

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Table 1

Treatment/ formulation	Rate, oz prod./acre	BAW per ten sweeps in alfalfa					
		PT[a]	3DAT	7DAT	14DAT	21DAT	PTA[c]
Check	---	1.05	0.85a	1.20a	5.25a	4.63ab	2.98a
Steward 1.25EC	6.7	0.60	0.00c	0.01c	3.10bc	4.55ab	1.94b
Lorsban Advanced 3.75EC	32.0	1.05	0.05c	0.08c	3.00bc	3.30bcde	1.61b
Intrepid 2F	6.0	1.35	0.03c	0.18c	3.98ab	3.98abcd	2.04b
Intrepid 2F	7.0	0.45	0.05c	0.05c	2.43bcd	4.13abc	1.66b
Baythroid XL	2.8	0.45	0.50b	0.88b	5.33a	5.33a	3.01a
Belt 480 SC	1.0	0.60	0.00c	0.13c	1.38cd	2.28cde	0.94c
Belt 480 SC	2.0	0.65	0.00c	0.00c	0.78d	2.13de	0.73c
Belt 480 SC	3.0	0.85	0.03c	0.05c	0.55d	1.43e	0.51c

Means within columns followed by the same letter are not significantly different, (LSD; *P*=0.05).
[a]Days Pre-treatment.
[b]Post treatment average.

Table 2

Treatment/ formulation	Rate, oz prod./acre	AC per ten sweeps in alfalfa					
		PT[a]	3DAT	7DAT	14DAT	21DAT	PTA[b]
Check	---	7.75	0.95a	0.25a	0.75a	0.28ab	0.56a
Steward 1.25EC	6.7	6.70	0.03c	0.00b	0.33b	0.20ab	0.14cd
Lorsban Advanced 3.75EC	32.0	6.90	0.10bc	0.00b	0.25b	0.43a	0.19bc
Intrepid 2F	6.0	6.40	0.13bc	0.00b	0.40ab	0.23ab	0.19bc
Intrepid 2F	7.0	6.55	0.13bc	0.00b	0.10b	0.10b	0.08de
Baythroid XL	2.8	6.85	0.38b	0.03b	0.23b	0.43a	0.26b
Belt 480 SC	1.0	6.15	0.00c	0.00b	0.15b	0.05b	0.05e
Belt 480 SC	2.0	7.85	0.00c	0.00b	0.10b	0.18b	0.09de
Belt 480 SC	3.0	7.15	0.10bc	0.00b	0.13b	0.08b	0.08de

Means within columns followed by the same letter are not significantly different, (LSD; *P*=0.05).
[a]Days Pre-treatment.
[b]Post treatment average.

Table 3

Treatment/ formulation	Rate, oz prod./acre	AWW per ten sweeps in alfalfa					
		PT[a]	3DAT	7DAT	14DAT	21DAT	PTA[b]
Check	---	0.45	0.25	0.28a	0.33a	0.10	0.24a
Steward 1.25EC	6.7	0.25	0.13	0.05c	0.00b	0.05	0.06bc
Lorsban Advanced 3.75EC	32.0	0.55	0.18	0.18ab	0.05b	0.05	0.11b
Intrepid 2F	6.0	0.35	0.08	0.05c	0.05b	0.10	0.07bc
Intrepid 2F	7.0	0.05	0.05	0.03c	0.05b	0.10	0.06bc
Baythroid XL	2.8	0.25	0.03	0.10bc	0.08b	0.23	0.11b
Belt 480 SC	1.0	0.45	0.08	0.03c	0.00b	0.03	0.03c
Belt 480 SC	2.0	0.30	0.05	0.00c	0.03b	0.03	0.03c
Belt 480 SC	3.0	0.25	0.08	0.03c	0.00b	0.05	0.04bc

Means within columns followed by the same letter are not significantly different, (LSD; *P*=0.05).
[a]Days Pre-treatment.
[b]Pt treatment average.

F9

ALFALFA: *Medicago sativa* L. 'CUF-101'

INSECTICIDES EFFICACY FOR WORM PEST CONTROL IN ALFALFA, 2009

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Beet armyworm (BAW): *Spodoptera exigua* (Hübner)
Alfalfa caterpillar (AC): *Colias eurytheme* Boisduval
Alfalfa webworm (AWW): *Loxostege cereralis* (Zeller)

The objective of the study was to evaluate the efficacy of the new and older insecticidal compounds used against larvae of lepidopterous pests (BAW, AC and AWW) on alfalfa grown for hay production under desert growing conditions. An insecticide efficacy trial was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was a RCB using four replicates with eight insecticide treatments and an untreated check. Plots were 25 ft wide by 50 ft long. Formulations and rates for each compound are provided and test materials were applied on 17 Aug at the specified rate equivalencies listed in the tables. Broadcast applications were delivered through 14 TJ-60 11003VS nozzles using a Lee Spider Spray Trac operated at 25 psi delivering 32.3 gpa. An adjuvant, Induce (Helena Chemical Co.), was applied at 0.1% vol/vol with all treatments. Pretreatment (PT) evaluations of insect populations in each plot were conducted on 14 Aug. Post treatment evaluations were made on 20, 23, 31 Aug, 8 Sep, representing 3, 6, 14 and 22 days after treatment (DAT). During each evaluation, ten sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of BAW, AC, and AWW larvae (Tables 1 - 3). Treatment means were analyzed using 2-way ANOVA and means separated by a protected LSD (P=0.05).

Pretreatment numbers of BAW larvae were similar (P=0.05) among treatments (Table 1). Beet armyworm means for all insecticide treatments were significantly lower (P=0.05) than the untreated check 3 DAT and all but the mean for Baythroid was lower than the check 6 DAT. Only the Radiant and the three rates of Belt 480 SC, had significantly lower beet armyworm means than the untreated check 14 DAT, and only the Intrepid and 4.0 fl oz rate of Belt 480 SC had means significantly lower than the untreated check 22 DAT. Beet armyworm post-treatment averages for all treatments but Baythroid were lower than the check. Pretreatment numbers of AC were similar (P=0.05) among treatments (Table 2). Means for AC were significantly lower (P=0.05) in all insecticide treatments compared to the check 3 DAT through 14 DAT, but none of the insecticide treatments means for AC were lower than the mean for the check 22 DAT. All insecticide treatments had AC post-treatment averages that were significantly lower than the AC post treatment average for the check. Pretreatment numbers of AWW were similar (P=0.05) among treatments (Table 3). All insecticide treatments except Baythroid had AWW means that were significantly lower (P=0.05) than the untreated check at 3 DAT and 6 DAT, and all insecticide treatments had AWW means that were lower than the check 14 DAT. Only Cobalt and Lorsban Advanced did not have AWW means that were lower than the check 22 DAT. All insecticide treatments except Baythroid had AWW post-treatment averages that were significantly lower than the AWW post treatment averages for the check. Belt 480 SC, Radiant and Intrepid displayed superior residual activity against BAW, AC and AWW. Baythroid did not perform well against beet armyworm and AWW.

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Table 1.

Treatment	Rate, oz product/ acre	BAW per ten sweeps in alfalfa					
		PT[a]	3DAT[b]	6DAT[c]	14DAT[c]	22DAT	PTA[cd]
Check	--------	39.50	20.75a	1.35a	1.07a	23.00a	1.30a
Intrepid	8.0	26.00	1.75c	0.37bc	0.82abcd	9.75c	0.78bc
Radiant	5.0	22.75	1.50c	0.08c	0.57cd	12.25bc	0.72c
Lorsban Advanced	32.0	30.75	0.25c	0.29bc	0.93abc	13.75abc	0.85bc
Cobalt	32.0	19.00	0.75c	0.68b	0.95ab	21.50ab	0.98b
Baythroid XL	2.8	21.25	11.50b	1.31a	0.82abcd	20.75ab	1.28a
Belt 480 SC	2.0	31.00	0.25c	0.08c	0.60bcd	20.00ab	0.82bc
Belt 480 SC	3.0	19.75	0.00c	0.12c	0.56cd	13.50abc	0.71c
Belt 480 SC	4.0	20.75	0.00c	0.00c	0.50d	5.00c	0.44d

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (P<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis.
[d] Post treatment average.

Table 2.

Treatment	Rate, oz product/ acre	AC per ten sweeps in alfalfa					
		PT[a]	3DAT[b]	6DAT[c]	14DAT	22DAT	PTA[d]
Check	---------	15.75	10.25a	0.69a	5.75a	2.00	5.56a
Intrepid	8.0	20.75	0.25b	0.19bc	1.50bc	1.50	1.00bc
Radiant	5.0	9.00	1.25b	0.08bc	0.75bcd	1.00	0.81bc
Lorsban Advanced	32.0	13.25	0.00b	0.15bc	1.75b	2.50	1.19bc
Cobalt	32.0	14.00	0.50b	0.00c	1.25bcd	1.25	0.75bc
Baythroid XL	2.8	13.00	0.50b	0.25b	0.75bcd	3.25	1.44b
Belt 480 SC	2.0	14.00	0.50b	0.08bc	0.25cd	0.00	0.25c
Belt 480 SC	3.0	12.50	0.75b	0.00c	0.00d	1.00	0.44bc
Belt 480 SC	4.0	14.25	0.50b	0.00c	0.25cd	0.50	0.31bc

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (P<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis.
[d] Post treatment average.

Table 3.

Treatment	Rate, oz product/ acre	AWW per ten sweeps in alfalfa					
		PT[a]	3DAT[bc]	6DAT[c]	14DAT[c]	22DAT	PTA[cd]
Check	---------	3.25	0.67ab	0.83b	0.71a	5.00a	0.76a
Intrepid	8.0	4.75	0.47bc	0.27cde	0.15bcd	1.75bc	0.36bc
Radiant	5.0	3.25	0.23c	0.21cde	0.19bcd	0.75c	0.23bc
Lorsban Advanced	32.0	2.50	0.25c	0.50bc	0.39bc	2.50abc	0.46b
Cobalt	32.0	1.50	0.15c	0.44cd	0.33bc	3.75ab	0.46b
Baythroid XL	2.8	2.50	1.08a	1.21a	0.42b	1.50bc	0.96a
Belt 480 SC	2.0	2.75	0.19c	0.00e	0.12cd	0.00c	0.10c
Belt 480 SC	3.0	2.00	0.33bc	0.00e	0.19bcd	1.25bc	0.27bc
Belt 480 SC	4.0	2.75	0.12c	0.08de	0.00d	0.50c	0.11c

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (P<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis.
[d] Post treatment average.

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(F7)

ALFALFA: *Medicago sativa* L. 'CUF-101'

INSECTICIDE EFFICACY AGAINST WORM PESTS IN ALFALFA, 2010

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Beet armyworm (BAW): *Spodoptera exigua* (Hübner)
Alfalfa caterpillar (AC): *Colias eurytheme* Boisduval

The objective of the study was to evaluate the efficacy of the new and older insecticidal compounds used against larvae of lepidopterous pests (BAW and AC) on alfalfa grown for hay production under desert growing conditions. An insecticide efficacy trial was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was RCB using four replicates with eight insecticide treatments and an untreated check. Plots were 24 ft wide by 50 ft long. Formulations and rates for each compound are provided and test materials were applied on 18 Aug 2010 at the specified rate equivalencies listed in the tables. Broadcast applications were delivered through 17, TJ-60 11003VS nozzles using a Lee Spider Spray Trac operated at 20 psi delivering 31.7 gpa. An adjuvant, Induce (Helena Chemical Co.), was applied at 0.25% vol/vol with all insecticide treatments. Pretreatment (PT) evaluations of insect populations in each plot were conducted on 17 Aug or 1 days pre-treatment (DPT). Post treatment evaluations were made on 20 Aug, 25 Aug, 1 Sep, and 8 Sep or, 2 days after treatment (DAT), 7 DAT, 14 DAT, and 21 DAT. During each evaluation, ten sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of BAW, AC, and AWW larvae (Tables 1 - 3). Treatment means were analyzed using 2-way ANOVA and means separated by a protected LSD ($P \leq 0.05$).

Pretreatment numbers of BAW larvae were similar among treatments (Table 1). Beet armyworm means for all insecticide treatments were significantly lower ($P \leq 0.05$) than the untreated check 2 DAT and 7 DAT, there were no differences among the treatment means 14 DAT and all insecticide treatments except for Voliam Xpress 1.25 ZC at 5 oz per acre and Warrior II 2.09 CS had BAW means that were lower than the check 21 DAT. The BAW post treatments averages for all insecticide treatments but were lower than the BAW post treatment average for the check.

Pretreatment numbers of AC were similar among treatments (Table 2). Alfalfa caterpillar means for all insecticide treatments were significantly lower ($P \leq 0.05$) than the untreated check 2 DAT and 7 DAT, all insecticide treatments except for Voliam Xpress 1.25 ZC at 5 oz per acre, Warrior II 2.09 CS, and Belt at 3 oz per acre had AC means that were lower than the check 14 DAT and there were no differences among the treatment means 21 DAT. The AC post treatments averages for all insecticide treatments but were lower than the AC post treatment average for the check. Belt 480 SC displayed superior residual activity against BAW and AC. Warrior II did not perform well against beet armyworm and AC. There were no symptoms of phytotoxicty on the alfalfa plants following the any of the insecticide applications.

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Table 1.

Treatment/ formulation	oz/acre	BAW per ten sweeps in alfalfa					
		1 DPT	2 DAT	7 DAT	14 DAT	21 DAT[y]	PTA[z]
Check	--	1.25	3.75a	11.75a	2.75	12.25a	7.63a
Voliam Xpress 1.25 ZC	5.0	3.75	0.75bc	0.50b	0.00	5.75ab	1.75cd
Voliam Xpress 1.25 ZC	7.0	1.50	0.25bc	0.25b	0.50	4.00bc	1.25cd
Voliam Xpress 1.25 ZC	9.0	1.25	0.00c	0.50b	0.50	5.50bc	1.63cd
Warrior II 2.09 CS	1.92	0.50	0.75bc	2.75b	2.50	9.75ab	3.94b
Intrepid	8.0	1.50	1.25b	3.25b	1.00	4.00bc	2.38bc
Belt 480 SC	2.0	0.50	0.25bc	0.00b	0.25	1.50c	0.50d
Belt 480 SC	3.0	0.75	0.25bc	0.00b	0.25	3.75bc	1.06cd
Belt 480 SC	4.0	1.00	0.00c	0.00b	0.50	1.75bc	0.56cd

Means within columns followed by the same letter are not significantly different, LSD ($P \leq 0.05$).
[y] Log_{10} (X+1) transformed data used for analysis, but actual means reported.
[z] Post treatment Average.

Table 2.

Treatment/ formulation	oz/acre	AC per ten sweeps in alfalfa					
		1 DPT	2 DAT	7 DAT	14 DAT[y]	21 DAT	PTA[yz]
Check	--	19.75	10.50a	7.75a	1.75a	4.75	6.19a
Voliam Xpress 1.25 ZC	5.0	14.75	1.50bc	0.50c	1.00ab	4.75	1.94bc
Voliam Xpress 1.25 ZC	7.0	14.75	1.75b	0.00c	0.00c	2.50	1.06cd
Voliam Xpress 1.25 ZC	9.0	17.75	0.50bc	0.75c	0.25bc	5.75	1.81bcd
Warrior II 2.09 CS	1.92	13.25	0.50bc	4.00b	0.75abc	7.50	3.19b
Intrepid	8.0	19.00	0.25bc	0.50c	0.25bc	5.50	1.63bcd
Belt 480 SC	2.0	12.75	0.00c	0.00c	0.00c	3.00	0.75d
Belt 480 SC	3.0	24.00	0.50bc	0.50c	1.00ab	1.00	0.75cd
Belt 480 SC	4.0	20.00	0.25bc	0.00c	0.25bc	2.75	0.81cd

Means within columns followed by the same letter are not significantly different, LSD ($P \leq 0.05$).
[y] Log_{10} (X+1) transformed data used for analysis, but actual means reported.
[z] Post treatment Average.

Table 3.

Treatment/ formulation	oz/acre	AWW per ten sweeps in alfalfa					
		1 DPT	2 DAT[y]	7 DAT[y]	14 DAT	21 DAT	PTA[yz]
Check	---------	0.75	0.75b	2.25a	0.25	0.25	0.88b
Voliam Xpress 1.25 ZC	5.0	0.50	0.00b	0.00b	0.25	0.25	0.13b
Voliam Xpress 1.25 ZC	7.0	0.50	0.00b	0.00b	0.00	0.00	0.00b
Voliam Xpress 1.25 ZC	9.0	0.25	0.25b	0.00b	0.00	0.00	0.06b
Warrior II 2.09 CS	1.92	0.75	20.50a	1.50a	0.50	1.25	5.94a
Intrepid	8.0	0.75	0.25b	0.25b	0.50	0.00	0.25b
Belt 480 SC	2.0	0.25	0.50b	0.00b	0.00	0.00	0.13b
Belt 480 SC	3.0	1.00	0.25b	0.00b	0.00	0.25	0.13b
Belt 480 SC	4.0	0.00	0.00b	0.00b	0.00	0.50	0.13b

Means within columns followed by the same letter are not significantly different, LSD ($P \leq 0.05$).
[y] Log_{10} (X+1) transformed data used for analysis, but actual means reported.
[z] Post treatment Average.

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F11

ALFALFA: *Medicago sativa* L. 'CUF-101'

EFFICACY OF INSECTICIDES FOR ALFALFA WORM PEST CONTROL, 2010

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Beet armyworm (BAW): *Spodoptera exigua* (Hübner)
Alfalfa caterpillar (AC): *Colias eurytheme* Boisduval
Alfalfa webworm (AWW): *Loxostege cereralis* (Zeller)

The objective of the study was to compare the efficacy of anthranilic diamide insecticidal compounds to standard insecticidal compounds used against larvae of lepidopterous pests (BAW, AC and AWW) on alfalfa grown for hay production under desert growing conditions. An insecticide efficacy trial was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was a RCB using four replicates of eight insecticide treatments and an untreated check. Plots were 24 ft wide by 50 ft long. Formulations and rates for each compound are provided and test materials were applied on 18 Aug at the specified rate equivalencies listed in the tables. Broadcast applications were delivered through 17 TJ-60 11003VS nozzles using a Lee Spider Spray Trac operated at 20 psi delivering 31.7 gpa. An adjuvant, Induce (Helena Chemical Co.), was applied at 0.1% vol/vol with all insecticide spray treatments. Pretreatment (PT) evaluations of insect populations in each plot were conducted on 17 Aug, or 1 day pre-treatment (DPT). Post treatment evaluations were made on 20 Aug, 25 Aug, 1 Sep, and 8 Sep, or 2 days after treatment (DAT), 7 DAT, 14 DAT, and 21 DAT. During each evaluation, ten 180º sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of BAW, AC, and AWW larvae (Tables 1 - 3). Treatment means were analyzed using 2-way ANOVA and means separated by a protected LSD (P=0.05).

Pretreatment numbers of BAW larvae were similar (P=0.05) among treatments (Table 1). Beet armyworm means for all insecticide treatments were significantly lower (P=0.05) than the untreated check 2 DAT, 7 DAT and for the post-treatment average. All but lowest rate of Voliam Xpress (5 oz/acre) and the Warrior treatment had BAW means significantly lower than the untreated check 21 DAT. Pretreatment numbers of AC were similar (P=0.05) among treatments (Table 2). Means for AC were significantly lower in all insecticide treatments compared to the untreated check 2 DAT, 7 DAT and for the post-treatment average. All but lowest rate of Voliam Xpress (5 oz/acre) the Warrior treatment and the 3 oz/acre rate of Belt had AC means significantly lower than the untreated check 14 DAT. There were no differences among the treatments for AC 21 DAT. Pretreatment numbers of AWW were similar (P=0.05) among treatments (Table 3). Means for AWW were significantly lower in all insecticide treatments except Warrior II compared to the untreated check 2 DAT, 7 DAT and for the post-treatment average. All rates of Voliam Xpress and Belt perform well against BAW, AC and AWW compared to the two standard insecticide treatments of Warrior II and Intrepid. No phytotoxic symptoms were detected following any of the insecticide treatments on any of the post-treatment sampling dates.

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Table 1.

Treatment	Rate, oz product/ acre	BAW per ten sweeps in alfalfa					
		1DPT[a]	2DAT[b]	7DAT	14DAT	21DAT[c]	PTA[d]
Check	---------	1.25	3.75a	11.75a	2.75	12.25a	7.63a
Volium Xpress 1.25 ZC	5.0	3.75	0.75bc	0.50b	0.00	5.75ab	1.75cd
Volium Xpress 1.25 ZC	7.0	1.50	0.25bc	0.25b	0.50	4.00bc	1.25cd
Volium Xpress 1.25 ZC	9.0	1.25	0.00c	0.50b	0.50	5.50bc	1.63cd
Warrior II 2.09 CS	1.92	0.50	0.75bc	2.75b	2.50	9.75ab	3.94b
Intrepid	8.0	1.50	1.25b	3.25b	1.00	4.00bc	2.38bc
Belt 480 SC	2.0	0.50	0.25bc	0.00b	0.25	1.50c	0.50d
Belt 480 SC	3.0	0.75	0.25bc	0.00b	0.25	3.75bc	1.06cd
Belt 480 SC	4.0	1.00	0.00c	0.00b	0.50	1.75bc	0.56cd

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (*P*<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis, but actual means reported.
[d] Post treatment average.

Table 2.

Treatment	Rate, oz product/ acre	AC per ten sweeps in alfalfa					
		1DPT[a]	2DAT[b]	7DAT	14DAT[c]	21DAT	PTA[cd]
Check	---------	19.75	10.50a	7.75a	1.75a	4.75	6.19a
Volium Xpress 1.25 ZC	5.0	14.75	1.50bc	0.50c	1.00ab	4.75	1.94bc
Volium Xpress 1.25 ZC	7.0	14.75	1.75b	0.00c	0.00c	2.50	1.06cd
Volium Xpress 1.25 ZC	9.0	17.75	0.50bc	0.75c	0.25bc	5.75	1.81bcd
Warrior II 2.09 CS	1.92	13.25	0.50bc	4.00b	0.75abc	7.50	3.19b
Intrepid	8.0	19.00	0.25bc	0.50c	0.25bc	5.50	1.63bcd
Belt 480 SC	2.0	12.75	0.00c	0.00c	0.00c	3.00	0.75d
Belt 480 SC	3.0	24.00	0.50bc	0.50c	1.00ab	1.00	0.75cd
Belt 480 SC	4.0	20.00	0.25bc	0.00c	0.25bc	2.75	0.81cd

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (*P*<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis, but actual means reported.
[d] Post treatment average.

Table 3.

Treatment	Rate, oz product/ acre	AWW per ten sweeps in alfalfa					
		PT[a]	2DAT[bc]	7DAT[c]	14DAT	21DAT	PTA[cd]
Check	---------	0.75	0.75b	2.25a	0.25	0.25	0.88b
Volium Xpress 1.25 ZC	5.0	0.50	0.00b	0.00b	0.25	0.25	0.13b
Volium Xpress 1.25 ZC	7.0	0.50	0.00b	0.00b	0.00	0.00	0.00b
Volium Xpress 1.25 ZC	9.0	0.25	0.25b	0.00b	0.00	0.00	0.06b
Warrior II 2.09 CS	1.92	0.75	20.50a	1.50a	0.50	1.25	5.94a
Intrepid	8.0	0.75	0.25b	0.25b	0.50	0.00	0.25b
Belt 480 SC	2.0	0.25	0.50b	0.00b	0.00	0.00	0.13b
Belt 480 SC	3.0	1.00	0.25b	0.00b	0.00	0.25	0.13b
Belt 480 SC	4.0	0.00	0.00b	0.00b	0.00	0.50	0.13b

Means within columns followed by the same letter are not significantly different, ANOVA; LSD (*P*<0.05).
[a] Days Pre-treatment.
[b] Days after treatment.
[c] Log transformed data used for analysis, but actual means reported.
[d] Post treatment average.

(F5)

ALFALFA: *Medicago sativa* L. 'CUF-101'

INSECTICIDE EFFICACY AGAINST ALFALFA WORM PESTS, 2011

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Beet armyworm (BAW): *Spodoptera exigua* (Hübner)
Alfalfa caterpillar (AC): *Colias eurytheme* Boisduval
Alfalfa webworm (AWW): *Loxostege cereralis* (Zeller)

The objective of the study was to evaluate the efficacy of the new and older insecticidal compounds used against larvae of lepidopterous pests (BAW, AC and AWW) on alfalfa grown for hay production under desert growing conditions. An insecticide efficacy trial was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was RCB using four replicates with seven insecticide treatments and an untreated check. Plots were 27 ft wide by 50 ft long. Formulations and rates for each compound are provided and test materials were applied on 19 Aug 2011 at the specified rate equivalencies listed in the tables. Broadcast applications were delivered through 17, TJ-60 11003VS nozzles using a Lee Spider Spray Trac, tractor mounted spray boom, operated at 20 psi, and delivering 30 gpa. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.25% vol/vol with all insecticide treatments. Pretreatment (PT) evaluations of insect populations in each plot were conducted on 18 Aug. Post treatment evaluations were made on the following specified dates and days after treatment (DAT), 22, 26 Aug, and 2 Sep or 3 DAT, 7 DAT, and 14 DAT. During each evaluation, ten 180° sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of BAW, AC, and AWW larvae (Tables 1 - 3). Treatment means were analyzed using 2-way ANOVA and means separated by a protected LSD ($P \leq 0.05$).

Pretreatment numbers of BAW larvae were similar among treatments (Table 1). Beet armyworm means for all insecticide treatments except Warrior II were significantly lower than the untreated check 3 DAT and 7 DAT. Pretreatment numbers of AC were low but similar among treatments (Table 2). Means for AC were significantly lower in all insecticide treatments except Voliam Xpress and Belt at 3.0 oz per acre, compared to the untreated check 3 DAT. There were no differences among the treatment means for AC at 7 DAT and at 14 DAT due to the near absence of AC larvae; most of the AC population pupated and many were emerging as adult alfalfa butterflies. Pretreatment numbers of AWW were low but were similar among treatments (Table 3). Only Intrepid and Belt at 2 oz and 4 oz per acre had AWW means that were significantly lower than the untreated check until 3 DAT. All insecticide treatments except Warrior II had AWW means that were lower than the check 7 DAT. There were no differences among the treatment means for AWW means 14 DAT. Belt displayed superior residual activity against BAW. Warrior II did not perform well against BAW and AWW. There were no symptoms of phytotoxicty on the alfalfa plants following the any of the insecticide applications. This research was supported by industry gifts.

Table 1.

		BAW per ten sweeps in alfalfa			
Treatment/formulation	Fl oz/acre	1 DPT	3 DAT	7 DAT	14 DAT
Check	-	22.75a	22.75a	21.25a	3.75b
Voliam Xpress 1.25ZC	9.0	28.25a	5.50b	2.00c	1.50cd
Warrior II 2.09CS	1.92	22.75a	22.25a	19.25ab	14.00a
Coragen 1.67SC	5.0	23.25a	7.50b	6.25bc	1.50cd
Intrepid 2F	8.0	35.50a	1.25b	1.25c	1.00cd
Belt 480 4SC	2.0	20.50a	1.00b	1.00c	0.25d
Belt 480 4SC	3.0	30.75a	2.25b	0.00c	0.50cd
Belt 480 4SC	4.0	26.00a	3.75b	0.50c	0. 50cd

Means within columns followed by the same letter are not significantly different (P=0.05)

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Table 2.

Treatment/formulation	Fl oz/acre	AC per ten sweeps in alfalfa			
		1 DPT	3 DAT	7 DAT	14 DAT
Check	-	6.25	4.00a	2.00	0.00
Voliam Xpress 1.25ZC	9.0	5.75	2.75ab	0.00	0.00
Warrior II 2.09CS	1.92	5.00	0.75bc	0.00	0.00
Coragen 1.67SC	5.0	4.75	0.00c	0.50	0.00
Intrepid 2F	8.0	5.25	1.50bc	0.00	0.00
Belt 480 4SC	2.0	6.50	0.75bc	0.00	0.00
Belt 480 4SC	3.0	5.25	2.75ab	0.00	0.00
Belt 480 4SC	4.0	5.25	0.50c	0.00	0.00

Means within columns followed by the same letter are not significantly different (P=0.05)

Table 3.

Treatment/formulation	Fl oz/acre	AWW per ten sweeps in alfalfa			
		1 DPT	3 DAT	7 DAT	14 DAT
Check	-	4.25	2.75ab	3.75a	0.25
Voliam Xpress 1.25ZC	9.0	5.25	1.00bc	0.75b	0.00
Warrior II 2.09CS	1.92	3.50	4.75a	3.75a	1.00
Coragen 1.67SC	5.0	5.00	2.75ab	0.00b	0.25
Intrepid 2F	8.0	4.25	0.25c	0.25b	0.00
Belt 480 4SC	2.0	4.50	0.25c	0.25b	0.25
Belt 480 4SC	3.0	8.25	1.00bc	0.75b	0.00
Belt 480 4SC	4.0	4.75	0.25c	0.00b	0.00

Means within columns followed by the same letter are not significantly different (P=0.05)

IP11

PEACH TWIG BORER DORMANT SEASON CONTROL, 2011

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A number of new products are now registered or in the registration process that provide viable options to the organophosphates for PTB, control. In 2011, we repeated a study to determine the best use of new products for control of PTB as a May spray. UC researchers have not promoted the use of May sprays for many years because of the potential for disrupting natural enemies in the orchards.

May sprays offer the potential to obtain some level of control of NOW which has a spring flight that overlaps somewhat with the PTB spring flight in many years. May sprays also have an advantage over hullsplit sprays in that there will be less overlapping of generations earlier in the season making May spray timing (and therefore efficacy) more precise. The current May spray timing recommendation (400 degree-days after the start of the spring flight is based on research developed for organophosphates that cause direct mortality to the PTB larvae. Many of the newer insecticide products have different modes of action, so spray timing may need to be earlier (or later) relative to products that kill larvae directly.

Treatments were applied to Nonpariel, Monterey and Wood Colony varieties that were grafted on Krymsk rootstock. The treatments were blocked by variety with 2 replicates of each insecticide treatment for each variety (6 replicates in all). The PTB biofix for the site was determined to be April 23, and the navel orangeworm biofix May 13. PTB pheromone traps and navel orangeworm (NOW) egg traps were deployed to determine biofix for the first flights of both species so that degree-days could be calculated to time treatments. It was our intention to base the treatments on degree-days (DD), so most applications were applied at a timing intended to be about 400 DD, the treatment timing for PTB recommended in the *UC Pest Management Guidelines for Almonds*. The actual application date was May 24, 2011, at 383 PTB DD. One *Bacillus thuringiensis* product, Dipel, was applied twice, on May 9 (211 PTB DD) and on May 24. Two products, Intrepid and Altacor were applied once on May 24 and separate trees at earlier (May 13, 0 NOW DD) and later (May 26, 91 NOW DD) treatment timings as well. All sprays were applied at the equivalent of 100 gal of water per acre with an Echo Duster-Mister Air Assist Sprayer. PTB shoot strikes were evaluated on June 22, 2011, at 870 PTB DD following biofix. Figure 1 presents trap counts and degree-day accumulations for both PTB and NOW. As in 2010, unusual rainy periods and cool temperatures occurred in May following biofix of both PTB and NOW, so it is possible that the rains may have killed some of the early emerging moths or their eggs, creating the equivalent of a later moth emergence. Data were anlyzed by one way ANOV and treatment means separated from the untreated control by Student’s t-test.

ANOVA results from our 2011 study revealed significant differences between treatments (F=4.1015, df=17,113, P<0.0001). Means were separated by Student's t-test. The analysis revealed that all treatments except for the diflubenzuron (Dimilin and generic version) significantly reduced the number of peach twig borer shoot strikes relative to the untreated check (Table 1). None of the other treatments differed significantly from one another.

Table 1. Mean (± SD) peach twig borer shoot strikes per tree, 2011

Treatment	Rate	Application date	PTB strikes/tree* Mean ± SD			
untreated	na	na	5.4	±	4.8	A
Dipel[1]	1 lb	5/9 & 5/24/11	2.3	±	2.9	CDE
Dimilin 2L	12 oz	5/24/11	3.5	±	3.0	ABCD
diflubenzuron 2L (generic)	12 oz	5/24/11	5.2	±	3.3	AB
Dimilin 2L + Lorsban	12 oz + 4 pt	5/24/11	3.8	±	3.5	ABC
Lorsban	4 pt	5/24/11	2.0	±	1.7	CDE
Intrepid 2F[3]	16 oz	5/13/11	2.5	±	2.0	BCDE
Intrepid 2F[3]	16 oz	5/24/11	2.0	±	1.5	CDE
Intrepid 2F[3]	16 oz	5/26/11	2.3	±	1.8	CDE
Delegate WG[3]	4.5 oz	5/24/11	0.5	±	0.5	E
Delegate WG[3]	7.0 oz	5/24/11	0.3	±	0.5	E
Altacor[2]	4.0 oz	5/13/11	0.2	±	0.4	E
Altacor[2]	4.0 oz	5/24/11	0.2	±	0.4	E
Altacor[2]	4.0 oz	5/26/11	0.3	±	0.5*	E
Assail 70WP + Lamda-Cy EC	4.1 oz + 2.56 oz	5/24/11	0.8	±	0.8	DE
Assail 70WP + Lamda-Cy EC	2.3 oz + 5.12 oz	5/24/11	0.5	±	0.5	E
Belt SC[2]	4 oz	5/24/11	0.3	±	0.8	E
cyazypyr 10SE[2]	16.9 oz	5/26/11	0.0	±	0.0	E

*Means followed by the same letter do not differ significantly at P<0.05 by Student's t-test.
[1] LI-700 added @ 0.5% v/v
[2] Dyne-Amic added @ 0.25%% v/v
[3] Induce added @ 0.25% v/v

The comparison of treatment timings of Altacor and Intrepid indicated that in 2011 all treatment timings were statistically equavalent for both prodcuts (Table 2). ANOV statistics among treatment timings and in comparison to the utreated control for each product were Altacor (*F*=6.5318, df=3,29, *P*<0.0019) and Intrepid (*F*=2.0598, df=3,29, *P*<0.1301). In 2009, the earlier treatment timing was as good as or better than the treatment timing currently recommended in the *UC Pest Management Guidelines for Almonds* in all cases and in each case, and the later treatment timing was not as effective. Results for 2011 aupport results from 2010, which also had period of rain and cool temperatures occurring during much of mid-May, following the first application. Our PTB and NOW trap captures from the site indicate a surppression in activity during this period, much as we observed in 2010. It is possible that there was significant PTB mortality during tht period, and under such conditions perhaps resetting the biofix should have been considered. In both years, ANOV did not indicate significant differences between the Intrepid treatments and the untreated control.

Table 2. Effects of treatment timing for peach twig borer control when using Altacor and Intrepid, 2011.

Treatment	Rate (form./ac.)	Degree-days	Application date	PTB strikes/tree Mean ± SD
untreated	na		na	5.4 ± 4.8
Intrepid 2F[1]	16 oz	0 NOW	5/13/11	2.5 ± 2.0*
Intrepid 2F[1]	16 oz	383 PTB	5/24/11	2.0 ± 1.5*
Intrepid 2F[1]	16 oz	91 NOW	5/26/11	2.3 ± 1.8*
Altacor[2]	4 oz	0 NOW	5/13/11	0.2 ± 0.4*
Altacor[2]	4 oz	383 PTB	5/24/11	0.2 ± 0.4*
Altacor[2]	4 oz	91 NOW	5/26/11	0.3 ± 0.5*

*Means significantly different from untreated control at *P*<0.05 by Student's t-test.
[1] Induce added @ 0.25% v/v
[2] Dyne-Amic added @ 0.25%% v/v

Figure 1. Peach twig borer and navel orangeworm degree-days. UC recommended treatment timings are at 400 PTB DD and 100 NOW DD.

Navel Orangeworm Control at the May Spray Timing, 2011

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A number of new products are now registered or in the registration process which may provide viable options to the organophosphates for navel orangeworm (NOW) control during the "May Spray" period. UC researchers have not promoted the use of May sprays for many years because of the potential for disrupting natural enemies in the orchards, but newer products registered may make this timing an option.

May sprays offer the potential to obtain some level of control of both NOW and peach twig borer (PTB) as these insects have flights that overlap somewhat in many years. May sprays also target the first generation following spring moth emergence, so there will be less overlap of generations for both NOW and PTB during this period. The current May spray timing recommendation for NOW is 100 degree-days after the first eggs are laid for 2 consecutive sampling periods on egg traps, and for PTB 400 degree-days after the start of the spring flight. These treatment timings are based on research developed for organophosphates that caused direct mortality to the NOW and PTB larvae. Many of the newer insecticide products have different activity against larvae, so spray timing may need to be earlier (or later) relative to products that kill larvae directly.

The site of our May navel orangeworm control study was a mature 20 acre almond orchard on E. Clinton South Ave, near Ripon, San Joaquin Co. The block had not been dormant treated by the grower and had a mummy load recorded on February 1, 2011, averaging 21 per tree. Mummies could still be found in trees when this study was initiated in late April, 2011, when NOW egg traps and PTB pheromone traps were hung to establish the biofix for each species. Ten black navel orangeworm eggs traps were hung for better resolution of a biofix.

Using the same protocol as proved successful for us in 2009 and 2010, twenty uninfested Nonpareil nuts saved from the 2010 harvest were hot glued to strands of vegetable mesh during April, 2011, and 449 strands were prepared in all. They were all deployed at mid-canopy in Nonpareil trees on May 10, the biofix date. There were 20 treatments in all, with 10 mummy strands allocated for each treatment including 19 to the water only controls. Treatments of Intrepid, Altacor and Delegate were applied directly to the strands at 3 timings, May 10 (0 DD), May 25 (100 NOW DD), and May 27 (400 PTB DD). The nuts were removed from the field on July 11 before the start of the hullsplit flight.

All products were applied as close to the treatment timing for NOW in the *UC Pest Management Guidelines for Almonds* (100 DD using navel orangeworm degree-day developmental thresholds) as practical. Three products, Intrepid, Altacor and Delegate were applied at earlier and later treatment timings as well. Figure 1 presents accumulated NOW and PTB degree-days and trap captures for the site.

Treatments and application dates are indicted on Table 1. The equivalent spray volume was 100 gal/acre, and any adjuvants included with each treatment are indicated as footnotes to the table.

ANOV indicated significant treatment differences (*F*=3.8322, df=21, 222, *P*<0.0001) in infested nut meats. All products significantly reduced kernal infestation except for the 2 MBI products and the 2 diflubenzuron products. There were no differences between the 3 treatment timings for Delegate, Intrepid and Altacor.

Table 1. Mean (± SD) proportion of NOW infested mummy nut meats in each treatment, Ripon, 2011.

Treatment	Rate (form./acre)	Treatment date	Mean ± SD[1]			
Control (water)	na		10.9	±	15.7	ABCD
Dipel*	1 lb	5/9 & 5/27	4.9	±	9.3	DE
MBI-203*	2 gal	5/9 & 5/27	10.0	±	6.6	AB
MBI-206*	2 gal	5/9 & 5/27	15.1	±	17.6	A
Dimilin 2L	12 oz	5/25	14.3	±	11.5	A
diflubenzuron (generic)	12 oz	5/25	11.0	±	11.8	ABC
Lorsban	4 pt	5/25	0.0	±	0.0	E
Intrepid 2F***	16 oz	5/10	1.7	±	3.7	E
Intrepid 2F***	16 oz	5/25	1.5	±	3.2	E
Intrepid 2F***	16 oz	5/27	0.9	±	2.6	E
Delegate 25WG ***	7.0 oz	5/10	2.6	±	4.2	E
Delegate 25WG***	7.0 oz	5/25	2.2	±	4.6	E
Delegate 25WG ***	7.0 oz	5/27	0.7	±	2.3	E
Altacor 35WDG***	4.0 oz	5/10	0.8	±	2.4	E
Altacor 35WDG***	4.0 oz	5/25	1.9	±	4.2	E
Altacor 35WDG***	4.0 oz	5/27	0.0	±	0.0	E
Assail 70WP + Lambda-Cy 11.4EC	4.1 oz + 2.56 oz	5/25	4.4	±	6.1	CDE
Assail 70WP + Lambda-Cy 11.4EC	2.3 oz + 5.12 oz	5/25	3.5	±	8.3	E
Belt 4SC**	4 oz	5/27	2.7	±	4.6	E
Dimilin 2L + Lorsban EW	12 oz+4 pt	5/25	3.2	±	5.7	DE
Dimilin 2L + Altacor 35WDG	12 oz+3 oz	5/25	1.6	±	3.0	E
HGW86	16.9 oz	5/27	5.0	±	7.4	BCDE

[1] Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsine transformation.
*LI-700 added @ 0.25% v/v
**Dyne-Amic @ 0.25% v/v
*** Induce @.25% v/v

ANOV also indicated significant treatment differences (*F*=4.2071, df=21, 222, *P*<0.0001) in infested nut meats and hulls combined (Table 2). Results were similar to those for kernal infestation alone. The total infestation of nuts is important in May as adults emerging from these larvae will attack the new crop nuts.

Table 2. Mean (± SD) proportion of NOW infested mummies (total with larvae in meats and hulls) in each treatment, Ripon, 2011.

Treatment	Rate (form./acre)	Treatment date	Mean ± SD[1]			
Control (water)	na		13.8	±	17.3	AB
Dipel*	1 lb	5/9 & 5/27	4.9	±	9.3	CD
MBI-203*	2 gal	5/9 & 5/27	11.6	±	7.7	AB
MBI-206*	2 gal	5/9 & 5/27	15.1	±	17.6	AB
Dimilin 2L	12 oz	5/25	14.9	±	11.2	A
diflubenzuron (generic)	12 oz	5/25	13.0	±	11.8	AB
Lorsban	4 pt	5/25	0.0	±	0.0	D
Intrepid 2F***	16 oz	5/10	1.7	±	3.7	CD
Intrepid 2F***	16 oz	5/25	1.5	±	3.2	CD
Intrepid 2F***	16 oz	5/27	2.0	±	3.9	CD
Delegate 25WG ***	7.0 oz	5/10	2.6	±	4.2	CD
Delegate 25WG***	7.0 oz	5/25	3.2	±	4.9	CD
Delegate 25WG ***	7.0 oz	5/27	0.7	±	2.3	D
Altacor 35WDG***	4.0 oz	5/10	1.7	±	3.6	CD
Altacor 35WDG***	4.0 oz	5/25	1.9	±	4.2	CD
Altacor 35WDG***	4.0 oz	5/27	0.0	±	0.0	D
Assail 70WP + Lambda-Cy 11.4EC	4.1 oz + 2.56 oz	5/25	4.4	±	6.1	CD
Assail 70WP + Lambda-Cy 11.4EC	2.3 oz + 5.12 oz	5/25	3.5	±	8.3	CD
Belt 4SC**	4 oz	5/27	3.3	±	4.6	CD
Dimilin 2L + Lorsban EW	12 oz+4 pt	5/25	3.7	±	5.6	CD
Dimilin 2L + Altacor 35WDG	12 oz+3 oz	5/25	1.6	±	3.0	CD
HGW86	16.9 oz	5/27	7.0	±	9.0	BC

[1] Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsine transformation.
*LI-700 added @ 0.25% v/v
**Dyne-Amic @ 0.25% v/v
*** Induce @.25% v/v

While cracking nuts, we found a considerable number of earwigs in the hulls and split nuts, so we recorded these data. Table 3 presents the number of live and dead earwigs found when cracking the nuts. We noted previously that earwigs are commonly associated with mummy nuts at the Manteca site. Differences in occurrence and survival may suggest differences between treatments in nontarget effects or in some cases possibly a greater infestation of navel orangeworm larvae.

Table 3. Number of mummy nuts with live and dead earwigs following application of various chemicals at the 'May' treatment timing, Manteca, 2011.

Treatment	Mean ± SD[1,3] live earwigs				Mean ± SD[2,3] dead earwigs			
Control (water)	0.3	±	0.5	AB	0.0	±	0.0	C
Dipel	0.0	±	0.0	B	0.2	±	0.4	BC
MBI-203	0.3	±	0.5	AB	0.3	±	0.5	BC
MBI-206	0.2	±	0.4	B	0.0	±	0.0	BC
Dimilin 2L	0.0	±	0.0	B	0.0	±	0.0	BC
diflubenzuron (generic)	0.1	±	0.4	B	0.3	±	0.5	BC
Lorsban	0.0	±	0.0	B	0.8	±	0.4	A
Intrepid 2F (5/10)	0.2	±	0.4	AB	0.2	±	0.4	BC
Intrepid 2F (5/25)	0.7	±	0.8	A	0.3	±	0.5	BC
Intrepid 2F (5/27)	0.6	±	0.5	A	0.0	±	0.0	BC
Delegate 25WG (5/10)	0.0	±	0.0	B	0.2	±	0.4	BC
Delegate 25WG (5/25)	0.0	±	0.0	B	0.2	±	0.4	BC
Delegate 25WG (5/27	0.0	±	0.0	B	0.0	±	0.0	BC
Altacor 35WDG (5/10)	0.0	±	0.0	B	0.2	±	0.4	BC
Altacor 35WDG (5/25)	0.0	±	0.0	B	0.2	±	0.4	BC
Altacor 35WDG (5/27)	0.2	±	0.4	B	0.0	±	0.0	BC
Assail 70WP+Lambda-Cy 11.4EC	0.0	±	0.0	B	0.0	±	0.0	BC
Assail 70WP+Lambda-Cy 11.4EC	0.0	±	0.0	B	0.3	±	0.6	ABC
Belt 4SC	0.2	±	0.4	AB	0.4	±	0.5	AB
Dimilin 2L+Lorsban EW	0.0	±	0.0	B	0.0	±	0.0	BC
Dimilin 2L+Altacor 35WDG	0.2	±	0.4	AB	0.0	±	0.0	BC
HGW86	0.0	±	0.0	B	0.1	±	0.4	BC

[1] F=1.7541, df=21, 127, P<0.0334
[2] F=1.7177, df=21, 127, P<0.0389
[3] Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test.

Figure 1. Navel orangeworm and peach twig borer degree-days and trap count at the Ripon site, 2011.

NAVEL ORANGEWORM CONTROL WITH HULL SPLIT SPRAYS IN ALMOND, 2012

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Navel orangeworm (NOW): *Amyelois transitella* (Walker)

In 2012 we conducted a trial for navel orangeworm at the UC West Side Research and Extension Center in Five Points, Fresno Co., CA. The trial evaluated the effects of insecticides on navel orangeworm in almonds. A total of 128 nonpareil trees were organized into a RCBD with six blocks of 21 treatments and an untreated check. The trees were planted in 2008 with a spacing of 22' x 15'.

Treatments were applied to individual trees with a hand gun at 200 GPA at 150 PSI on 19/20 Jul. This corresponded with the second flight of navel orangeworm and the initiation of hull-split on the nonpareil trees. The trials were harvested by hand on 23/24 Aug by collecting 300 to 400 nuts per tree into brown paper sacks. Samples were taken to the lab and allowed to dry for approximately three weeks. At that time they were placed into a walk-in refrigerator to stop development of navel orangeworm until the nuts could be processed. All nuts from each sample were cracked to determine the percentage nuts from each tree that were infested by navel orangeworm. Data were analyzed by ANOVA with means separated by Fisher's Protected LSD (P = 0.05). Data were also analyzed by mode of action. To do this, data from all treatments within a single mode of action were averaged for each block. The data were analyzed as a RCBD with 6 blocks of 5 treatments (diamides, other larvicides, pyrethroids, pyrethroids + diamides, and the untreated check) with ANOVA with means separated by Fisher's Protected LSD (P=0.05)

The density of Pacific spider mite was assessed on each tree approximately two weeks after insecticide applications. On 1 Aug we collected twenty random leaves from each individual tree. Leaves were transported to a laboratory where motile Pacific spider mites (larvae, nymphs, and adults) were counted on each leaf. Average mites per leaf were analyzed by ANOVA using transformed data (square root (x + 0.5)) with means separated by LSD (P = 0.05).

Results
The effects of insecticide treatments on navel orangeworm damage are shown in Table 1. The same data are also presented for convenience as Figures 1 and 2. Damage in the untreated check was 17.8% compared to 5.6 to 14.7% in treated plots. The four treatments of tank mixes of a diamide and a pyrethroid had 4.6 to 9.2% damage. This is a 48 to 69% reduction in damage compared to the untreated check. There were no significant differences among any of these four tank-mix treatments.

The trial included six insecticide treatments of products containing only the diamides chlorantraniliprole (Altacor), cyantraniliprole (Exirel), or flubendiamide (Belt, Tourismo). Plot where these products were used had 6.2 to 11.4% damage. This is the equivalent of 36 to 65% reductions in damage compared to the untreated check. These results were very similar to the results of other insecticides that work primarily as larvicides. Plots treated with Proclaim, Delegate or Intrepid had between 6.4 and 9.6% damage. This was the equivalent of a 46 to 64% reduction in damage compared to the untreated check.

Pyrethroid treatments resulted in more variable results in the trial, likely due to the fact that these products have varying residual effects in the field and that they rely on their activity as adulticides for a significant portion of the control they provide. As a result of how they work, it is likely that trials containing treatments to individual trees will accurately assess the effectiveness of larvicides, but that effects of adulticides are more likely to be underestimated compared to the control that could be achieved by applying adulticides on a commercial scale. In our trial we tested 8 pyrethroids that resulted in 6.4 to 14.7% damage. This is the equivalent of 17 to 64% reductions in navel orangeworm damage compared to the untreated check. There were no significant differences in damage among the eight pyrethroid treatments, though five of these treatments had damage under 10% that was significantly lower than the untreated check (Brigade, Hero + Oil, Danitol, Brigade + Oil, and Athena + Oil) while three treatments had damage over 10% and were not significantly different than the untreated check (Warrior II, Athena, Baythroid).

Analysis of data by mode of action showed that all modes of action caused a significant reduction in damage by navel orangeworm compared to the untreated check (Fig. 3). The lowest damage numerically was in plots treated with tank mixes of diamides and pyrethroids (7.2%). This is consistent with previous research that has shown that tank mixes of diamides and pyrethroids typically have reduced damage compared to when products with these modes of action are used individually. However, damage levels in the diamide + pyrethroid treatment (7.2%) were not significantly different from damage levels for diamides (8.6%), other larvicides (8.1%), or pyrethroids (9.7%).

Analysis of spider mite data (Table 1) did not result in any significant differences in the density of Pacific spider mites two weeks after plots were treated for navel orangeworm.

Table 1. Effects of insecticide treatments on damage by navel orangeworm to kernels and density of Pacific spider mites on leaves, 2012.

Mode of Action	Treatment[1]	Rate per acre	Mean (± SE) kernel damage by NOW[2] (%)	Reduction in NOW damage	Mean (±SE) mites per leaf 2 WAT [3]
Diamide + Pyrethroid	Voliam Xpress	9 fl oz	5.6 ± 1.0a	69%	1.6 ± 1.2
	Altacor WG 35PC + Biphrenin 2E	3 oz + 6.4 fl oz	6.2 ±1.9ab	65%	0.2 ± 0.2
	Tourismo + Brigade WSB	14 fl oz + 16 oz	8.0 ± 2.2ab	55%	0.4 ± 0.3
	Belt SC + Baythroid XL	4 fl oz + 2.8 fl oz	9.2 ± 2.9abc	48%	0.9 ± 0.7
Diamide	Belt SC	4 fl oz	6.2 ± 1.1ab	65%	4.6 ± 4.6
	Exirel 10SE	13.5 fl oz	6.3 ± 0.4ab	65%	0.5 ± 0.4
	Altacor WG 35PC	4 oz	8.2 ± 3.0abc	54%	1.0 ± 0.6
	Tourismo	14 fl oz	9.5 ± 1.9abc	47%	3.0 ± 2.4
	Altacor WG 35PC	3 oz	10.1 ± 1.9abc	43%	0.1 ± 0.1
	Exirel 10SE	20.5 fl oz	11.4 ± 3.7abcd	36%	2.3 ± 1.6
Pyrethroid	Brigade WSB	16 oz	6.4 ± 1.5ab	64%	0.8 ± 0.4
	Hero EW + 415° Oil	11.6 fl oz + 1% v/v	6.4 ± 2.7ab	64%	0.9 ± 0.8
	Danitol 2.4EC	21.3 fl oz	7.3 ± 3.1ab	59%	0.3 ± 0.3
	Brigade WSB + 415° Oil	16 oz + 1% v/v	9.2 ± 3.1abc	49%	0.6 ± 0.3
	Athena + 415° Oil	19.2 fl oz + 1% v/v	9.9 ± 3.8abc	44%	0.1 ± 0.1
	Warrior II	2.56 fl oz	11.6 ± 2.5abcd	35%	0.1 ± 0.1
	Athena	19.2 fl oz	12.1 ± 1.8bcd	32%	0.1 ± 0.1
	Baythroid XL	2.8 fl oz	14.7 ± 3.7cd	17%	0.0 ± 0.0
Other Larvicide	Proclaim	4.5 oz	6.4 ± 0.5ab	64%	1.3 ± 0.8
	Delegate WG	6.4 oz	8.1 ± 1.9ab	54%	2.7 ± 1.4
	Intrepid	16 fl oz	9.6 ± 2.4abc	46%	0.9 ± 0.4
Untreated	UTC	--	17.8 ± 2.2d	0%	0.9 ± 0.5
		F =	1.73	--	1.03
		P =	0.0372	--	0.4328

[1]Dyne-Amic was used as a surfactant at 4 fl oz per 100 gallons for all treatments except where 1% 415° Oil was used.
[2]Means in a column followed by the same letter are not significantly different ($P > 0.05$).
[3]Means in a column followed by the same letter are not significantly different ($P > 0.05$, Fisher's protected LSD) after sqrt (x) transformation of the data. Untransformed means are shown.

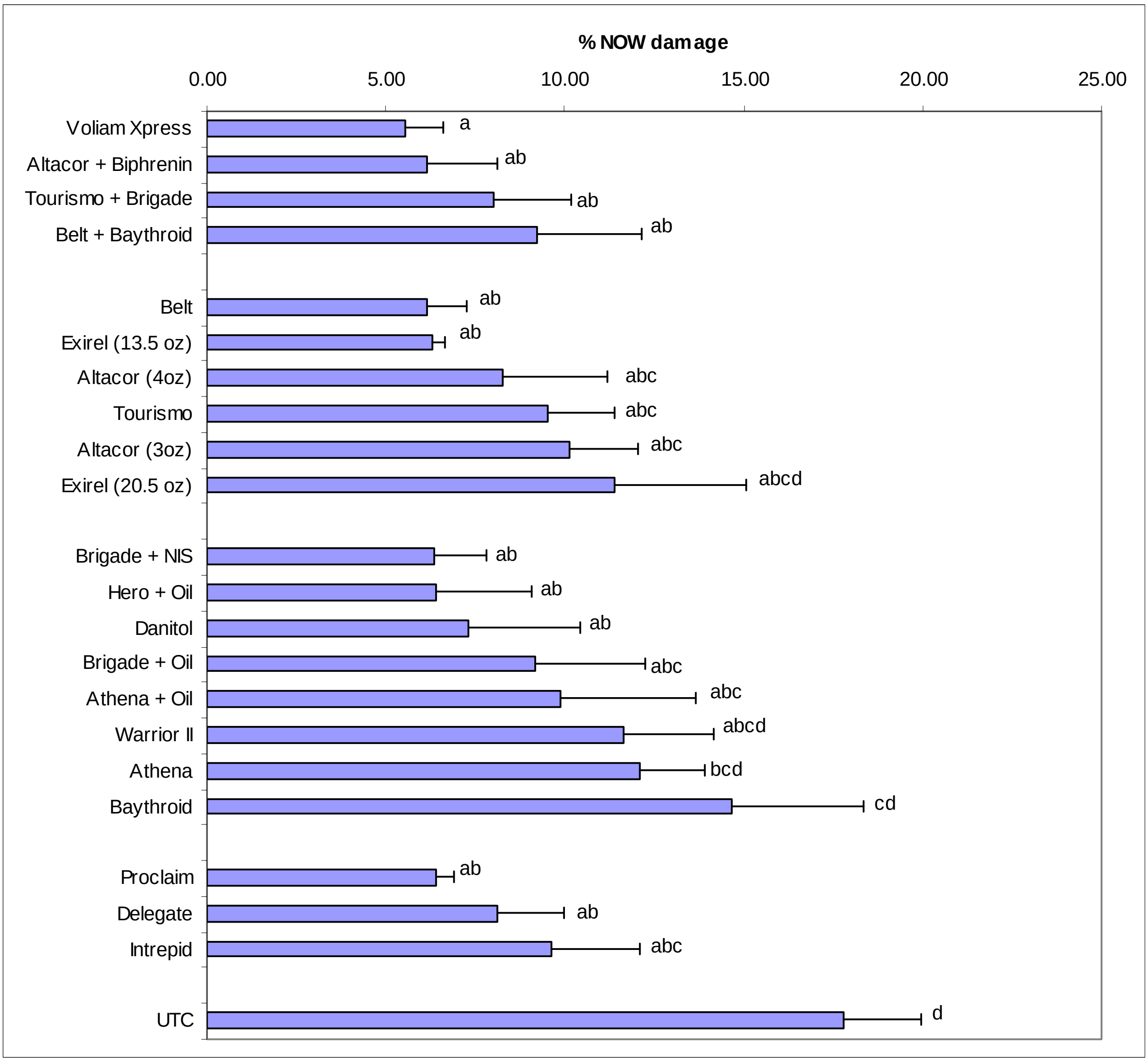

Figure 1. Effects of insecticide treatments on the percentage of kernels infested by navel orangeworm.

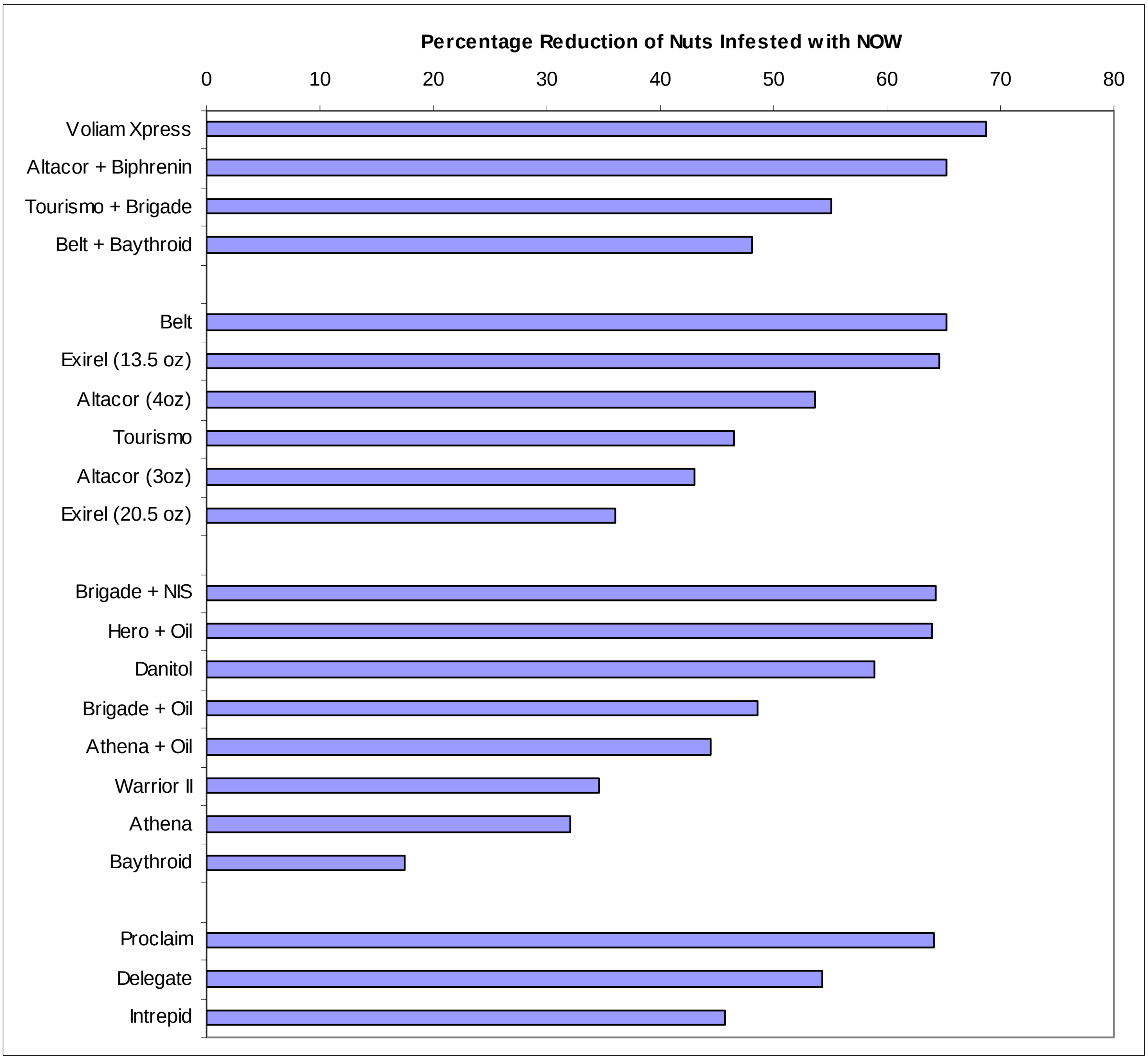

Figure 2. Percentage reduction of kernels infested with navel orangeworm compared to the untreated check.

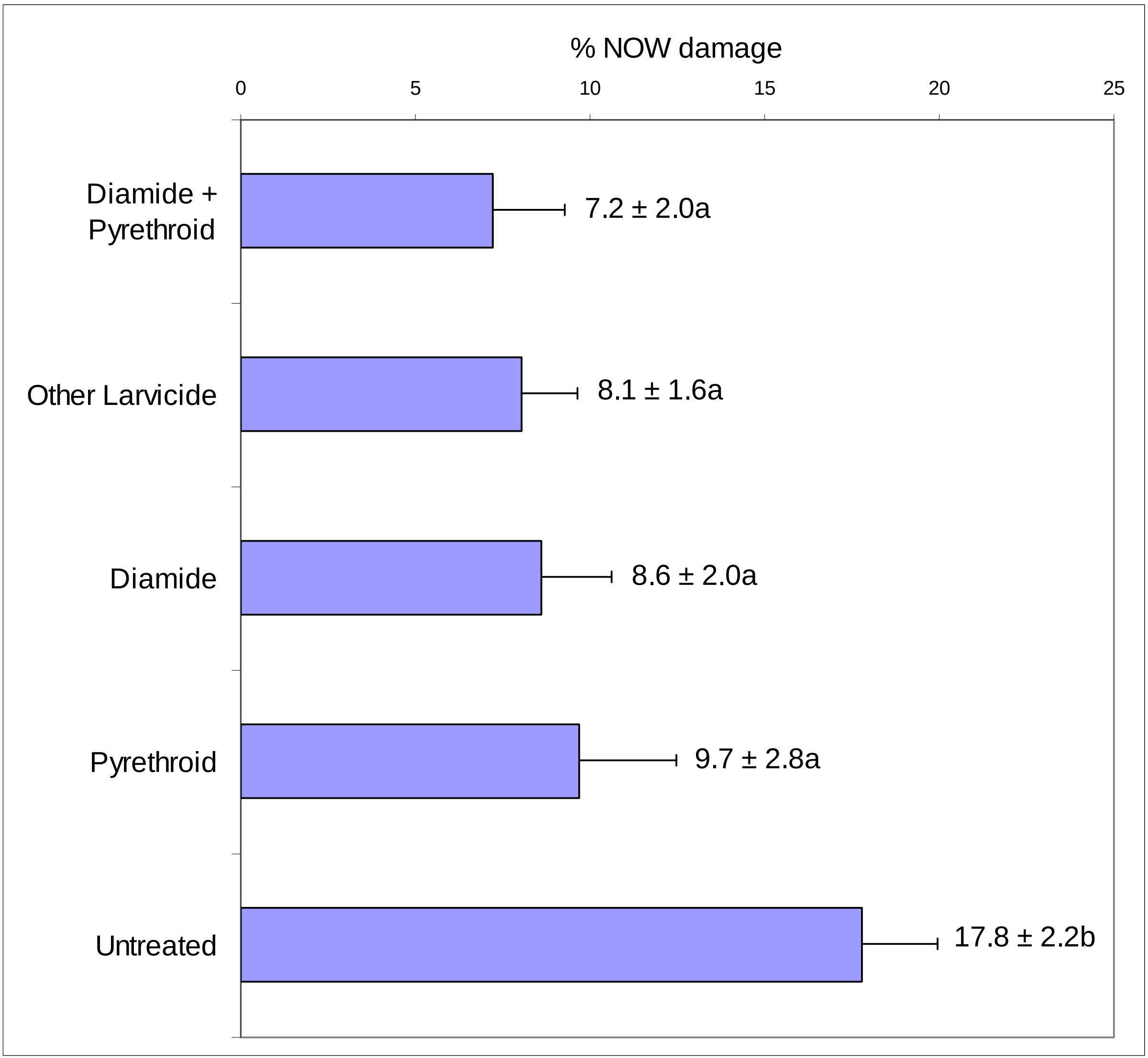

Figure 3. Effects of insecticide treatments from the same mode of action on the percentage of kernels infested by navel orangeworm.

2013 Almond Insecticide Research

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The ‘May spray’ timing offers the potential to obtain some level of control of both NOW and PTB as these insects have flights that overlap somewhat in many years. The May spray controls the first generation of NOW following spring moth emergence. Females of the first flight lay their eggs on the mummy nuts that remain in the orchards, so the infestation of mummy nuts can be quite high. The current May spray timing recommendation for NOW is 100 degree-days after the first eggs are laid for 2 consecutive sampling periods on egg traps, but this will probably be modified when the relationship between male flights as recorded using the new navel orangeworm pheromone is better understood relative to egg hatch as monitored with egg traps. The recommended PTB treatment timing is at 400 degree-days after the first females are captured in pheromone traps. Ten NOW eggs traps, 5 NOW pheromone traps baited with the new Suterra Biolures, and 10 peach twig borer (PTB) pheromone traps baited with 'long life' lures were hung on March 26, 2013, in a mature 20 acre almond orchard near Ripon, but in San Joaquin Co., and monitored to determine the spring flights of NOW and PTB. This almond orchard was also the site of our NOW insecticide research for 2013.

The focus of our 2013 NOW research was twofold, first to evaluate efficacy and treatment timing for NOW at the May spray timing and to relate these to NOW phenology as indicated from monitoring with both NOW egg traps and the new Biolure pheromone traps that are a measure male NOW flight, and second to estimate the residual efficacy of four registered insecticides applied during the spring.

Using the same protocol as proved successful for us in the last 4 years, twenty uninfested Nonpareil nuts saved from the 2012 harvest were hot glued to strands of vegetable mesh during early March 2013, and these served a surrogate mummies for both studies.

For the first experiment, 260 strands of surrogate mummies were hung in the orchard when the egg trap monitoring indicated the beginning of the spring NOW flight (April 16), so that females ovipositing on these mummies or larvae already present prior to the subsequent experimental applications would be exposed to the insecticides as they would in naturally occurring mummies in the orchard. Eight strands each were treated with either chlornitraniliprone (Altacor), flubendiamide (Belt), methoxyfenozide (Intrepid) bifenthrin (Brigade), or spinetoram (Delegate) weekly starting the week that the strands were first deployed (treatment dates were from April 16 through May 21). Twenty strands remained untreated as controls to establish the damage level in the absence of treatment. The number of strands deployed totaled 260 representing 5 treatments X 8 reps X 6 weeks, plus 2 complete reps of untreated control strands. The rates of the insecticides applied were Altacor (4 oz), Belt (4 oz.), Intrepid (16 oz.), Brigade (16 oz.), and Delegate (7 oz.). All were mixed into the equivalent of 100 gal per acre, and included the nonionic surfactant, Dyne-amic, at 0.25% v/v. The strands were removed from the trees at 615 NOW degree-days from the date they were deployed, and returned to UC Davis where they were hand-cracked to determine infestation (nuts with larvae or pupae present) and damage (nuts with larvae, pupae or damage present). Data were analyzed by analysis of variance following arcsin transformation, with individual treatments and treatment timing compared to the untreated control and means for treatment timings for each product compared to one another by Students t-test.

The second experiment was conducted using the same almond strand approach, but was intended to provide a better estimate of residual activity as well. A total of 176 strands of almond mummies were used for this experiment. Forty strands were designated for each of the 4 chemicals, and 16 strands for the untreated control. Each week starting April 15, 8 of the 40 strands designated for each chemical treatment were treated and hung within the tree canopy of isolated roadside olive trees, a non-host for NOW, with no obvious source trees nearby. When the last set of 8 strands were treated 0n May 14, all of the strands were transferred to the Manteca/Ripon almond orchard, along with the 16 untreated strands. The strands were left in the almond orchard for 2 weeks (May 29), then returned to the laboratory and held separately by treatment and date until about 600 NOW DD were accumulated to determine infestation. The nuts were hand-cracked to determine infestation at that time. Analysis of variance following arcsin transformation was conducted to determine differences in infestation between treatments (including untreated) on each date. Rates of the insecticides applied were Altacor (4 oz), Belt (4 oz.), Intrepid (16 oz.), and Brigade (16 oz.). All were mixed into the equivalent of 100 gal per acre, with the nonionic surfactant, Dyne-amic, included at 0.25% v/v. This design effectively provides 6 two-week duration treatment residue periods following each application.

It was interesting to note that males were captured in the pheromone traps as soon as they were deployed in late March while the first eggs were detected in the egg traps about a month later. However, the peak of male moth capture in the pheromone trap occurred on April 30 while the peak number of eggs recorded on the egg traps was on May 7, or only a week apart.

The first study provides an estimate of treatment success with either Altacor, Belt, Intrepid, Brigade, or Delegate by timing treatments at weekly intervals starting the week following the beginning of egg-laying and we hope that these results can be used to start to address treatment timing of "May sprays' using the new NOW Biolure pheromone lure by comparison to the traditional NOW egg trap. Results (Table 1) indicated that all treatment timings of all products resulted in less navel orangeworm infestation (F=8.1816, df=30,258, P<0.0001) and damage (F=10.9699, df=30,258, P<0.0001) when compared to the untreated control. However, in general, the earlier treatment timings had less damage than the later (May 15 and May 21) treatment timings.

The second study provides data to help interpret the residual effect of 4 of these products, Altacor, Belt, Intrepid, and Brigade. The results of this experiment for resulting navel orangworm damage are provided on Figure 2. Unfortunately, because of high variability between replicates, especially in the untreated controls, these results were not statistically different by analysis of variance (*F*=1.0579, df=20,162, *P*<0.4005). However, it is relevant to note after which period of time damage was first observed. This period would suggest that Brigade residual activity sufficient to avoid infestation was about 2 weeks, Intrepid 4 weeks, Altacor 3 weeks, and Belt 3 weeks. Live larvae were not detected in any of the treated almonds at any of the treatment timings, while an average of 2 percent infestation was detected in the untreated nuts, a statistically significant difference (*F*=2.3483, df=20,162, *P*=0.002).

Figure 1. Navel orangeworm and peach twig borer trap captures in the study orchard during Spring, 2013.

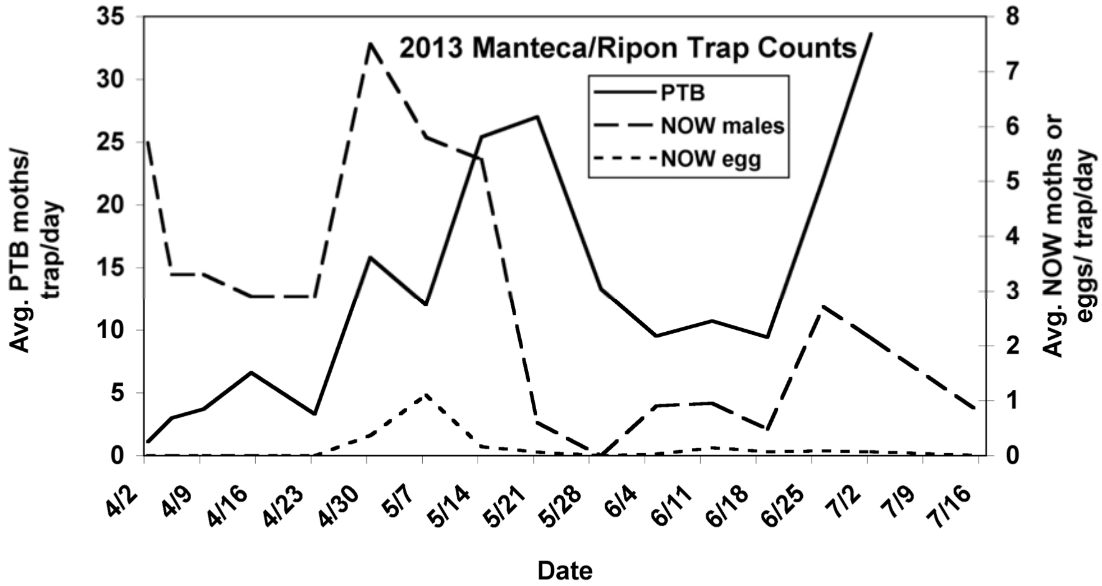

Figure 2. Average percent navel orangworm damage resulting from nuts pre-treated weekly over a six week period and then simultaneously exposed to navel orangeworm oviposiion for a two week period in a commercial almond orchard near Ripon in May, 2013.

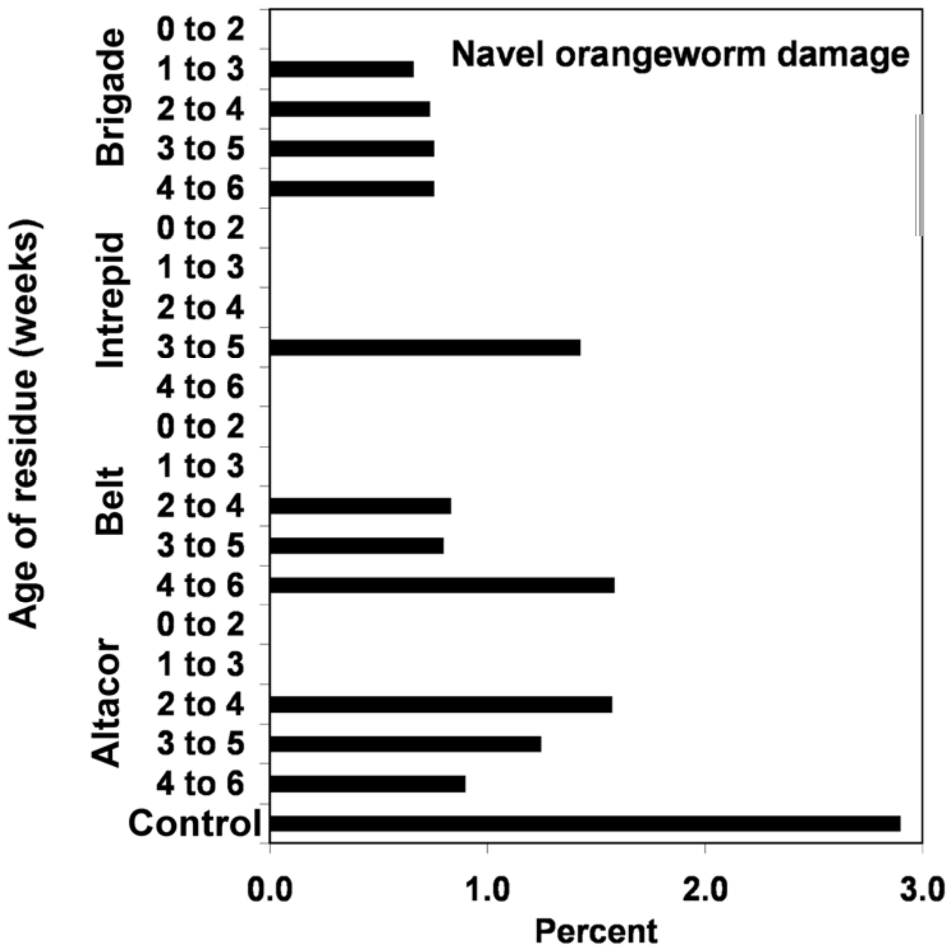

Table 1. Infestation and damage of almond mummies treated with different registered insecticides at weekly intervals starting at the initiation of oviposition of the overwintering flight of navel orangeworm at Manteca/Ripon, 2013.

Treatment	Spray date	Rate/ac.	Chemical	Mean ± SD[1] % infestation				Mean ± SD[2] % damage			
Control	n/a	-	-	14.4			A	18.8	±	12.4	A
Altacor	4/16	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	4/23	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	4/30	4 oz.	chlorantraniliprole	0.0	±	0.0	B	1.3	±	2.4	B
Altacor	5/7	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	5/15	4 oz.	chlorantraniliprole	1.4	±	2.5	B	2.9	±	4.2	B
Altacor	5/21	4 oz.	chlorantraniliprole	1.3	±	3.5	B	2.5	±	3.8	B
Belt	4/16	4 oz.	flubendiamide	0.7	±	1.9	B	0.7	±	1.9	B
Belt	4/23	4 oz.	flubendiamide	0.0	±	0.0	B	0.7	±	2.0	B
Belt	4/30	4 oz.	flubendiamide	0.0	±	0.0	B	0.8	±	2.2	B
Belt	5/7	4 oz.	flubendiamide	0.0	±	0.0	B	0.7	±	1.9	B
Belt	5/15	4 oz.	flubendiamide	0.0	±	0.0	B	0.0	±	0.0	B
Belt	5/21	4 oz.	flubendiamide	0.0	±	0.0	B	2.1	±	3.0	B
Intrepid	4/16	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	4/23	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	4/30	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/7	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/15	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/21	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.7	±	2.1	B
Brigade	4/16	16 oz.	bifenthrin	0.0	±	0.0	B	1.4	±	2.6	B
Brigade	4/23	16 oz.	bifenthrin	0.7	±	2.0	B	0.7	±	1.9	B
Brigade	4/30	16 oz.	bifenthrin	0.0	±	0.0	B	2.0	±	4.1	B
Brigade	5/7	16 oz.	bifenthrin	3.0	±	4.2	B	3.3	±	3.5	B
Brigade	5/15	16 oz.	bifenthrin	1.7	±	3.3	B	2.8	±	4.2	B
Brigade	5/21	16 oz.	bifenthrin	0.7	±	2.0	B	3.8	±	5.2	B
Delegate	4/16	17 oz.	spinetoram	0.0	±	0.0	B	0.8	±	2.0	B
Delegate	4/23	17 oz.	spinetoram	0.0	±	0.0	B	1.3	±	2.4	B
Delegate	4/30	17 oz.	spinetoram	0.0	±	0.0	B	0.0	±	0.0	B
Delegate	5/7	17 oz.	spinetoram	0.0	±	0.0	B	0.7	±	1.9	B
Delegate	5/15	17 oz.	spinetoram	0.7	±	2.0	B	1.4	±	2.5	B
Delegate	5/21	17 oz.	spinetoram	1.4	±	3.9	B	1.4	±	3.9	B

[1] ANOVA statistics, F=8.1816, df=30,258, P<0.0001. Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test following arcsine transformation.
[2] ANOVA statistics, F=10.9699, df=30,258, P<0.0001. Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test following arcsine transformation.

2014 Navel Orangeworm Insecticide Efficacy Trial

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Objective: To evaluate the efficacy of two rates of A16971B + Agri-Mek® (abamectin) , Altacor® (chlorantraniliprole) with and without a surfactant, Belt® (flubendiamide), Warrior II® (lambda-cyhalothrin) +Belt®, Intrepid® (methoxyfenocide), Intrepid Edge® (methoxyfenozide+ spinetoram), Proclaim® (Emamectin benzoate), Warrior II® , Warrior II®+Proclaim®, and Voliam Xpress® (lambda-cyhalothrin+chlorantraniliprole) for control of navel orangeworm (NOW) timed at 'Nonpareil' hull-split in California almonds.

Target Pests: Navel orangeworm, *Amyelois transitella*.

Application Timing: Insecticides applied to 'Nonpareil' at approximately 10% hull split (June 27, 2014).

Target Pest Stage at Application: Eggs and early larval stages

Application Methods: Plot was established as a randomized complete block design with five blocks of a single tree. Thirteen treatments were applied which include Intrepid® at 16 oz/acre, Intrepid Edge® at 12 oz/acre, Altacor® with surfactant at 4.5 oz/acre, Altacor® without surfactant at 4.5 oz/acre, Proclaim® at 4.5 oz/acre, WarriorII® at 2.56 oz/acre, Voliam Express® 12 oz/acre, a combination of Warrior II® and Proclaim®at 2.56 and 4.5 oz/acre, respectively, A16971B + Agri-Mek® at 3.57 and 2.6 oz/acre, respectively, A16971B + Agri-Mek® at 4.92 and 3.75 oz/acre, respectively, Belt® at 4 fl oz/acre, Belt® + Warrior II at 4 fl and 2.56 oz/acre, respectively, and a control (Table 1). Latron B-1956 was added as an adjuvant to every treatment at 0.125%. Treatments were applied using a hand-held spray gun using approximately 2.5 gallons per tree and sprayed until run-off to ensure thorough coverage.

Orchard: 'Nonpareil' and 'Monterey' orchard at 20 ft x 18 ft spacing, 110 trees per acre, 360 sq ft per tree. The orchard was a fifth leaf almond orchard located near Le Grand, CA. Only 'Nonpareil' trees were treated in this experiment. Nuts were harvested on August 1st.

Evaluation Methods:
Two hundred and fifty (150) nuts were collected and cracked-out for each of five (5) replications, resulting in 750 nuts per treatment. Percent damage by larval feeding on kernels was determined per treatment. Observed damage to the hull by NOW was also counted. Damaged hulls must have had NOW larvae present to count. In order to prevent double counting, kernel and hull damage to the same nut was only counted once and classified as 'kernel damage.' Damage from kernels and hulls were combined to determine % of nut infestation.

Table 1: Treatments and rates used within the 2013 Navel Orangeworm hull-split trial in Merced County.

Treatment	Company	Method	Rate/Acre oz. or fl.oz.	Rate/Tree oz. or fl.oz. (g or mL)
A16971B + Agri-Mek® Low*	Syngenta	Liquid/Liquid	3.57 + 2.6	0.03 (1.0) + 0.02 (0.7)
A16971B + Agri-Mek® High*	Syngenta	Liquid/Liquid	4.92 + 3.75	0.04 (1.3) + 0.03 (1.0)
Altacor® w/ Surfactant	DuPont	Solid	4.5	0.04 (1.2)
Altacor® w/o Surfactant*	DuPont	Solid	4.5	0.04 (1.2)
Belt®*	Bayer	Liquid	4	0.04 (1.1)
Belt® + Warrior II®*	Bayer/ Syngenta	Liquid/Liquid	4 + 2.56	0.04 (1.1) + 0.02 (0.7)
Intrepid®*	Dow	Liquid	16	0.15 (4.3)
Intrepid Edge™*	Dow	Liquid	12	0.11 (3.2)
Proclaim®*	Syngenta	Solid	4.5	0.04 (1.2)
Proclaim® + Warrior II®*	Syngenta	Solid/Liquid	4.5 + 2.56	0.04 (1.2) + 0.02 (0.7)
Voliam Xpress®*	Syngenta	Liquid	12	0.11 (3.2)
Warrior II®*	Syngenta	Liquid	2.56	0.02 (0.7)

* Latron B-1956 was added as an adjuvant at 0.125%.

Table 2: Navel Orangeworm (NOW) nut infestation rates among treatments.

Treatment	% Nuts Infested w/NOW [1]
Control	3.5 % [A]
Proclaim®	3.3 % [AB]
A16971B + Agri-Mek® Low	2.5 % [AB]
A16971B + Agri-Mek® High	2.4 % [AB]
Warrior II®	2.3 % [AB]
Altacor® w/o Surfactant	2.3 % [AB]
Altacor® w/ Surfactant	2.3 % [AB]
Belt® + Warrior II®	2.0 % [AB]
Intrepid®	1.8 % [AB]
Proclaim® + Warrior II®	1.7 % [AB]
Belt®	1.4 % [AB]
Voliam Xpress®	1.3 % [AB]
Intrepid Edge™	0.8 % [B]

[1] Different letters indicate significant differences between treatments (One-way ANOVA of $\sin^{-1}\sqrt{(\text{proportion infested})}$, $p=0.0409$,and Tukey-Kramer HSD post-hoc test).

(E24)

BROCCOLI: *Brassica oleracea* var. *italica* Plenck, 'Captain'

EVALUATION OF SYNAPSE AND CORAGEN FOR CONTROL OF LEPIDOPTEROUS LARVAE ON FALL BROCCOL, 2007

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Cabbage looper (CL); *Trichoplusia ni* (Hübner)
Beet armyworm (BAW); *Spodoptera exigua* (Hübner)
Diamondback moth (DBM); *Plutella xylostella* L.

The objective of the study was to evaluate the efficacy of the new compounds Coragen and Synapse with novel modes of action against lepidopterous larvae on broccoli under desert growing conditions. Broccoli was direct seeded on Sep 14, 2007 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Sprays were applied on 10 Oct, 18 Oct and 31 Oct. Foliar sprays were applied with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 24 gpa with 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied to all treatments at a rate of 0.25% v/v. Evaluation of efficacy was based on the number of live larvae per plant. Ten plants per replicate were destructively sampled on each sample date. The sample unit consisted of examination of whole plants for presence of small (neonate and 2nd instar larvae) and large (3rd or > instar) CL, BAW and DBM. Treatment means were analyzed using a 1-way ANOVA and means separated by a protected LSD ($P<0.05$).

Larval pressure was low-moderate compared to past years. Treatment differences for CL, BAW and DBM control were consistent among the following each application. CL efficacy was comparable among the Synapse and Coragen treatments where significant post-treatment reduction of large larvae was similar for all rates applied compared to the untreated check (Table 1). Renounce and Baythroid provided less consistent CL control, particularly following the 2nd and 3rd applications. Trends were similar for BAW and DBM control where the Synapse and Coragen treatments provided significant reductions of large larvae relative to the untreated check (UTC) (Table 2 and 3). In general, Synapse and Coragen appeared to provide consistent efficacy at higher rates. Differences in small CL among the spray treatments and the untreated control following sprays varied throughout the trial and did not reflect a lack of control because many of the small larvae had hatched 1-2 days prior o post-treatment evaluations. These results suggest that both Synapse and Coragen should provide commercially acceptable control of lepidopterous larvae in desert broccoli.

Table 1.

		CL/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
Treatment	Rate/ acre	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0c	4.5a	0.0c	1.0ab	0.5cd	1.2a	0.1d
Coragen 1.6 SC	5.0 oz	0.0a	0.0b	0.0a	0.4b	0.0a	0.0c	2.0a	0.5bc	0.0b	1.0bcd	0.4a	0.4cd
Coragen 1.6 SC	6.7 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0c	2.0a	0.0c	0.0b	0.0d	0.5a	0.0d
Baythroid XL	2.4 oz	0.0a	0.0b	0.4a	0.4b	2.1a	1.3b	2.5a	2.5b	3.5a	3.5ab	1.7a	1.5b
Renounce 20WP	3.0 oz	0.8a	0.0b	0.0a	0.0b	0.4a	2.9a	3.5a	0.0c	3.5a	3.0bc	1.7a	1.2bc
Synapse 24WG	2.0 oz	0.4a	0.0b	0.4a	0.0b	0.0a	0.0c	1.0a	0.5bc	1.5ab	0.0d	0.7a	0.1d
Synapse 24WG	3.0 oz	0.4a	0. 0b	0.0a	0.0b	0.0a	0.0c	1.5a	0.0c	0.5b	0.0d	0.5a	0.0d
UTC	0.8a	1.3a	0.0a	1.7a	0.8a	2.1ab	3.5a	6.5a	2.5ab	6.0a	1.6a	3.5a	

Means followed by the same letter are not significantly different, ANOVA; protected LSD ($P > 0.05$)

Table 2.

		BAW/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
Treatment	Rate/ acre	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0b	0.4a	0.0a	0.0b	0.0a	0.4b	0.0a	0.0b	0.0a	0.0b	0.0a	0.2b
Coragen 1.6 SC	5.0 oz	0.0b	0.0a	0.0a	0.8b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.2b
Coragen 1.6 SC	6.7 oz	0.0b	0.0a	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Baythroid XL	2.4 oz	1.7ab	0.0a	5.4a	0.8b	0.4a	1.3ab	0.5a	0.5b	0.0a	0.0b	1.6a	0.5b
Renounce 20WP	3.0 oz	0.0b	0.0a	0.0a	0.0b	2.1a	2.2a	0.5a	1.0b	0.0a	0.0b	0.5a	0.7b
Synapse 24WG	2.0 oz	0.0b	0.4a	0.4a	0.0b	0.0a	0.0b	0.0a	0.0b	1.0a	0.0b	0.3a	0.1b
Synapse 24WG	3.0 oz	0.0b	0.0a	0.4a	0.0b	1.3a	0.0b	0.5a	0.0b	0.0a	0.0b	0.4a	0.0b
UTC		4.6a	0.4a	2.9a	4.6a	1.7a	2.2a	0.5a	3.5a	0.5a	3.5a	2.0a	2.8a

Means followed by the same letter are not significantly different, ANOVA; protected LSD (*P* > 0.05)

Table 3.

		DBM/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
Treatment	Rate/ acre	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
Coragen 1.6 SC	5.0 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.5b	0.5b	0.0b	0.5b	0.1b	0.2b
Coragen 1.6 SC	6.7 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
Baythroid XL	2.4 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	2.0b	0.0b	0.0b	0.0b	0.4b
Renounce 20WP	3.0 oz	0.0a	0.4b	0.0a	0.4b	0.0a	0.6ab	0.0b	0.0b	0.0b	0.0b	0.0b	0.2b
Synapse 24WG	2.0 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	1.0b	0.0b	0.0b	0.0b	0.2b	0.0b
Synapse 24WG	3.0 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0b	1.0b	0.0b	0.0b	0.5b	0.3b	0.1b
UTC		0.8a	1.3a	0.0a	0.8a	0.0a	1.3a	5.0a	9.5a	1.0a	10.0a	1.4a	4.6a

Means followed by the same letter are not significantly different, ANOVA; protected LSD (*P* > 0.05)

(E24)

BROCCOLI: *Brassica oleracea* var. *italica* Plenck, 'Captain'

EVALUATION OF SYNAPSE AND CORAGEN FOR CONTROL OF LEPIDOPTEROUS LARVAE ON FALL BROCCOL, 2007

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Cabbage looper (CL); *Trichoplusia ni* (Hübner)
Beet armyworm (BAW); *Spodoptera exigua* (Hübner)
Diamondback moth (DBM); *Plutella xylostella* L.

The objective of the study was to evaluate the efficacy of the new compounds Coragen and Synapse with novel modes of action against lepidopterous larvae on broccoli under desert growing conditions. Broccoli was direct seeded on Sep 14, 2007 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Sprays were applied on 10 Oct, 18 Oct and 31 Oct. Foliar sprays were applied with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 24 gpa with 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied to all treatments at a rate of 0.25% v/v. Evaluation of efficacy was based on the number of live larvae per plant. Ten plants per replicate were destructively sampled on each sample date. The sample unit consisted of examination of whole plants for presence of small (neonate and 2nd instar larvae) and large (3rd or > instar) CL, BAW and DBM. Treatment means were analyzed using a 1-way ANOVA and means separated by a protected LSD (P<0.05).

Larval pressure was low-moderate compared to past years. Treatment differences for CL, BAW and DBM control were consistent among the following each application. CL efficacy was comparable among the Synapse and Coragen treatments where significant post-treatment reduction of large larvae was similar for all rates applied compared to the untreated check (Table 1). Renounce and Baythroid provided less consistent CL control, particularly following the 2nd and 3rd applications. Trends were similar for BAW and DBM control where the Synapse and Coragen treatments provided significant reductions of large larvae relative to the untreated check (UTC) (Table 2 and 3). In general, Synapse and Coragen appeared to provide consistent efficacy at higher rates. Differences in small CL among the spray treatments and the untreated control following sprays varied throughout the trial and did not reflect a lack of control because many of the small larvae had hatched 1-2 days prior o post-treatment evaluations. These results suggest that both Synapse and Coragen should provide commercially acceptable control of lepidopterous larvae in desert broccoli.

Table 1.

		CL/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
Treatment	Rate/ acre	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0c	4.5a	0.0c	1.0ab	0.5cd	1.2a	0.1d
Coragen 1.6 SC	5.0 oz	0.0a	0.0b	0.0a	0.4b	0.0a	0.0c	2.0a	0.5bc	0.0b	1.0bcd	0.4a	0.4cd
Coragen 1.6 SC	6.7 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0c	2.0a	0.0c	0.0b	0.0d	0.5a	0.0d
Baythroid XL	2.4 oz	0.0a	0.0b	0.4a	0.4b	2.1a	1.3b	2.5a	2.5b	3.5a	3.5ab	1.7a	1.5b
Renounce 20WP	3.0 oz	0.8a	0.0b	0.0a	0.0b	0.4a	2.9a	3.5a	0.0c	3.5a	3.0bc	1.7a	1.2bc
Synapse 24WG	2.0 oz	0.4a	0.0b	0.4a	0.0b	0.0a	0.0c	1.0a	0.5bc	1.5ab	0.0d	0.7a	0.1d
Synapse 24WG	3.0 oz	0.4a	0. 0b	0.0a	0.0b	0.0a	0.0c	1.5a	0.0c	0.5b	0.0d	0.5a	0.0d
UTC	0.8a	1.3a	0.0a	1.7a	0.8a	2.1ab	3.5a	6.5a	2.5ab	6.0a	1.6a	3.5a	

Means followed by the same letter are not significantly different, ANOVA; protected LSD (P > 0.05)

Table 2.

Treatment	Rate/ acre	BAW/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
		Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0b	0.4a	0.0a	0.0b	0.0a	0.4b	0.0a	0.0b	0.0a	0.0b	0.0a	0.2b
Coragen 1.6 SC	5.0 oz	0.0b	0.0a	0.0a	0.8b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.2b
Coragen 1.6 SC	6.7 oz	0.0b	0.0a	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Baythroid XL	2.4 oz	1.7ab	0.0a	5.4a	0.8b	0.4a	1.3ab	0.5a	0.5b	0.0a	0.0b	1.6a	0.5b
Renounce 20WP	3.0 oz	0.0b	0.0a	0.0a	0.0b	2.1a	2.2a	0.5a	1.0b	0.0a	0.0b	0.5a	0.7b
Synapse 24WG	2.0 oz	0.0b	0.4a	0.4a	0.0b	0.0a	0.0b	0.0a	0.0b	1.0a	0.0b	0.3a	0.1b
Synapse 24WG	3.0 oz	0.0b	0.0a	0.4a	0.0b	1.3a	0.0b	0.5a	0.0b	0.0a	0.0b	0.4a	0.0b
UTC		4.6a	0.4a	2.9a	4.6a	1.7a	2.2a	0.5a	3.5a	0.5a	3.5a	2.0a	2.8a

Means followed by the same letter are not significantly different, ANOVA; protected LSD (*P* > 0.05)

Table 3.

Treatment	Rate/ acre	DBM/10 plants											
		16-Oct		24-Oct		29-Oct		9-Nov		16-Nov		Avg	
		Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Coragen 1.6 SC	3.4 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
Coragen 1.6 SC	5.0 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.5b	0.5b	0.0b	0.5b	0.1b	0.2b
Coragen 1.6 SC	6.7 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
Baythroid XL	2.4 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	0.0b	2.0b	0.0b	0.0b	0.0b	0.4b
Renounce 20WP	3.0 oz	0.0a	0.4b	0.0a	0.4b	0.0a	0.6ab	0.0b	0.0b	0.0b	0.0b	0.0b	0.2b
Synapse 24WG	2.0 oz	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b	1.0b	0.0b	0.0b	0.0b	0.2b	0.0b
Synapse 24WG	3.0 oz	0.0a	0.0b	0.0a	0.0b	0.4a	0.0b	1.0b	0.0b	0.0b	0.5b	0.3b	0.1b
UTC		0.8a	1.3a	0.0a	0.8a	0.0a	1.3a	5.0a	9.5a	1.0a	10.0a	1.4a	4.6a

Means followed by the same letter are not significantly different, ANOVA; protected LSD (*P* > 0.05)

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(F23)

COTTON: *Gossypium hirsutum* L., 'DP 434 RR'

EVALUATION OF SELECTED FOLIAR-APPLIED INSECTICIDES FOR CONTROL OF BOLLWORM IN VIRGINIA COTTON, 2008.

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Bollworm (BW): *Helicoverpa zea* (Boddie)

In two tests, selected insecticides applied as foliar broadcasts were evaluated for control of BW in Virginia cotton. 'Deltapine 434 RR' cotton was planted 14 May (Test 1) and 15 May (Test 2) at the Virginia Tech Tidewater Agric. Res. & Ext. Ctr., Suffolk, VA, using 36-inch row spacing. All treatments were broadcast at egg threshold (BC @ ET) on 4 Aug; some were broadcast again 8 days later (BC @+8d). Treatments were applied with a Spider Spray Trac-mounted CO_2-pressurized sprayer at 16.5 gpa and 30 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. A RCB experimental design was used with 4 replicates; plots were 4 rows by 40 ft. External boll damage was determined by visually inspecting 25 bolls per plot for evidence of BW feeding on three dates. Yield was determined by harvesting 2 rows of each plot (80 row ft) using a commercial 2-row cotton picker. Sub-samples were ginned to determine lint versus seed and trash weight (41% lint, 59% seed and trash). Data were analyzed using ANOVA and LSD statistical procedures.

In general, treatments performed similarly. In both tests, all treatments had significantly less boll damage than the untreated check on all three sample dates. Treatments resulted in an average of 358 and 399 lb/acre more lint compared with the untreated check in Tests 1 and 2.

Table 1: Test 1

Treatment/ formulation	Rate lb (AI)/acre[a]	Percent external boll damage			Lint lb/acre
		19 Aug	26 Aug	2 Sep	
Coragen 1.67SC	0.088 (BC @ ET)	2.0c	3.0b	1.0b	1490b
Coragen 1.67SC + Coragen 1.67 SC	0.088 (BC @ ET) + 0.066 (BC @+8d)	4.0bc	3.0b	2.0b	1716a
Coragen 1.67SC + Coragen 1.67 SC	0.088 (BC @ ET) + 0.088 (BC @+8d)	2.0c	1.0b	0.0b	1523ab
Belt 480SC + Belt 480SC	0.0938 (BC @ ET) + 0.0938 (BC @+8d)	9.0b	6.0b	6.0b	1630ab
Baythroid XL + Baythroid XL	0.0125 (BC @ ET) + 0.0203 (BC @+8d)	0.0c	2.0b	3.0b	1672ab
Leverage 2.7EC + Leverage 2.7EC	0.080 (BC @ ET) + 0.1055 (BC @+8d)	0.0c	0.0b	2.0b	1616ab
Endigo 2.06SC + Endigo 2.06SC	0.0644 (BC @ ET) + 0.0644 (BC @+8d)	0.0c	1.0b	5.0b	1541ab
Check	---	35.0a	28.0a	15.0a	1240c
LSD	---	5.2	9.4	7.30	195.9

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; *P*=0.05).
[a]Treatments broadcast at egg threshold (BC @ ET) were applied on 4 Aug; treatments broadcast 8 days after egg threshold (BC @+8d) were applied on 12 Aug.

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Table 2: Test 2

Treatment/ formulation	Rate lb (AI)/acre[a]	Percent external boll damage			Lint lb/ acre
		19 Aug	26 Aug	3 Sep	
Coragen 1.67SC	0.088 (BC @ ET)	4.0b	9.0b	2.0b	1474a
Coragen 1.67SC + Coragen 1.67 SC	0.088 (BC @ ET) + 0.066 (BC @+8d)	2.0b	3.0b	2.0b	1518a
Coragen 1.67SC + Coragen 1.67 SC	0.088 (BC @ ET) + 0.088 (BC @+8d)	2.0b	2.0b	1.0b	1463a
Belt 480SC + Belt 480SC	0.0938 (BC @ ET) + 0.0938 (BC @+8d)	12.0b	10.0b	4.0b	1450a
Baythroid XL + Baythroid XL	0.0125 (BC @ ET) + 0.0203 (BC @+8d)	4.0b	5.0b	4.0b	1417a
Leverage 2.7EC + Leverage 2.7EC	0.080 (BC @ ET) + 0.1055 (BC @+8d)	2.0b	1.0b	5.0b	1538a
Endigo 2.06SC + Endigo 2.06SC	0.0644 (BC @ ET) + 0.0644 (BC @+8d)	4.0b	7.0b	5.0b	1464a
Check	---	36.0a	29.0a	18.0a	1076b
LSD	---	15.7	13.6	7.80	142.9

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; *P*=0.05).
[a]Treatments broadcast at egg threshold (BC @ ET) were applied on 4 Aug; treatments broadcast 8 days after egg threshold (BC @+8d) were applied on 12 Aug.

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C16

GRAPES: *Vitis labrusca* L., 'Concord'

CHEMICAL EVALUATIONS FOR CONTROL OF GRAPE BERRY MOTH ON GRAPES, 2009:

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Grape Berry Moth**:** *Paralobesia viteana* (Clemens)

Treatments were evaluated for efficacy against the grape berry moth in an experimental 'Concord' vineyard at Wooster, Ohio. Plots consisted of two grape vines, with 4 replications per treatment in a randomized block design. Treatments were applied as foliar sprays at a rate of 100 gpa (935 liter/ha) on 14 Jul, and 27 Jul. A hand-held CO_2 sprayer operating at 45 psi (3.2 kg/cm^2) and equipped with a 9505-E-TeeJet nozzle was used to apply treatments. On 25 Sep, all the grape clusters in each replicate plot were examined to determine the number of clusters infested by grape berry moth.

Results indicated that all of the treatments were statistically better than the check, with no statistical differences within the chemical treatments. The insecticide Danitol performed the best with no detectable berry moth damage. This was the first time we tested the new product Belt (flubendiamide) by Bayer™. Berry moth pressure this season was later than normal and below average in numbers. No phytotoxicity was observed in any of the treatments.

Table 1.

Treatment/formulation	amt form/acre	Mean no. of infested clusters/replicate
Belt 480SC	4.00 oz	0.50a
Danitol 2.4 EC	10.70 oz	0.00a
Intrepid 2F	8.00 oz	0.50a
Delegate 25 WG	5.00 oz	1.25a
Check (untreated)	---	9.00b

Means within the same column followed by the same letter are not significantly different as determined by LSD test (P=0.05).

(E18)

LETTUCE (HEAD): *Lactuca sativa* var. *capitata* L. 'Sun Devil'

EVALUATION OF FLUBENDIAMIDE FOR CONTROL OF LEPIDOPTEROUS LARVAE ON FALL LETTUCE, 2006

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Cabbage looper (CL): *Trichoplusia ni* (Hübner)
Beet armyworm (BAW): *Spodoptera exigua* (Hübner)

The objective of the study was to evaluate the efficacy of the new compound Flubendiamide relative to standard materials used against lepidopterous larvae on head lettuce under desert growing conditions. Lettuce was direct seeded on 15 Sep 2006 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Sprays were applied on 29 Sep, 7 Oct, 15 Oct, 24 Oct and 6 Nov. The applications were made with a CO_2 operated boom sprayer at 50 psi and 19 gpa. A broadcast application was delivered through 3 TX-12 ConeJet nozzles per bed. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.125% v/v with all treatments, except Alverde where Penetrator Plus (Helena Chemical Co.), at 0.5% v/v was added. Evaluation of efficacy was based on the number of live larvae per plant. Ten plants per replicate were destructively sampled on each sample date. The sample unit consisted of examination of whole plants for presence of small and large BAW and CL. For BAW, larvae were considered small if < 5 mm in length, large if > 5mm in length. For CL, larvae were considered small if < 10 mm, large if > 10 mm. Treatment means were analyzed using a 1-way ANOVA and means separated by a protected LSD $_{(P < 0.05)}$.

CL and BAW pressure was moderate-heavy compared to past years. In general, treatment differences for larval control were consistent following each application. Significant post-treatment reductions of large CL larvae were similar for all Flubendiamide rates applied compared to the untreated check (Table 1) with the exception of 30 Oct (7-DAT #3), where residual control was significantly greater when flubendiamide was applied at the high rates. Furthermore, the higher rates of flubendiamide reduced large CL larvae numbers comparable to Success and Rynaxypyr. Trends were similar for BAW where flubendiamid treatments provided significant reductions of large larvae comparable to the other materials evaluated (Table 2). Flubendiamide also provided good residual control as indicated by significant reductions in small larvae late in the trial. Alaverde appeared to provide less consistent control of CL when applications were alternated with Success as compared with the tank mixture of Alverde + Mustang Max. No phytotoxicity was observed.

Table 1

Treatment	Rate (lb ai/acre)	Mean CL larvae/10 plants							
		2-Oct		6-Oct		10-Oct		14-Oct	
		small	large	small	large	small	large	small	large
Flubendiamide 480 SC	0.03	1.7b	0.0a	2.3b	0.0c	2.5a	0.0b	16.9a	0.0b
Flubendiamide 480 SC	0.06	0.8b	0.0a	1.0bc	0.0c	4.4a	0.0b	13.5a	0.3b
Flubendiamide 480 SC	0.09	0.6b	0.0a	2.5b	0.0c	2.8a	0.0b	11.9a	0.0b
Success 2SC	0.078	2.7b	0.0a	2.5b	0.0c	4.4a	0.0b	17.5a	0.0b
Rynaxypyr 1.6SC	0.066	1.0b	0.0a	0.3c	0.0c	0.0a	0.0b	15.3a	0.0b
Alverde 2SC + Mustang Max	0.25 + 0.02	2.3b	0.0a	0.8bc	0.0c	0.6a	0.0b	16.5a	0.0b
Alverde 2SC[1]	0.25 [2]	3.5ab	0.0a	1.3bc	1.3b	1.3a	0.0b	14.0a	0.0b
Untreated	---	6.3a	0.8a	5.3a	2.3a	7.5a	8.1a	14.7a	4.7a

Treatment	Rate (lb ai/acre)	Mean CL larvae/10 plants							
		21-Oct		30-Oct		4-Nov		13-Nov	
		small	large	small	large	small	large	small	large
Flubendiamide 480 SC	0.03	12.5bc	0.4b	0.0b	4.2b	0.0b	1.7b	0.0a	1.3b
Flubendiamide 480 SC	0.06	10.0bcd	0.4b	0.0b	0.6c	0.0b	0.8b	0.0a	0.4b
Flubendiamide 480 SC	0.09	7.5de	0.0b	0.0b	0.3c	0.4a	1.3b	0.0a	0.4b
Success 2SC	0.078	5.0e	0.4b	0.6b	0.3c	1.3a	0.0b	0.0a	0.0b
Rynaxypyr 1.6SC	0.066	8.2cde	0.4b	0.6b	1.3c	0.4a	1.3b	0.0a	0.4b
Alverde 2SC + Mustang Max[a]	0.25 + 0.02	13.2b	0.4b	0.9b	0.3c	0.0a	0.0b	0.0a	0.0b
Alverde 2SC[b]	0.25 [2]	13.6b	0.7b	0.3b	2.2bc	0.0a	0.4b	0.8a	0.4b
Untreated	---	19.3a	15.0a	4.4a	27.8a	1.7a	30.8a	0.4a	9.6a

[a] Applied Capture 2EC at 0.05 lb ai/ac instead of Mustang Max on applications # 4 and 5.
[b] Rotated with Success 2F; Alverde applied on sprays #1 and 3; Success applied at 0.078 lb AI/acre on applications # 2 and 4.
Means followed by the same letter are not significantly different, ANOVA; protected $LSD_{(P < 0.05)}$

Table 2

Treatment	Rate (lb ai/acre)	Mean BAW larvae/10 plants							
		2-Oct		6-Oct		10-Oct		14-Oct	
		small	large	small	large	small	large	small	large
Flubendiamide 480 SC	0.03	4.8ab	0.0b	0.0c	0.0b	1.3bc	0.0b	0.0b	0.3bc
Flubendiamide 480 SC	0.06	2.7b	0.0b	1.3bc	0.0b	0.0c	0.0b	0.6b	0.3bc
Flubendiamide 480 SC	0.09	0.8b	0.0b	0.0c	0.0b	0.0c	0.3b	0.0b	0.0c
Success 2SC	0.078	3.1b	0.0b	0.8c	0.0b	1.3bc	0.3b	1.9b	0.0c
Rynaxypyr 1.6SC	0.066	0.0b	0.0b	0.0c	0.0b	0.3c	0.0b	0.0b	0.3bc
Alverde 2SC + Mustang Max[a]	0.25 + 0.02	0.2b	0.0b	7.3a	0.3b	2.8ab	0.3b	1.9b	1.5b
Alverde 2SC[b]	0.25 [2]	5.2ab	0.4b	2.5bc	0.3b	1.3bc	0.3b	0.3b	1.5b
Untreated	---	8.8a	1.7a	5.8ab	1.8a	5.0a	8.1a	7.2a	5.6a

Treatment	Rate (lb ai/acre)	Mean BAW larvae/10 plants							
		21-Oct		30-Oct		4-Nov		13-Nov	
		small	large	small	large	small	large	small	large
Flubendiamide 480 SC	0.03	0.0b	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Flubendiamide 480 SC	0.06	0.0b	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Flubendiamide 480 SC	0.09	0.4b	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Success 2SC	0.078	0.0b	0.0b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Rynaxypyr 1.6SC	0.066	0.0b	0.4b	0.0a	0.0b	0.0a	0.0b	0.0a	0.0b
Alverde 2SC + Mustang Max[a]	0.25 + 0.02	0.7b	0.7b	0.3a	0.0b	0.0a	0.4b	0.4a	0.0b
Alverde 2SC[b]	0.25 [2]	0.0b	0.0b	0.0a	0.0b	0.0a	0.4b	0.0a	0.0b
Untreated	---	2.9a	6.4a	0.3a	6.6a	0.4a	2.5a	0.4a	2.5a

[a] Applied Capture 2EC at 0.05 lb ai/ac instead of Mustang Max on applications # 4 and 5.
[b] Rotated with Success 2F; Alverde applied on sprays #1 and 3; Success applied at 0.078 lb AI/acre on applications # 2 and 4.
Means followed by the same letter are not significantly different, ANOVA; protected $LSD_{(P < 0.05)}$

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(E31)

LETTUCE (HEAD): *Lactuca sativa* L. var. *capitata* L., '1221'

CROSS-SPECTRUM INSECT CONTROL WITH FOLIAR INSECTICIDES IN HEAD LETTUCE, 2012

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Sweetpotato whitefly (SWF): *Bemisia tabaci* (Gennadius) – biotype B
Cabbage looper (CL): *Trichoplusia ni* (Hübner)
Beet armyworm (BAW): *Spodoptera exigua* (Hübner)

The objective of this trial was to evaluate the efficacy of a several insecticide mixtures for cross-spectrum (sucking and chewing insect pests) control of major insects in head lettuce under fall growing conditions. Head lettuce '1221' was direct seeded into double row beds on 42 inch centers on 6 Sep, 2012. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Stand establishment was achieved using overhead sprinkler irrigation, and irrigated with furrow irrigation thereafter. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Three foliar spray applications were made on 20Sep, 3 Oct and 19 Oct with a CO_2 operated boom sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 19.5 GPA. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.125% v/v with all treatments. On the 3rd application, only the products with activity against lepidopterous larvae were applied and included: Radiant, Vetica, and Voliam Xpress, Coragen, Cyazypyr, Belt, Proclaim and NNI-1171. At various intervals after application (3, 7, and 14 DAT), 10 plants were randomly selected from each replicate and sampled for the presence of each insect species. BAW and CL control was based on the examination of whole plants for presence of large (2nd instar or older) larvae. SWF immature densities were estimated by examining 10 leaves per replicate (collected near the base node of the plant) on each sample date. Leaves were taken into the laboratory where the total number of nymphs was counted on two 2-cm^2 leaf discs from each leaf using a dissecting microscope. Data for CL, BAW and SWF were averaged across all sample dates and because of heterogeneity of mean variances, data were log transform (mean+1) and subjected to ANOVA. Means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

SWF pressure was moderate during the trial, while CL larvae numbers were high with levels reaching 13.0 larvae / 10 plants in the untreated check following the 3rd application. All the foliar spray treatments provided significant control of CL following the three applications. In particular, the Belt+Movento, Voliam Xpress+Actara and Exirel treatments provided the most consistent activity against CL larvae. All of the spray treatments provided significant efficacy against BAW larvae compared to the untreated check. All spray treatments had significant activity against SWF except the Voliam Xpress+Actara combination. The Vetica+NNI-0101 and Exirel treatmenst provided the most significant control of SWF relative to the other treatments and untreated check. Overall, these results are encouraging and suggest that the activity provided by foliar applications of Exirel, as a standalone product, can provide excellent levels of cross-spectrum activity in head lettuce that is commonly expected from insecticide mixtures containing products that have activity against either sucking or chewing insect pests. No phytotoxicity symptoms were observed following any of the insecticide treatments. This research was supported by a grant from the Arizona Iceberg Lettuce Research Council, 13-01.

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Treatment	Rate/ac	CL larvae / 10 plants	BAW larva / 10 plants	SWF Nymphs /cm^2
Radiant SC+Closer 2SC	5 oz + 5 oz	0.8cd	0.8b	0.6cd
Vetica 20SC+ NNI-0101 20SC	17 + 3.2 oz	1.6bc	0.3b	0.2e
Voliam Xpress + Actara 25WG	8 + 5.5 oz	0.4d	0.3b	1.1ab
Coragen 1.6SC+ Scorpion 35SL	5 + 7 oz	1.0cd	0.5b	0.5cd
Exirel 10SC	14 oz	0.7d	0.3b	0.3e
Belt 4SC + Movento 2SC	1.5 + 5 oz	0.5d	0.1b	0.4de
Proclaim 5SG+ Endigo ZC	3.6 + 4.5 oz	0.9cd	0.5b	0.9bc
NNI-1171 SC	21 oz	2.1b	0.3b	0.6cd
UTC	---	5.4a	2.7a	1.3a
F value		31.33	9.01	10.07
Pr>F		<.0001	>.0001	<.0001

Means in a column followed by the same letter are not significantly different
(P > 0.05, F-protected LSD)

(F28)

PEANUT: *Arachis hypogaea* L., 'VA 98R'

EVALUATION OF SELECTED FOLIAR APPLIED INSECTICIDES FOR CONTROL OF BEET ARMYWORM IN VIRGINIA PEANUT, 2007.

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Beet armyworm (BAW): *Spodoptera exigua* (Hübner)

Selected foliar treatments were evaluated for control of BAW in a grower's virginia-type peanut field in Southampton Co., VA. Steward EC, Tracer, Larvin, Baythroid XL, Cobalt, Belt, Karate Z, and two experimental treatments, NUP 05077 and DPX-E2Y45 SC, were applied with a full-coverage boom on 1 Aug with a CO_2 pressurized backpack sprayer at 14.7 gpa and 42 psi through D2-13 nozzles with 3 nozzles per row. Treatments were evaluated by recording the number of small, medium, and large BAW per 3-ft beat cloth sample at 2, 5, and 7 DAT. A randomized complete block experimental design was used with 4 replicates; plots were 4 rows by 20 ft. Data were analyzed using ANOVA and LSD procedures.

Pre-treatment counts on 1 Aug indicated 10.2 small, 15.8 medium, and 5.3 large BAW per 6-ft beat cloth sample (n = 6). Belt, DPX-E2Y45 SC, and Steward EC consistently had fewer total BAW than the untreated control.

Table 1.

		Beet armyworm larvae/sample[a]											
		2 DAT				5 DAT				7 DAT			
Treatment/ formulation	Rate lb (AI)/acre	Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total
Steward 1.25 SC	0.09	1.8cd	7.9	1.0cd	10.6d	0.3c	4.4c	2.1a-c	6.8c-e	0.0c	3.0cd	2.0	5.0de
Tracer 4SC	0.063	0.8d	13.3	7.1a	21.1a-c	0.3c	5.9bc	3.0ab	9.1a-d	0.0c	3.3cd	1.5	4.8de
Larvin 3.2F	0.25	5.0a	15.9	4.1a-c	25.0ab	1.1a	8.8ab	3.4a	13.3a	0.3bc	7.5a-c	3.5	11.3ab
Baythroid XL 1.0EC	0.019	3.8a-c	12.8	5.0a	21.5a-c	0.4bc	6.4a-c	3.9a	10.6a-c	0.0c	6.5a-d	3.0	9.5a-c
Cobalt 2.545EC	See footnote *b*	2.1b-d	11.0	4.6ab	17.8b-d	0.4bc	6.5a-c	2.4ab	9.3a-d	0.0c	5.0a-d	2.0	7.0b-d
NUP 05077 24WDG	0.03	5.5a	18.0	5.8a	29.3a	1.0ab	9.6a	2.4ab	13.0ab	1.0a	8.3ab	2.3	11.5a
DPX-E2Y45 200SC	0.088	3.8a-c	9.3	0.6d	13.6cd	0.0c	3.4c	0.4c	3.8e	0.0c	1.8d	0.3	2.0e
Belt 480SC	0.094	3.4a-d	12.6	1.5b-d	17.5b-d	0.0c	4.4c	1.4bc	5.8de	0.0c	2.5d	0.5	3.0de
Karate Z 2.08SC	0.03	4.8ab	14.1	4.1a-c	23.0a-c	0.5a-c	6.0bc	2.1a-c	8.6b-d	0.8ab	3.5b-d	2.3	6.5cd
Check	---	5.0a	16.1	7.3a	28.4a	0.3c	8.8ab	4.0a	13.0ab	0.0c	8.5a	1.3	9.8a-c
LSD		2.72	NS	3.40	10.14	0.74	3.52	1.93	4.58	0.64	4.79	NS	4.43

Means within a column followed by the same letter(s) are not significantly different (LSD; *P* = 0.05).
[a]Two 3-ft samples were taken per plot on 2 and 5 DAT; one 3-ft sample was taken on 7 DAT.
[b]Cobalt = chlorpyrifos @ 0.51 lb (AI)/acre + *gamma*-cyhalothrin @ 0.009 lb (AI)/acreA

(F29)

PEANUT: *Arachis hypogaea* L., 'Gregory'

EVALUATION OF SELECTED FOLIAR APPLIED INSECTICIDES FOR CONTROL OF CORN EARWORM IN VIRGINIA PEANUTS, 2007

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

An efficacy trial was conducted to evaluate selected insecticides applied as foliar broadcasts for control of CEW larvae in peanuts at a commercial peanut farm in Chowan Co., NC, using 36 inch row spacing. Treatments were applied on 13 Aug with a CO_2 pressurized backpack sprayer as a broadcast at 14.7 gpa and 42 psi through D2-13 nozzles spaced at three nozzles per row on the spray boom. A RCB design was used with 4 replicates; plots were 4 rows by 40 ft. One 3 ft rigid beat cloth sample was randomly taken in each plot on three post-treatment dates (3, 7, and 14 DAT). Instars 1-2, 3-4, and 5-6 were counted as small, medium, and large CEW larvae. Data were analyzed using ANOVA and LSD procedures.

All treatments had significantly fewer total larvae compared with the untreated check at 3 DAT. At 7 DAT all treatments had significantly fewer larvae except Karate Z. By 14 DAT, populations had decreased and only DPX-E2Y45 had significantly fewer total larvae than the untreated check. Cumulative larval days indicated that overall, Steward and DPX-E2Y45 provided the best control.

Table 1.

Treatment/ formulation	Rate lb (AI)/acre	Number of corn earworm larvae/sample[a] 3 DAT Small				7 DAT Small				14 DAT Small				Cumulative larval days
		Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total	
Steward 1.25 SC EC	0.09	0.00c	1.75c	1.00	2.75e	0.25b	0.75d	0.25	1.25ef	0.00	0.25	1.25a-c	1.50a-d	21.5
Tracer 4SC	0.047	0.25bc	4.75bc	3.25	8.25b-e	0.25b	2.00cd	1.00	3.25d-f	0.00	0.75	2.00a	2.75a	52.3
DPX-E2Y45 200SC	0.088	0.00c	4.00bc	0.75	4.75c-e	0.00b	0.25d	0.00	0.25f	0.00	0.25	0.00d	0.25d	20.8
Belt 480SC	0.094	0.50bc	2.75bc	1.50	4.75c-e	0.25b	0.50d	0.50	1.25ef	0.00	0.75	0.50b-d	1.25b-d	27.8
Cobalt 2.545EC	0.377	2.75bc	5.00bc	2.50	10.25b-d	0.25b	5.00ab	1.25	6.50bc	0.00	1.50	0.50b-d	2.00a-c	63.3
Danitol 2.4 EC	0.199	0.25bc	2.25c	1.50	4.00de	0.00b	3.75a-c	1.00	4.75b-d	0.50	0.25	0.25cd	1.00cd	37.6
Baythroid XL 1.0EC	0.014	1.75bc	6.25b	3.25	11.25bc	0.25b	2.50b-d	1.00	3.75c-e	0.00	0.75	1.50ab	2.25a-c	51.0
NUP 05077 24WDG	0.0199	1.75bc	4.00bc	2.00	7.75b-e	0.50b	4.25a-c	1.75	6.50bc	0.50	0.00	0.50b-d	1.00cd	54.8
Karate Z 2.08cs	0.02	3.75b	6.25b	4.75	14.75b	0.25b	5.00ab	2.00	7.25ab	0.00	1.50	1.00a-d	2.50ab	78.1
Check	---	9.00a	12.00a	6.00	27.00a	1.75a	6.00a	2.50	10.25a	0.00	0.50	1.25a-c	1.75a-c	116.5
LSD		3.69	3.63	ns	7.07	0.83	2.51	ns	3.05	ns	ns	1.06	1.35	---

Means within a column followed by the same letter(s) are not significantly different (LSD; *P* = 0.05).
[a]One 3 ft rigid beat cloth sample was taken per plot. Treatments were applied on 13 Aug.

(F30)

SOYBEAN: *Glycine max* (L.) Merrill, 'Asgrow 5605RRST'

EVALUATION OF SELECTED FOLIAR APPLIED INSECTICIDES FOR CONTROL OF CORN EARWORM IN VIRGINIA SOYBEAN, 2007

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

An efficacy trial was conducted to evaluate selected insecticides applied as foliar broadcasts for control of CEW larvae in soybean at the Virginia Tech Tidewater Agric. Res. & Ext. Ctr. in Suffolk, VA, using 36-inch row spacing. Treatments were applied on 14 Aug with a CO_2 pressurized backpack sprayer as a broadcast at 16.5 gpa and 30 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. A RCB design was used with 4 replicates; plots were 4 rows by 40 ft. Two 3 ft rigid beat samples were randomly taken in each plot on two post-treatment dates (2 and 8 DAT) and one 6 ft beat cloth sample was taken on 13 DAT. Instars 1-2, 3-4, and 5-6 were counted as small, medium, and large CEW larvae. Data were analyzed using ANOVA and LSD procedures.

All treatments had significantly fewer total larvae compared with the untreated check at 2 and 8 DAT. By 13 DAT, larval populations had decreased and no significant differences were determined. Overall, Baythroid, Tracer, DPX-E2Y45 SC, Belt, and Larvin provided the highest levels of control of total larvae.

Table 1.

		Number of corn earworm larvae/sample[a]											
		2 DAT				8 DAT				13 DAT			
Treatment/ formulation	Rate lb (AI)/acre	Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total
Steward 1.25SC	0.045	0.38b	0.75b-d	0.00b	1.13bc	0.00b	0.63b	0.13b	0.75bc	0.00	0.00	0.00	0.00
Tracer 4SC	0.047	0.00b	0.13d	0.13b	0.25c	0.00b	0.13b	0.00b	0.13c	0.00	0.00	0.00	0.00
DPX-E2Y45 20SC	0.088	0.00b	0.50cd	0.00b	0.50c	0.00b	0.00b	0.00b	0.00c	0.25	0.00	0.00	0.25
Belt	0.094	0.25b	0.50cd	0.25b	1.00c	0.00b	0.38b	0.00b	0.38c	0.00	0.00	0.00	0.00
Larvin 3.2F	0.25	0.13b	0.13d	0.00b	0.25c	0.00b	0.00b	0.00b	0.00c	0.00	0.25	0.00	0.25
Lorsban 4E	0.5	0.25b	2.00bc	0.63b	2.88b	0.00b	0.63b	0.25b	0.88bc	0.00	0.00	0.25	0.25
Cobalt 2.545 EC	0.377	0.13b	1.00b-d	0.13b	1.25bc	0.00b	0.50b	0.50b	1.00bc	0.25	0.25	0.00	0.50
NUP 05077 24WGB	0.015	0.13b	0.63b-d	0.25b	1.00c	0.25ab	0.88b	0.38b	1.50b	0.00	0.00	0.25	0.25
Karate Z 2.08CS	0.016	0.13b	2.25b	0.50b	2.88b	0.00b	0.38b	0.50b	0.88bc	0.00	0.50	0.00	0.50
Baythroid XL 1EC	0.0125	0.00b	0.00d	0.00b	0.00c	0.13b	0.00b	0.13b	0.25c	0.25	0.00	0.00	0.25
Check	---	1.88a	10.88a	3.00a	15.75a	0.50a	3.88a	2.25a	6.63a	0.00	0.25	0.00	0.25
LSD		0.68	1.72	0.75	1.83	0.28	0.92	0.77	1.10	ns	ns	ns	ns

Means within a column followed by the same letter(s) are not significantly different (LSD: $P = 0.05$).
[a]Two, 3-ft rigid beat cloth samples were taken per plot on 2 and 8 DAT. One 6-ft beat cloth sample was taken per plot on 13 DAT. Treatments were applied on 14 Aug.

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(F61)

SOYBEAN: *Glycine max* (L.) Merr., 'Asgrow 5505'

EVALUATION OF FOLIAR INSECTICIDE EFFICACY AGAINST SOYBEAN LOOPER IN SOYBEANS, 2008

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Soybean looper (SBL): *Pseudoplusia includens* (Walker)

Three field trials evaluated selected foliar insecticides against soybean looper (SBL) on R5 soybeans at the Macon Ridge Research Station (Franklin Parish). Soybean seed were planted into a Gigger-Gilbert silt loam soil on 29 May, 10 Jun, and 28 May in trials 1, 2 and 3, respectively. Plot size was three-four rows (40-inches on centers) x 50 ft with a minimum of five replications in each trial. Insecticides were applied with a high-clearance sprayer and compressed air system calibrated to deliver 6 gpa through TeeJet TX-6 hollow cone nozzles (2/row) at 55 psi. In Trial 1, insecticides were applied on 17 Aug, and post-treatment evaluations were made on 19 Aug (2 DAT), 22 Aug (5 DAT), 24 Aug (8 DAT), and 1 Sep (15 DAT). In Trial 2, insecticides were applied on 17 Aug, and post-treatment evaluations were made on 19 Aug (2 DAT), 22 Aug (5 DAT), 24 Aug (8 DAT), and 1 Sep (15 DAT). In Trial 3, insecticides were applied on 26 Aug, and post-treatment evaluations were made on 28 Aug (2 DAT), 1 Sep (5 DAT), and 5 Sep (9 DAT). Insecticide efficacy was measured by making 25 sweeps with a sweep net (15 inches diameter) in each plot and recording the number of SBL larvae. Soybean seed yield was recorded in Trial 3 by mechanically harvesting two rows of each plot on 13 Oct. Data were subjected to ANOVA and means separated according to DNMRT. Rainfall of 15 inches (Hurricane Gustav) was recorded on 3 Sep and reduced SBL at 9 DAT in all treatments of Trial 3.

Pre-treatment numbers of SBL exceeded Louisiana action threshold of 37.5 insects/25 sweeps across all trial areas. In Trial 1, all insecticide treatments significantly reduced SBL compared to that in the non-treated check on all evaluation dates. Belt and Steward (0.078 and 0.098 lb AI/acre) significantly reduced SBL compared to that in the Steward (0.0625 lb AI/acre) treated plots at 2 DAT. At 15 DAT, Belt and Steward (0.098 lb AI/acre) significantly reduced SBL compared to that in plots treated with Steward (0.0625 and 0.078 lb AI/acre). Belt provided >90% control of SBL on all evaluation dates. In Trial 2, all insecticides significantly reduced SBL compared to that in the non-treated check on all evaluation dates. Larvin, Steward, and Coragen also significantly reduced SBL below that in all Intrepid-treated plots at 2 and 5 DAT. At 8 DAT, the highest rate of Intrepid provided SBL control comparable to Larvin and Steward. At 15 DAT, Coragen and Intrepid (0.125 and 0.094 lb AI/acre) significantly reduced SBL below that in all other insecticide-treated plots. In Trial 3, all treatments significantly reduced SBL compared to that in the non-treated check on all evaluation dates. At 2 DAT, Steward significantly reduced SBL below that in the Coragen and Belt-treated plots. However, at 5 DAT, plots treated with Coragen and Belt had fewer SBL compared to that in Steward-treated plots. At 9 DAT, no difference in SBL was observed among insecticide treated plots. All insecticide-treated plots produced significantly higher seed yields compared to that in the non-treated check.

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Trial 1

Treatment/ form.	Rate lb (AI)/acre	No. SBL/25 sweeps			
		2 DAT	5 DAT	8 DAT	15 DAT
Belt 4SC	0.0312	5.6c	2.4c	1.4c	1.6d
Steward 1.25SC	0.0625	24.2b	9.4b	16.8b	22.2b
Steward 1.25SC	0.078	9.0c	5.8bc	10.0bc	11.8c
Steward 1.25SC	0.098	5.2c	3.6bc	7.6bc	4.6d
Check	---	61.2a	44.2a	54.4a	35.6a
P>F (ANOVA)	---	<0.001	<0.001	<0.001	<0.001

Means within columns followed by a common letter do not significantly differ (DNMRT, $P = 0.05$).

Trial 2

Treatment/ form.	Rate lb (AI)/acre	No. SBL/25 sweeps			
		2 DAT	5 DAT	8 DAT	15 DAT
Intrepid 2F	0.0625	43.3b	27.5b	29.5b	11.2b
Intrepid 2F	0.094	34.3b	16.0c	21.3c	1.8c
Intrepid 2F	0.125	31.8b	18.2c	15.4cd	2.3c
Larvin 3.2F	0.06	2.7c	1.7d	10.2de	11.3b
Steward 1.25SC	0.0625	12.2c	8.2d	17.5cd	7.5b
Coragen 1.67SC	0.066	14.3c	2.2d	2.7e	1.2c
Check	---	80.5a	49.0a	63.7a	25.2a
P>F (ANOVA)	---	<0.001	<0.001	<0.001	<0.001

Means within columns followed by a common letter are not significantly different (DNMRT, $P = 0.05$).

Trial 3

Treatment/ form.	Rate lb (AI)/acre	No. SBL/25 sweeps			Yield[a] (bu/acre)
		2 DAT	5 DAT	8 DAT	
Coragen 1.67SC	0.044	52.4b	2.3c	0.5b	21.6a
Belt 4SC	0.031	56.8b	1.8c	2.0b	22.2a
Steward 1.25SC	0.078	5.0c	12.3b	2.5b	23.8a
Check	---	95.6a	68.8a	41.5a	15.3b
P>F (ANOVA)	---	<0.001	<0.001	<0.001	<0.001

Means within columns followed by a common letter do not significantly differ (DNMRT, $P = 0.05$).
[a]Soybean seed moisture standardized to 13% for yields.

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F42

SOYBEAN: Glycine max L. 'Asgrow 6301'

EVALUATION OF INSECTICIDES FOR PODWORM, 2009

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Podworm (PW): *Helicoverpa zea* (Boddie)

Soybean seed was planted on 20 May in conventional tillage on a Lynchburg fine sandy loam soil at the Upper Coastal Plain Research Station near Rocky Mount. Plots were eight rows by 45 ft with four replicates in a RCBD. Treatments were applied to the middle six rows with a CO_2-powered backpack sprayer calibrated to deliver 8.0 gpa at 50 psi with a single TX-8 Spraying Systems[R] nozzle per row on 11 Aug. Assessments of small (L1-L3) and large (L4-L5) corn earworms were conducted on 17 Aug by taking two standard 3-ft ground cloth samples per plot (12 ft sampled/plot). On 1 Dec, the middle four rows were harvested with 12-ft cutter bar. All insect and yield data were entered into Gylling═s ARM 6.1.11 software and analyzed via ANOVA with LSD (*P*=0.05) values shown in the tables.

All treatments provided statistically better control of both small (L1-L3), large (L4-L5) and total (L1-L5) PW. The three lowest rates of Declare (0.77, 1.02 and 1.28 oz [AI]/acre) provided statistically less control of small and total podworms than the higher rates (1.54 and 3.07 oz [AI]/acre) and the 1.28 oz rate + Nufos. Both Coragen and HGW 86 provided over 99% control of PW. Although the untreated check had the lowest yield numerically, it was not significantly less that several of the treatments that offered the highest level of PW control except Endigo 2.06SC, HGW 86, and Declare 1.25CS at 1.02 oz rate.

		17 Aug						
Treatment/form.	Rate/ oz acre	Small podworms (L1-3)/ 12 ft	% control (L1-3)	Large podworms (L4-5)/ 12 ft	% control (L4-5)	Total podworms/ (L1-5)/ 12 ft	% control (L1-5)	Yield (bu/acre) 1 Dec
Check	---	24.0a	0.0e	18.3a	0.0e	42.3a	0.0e	25.6d
Karate Z 2.08CS	1.6	1.5de	93.8a	1.3cd	94.0ab	2.8de	93.5ab	30.9bcd
Belt 480SC	3.0	0.8e	96.5a	0.5d	97.2ab	1.3e	97.1a	26.4d
Belt 480 SC +NIS	3.0 + 0.25% V/V	1.8cde	92.9ab	0.8d	95.7ab	2.5e	94.1a	27.2cd
Larvin 3.2EC	10.0	1.8cde	92.9ab	0.5d	97.2ab	2.3e	94.7a	31.6a-d
Coragen 20SC	3.5	0.3e	98.8a	0.0d	100.0a	0.3e	99.4a	30.0bcd
Endigo 2.06SC	4.0	2.3cde	90.4abc	1.3cd	93.7ab	3.5de	91.7ab	34.3ab
HGW 86 10SC	10.12	0.0e	100.0a	0.3d	98.6ab	0.3e	99.4a	37.9a
Declare 1.25CS	0.77	8.3b	63.5d	4.3b	77.4d	12.5b	70.7d	29.0bcd
Declare 1.25CS	1.02	5.3bc	77.3cd	3.3bc	81.5cd	8.5bc	79.8cd	33.5abc
Declare 1.25CS	1.28	5.0bcd	77.6bcd	2.3bcd	88.1bcd	7.3cd	82.9bc	28.2bcd
Declare 1.25CS	1.54	1.3e	95.1a	1.0cd	94.7ab	2.3e	94.6a	31.8a-d
Declare 1.25CS	3.07	1.3e	94.9a	0.8d	96.4ab	2.0e	95.3a	26.9cd
Declare 1.25CS + Nufos	1.28 + 24.0	0.8e	96.5a	1.8cd	89.0abc	2.5e	94.0a	29.0bcd
LSD (*P*= 0.05)		3.75	15.63	2.31	11.9	4.66	10.91	6.89

Means followed by the same letter are not significantly different (*P* = 0.05; LSD).

F52

SOYBEAN: *Glycine max*

EFFICACY OF FOLIAR INSECTICIDES AGAINST SOYBEAN LOOPER IN SOYBEAN, 2009

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Soybean looper: *Chrysodeixis includens*

On 26 Aug, a soybean efficacy trial was conducted on a commercial farm in Tchula (Holmes Co.), MS in the Mississippi Delta. Plot size was 12.6 ft by 75 ft planted on 19 inch row centers. Statistical design was a RCB with 4 replications. Insecticides were applied with a tractor-mounted sprayer calibrated to deliver 10.0 gpa at 60 psi through TX-6 Hollow Cone nozzles (19 inch nozzle spacing). Treatments were applied on 20 Aug (rain event occurred 1 hr after application). Plants were ~4 ft tall and at growth stage R5.5. Estimates of soybean looper density were determined by taking 25 sweeps per plot with a standard 15 inch diameter sweep net 6 DAT. Data were analyzed with ANOVA and means were separated using a Fisher's Protected LSD ($P \leq 0.05$). Data were log transformed for better mean separation.

At 6 DAT all treatments significantly reduced soybean looper numbers except Karate Z and Karate Z + Orthene compared to the non-treated control. Foliar applications of Coragen, Belt 480 SC at 0.0625 lb (AI)/acre, and Belt 480 SC at 0.094 lb (AI)/acre provided the best control of insecticides tested in this trial.

Table 1.

Treatment/ Formulation	Rate lb (AI)/Acre	Soybean loopers/25 sweeps 6 DAT
Coragen 1.67 SC	0.044	1.0e
Belt 480 SC	0.0625	1.3e
Belt 480 SC	0.094	0.3e
Intrepid 2F	0.0625	6.3cd
Intrepid 2F	0.094	3.7de
Steward 1.25 EC	0.0735	9.0cd
Karate Z 2.08 EC	0.0312	23.0a
Orthene 90 S	1.0	21.0a
Karate Z 2.08 EC +	0.0312	10.3bc
Orthene 90 S	1.0	
Larvin 3.2 SC	0.6	10.3bc
Untreated Check		29.0a
LSD (0.10)		10.48

Means within a column sharing the same letter are not significantly different (LSD; $P = 0.10$).

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F53

SOYBEAN: *Glycine max* (L.) Merr., 'Asgrow 6303'

EVALUATION OF INSECTICIDE EFFICACY AGAINST SOYBEAN LOOPER AND A STINKBUG COMPLEX IN SOYBEANS, 2009

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Soybean looper (SBL): *Pseudoplusia includens* (Walker)
Redbanded stinkbug (RBSB): *Piezodorus guildinii* (Westwood)
Southern green stink bug (SGSB): *Nezara viridula* (L.)
Brown stink bug (BSB): *Euschistus servus* (Say)

Two field trials evaluated selected foliar insecticides against soybean looper (SBL) and a stinkbug complex on R5.5 soybeans at the Macon Ridge Research Station (Franklin Parish). Soybean seed were planted into a Gigger-Gilbert silt loam soil on 24 Jun in both trials. Plot size was eight rows (40-inches on centers) X 50 ft. Treatments were arranged in a RCB design with four replications in each trial. Insecticides were applied with a high-clearance sprayer and compressed air system calibrated to deliver 9.5 gpa through TeeJet TX-8 hollow cone nozzles (2/row) at 50 psi. In each trial, insecticides were applied on 24 Aug, and post-treatment evaluations were conducted on 27 Aug (3 DAT) and 1 Sep (8 DAT). Insecticide efficacy was measured by taking 25 sweep-samples with a sweep net (15 inch diameter) in each plot and recording the number of SBL larvae and stinkbugs (nymphs and adults). Data were subjected to ANOVA and means separated according to DNMRT. One rainfall event of 0.4 inch was recorded during the test period.

Pre-treatment populations of SBL exceeded the Louisiana action threshold of 150 insects/100 sweeps in both trial areas. Additionally, pre-treatment stinkbug infestations (RBSB, SGSB, and BSB combined) in both trial areas exceeded Louisiana action thresholds of 24 to 36 insects/100 sweeps. In Test 1, all insecticide treatments significantly reduced SBL and stinkbugs compared to that in the non-treated control on both evaluation dates. Coragen (both rates) and Steward significantly reduced SBL compared to that in plots treated with Discipline, Orthene, and the Discipline + Orthene combination at 3 and 8 DAT. SBL were significantly lower in plots treated with the Discipline + Orthene combination compared to that in plots treated separately with the two products at 8 DAT. Stinkbugs were significantly reduced below that in the non-treated control plots by all insecticides at 3 and 8 DAT. Stinkbugs were significantly lower in plots treated with Discipline, Orthene, and the Discipline + Orthene combination compared to that in plots treated with Coragen (both rates) and Steward. In Test 2, all insecticides significantly reduced SBL compared to that in the non-treated control on both evaluation dates. There were no significant differences in SBL among insecticide-treated plots. Steward (both rates) significantly reduced stinkbugs below that in non-treated control plots with the exception of plots treated with Steward at 3 DAT. No phytotoxicity was observed in any insecticide-treated plot.

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Test 1

Treatment/form.	Rate lb (AI)/acre	No./25 sweeps SBL 3 DAT	SBL 8 DAT	Stinkbug complex[a] 3 DAT	Stinkbug complex[a] 8 DAT
Discipline 2EC	0.063	32.0b	13.0b	1.0c	4.8c
Orthene 90SP	0.5	28.3b	12.0b	0.0c	2.8c
Discipline 2EC + Orthene 90SP	0.063 + 0.5	24.8b	6.3c	0.0c	2.0c
Coragen 1.67SC	0.046	5.5c	0.3d	5.8b	10.8b
Coragen 1.67SC	0.065	2.3c	0.0d	4.3b	10.8b
Steward 1.25EC	0.065	9.3c	0.3d	6.5b	10.3b
Non-treated control	---	68.8a	30.3a	9.5a	20.8a
P>F (ANOVA)		<0.001	<0.001	<0.001	<0.001

Means within columns followed by a common letter are not significantly different (DNMRT; *P = 0.05).*
[a]Combined number of redbanded (RBSB), southern green (SGSB), and brown (BSB) stinkbugs.

Test 2

Treatment/form.	Rate/acre lb (AI)	No./25 sweeps SBL 3 DAT	SBL 8 DAT	Stinkbug complex[a] 3 DAT	Stinkbug complex[a] 8 DAT
Steward 1.25EC	0.063	6.5b	0.3b	3.8c	11.3c
Steward 1.25EC	0.068	2.5b	0.3b	5.5bc	14.3bc
Belt 4SC	0.063	11.5b	0.8b	9.5a	24.0a
Belt 4SC	0.094	2.8b	0.8b	6.5abc	21.8a
Intrepid 2F	0.094	11.3b	0.5b	8.5ab	18.8ab
Non-treated control	---	43.5a	26.0a	8.3ab	21.0a
P>F (ANOVA)		<0.001	<0.001	<0.001	<0.001

Means within columns followed by a common letter are not significantly different (DNMRT; P = 0.05).
[a]Combined number of redbanded (RBSB), southern green (SGSB), and brown (BSB) stinkbugs.

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(F67)

SOYBEAN: *Glycine max* (L.)

EFFICACY OF SELECTED INSECTICIDES AGAINST LOOPERS IN SOYBEAN, 2010A

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Cabbage looper: *Trichoplusia ni* (Hübner)
Soybean looper: *Chrysodeixis includens* (Walker)

Selected insecticides were evaluated for control of loopers at the Rohwer Research Station near Rohwer, AR. Treatments were applied to R4 (full pod) soybean on 13 Aug. Plot size was 4 rows (38-inch centers) x 100 ft long, arranged in an RCBD with four replications. Treatment applications were made with a Mudmaster® 4WD multi-purpose sprayer equipped with a rear-mounted CO_2-charged multi-boom system (R&D Sprayers®, Opelousas, LA) calibrated to deliver 10 gpa through Teejet® TX-6 hollow cone nozzles (19-inch nozzle spacing). Treatment efficacy was evaluated at 4 and 7 DAT by sampling the middle two rows of each plot (row 2 at 4 DAT and row 3 at 7 DAT) with a standard 15-in diameter sweep net (25 sweeps per plot). Data were square root-transformed and subjected to ANOVA with means separated using DNMRT P=0.05).

Due to the time of year at application, coupled with the proportion of larvae with black true legs encountered in samples, soybean looper was believed to be the predominant species in the trial. At 4 DAT, Karate Z and Brigade each applied alone merely suppressed looper numbers, suggesting that a large portion of the population tested were indeed soybean loopers. Treatments that provided acceptable control at 4 DAT were those that included Belt, Coragen, Steward, and the higher rate of Intrepid. At 7 DAT, the lower rate of Intrepid provided acceptable control as well. Steward, Belt and Coragen maintained good to excellent control of loopers at 7 DAT. Orthene applied alone and with Brigade also provided acceptable control of loopers at both 4 and 7 DAT. Although it was intended to collect data weekly to 28 DAT, a virus decimated the looper population shortly after trial initiation (<20 loopers in untreated check at 14 DAT). This research was supported by industry gifts of products and research funding.

Treatment/ Formulation	Rate lb (AI)/acre	Total loopers (No./25 sweeps) 4 DAT	7 DAT
Intrepid 2F	0.06	65.0bcd	28.3de
Intrepid 2F	0.09	38.8cde	22.8de
Belt 4SC	0.06	30.8ef	9.3d
Belt 4SC	0.09	8.5f	7.0d
Karate Z 2.08CS	0.03	93.3b	89.3ab
Steward 1.25EC	0.07	31.8de	23.5de
Brigade 2EC	0.08	70.5bc	58.0bc
Orthene 97WP	0.75	27.8ef	26.5de
Steward 1.25EC + Orthene 97WP	0.05 + 0.5	24.5ef	38.8cd
Coragen 1.67SC	0.044	28.5ef	20.0de
Coragen 1.67SC	0.066	14.3ef	8.3e
Brigade 2EC + Orthene 97WP	0.08 + 0.75	28.0ef	22.0de
Untreated check	-	155.3a	128.5a
P>F (ANOVA)		<0.0001	<0.0001

Means within columns followed by a common letter are not significantly different (DNMRT; *P*=0.05).

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(F68)

SOYBEAN: *Glycine max* (L.)

EFFICACY OF SELECTED INSECTICIDES AGAINST LOOPERS IN SOYBEAN, 2010B

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Cabbage looper: *Trichoplusia ni* (Hübner)
Soybean looper: *Chrysodeixis includens* (Walker)

Various insecticides were evaluated for control of loopers at the Rohwer Research Station near Rohwer, AR. Treatments were applied to R5 (beginning seed) soybean on 19 Aug. Plot size was 4 rows (38-inch centers) x 100 feet in length, arranged in an RCBD with four replications. Treatment applications were made with a Mudmaster® 4WD multi-purpose sprayer equipped with a rear-mounted CO_2-charged multi-boom system (R&D Sprayers®, Opelousas, LA) calibrated to deliver 10 gpa through Teejet® TX-6 hollow cone nozzles (19-inch nozzle spacing). Treatment efficacy was evaluated at 5 and 8 DAT by sampling the middle two rows of each plot (row 2 at 5 DAT and row 3 at 8 DAT) with a standard 15-in diameter sweep net (25 sweeps per plot). Data were square root-transformed and subjected to ANOVA with means separated using DNMRT (P=0.05)

Because of to the time of year, coupled with the number of specimens with black true legs encountered in samples, soybean looper was believed to be the predominant species in the trial. At 5 DAT, the only treatment that did not provide adequate control of loopers was Karate Z and the lower rate of Orthene, both applied alone. Because cabbage loopers are typically more susceptible to insecticides, this observation suggests that the population likely consisted predominantly of soybean looper. While both co-applications and the high rate of Orthene alone performed well, treatments that contained lepidopteran-specific active ingredients (e.g., Intrepid, Belt, both Voliam formulations) provided the best control at 5 DAT. At 8 DAT, numbers of loopers across the entire test declined significantly due to a virus that occurred, resulting in only 53.6 loopers in the untreated check (down from 135/25 sweeps 3 days earlier). Although numbers relative to the 5 DAT sampling had declined, treatments containing Intrepid, Belt, Voliam Xpress, and Voliam Flexi provided excellent control of loopers at 8 DAT. Although the intent was to collect data weekly to 28 DAT, the occurrence of the aforementioned virus resulted in <10 loopers in the untreated check at 14 DAT). This research was supported by industry gifts of products and research funding.

Treatment/ Formulation	Rate lb (AI)/acre	Total loopers (No./25 sweeps) 5 DAT	8 DAT
Karate Z 2.08CS	0.026	84b	43.3a
Karate Z 2.08CS + Orthene 97WP	0.026 + 0.5	27.8c	15.3bc
Karate Z 2.08CS + Orthene 97WP	0.026 + 1.0	22.0cde	12bc
Intrepid 2F	0.0625	1.4e	1.8c
Intrepid 2F	0.0938	5.8de	1.5c
Belt 4SC	0.0625	3.5e	1.0c
Belt 4SC	0.0938	1.4e	2.0c
Orthene 97WP	0.5	70.5b	24.3b
Orthene 97WP	1.0	26.5c	14.3bc
Voliam Xpress 1.25ZC	0.75	5.4de	2.0c
Voliam Xpress 1.25ZC	0.05	2.7e	1.0c
Voliam Flexi 40WG	0.07	4.7de	1.3c
Untreated check	-	135.0a	53.6a
P>F (ANOVA)		<0.0001	<0.0001

Means within columns followed by a common letter are not significantly different (DMRT; *P*=0.05).

F74

Soybean: *Glycene max* L. 'AG6031'

EVALUATION OF INSECTICICES FOR PODWORM CONTROL ON SOYBEAN, 2010 A

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Podworm (PW): Helicoverpa zea (Boddie)

Soybean seed were planted on 13 May in conventional tillage on a Rains fine sandy loam soil at the Upper Coastal Plain Research Station near Rocky Mount, NC. Plots were 4 rows by 40 ft with four replicates in a RCBD. The foliar sprays indicated in the table were applied to all 6 rows of each treatment on 3 Aug with a CO_2-powered backpack sprayer calibrated to deliver 8.0 gpa at 50 psi with a single TX-8 Spraying Systems^R nozzle per row. On 9 Aug, PW larvae were sampled by taking two 3-ft beat sheet samples from the middle two rows of each plot (12 row ft total), and divided into two groupings based on size - small (L1 to L3) and large (L4 and L5). On Dec 10, the middle 4 rows were harvested with a 12-ft cutter bar. All insect and yield data were entered into Gylling's ARM software and analyzed via ANOVA with LSD (P = 0.05) mean values shown in the table.

Control of small PW larvae was statistically similar, with HGW86 plus MSO and Belt showing fewer small larvae than Declare alone at the low rate, while the untreated check had less control of small PW larvae than all of the other plots. Most treatments provided more effective control of smaller instars than large. Declare plus Nufos showed higher survival of large larvae that all of the other treatments except for the untreated check. Although a number of numerical differences were noted, no significant differences were found between treatments except that all showed significant reductions in overall larval levels that the untreated check. Likewise, very few yield differences were noted, except Belt showed significantly greater yields than Mustang Max or Endigo.

Treatment/ form	Rate (oz/acre)	Small (L1-L3) larvae/12 ft	% control small larvae	Large (L4-L5) larvae/12 ft	% control large larvae	Total (L1-L5) larvae/12 ft	% control total larvae	Yield (bu/acre)
				9 Aug				
Untreated	-	8.0a	0.0a	1.3ab	0.0bc	9.3a	0.0bc	17.0b
Declare 1.23CS	0.01	3.0b	62.5b	0.3bc	76.9ab	3.3bc	64.5a	17.6ab
Declare 1.23CS	0.0125	0.8bc	90.0ab	0.8abc	38.5ab	1.5bc	83.9a	19.4ab
Declare 1.25 CS + Nufos 4E	0.01 + 0.375	1.5bc	81.3ab	1.5a	0.0c	3.0bc	67.7a	18.4ab
Karate Z 2.08CS	0.025	0.3bc	96.3ab	0.3bc	76.9a	0.5bc	94.6a	18.8ab
Mustang Max 0.8E	0.0125	2.8bc	65.0ab	1.0abc	23.1ab	3.8b	59.1ab	17.1b
Endigo ZE 2.06SE	0.064	2.0bc	75.0ab	0.5abc	61.5a	2.5bc	73.1a	17.1b
Coragen 1.67SC	0.0547	0.3bc	96.3ab	0.0c	100a	0.3c	96.8a	18.8ab
HGW 10OD + MSO 100E	0.273 V/V	0.0c	100a	0.3bc	76.9ab	0.3c	96.8a	17.8ab
Belt 480SC	0.094	0.0c	100a	0.3bc	76.9a	0.3c	96.8a	21.0a
Baythriod XL 1E	0.03	0.3bc	96.3ab	0.0c	100a	0.3c	96.8a	19.7ab

Means sharing the same letter are not significantly different (LSD; *P* = 0.05)

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F75

Soybean: *Glycene max* L. 'S80-P2'

EVALUATION OF INSECTICICES FOR PODWORM CONTROL, 2010 B

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Podworm (PW): *Helicoverpa zea* (Boddie)

Soybean seed were planted on 12 Jun following wheat on a Wagram loamy sand near Princeville, NC. Plots were 4 rows by 40 ft with four replicates in a RCBD. The foliar sprays indicated in the table were applied to all 4 rows of each treatment on 18 Aug with a CO_2-powered backpack sprayer calibrated to deliver 8.0 gpa at 50 psi with a single TX-8 Spraying Systems[R] nozzle per row. On 23 Aug, PW larvae were sampled by taking 25 sweeps per plot (100 sweeps/treatment), and divided into two PW groupings based on size - small (L1 to L3) and large (L4 and L5). Insect data were entered into Gylling's ARM software and analyzed via ANOVA with LSD (P = 0.05) mean values shown in the table.

Control of small both small (L1-L3) and large (L4-L5) PW larvae were similar and statistically better than the check plots. All products evaluated provided excellent control at this location in 2010, unlike other locations in NC in 2010 where pyrethroid resistance was noted or where the presence of tobacco budworms impacted test results.

Treatment/ form	Rate (AI)/acre)	Small (L1-L3) larvae/ 25 sweeps	% control small larvae	Large (L4-L5) larvae/ 25 sweeps	% control large larvae	Total (L1-L5) larvae/ 25 sweeps	% control total larvae
				23 Aug			
Untreated	-	28.5a	0.0c	4.8a	0.0c	33.3a	0.0c
Declare 1.23CS	0.01	2.0b	93.0b	0.5b	89.6ab	2.5b	92.5b
Karate Z 2.08CS	0.025	0.3b	98.5a	0.3b	93.8a	0.5b	98.5a
Endigo 2.06ZC	0.0644	1.0b	96.5ab	0.3b	93.8a	1.3b	96.1a
Coragen 1.67SC	0.547	0.0b	100.0a	0.0b	100.0a	0.0b	100.0a
HGW 10SC	0.79	0.0b	100.0a	0.0b	100.0a	0.0b	100.0a
Belt 480SC	11.2	0.0b	100.0a	0.0b	100.0a	0.0b	100.0a

Means sharing the same letter are not significantly different (LSD; $P = 0.05$)

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F80

SOYBEAN: *Glycine max* L., 'NK Syngenta S51-T8'

RESIDUAL EFFICACY OF FOLIAR INSECTICIDES FOR SOYBEAN LOOPER AND VELVETBEAN CATERPILLAR CONTROL, 2010

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Soybean looper (SBL): *Pseudoplusia includens* (Walker)
Velvetbean caterpillar (VBC): *Anticarsia gemmatalis* Hübner

Foliar insecticide trials to evaluate control of soybean looper (SBL), *Pseudoplusia includens* (Walker) and velvetbean caterpillar (VBC), *Anticarsia gemmatalis* (Hübner) were conducted at the Dean Lee Research Station, LSU AgCenter, Alexandria, LA. Soybeans were planted at 8 seed per ft on 30 inch centers on 6 Jun in a Norwood silt loam. Plots were 4 rows wide by 25 ft in length and treatments were arranged in a RCBD with four replications. Insecticides were applied on 9 Aug using a CO_2 backpack sprayer equipped with a T-jet nozzle, delivering 20 gpa at 40 psi. Weather conditions for the day of application were 0.00 inches of precipitation, wind speed of 4 mph, with a relative humidity of 94% and an air temperature of 100°F. Treatment efficacy against SBL and VBC was determined at 3, 7, 14, 21 and 28 DAT using a standard (15 inch diameter) sweep net to take 25 sweeps per plot and counting number of pests collected. Analysis of variance was performed following transformation of count data using $\log_{10}(x+1)$. The level of significance was set at $P= 0.05$ and the REGWQ test was used to separate means.

At time of application, soybeans had reached R5 growth stage and insect populations had not reached action thresholds (150 per 100 sweeps for SBL and 300 per 100 sweeps per VBC); 6 per 25 sweeps for SBL and 20 per 25 sweeps for VBC. However, defoliation levels were beginning to rise and applications were warranted. At 3 DAT, all products significantly controlled SBL (Table 1). At 7 DAT, Steward failed to control SBL and 14 DAT, Intrepid failed. At 21 DAT, Belt and Coragen were the only products providing SBL control. By 28 DAT, all products had lost efficacy. Significant VBC control was achieved by all products through 21 DAT except for Steward which failed 14 DAT (Table 2). All products significantly reduced defoliation, keeping it below the action threshold of 20% (Table 3); however there were no differences in yield (Table 4).

Table 1.

Treatment/	Rate amt	Mean SBL/25 sweeps				
formulation	product/acre	3 DAT	7 DAT	14 DAT	21 DAT	28 DAT
Untreated check	—	6.3a	3.5a	2.8ab	7.3a	0.5a
Belt SC	3.0 fl oz	1.4b	1.4b	1.5b	3.9b	2.1a
Coragen	5.0 fl oz	2.3b	1.5b	0.0b	1.3c	2.0a
Intrepid 2F	4.0 fl oz	0.0b	1.9b	2.5ab	4.6ab	1.6a
Steward EC	6.7 fl oz	2.5b	3.0a	4.3a	6.3a	2.0a

Means followed by the same letter within columns are not significantly different (REGWQ; $P>0.05$).

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Table 2.

Treatment/ formulation	Rate amt product/acre	Mean VBC/25 sweeps 3 DAT	7 DAT	14 DAT	21 DAT	28 DAT
Untreated check	—	9.8a	12.0a	13.5a	16.8a	2.8a
Belt SC	3.0 fl oz	0.0b	1.4b	1.3b	2.0b	1.5a
Coragen	5.0 fl oz	0.0b	1.0b	0.0b	0.5b	0.3a
Intrepid 2F	4.0 fl oz	0.0b	1.6b	2.2b	3.3b	2.1a
Steward EC	6.7 fl oz	3.5b	2.4b	17.8a	12.3a	3.3a

Means followed by the same letter within columns are not significantly different (REGWQ; P>0.05).

Table 3.

Treatment/ formulation	Rate amt product/acre	% Defoliation 21 DAT
Untreated check	—	26.3a
Belt SC	3.0 fl oz	3.8c
Coragen	5.0 fl oz	3.8c
Intrepid 2F	4.0 fl oz	6.3c
Steward EC	6.7 fl oz	13.8b

Means followed by the same letter within columns are not significantly different (REGWQ; P>0.05).

Table 4.

Treatment/ formulation	Rate amt product/acre	Yield bu/acre
Untreated check	—	42.5a
Belt SC	3.0 fl oz	54.2a
Coragen	5.0 fl oz	47.8a
Intrepid 2F	4.0 fl oz	47.3a
Steward EC	6.7 fl oz	52.2a

Means followed by the same letter within columns are not significantly different (REGWQ; *P*>0.05).

(F83)

Soybean: *Glycine max* L., 'Asgrow 6606, Pioneer 95Y80'

EVALUATION OF SELECTED INSECTICIDES FOR CONTROL OF SOYBEAN LOOPER AND THREECORNERED ALFALFA HOPPER, 2011

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Soybean looper (SBL): *Pseudoplusia includens* (Walker)
Threecornered alfalfa hopper (TCAH): *Spissistilus festinus* (Say)

Selected insecticides were evaluated for control of SBL and TCAH in two tests at the Macon Ridge Research Station (Franklin Parish). Soybean seed were planted into a Gigger silt loam soil on 15 Jun for both Test 1 (Asgrow 6606) and Test 2 (Pioneer 95Y80). Plot size was four rows and eight rows (40-inches on centers) x 50 ft in Test 1 and Test 2, respectively. Treatments were placed in a RCB design with four replications in both tests. Insecticides were applied with a John Deere high clearance sprayer and CO_2-charged system calibrated to deliver 4.8 gpa through Teejet TX-8 hollow cone nozzles (2/row) at 48 psi on 16 Aug in Test 1. Insecticides were applied with a John Deere high clearance sprayer and CO_2-charged system calibrated to deliver 6 gpa through Teejet TX-8 hollow cone nozzles (2/row) at 58 psi on 23 Aug in Test 2. Treatment efficacy against SBL and TCAH was determined at 3, 6 DAT in Test 1 and 2, 8 DAT in Test 2 using a standard (15 inches diameter) sweep net and taking 25 sweeps in each plot. Data were subjected to ANOVA and means separated according to DMRT. No rainfall occurred during these tests.

Pre-treatment SBL numbers exceeded the Louisiana soybean action threshold (38 larvae/25 sweeps) for insecticide treatment in both tests. Pre-treatment TCAH numbers only reached the action threshold (25 insects/25 sweeps) in Test 2. All insecticide-treated plots had significantly fewer SBL at 3 and 6 DAT compared to that in the non-treated plots In Test 1. Prevathon (both rates) provided significantly better control of SBL compared to Cobalt Advanced, Leverage 360 + Orthene, Intrepid, and Intrepid + Discipline at 3 DAT. Belt (0.0625 lb AI/acre, 0.094lb AI/acre) and Prevathon (both rates) provided significantly better control of SBL at 6 DAT compared to Cobalt Advanced and Leverage + Orthene. No treatment effects were detected in numbers of TCAH at 3 DAT. Leverage 360 + Orthene, Steward, Prevathon (both rates), and Intrepid + Discipline resulted in significantly lower numbers of TCAH compared to that in the non-treated plots by 6 DAT. In Test 2, all insecticide treatments except Karate significantly reduced SBL numbers compared to that in the non-treated control at 2 and 8 DAT. Besiege and Karate significantly reduced TCAH numbers compared to that in the non-treated control at 2 DAT. By 8 DAT, TCAH infestations exceeded the action threshold in all treated plots. No phytotoxicity was observed with any of the insecticide treatments in either test.

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Test 1

Treatment/form.	Rate, lb (AI)/acre	Insects/25 sweeps			
		SBL		TCAH	
		3 DAT	6 DAT	3 DAT	6 DAT
Cobalt Advanced 2.632EC	0.513	20.5b	19.0b	5.3abc	13.5ab
Belt 4SC	0.047	4.8def	3.5cd	7.0ab	12.0a
Belt 4SC	0.0625	7.5cdef	0.0d	6.5ab	13.5a
Belt 4SC	0.094	6.0cdef	0.5d	7.3ab	14.5a
Leverage 2.7SE	0.0656				
+Orthene 90SP	+ 0.5	11.5cd	11.8bc	0.8a	2.0b
Steward 1.25SC	0.052	4.0ef	6.0cd	2.3a	4.0b
Prevathon 0.43SC	0.0437	0.8f	1.0d	1.0a	3.3b
Prevathon 0.43SC	0.066	1.8f	0.0d	4.5a	5.0b
Intrepid 2F	0.0625	12.5c	9.8bcd	6.5a	15.5a
Intrepid 2F	0.094				
+Discipline 2EC	+ 0.0625	9.3cde	2.0cd	3.0a	6.5b
Non-treated		48.3a	59.0a	8.8a	18.0a
P>F		<0.01	<0.01	0.11	0.035

Means within columns followed by a common letter are not significantly different (DMRT, *P* = 0.05).

Test 2

Treatment/form.	Rate, lb (AI)/acre	Insects/25 sweeps			
		SBL		TCAH	
		2 DAT	8 DAT	2 DAT	8 DAT
Intrepid 2F	0.0625	19.0b	9.8b	29.5a	47.3a
Intrepid 2F	0.094	12.3bcd	7.0b	38.0a	47.0a
Intrepid 2F	0.0625				
+ Karate-Z 2.08EC	+ 0.026	13.5bc	7.5b	21.3ab	32.3bc
Tracer 4F	0.0313	13.3bc	6.3b	34.3a	39.3ab
Belt 4SC	0.047	10.3cd	0.5c	34.5a	47.0a
Steward 1.25SC	0.0684	5.3cd	0.5c	34.8a	44.3a
Prevathon 0.43SC	0.033	5.0cd	0.0c	32.8a	47.0a
Besiege 1.252SC	0.0684	4.0d	0.0c	16.0b	38.3ab
Karate-Z 2.08SC	0.0325	29.5a	10.5ab	12.8b	29.0c
Non-treated		35.0a	15.8a	33.0a	49.3a
P>F		<0.01	0.021	0.026	0.041

Means within columns followed by a common letter are not significantly different (DMRT, *P* = 0.05).

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F86

SOYBEAN: *Glycine max* (L.) Merrill, 'AG4907'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF SOYBEAN LOOPER IN SOYBEAN, 2010.

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Soybean looper (SL): *Pseudoplusia includens* (Walker)

The Virginia/North Carolina region saw unusually high SL populations in 2010. We conducted two adjacent tests to determine efficacy of foliar-applied insecticides against SL in soybean. 'Asgrow AG4907' soybean seed was planted 2 Jun at the E. Winslow farm in Belvidere, North Carolina, using 14-inch row spacing. A RCBD was used with 4 replicates; plots were 6 rows by 45 ft. Treatments were broadcast (BC) on 31 Aug with a CO_2-pressurized backpack sprayer at 14.3 gpa and 18 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. Efficacy against SL was determined at 2, 10, and 13 d after treatment (DAT) by taking 15 sweeps/plot with a standard 15-inch diameter sweep net, recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Pre-treatment field counts indicated 149 SL larvae per 15 sweeps. In Tests 1 and 2, all treatments had significantly lower total SL larvae than the untreated check at 2 DAT, with differences between treatments. SL populations declined in the untreated check by 10 and 13 DAT, making it difficult to interpret the effect of treatments for these dates.

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Test 1.

Treatment/ formulation	Rate (oz/acre)	2 DAT Small	2 DAT Medium	2 DAT Large	2 DAT Total	10 DAT Small	10 DAT Medium	10 DAT Large	10 DAT Total	13 DAT Small	13 DAT Medium	13 DAT Large	13 DAT Total
Success 480SC	3.0	1.0e	3.5c	2.3bc	6.8d	0.5bc	8.3ab	12.0ab	20.8ab	0.0	1.5bc	8.8ab	10.3ab
Intrepid 2F	4.0	6.8ab	12.8bc	4.0bc	23.5bc	0.8bc	5.5b-d	6.0cd	12.3b-d	0.3	2.0a-c	2.3c	4.5bc
Intrepid 2F	6.0	5.3b-d	12.5bc	4.3bc	22.0b-d	0.5bc	2.8d	2.5d	5.8d	0.3	0.8c	2.3c	3.3c
Radiant SC	2.0	2.3de	8.5bc	4.0bc	14.8cd	0.0c	7.5a-c	15.0a	22.5a	0.0	3.3ab	10.3a	13.5a
Radiant 1SC	4.0	1.0e	5.3c	1.5c	7.8cd	0.3c	6.8a-c	8.3bc	15.3a-c	0.0	4.0a	8.8ab	12.8a
Consero 5.25SC	2.0	2.5c-e	11.8bc	4.3bc	18.5b-d	0.8bc	5.3b-d	9.0bc	15.0a-c	0.0	3.3ab	9.8a	13.0a
Consero 5.25SC	3.0	0.8e	10.3bc	2.8bc	13.8cd	0.3c	4.3cd	5.5cd	10.0cd	0.3	3.0ab	9.3ab	12.5a
Karate Z 2.08 CS	1.92	5.5a-c	17.8b	8.8ab	32.0b	2.5a	10.0a	10.3a-c	22.8a	0.8	4.0a	8.3ab	13.0a
XenTari 54%	16.0	5.3b-d	9.8bc	0.5c	15.5cd	0.5bc	5.0b-d	9.3bc	14.8a-c	0.0	1.3bc	8.0ab	9.3ab
Untreated check	-	8.5a	41.3a	15.0a	64.8a	1.8ab	4.8cd	8.0bc	14.5a-c	0.3	1.3bc	4.8bc	6.3bc
LSD		3.20	9.93	6.92	15.76	1.43	3.50	5.45	8.74	NS	2.20	4.60	5.76

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; *P*=0.05).

Test 2.

Treatment/ formulation	Rate (oz/acre)	2 DAT Small	2 DAT Medium	2 DAT Large	2 DAT Total	10 DAT Small	10 DAT Medium	10 DAT Large	10 DAT Total	13 DAT Small	13 DAT Medium	13 DAT Large	13 DAT Total
Steward 1.25SC	6.0	0.0c	0.5c	0.3b	0.8c	0.8	4.3c	2.8bc	7.8bc	0.0	5.0b	1.8a-c	6.8b
Steward 1.25SC	8.0	0.3c	0.8c	0.0b	1.0c	0.0	2.3cd	0.3d	2.5d	0.5	4.5bc	1.8a-c	6.8b
Prevathon 0.43SC	9.8	3.0bc	8.3bc	3.5b	14.8bc	0.8	3.5cd	0.3d	4.5cd	0.5	0.5d	0.0c	1.0c
Prevathon 0.43SC	13.4	3.0bc	6.0bc	2.0b	11.0bc	0.0	0.5d	0.0d	0.5d	0.0	0.5d	0.8a-c	1.3c
Belt 480SC	2.0	1.8bc	5.5bc	0.5b	7.8bc	1.0	1.3cd	0.3d	2.5d	0.0	1.8cd	0.0c	1.8c
Belt 480SC	3.0	0.8c	4.3bc	0.3b	5.3bc	0.8	2.3cd	1.0cd	4.0cd	0.0	1.8cd	0.3bc	2.0c
Larvin 3.2F	16.0	0.8c	1.5c	0.5b	2.8c	1.8	11.0ab	5.8a	18.5a	0.5	9.5a	2.3a	12.3a
Larvin 3.2F	18.0	1.5bc	2.8c	2.0b	6.3bc	0.3	8.0b	3.8b	12.0b	1.0	3.8bc	2.5a	7.3b
Baythroid XL 1E	2.8	4.3b	14.8b	4.0b	23.0b	3.3	14.0a	4.0ab	21.3a	1.5	12.3a	2.5a	16.3a
Untreated check	-	10.3a	35.5a	25.8a	71.5a	2.3	4.0cd	3.5b	9.8b	1.3	4.0bc	2.0ab	7.3b
LSD		3.07	10.83	6.84	18.09	NS	3.74	1.92	5.12	NS	2.80	1.90	4.11

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; *P*=0.05).

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F94

SOYBEAN: *Glycine max* L., 'HBK C5941'

EVALUATION OF SELECTED INSECTICIDES FOR CONTROL OF INSECT PESTS IN SOYBEAN, 2010

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Redbanded stink bug (RBSB): *Piezodorus guildinii* (Westwood)
Green stink bug (GSB): *Acrosternum hilare* (Say)
Brown stink bug: *Euschistus servus* (Say)
Velvetbean caterpillar (VBC): *Anticarsia gemmatalis* Hubner
Soybean looper (SL): *Pseudoplusia includens* (Walker)
Green cloverworm (GCW): *Plathypena scabra* (Fabricius)
Threecornered alfalfa hopper (TCAH): *Spissistilus festinus* (Say)

Insect pest management is becoming increasingly important to successful soybean production in Southeast Texas. Many farmers spray multiple times annually to control these pests. New chemistries must be evaluated continually to provide stakeholders with the best pest management tools possible. The experiment was conducted at the Texas AgriLife Research and Extension Center located near Beaumont, TX. The experiment was designed as a RCB with 9 treatments and 3 replications. Plot size was 8 rows (30 inches between rows) by 28 ft. On 22 May, plots were drill-planted into Morey silt loam soil. Seeding rate was about 8 seeds per linear ft. First Rate and Dual Magnum herbicides were applied before soybean emergence which occurred about 5 d after planting. Weed control was excellent throughout the experiment. The experiment was rain-fed; plots were not irrigated. Plots were periodically inspected for insect pests, particularly stink bugs and Lepidoptera, which were not observed in abundance until about early Sep. Thus, treatments were applied 5 Sep. Treatments were applied with a 2-nozzle, CO2 pressurized spray boom (no. 2 cones on 30 inch centers) and 50 mesh screens. Final spray volume was 20 gpa. Soybeans were in R5/6 stage of development. At 2, 5 and 11 DAT, plots were sampled with a 15 inch diameter sweep net. Fifteen sweeps were taken in each plot on each sample date. Arthropods were identified and counted. On 15 Oct, the 2 middle rows of each plot were harvested with a combine. Yields were adjusted to 13% moisture. Seed was visually rated for quality using a 1-5 scale where 1 is excellent and 5 is poor. Counts were transformed [square root (x + ½)] and all data analyzed by ANOVA and means separated at the 5% level using LSD.

Only statistically or biologically significant results are discussed. All stink bug and TCAH counts in tables are sums of nymphs and adults. Populations of Lepidoptera defoliators, particularly VBC, stink bugs, particularly GSB, and TCAH were relatively high throughout the experiment. At 2 DAT, GSB was the most abundant stink bug in the experiment (Table 1). The Leverage and Endigo treatments provided best control, but all treatments significantly reduced populations compared to the untreated. Populations of VBC were very high, but were controlled by all treatments. TCAHs were not controlled by the Belt treatments. At 5 DAT, GSB populations were not controlled by the Belt treatments---all other treatments reduced GSB populations (Table 2). Again, VBC were in high numbers, but all treatments provided good control. TCAH populations increased in the experiment at 5 DAT, but all treatments, except the Belt treatments, significantly reduced numbers. At 11 DAT, GSB and BSBs populations were sufficiently high to detect treatment differences (Table 3). Basically, the Belt treatments did not control GSB or BSBs. The Endigo treatment perfomed best against BSBs. All other treatments significantly reduced high populations of all stink bugs. Populations of TCAH were very high in the untreated and Belt treatments, but all other treatments significantly reduced their numbers. In general, the addition of NIS to Belt appeared to improve efficacy, compared to the addition of COC. However, this is not a conclusive statement. Yields were low in the untreated, in large part due to the abundance of pest insects in this experiment. Highest yields were produced by the Leverage, Baythroid + Orthene, Karate and Endigo treatments (Table 4). The highest yield was produced by the Leverage + NIS treatment which was 7.7 bu/acre more than the untreated. Seed quality was not good among the treatments. Although significant differences were detected among the treatments, these differences were minor.

Table 1.

Treatment	Rate, fl oz/acre	No. per 15 sweeps 2 DAT GSB	VBC	(SL + GCW + VBC)	TCAH
Untreated	-	6.3a	26.7a	30.0a	8.7b
Belt 480SC	2	2.7b	2.3b	3.7b	10.3ab
Belt 480SC	3	2.0b	2.3b	3.7b	18.3a
Leverage 360 + NIS	2.8 + 0.25% v/v	0c	2.7b	3.3b	2.3c
Leverage 360 + COC	2.8 + 1% v/v	0c	1.7b	3.3b	2.3c
Baythroid XL + Orthene 90S	2 + 0.33 lb/acre	0.7bc	1.7b	4.0b	2.3c
Baythroid XL	2.3	0.7bc	1.0b	1.7b	3.0c
Karate Z	1.7	2.0bc	2.0b	2.7b	2.3c
Endigo ZC	4	0.3bc	1.7b	3.7b	1.0c

Means in a column followed by the same letter are not significantly different (*P* = 0.05, ANOVA and LSD).

Table 2.

Treatment	Rate, fl oz/acre	No. per 15 sweeps 5 DAT GSB	(RBSB + GSB + BSBs)	VBC	(SL + GCW + VBC)	TCAH
Untreated	-	8.3ab	10.7ab	35.7a	41.0a	25.3a
Belt 480SC	2	6.3abc	11.7ab	0b	0.3c	31.0a
Belt 480SC	3	10.7a	16.7a	0b	0c	23.7a
Leverage 360 + NIS	2.8 + 0.25% v/v	0.3de	0.7c	0.3b	1.7bc	4.3b
Leverage 360 + COC	2.8 + 1% v/v	4.3bcd	6.3bc	4.0b	7.7b	7.7b
Baythroid XL + Orthene 90S	2 + 0.33 lb/acre	0e	1.0c	0b	1.0bc	2.0b
Baythroid XL	2.3	1.7cde	4.7bc	0.3b	2.0bc	3.3b
Karate Z	1.7	0.7de	2.0c	0b	1.0bc	5.3b
Endigo ZC	4	0.3de	1.0c	1.0b	3.7bc	3.7b

Means in a column followed by the same letter are not significantly different (*P* = 0.05, ANOVA and LSD).

Table 3.

Treatment	Rate, fl oz/acre	No. per 15 sweeps 11 DAT GSB	BSBs	(RBSB + GSB + BSBs)	TCAH
Untreated	-	32.3a	2.7bc	38.7a	79.7a
Belt 480SC	2	43.7a	5.7a	51.0a	83.3a
Belt 480SC	3	23.3a	3.7ab	31.7a	93.3a
Leverage 360 + NIS	2.8 + 0.25% v/v	8.0b	2.7bc	10.7b	19.3b
Leverage 360 + COC	2.8 + 1% v/v	2.7b	1.0cd	5.0b	30.0b
Baythroid XL + Orthene 90S	2 + 0.33 lb/acre	4.3b	1.3cd	6.7b	19.7b
Baythroid XL	2.3	4.0b	3.0bc	7.3b	33.3b
Karate Z	1.7	8.0b	1.3cd	10.7b	35.7b
Endigo ZC	4	9.0b	0.7d	10.0b	32.7b

Means in a column followed by the same letter are not significantly different (*P* = 0.05, ANOVA and LSD).

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Table 4.

Treatment	Rate, fl oz/acre	Seed quality (1 – 5)	Yield bu/acre
Untreated	-	3.7a	17.0c
Belt 480SC	2	3.7a	16.7c
Belt 480SC	3	3.7a	20.3abc
Leverage 360 + NIS	2.8 + 0.25% v/v	3.3bc	24.7a
Leverage 360 + COC	2.8 + 1% v/v	3.2c	22.7abc
Baythroid XL + Orthene 90S	2 + 0.33 lb/acre	3.3bc	23.7a
Baythroid XL	2.3	3.5ab	18.3bc
Karate Z	1.7	3.3bc	22.7ab
Endigo ZC	4	3.3bc	22.3ab

Means in a column followed by the same letter are not significantly different (P = 0.05, ANOVA and LSD).

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(F66)

SOYBEAN: *Glycine max*

EFFICACY OF SELECTED INSECTICIDES FOR CONTROL OF SOYBEAN LOOPER AND CORN EARWORM IN SOYBEANS, 2011

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Soybean looper: *Chrysodeixis* (*Pseudoplusia*) *includens*
Corn earworm: *Helicoverpa zea* (Boddie)

On 9 August 2011, a foliar insecticide study was conducted in soybeans on a commercial field in Tchula, Mississippi. Soybeans were at approximately R5 stage of maturity. Plots were arranged in a randomized complete block with four replications. Plot size was 4 rows by 50 ft long on 38 in centers. Eight insecticides were evaluated against the untreated control (UTC) for control of soybean looper (SBL) and corn earworm (CEW). Insecticides were applied with a tractor-mounted sprayer calibrated to deliver 10.0 gpa at 60 psi through TX-6 Hollow Cone nozzles (2 per row). There are two sample dates following the application of treatments: 6 days after treatment (6 DAT) and 10 day after treatment (10 DAT). Plots were sampled by taking 25 sweeps per plot with a sweep net and recording the number of SBL and CEW larvae per 25-sweep sample. Data was analyzed with ANOVA and means were separated using Fisher's Protected LSD ($P \leq 0.05$). All insecticide treatments on both sample dates had significantly fewer SBL larvae compared to the UTC, but were not different from one another. There were no significant differences among any of the insecticides evaluated and the UTC against CEW at either sample date.

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Table 1.

Treatment Formulation	Rate lb (AI)/Acre	Average number of SBL and CEW/25 sweeps			
		6 DAT		10 DAT	
		SBL	CEW	SBL	CEW
Intrepid 2 F	0.063	3.3b	0.0a	1.5b	0.0a
Intrepid 2 F	0.094	0.5b	0.0	0.5b	0.0a
Intrepid 2 F	0.063				
Karate Z 2.08	0.026	4.3b	0.0a	3.8b	0.0a
Belt 4 SC	0.047	2.3b	0.0a	2.0b	0.0a
Belt 4 SC	0.063	1.5b	0.0a	2.0b	0.0a
Belt 4 SC	0.094	0.8b	0.0a	2.0b	0.5a
Besiege	0.068	0.8b	0.0a	0.5b	0.0a
Prevathon	0.044	0.0b	0.0a	0.5b	0.0a
Untreated Check		13.3a	0.3a	7.8a	0.3a
LSD (0.05)		4.46	0.24	3.36	0.52

Means within a column sharing the same letter are not significantly different (LSD; $P > 0.10$).

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(F70)

SOYBEAN: *Glycine max* (L.)

PERFORMANCE OF VARIOUS INSECTICIDES AGAINST CORN EARWORM IN SOYBEAN—2011

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Corn earworm: *Helicoverpa zea* (Boddie)

Two experiments evaluating foliar insecticides for control of corn earworm were conducted on a commercial farm near Pickens, AR, and at the Rohwer Research Station near Rohwer, AR. Treatments were applied to R2 (full bloom) soybean at Pickens on 14 Jul and R3 (beginning pod) soybean at Rohwer on 5 Aug. Plot size was 4 rows (38-inch centers) x 80 feet long arranged in an RCBD with four replications. Treatment applications were made with a Mudmaster® 4WD multi-purpose sprayer equipped with a rear-mounted CO_2-charged multi-boom system calibrated to deliver 7.5 gpa through Teejet® TX-6 hollow cone nozzles (19-inch nozzle spacing). Dyne-Amic® (non-ionic surfactant) was added to all treatments in the Pickens trial at 0.25% v/v. Prime-Oil® (crop oil concentrate) was added to all treatments at the Rohwer trial at 1% v/v. Treatment efficacy was evaluated at 4, 7, and 15 DAT at Pickens and at 7 DAT at Rohwer. Samples were taken from the middle two rows of each plot with a standard 15-inch diameter sweep net (25 sweeps per plot). 7 DAT data at Pickens were square root-transformed prior to analysis. All data were subjected to ANOVA and means separated using DNMRT (P=0.05)

At Pickens, AR (Table 1), all treatments reduced the number of corn earworm compared to the untreated check at 4 and 7 DAT. Only treatments containing Steward or Prevathon reduced numbers significantly below that of Brigade alone at 4 DAT. The addition of a second insecticide to Intrepid did not significantly reduce corn earworm numbers compared to a higher rate of Intrepid alone. At 7 DAT, Prevathon was the most effective treatment with <1 larva in 25 sweeps, significantly lower than several treatments. At 15 DAT, fewer treatments had significantly lower number of corn earworms relative to the untreated check than at earlier ratings. The most effective treatments at 15 DAT were Prevathon, Intrepid alone (higher rate), and the higher rate of Steward, as these treatments provided better residual control than others (e.g., Brigade alone). At Rohwer, AR (Table 2), all treatments reduced the number of bollworms relative to the untreated check at 7 DAT. Belt was arguably the most effective treatment, resulting in <1 corn earworm in 25 sweeps for both rates. There was no significant difference between pyrethroids with regards to corn earworm control at 7 DAT. The corn earworm population was not sufficient for data collection at 14 DAT.

Table 1.

Treatment/ formulation	Rate lb (AI)/acre	corn earworm (No./25 sweeps)		
		4 DAT	7 DAT	15 DAT
Intrepid 2F	0.0938	3.3bc	4.0bc	4.3def
Intrepid 2F	0.0625 +	3.8bc	2.5b-e	8.5b-e
+ Karate Z 2.08CS	0.026			
Karate Z 2.08CS	0.026	2.8bcd	2.8b-e	8.0b-e
Intrepid 2F	0.0625 +	3.5bc	3.3bcd	10.0a-d
+ Cobalt Advanced 2.632EW	0.514			
Cobalt Advanced 2.632EW	0.514	2.5bcd	1.5cde	10.3abc
Intrepid 2F	0.0625 +	4.8b	4.8b	10.0a-d
+ Brigade 2EC	0.0781			
Brigade 2EC	0.0781	4.8b	4.0bc	11.5abc
Belt 4SC	0.0625	2.0bcd	1.8cde	6.0c-f
Steward 1.25EC	0.0625	1.8cd	1.5cde	12.3ab
Steward 1.25EC	0.1074	0.0d	-	3.5ef
Steward 1.25EC	0.0518 +	1.3cd	1.8de	14.8a
+ Orthene 97WP	0.5			
Prevathon 0.43SC	0.044	1.5cd	0.8e	3.0ef
Prevathon 0.43SC	0.066	1.3cd	0.3e	0.8f
Untreated check	---	10.5a	18.0a	15.5a
P>F (ANOVA)		<0.0001	<0.0001	<0.0001

Means within columns followed by a common letter are not significantly different (DNMRT; *P*=0.05).

Table 2.

Treatment/ formulation	Rate lb (AI)/acre	corn earworm (No./ 25 sweeps)
		7 DAT
Belt 4SC	0.0625	0.8d
Belt 4SC	0.0938	0.5d
Prevathon 0.43SC	0.0571	1.3bcd
Prevathon 0.43SC	0.037	1.0cd
Brigade 2EC	0.1	4.5bcd
Brigade 2EC	0.0664	5.5b
Karate Z 2.08CS	0.0312	4.3bcd
Karate Z 2.08CS	0.026	5.3bc
Baythroid XL 1EC	0.0219	1.0cd
Baythroid XL 1EC	0.0172	2.3bcd
Mustang Max 0.8EC	0.025	1.3bcd
Mustang Max 0.8EC	0.0225	3.0bcd
UTC	---	10.5a
P>F (ANOVA)		3.77

Means within columns followed by a common letter are not significantly different (DNMRT; *P*=0.05).

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F70

PEANUT: *Arachis hypogaea* L., 'Phillips'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF CORN EARWORM AND TOBACCO BUDWORM IN PEANUT, 2010.

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)
Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)

A test was conducted to determine efficacy of foliar-applied insecticides against CEW and TBW, both major foliage-feeding pests in Virginia peanut. 'Phillips' peanut was planted 28 May at the M&W Incorporated farm in Suffolk, VA, using 36-inch row spacing. A RCBD was used with 4 replicates; plots were 4 rows by 40 ft. Treatments were broadcast (BC) on 6 Aug with a CO_2-pressurized backpack sprayer at 14.7 gpa and 42 psi through three D2-13 nozzles per row. Efficacy against CEW and TBW was determined at 3, 6, and 14 d after treatment (DAT) by taking two 3-ft beat cloth samples per plot and recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Pre-treatment counts on 6 Aug indicated 1 small, 8 medium, and 11 large larvae per 3-ft beat cloth sample. Mandibular dissection of 36 larvae collected on 12 Aug from an insecticide-treated area outside the test (Baythroid XL at 2 oz/acre on 10 Aug) indicated 14% CEW and 86% TBW. All treatments had significantly lower total larvae than the untreated check at 3 DAT, with differences between treatments. All treatments (except Karate and Baythroid) also had lower total larvae than the untreated check at 6 DAT. No larvae were detected in the test at 14 DAT.

Treatment/ formulation	Rate (oz/acre)	3 DAT				6 DAT			
		Small	Medium	Large	Total	Small	Medium	Large	Total
Prevathon 0.43SC	9.8	0.1b	0.8b-e	0.0e	0.9cd	0.0	0.3cd	0.1d	0.4de
Prevathon 0.43SC	13.4	0.0b	0.3de	0.9c-e	1.1cd	0.0	0.0d	0.0d	0.0e
DPX-HGW86 10 OD	6.9	0.4b	1.0b-e	0.9c-e	2.3c	0.0	0.5b-d	0.4cd	0.9c-e
Prevathon 0.43SC	9.8	0.0b	0.0e	0.0e	0.0d	0.0	0.0d	0.1d	0.1de
+ Asana XL	7.0								
Belt 4SC	3.0	0.4b	1.5bc	0.3de	2.1c	0.0	0.4b-d	0.1d	0.5de
Steward 1.25SC	4.6	0.0b	0.3de	1.0c-e	1.3cd	0.1	0.8b-d	1.3a-c	2.1bc
Steward 1.25SC	6.7	0.1b	0.4de	1.3b-d	1.8c	0.0	0.3cd	0.5b-d	0.8de
Karate Z 2.08CS	1.92	0.5b	1.1b-d	2.4ab	4.0b	0.3	1.0bc	1.8a	3.0ab
Baythroid XL 1EC	2.4	0.8b	1.8b	1.8a-c	4.3b	0.0	1.3ab	1.5ab	2.8ab
Brigade 2EC	5.12	0.3b	0.6c-e	1.1c-e	2.0c	0.0	0.8b-d	0.6b-d	1.4cd
Danitol 2.4EC	10.67	0.1b	0.6c-e	0.8c-e	1.5cd	0.0	0.4b-d	0.5b-d	0.9c-e
Untreated check	---	2.6a	3.8a	2.8a	9.1a	0.0	2.1a	1.8a	3.9a
LSD		0.79	1.03	1.18	1.63	NS	0.95	1.04	1.28

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; P=0.05).

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(F77)

SOYBEAN: *Glycine max* (L.) Merrill, 'MFS-541'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF CORN EARWORM IN 15-INCH ROW SPACED SOYBEAN, 2011

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

A test was conducted to determine efficacy of foliar-applied insecticides against CEW, a major late-season pest in Virginia soybean. 'MFS-541' soybean was planted on 17 Jun 2011 at the B. Speight farm in Suffolk, VA, using 15-inch row spacing. A RCBD was used with 4 replicates; plots were 11.25 ft by 40 ft. Treatments were broadcast (BC) on 12 Aug with a CO_2-pressurized backpack sprayer at 14.7 gpa and 42 psi through six D2-13 nozzles on a 6-ft full-coverage spray boom. Efficacy against CEW was determined at 3 and 6 days after treatment (DAT) by taking 10 sweeps/plot with a standard 15-inch diameter sweep net (covering 2 rows per sweep) and recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Pre-treatment counts on 12 Aug indicated 6.0 small, 12.5 medium, and 8.5 large larvae per 15 sweeps (n=2). Mandibular dissection of 25 larvae indicated 96% CEW and 4% *Heliothis virescens* (F.) (tobacco budworm) on 12 Aug, and 100% CEW on 18 Aug. All treatments had significantly lower total CEW larvae than the untreated check at both 3 and 6 DAT, with differences between treatments at 3 DAT.

Treatment/ formulation	Rate/ oz acre	3 DAT				6 DAT			
		Small	Medium	Large	Total	Small	Medium	Large	Total
Steward 1.25SC	6.0	6.25	1.50b	1.50b	9.25b	0.00b	1.25b	1.00b	2.25b
Steward 1.25SC	10.0	0.00	0.50b	0.00b	0.50c	0.00b	0.50b	0.00b	0.50b
Steward 1.25SC	6.0	0.00	0.00b	0.50b	0.50c	0.00b	0.75b	1.00b	1.75b
+ Baythroid XL 1E	2.0								
Belt 4SC	2	0.75	3.00b	1.00b	4.75bc	0.25b	0.25b	1.00b	1.50b
Belt 4SC	3	0.25	3.25b	1.25b	4.75bc	0.00b	0.00b	0.50b	0.50b
Belt 4SC	2	0.25	0.25b	0.00b	0.50c	0.00b	0.25b	0.25b	0.50b
+ Baythroid XL 1E	2								
Baythroid XL 1E	2.8	0.25	0.50b	0.00b	0.75c	0.00b	0.00b	0.50b	0.50b
+ Orthene 97PE	8.0								
Larvin 3.2SC	10.0	1.25	1.25b	0.25b	2.75bc	0.00b	0.00b	0.50b	0.50b
Larvin 3.2SC	16.0	0.00	0.25b	0.25b	0.50c	0.00b	0.00b	1.25b	1.25b
Larvin 3.2SC	10.0	0.00	0.00b	0.25b	0.25c	0.00b	0.00b	0.50b	0.50b
+ Baythroid XL 1E	2.0								
Cobalt 2.545E	19.0	0.25	0.50b	0.25b	1.00c	0.00b	1.75b	2.50b	4.25b
Check	--	4.75	12.75a	18.00a	35.50a	4.00a	12.25a	16.50a	32.75a
LSD		NS	3.42	2.35	8.07	0.92	2.07	2.59	3.83

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; P=0.05).

Arthropod Management Tests 2013, Vol. 38 doi: 10.4182/amt.2013.F77

(F77)

TOBACCO: *Nicotiana tobacum*, ‘NC71’

LEPIDOPTERA CONTROL IN TOBACCO WITH FOLIAR MATERIALS, 2012

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)

The efficacy of foliar insecticides against tobacco budworm (TBW) was assessed in at two locations, the Lower Coastal Plain Research Station in Kinston, NC and at the Upper Coastal Plain Research Station in Rocky Mount, NC. Twelve treatments, including an unsprayed check, were arranged a RCB design with four replicates per treatment. Each 0.018 acre plot consisted of 4, ca. 25 plant, rows. Plants were treated in the greenhouse with Admire Pro® 4.6F (Bayer Crop Sciences) at a rate of 0.6 fl oz/1000 plants 2-3 days prior to transplanting to control aphids and flea beetles. Plants were transplanted on 18 April at the Lower Costal Research Plain and 1 May at the Upper Coastal Plain Research Station, and TBW were counted on all plants in the middle two rows weekly beginning 4 weeks after transplant. Transplant water treatments of Corgen® were applied in ca. 200 gal per acre using 5 gal mini tanks fitted to the transplanter. TBW counts exceeded the 10% treatment threshold on 31 May at the Lower Coastal Plain Research Station, and the plots were treated on 4 June using a CO_2 pressurized backpack sprayer fitted with a single TG3 solid cone nozzle at 65 psi pressure. Natural pest levels remained low at the Upper Coastal Plain Research Station, so plots were artificially infested with one lab-reared TBW each in 10 previously uninfested plants in the middle two rows, on 13 June and treated as described above on 14 June. The proportion of TBW infested plants per plot was assessed 3, 7, and 16 days after treatment (DAT) at the Lower Coastal Plain Research Station. Artificially infested TBW larvae were assessed 4, 7, and 11 DAT at the Upper Coastal Plain Research Station. In addition, the proportion of TBW infested plants, which included natural infestation, per plot was determined at the Upper Coastal Plain Research Station on the same dates. Data were analyzed via analysis of variance (ANOVA; SAS v. 9.3.1) and means were separated via Fisher’s Protected LSD ($\alpha = 0.05$).

At 3 DAT at both locations, all insecticide treatments significantly reduced the proportion of TBW infested plants or the number of artificially infested TBW larvae compared to the UTC, and treated plots were at or below threshold levels. At the Lower Coastal Plain Research Station, the proportion of TBW larvae exceeded threshold levels 16 DAT. After 11 days at the Upper Coastal Plain Research Station, the artificially infested TBW densities in the insecticide treated plots were no different from the UTC, as larvae matured or died. However, the proportion of infested plants per plot was significantly less than the UTC and below threshold for all insecticide treatments.TBW budworm populations in plots treated with Coragen® at transplant were below the economic threshold for one week longer than the UTC, or six weeks after treatment. Transplant water treated plants also resulted in lower survivorship of artificially infested TBW larvae 3 days after infestation.

This research was supported by industry gifts of product and research funding.

Arthropod Management Tests 2013, Vol. 38
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Table 1.

Product	Rate/acre	Pre-Treatment	Proportion TBW infested plants, Lower Costal Plain Research Station[1] 3 DAT	7 DAT	16 DAT
Untreated Check	n/a	0.08a	0.20c	0.51e	0.75d
Besiege	9 fl oz	0.07a	0.10b	0.08cd	0.46ab
Tracer	0.75 fl oz	0.09a	0.05ab	0.03ab	0.48ab
Tracer	1.25 fl oz	0.06a	0.06ab	0.05abcd	0.31a
Tracer	1.75 fl oz	0.15a	0.03a	0.04abc	0.40ab
Denim	10 fl oz	0.07a	0.06ab	0.05abc	0.56bc
Blackhawk	1.04 oz	0.08a	0.06ab	0.06abcd	0.54bc
Blackhawk	1.74 oz	0.07a	0.03a	0.03a	0.41ab
Blackhawk	2.43 oz	0.06a	0.06ab	0.09cd	0.52b
Belt	2 fl oz	0.06a	0.06ab	0.07bcd	0.54bc
Coragen	5 fl oz	0.05a	0.05ab	0.04abc	0.34a
Coragen, applied at transplant in furrow	7 fl oz	0.02 a	0.06 ab	0.14 d	0.70 cd

[1]Means followed by the same letter are not significantly different ($\alpha = 0.05$) via Fisher's Protected LSD.

Table 2.

		TBW, Upper Costal Research Station[1]					
		4 DAT		7 DAT		11 DAT	
Product	Rate/acre	Artificially infested TBW	Proportion TBW infested plants	Artificially infested TBW	Proportion TBW infested plants	Artificially infested TBW	Proportion TBW infested plants
Untreated Check	n/a	4.00c	0.22d	4.75c	0.29e	1.75a	0.22c
Besiege	9 fl oz	1.00ab	0.03abc	0.50ab	0.04bcd	0.50a	0.02ab
Tracer	0.75 fl oz	1.75b	0.06c	1.00ab	0.04bcd	0.00a	0.04ab
Tracer	1.25 fl oz	1.75b	0.06bc	1.25ab	0.04cd	0.75a	0.03ab
Tracer	1.75 fl oz	0.50a	0.01ab	0.25ab	0.00ab	0.00a	0.01a
Denim	10 fl oz	0.75ab	0.04abc	0.00a	0.02abcd	0.00a	0.02ab
Blackhawk	1.04 oz	0.25a	0.02abc	0.50ab	0.01abc	0.00a	0.01ab
Blackhawk	1.74 oz	0.25a	0.00a	0.25ab	0.00ab	0.25a	0.00a
Blackhawk	2.43 oz	0.50a	0.02abc	0.00a	0.00a	0.00a	0.00a
Belt	2 fl oz	0.50a	0.03abc	0.75ab	0.03abcd	0.75a	0.02ab
Coragen	5 fl oz	0.75ab	0.03abc	0.25ab	0.01abcd	0.00a	0.01ab
Coragen, applied at transplant in furrow	7 fl oz	2.00b	0.06c	2.25b	0.07d	1.50a	0.08b

[1]Means followed by the same letter are not significantly different ($\alpha = 0.05$) via Fisher's Protected LSD.

(F78)

SOYBEAN: *Glycine max* (L.) Merrill, 'Pioneer 95M82'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF CORN EARWORM IN 7.5-INCH ROW SPACED SOYBEAN, 2011

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

A test was conducted to determine efficacy of foliar-applied insecticides against CEW, a major late-season pest in Virginia soybean. 'Pioneer 95M82' soybean was planted on 14 Jun 2011 at the K. Worrell farm in Suffolk, VA, using 7.5-inch row spacing. A RCBD was used with 4 replicates; plots were 6 ft by 40 ft. Treatments were broadcast (BC) on 12 Aug with a CO_2-pressurized backpack sprayer at 14.3 gpa and 17.9 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. Efficacy against CEW was determined at 3 and 6 days after treatment (DAT) by taking 10 sweeps/plot with a standard 15-in diameter sweep net (covering 2 rows per sweep) and recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Mandibular dissection of 25 larvae indicated 92% CEW and 8% *Heliothis virescens* (F.) (tobacco budworm) on 12 Aug. All treatments had significantly lower total larvae than the untreated check at both 3 and 6 DAT, with differences between treatments on both sample dates.

Treatment/ formulation	Rate/ oz acre	3 DAT				6 DAT			
		Small	Medium	Large	Total	Small	Medium	Large	Total
Fastac 100EC	4.0	1.00cd	1.25d-f	0.50d	2.75d-f	0.75bc	1.75c-e	1.50b-e	4.00d-g
Prevathon 0.43SC	9.8	0.75cd	2.50b-e	0.50d	3.75c-f	0.50c	0.50de	1.00b-e	2.00f-h
Prevathon 0.43SC	13.4	0.75cd	2.25b-f	1.00cd	4.00c-f	0.25c	0.50de	0.75c-e	1.50gh
Prevathon 0.43SC	4.0	2.00b-d	1.00d-f	0.50d	3.50c-f	0.25c	0.50de	0.25e	1.00gh
+ Asana 0.44ECXL	4.5								
Besiege 2EC	9.0	0.25d	0.75d-f	0.25d	1.25ef	0.00c	0.25e	0.25e	0.50h
Belt 4SC	2.0	3.75b	1.00d-f	1.75b-d	6.50b-d	1.00bc	1.00de	0.75c-e	2.75e-h
Steward 1.25EC	6.0	1.00cd	0.00f	0.00d	1.00ef	0.25c	0.25e	0.50de	1.00gh
DiPel ES (Kur.)	16 (dry wt)	2.25b-d	4.00ab	3.50ab	9.75b	2.00bc	2.25b-d	2.25a-d	6.50b-d
Karate Z 2.08CS	0.96	1.50b-d	3.75a-c	2.75a-c	8.00bc	2.75b	3.75b	2.75ab	9.25b
Karate Z 2.08CS	1.6	0.00d	0.50ef	0.25d	0.75f	0.75bc	1.25de	1.75b-e	3.75d-h
DiPel ES (Kur.)	16(dry wt)	1.75b-d	2.25b-f	1.75b-d	5.75b-e	0.00c	1.50c-e	3.75a	5.25c-f
+ Karate Z	0.96								
DiPel ES (Kur.)	16 (dry wt)	2.75bc	3.00b-d	1.50b-d	7.25b-d	2.75b	3.25bc	2.50a-c	8.50bc
+ Karate Z 2.08CS	1.6								
Endigo 2.06 ZC	4.5	0.25d	1.50c-f	0.75cd	2.50d-f	1.00bc	2.25b-d	2.25a-d	5.50c-e
Check	-	6.75a	6.00a	4.00a	16.75a	6.00a	6.50a	4.00a	16.50a
LSD		2.42	2.50	2.24	4.87	2.14	1.86	1.83	3.50

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; P=0.05).

doi: 10.4182/amt.2012.F85

(F85)

SOYBEAN: *Glycine max* (L.) Merr., 'AG6730'

EVALUATION OF BELT SC AND COBALT ADVANCED FOR SOYBEAN INSECT PEST CONTROL, 2011

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Soybean looper (SL): *Pseudoplusia includens* (Walker)
Green cloverworm (GCW): *Plathypena scabra* (Fabricius)
Velvetbean caterpillar (VBC): *Anticarsia gemmatalis* (Hübner)
Threecornered alfalfa hopper (TCAH): *Spissistilus festinus* (Say)

The experiment was designed as a RCB with 4 treatments and 4 replications. Plot size was 20 ft by 4 rows (30 inches between rows). Soybeans were drill-planted 27 May and irrigated as needed. Recommended herbicides were applied preplant. No nitrogen fertilizer was applied, but seed was inoculated with bacteria to promote nodulation. In mid-Sep, Lepidoptera pest populations were observed to be increasing. Thus, treatments were applied 15 Sep using a 2-nozzle hand-held spray rig (no. 2 cone nozzles on 30 inch centers, 20 gpa final spray volume). Soybeans were R6 at this time. Plots were sampled for insects at 1, 5 and 8 DAT with a 15-inch diameter sweep net. Ten consecutive sweeps were taken in each plot on each sample date. The contents of each 10-sweep sample were placed in a plastic bag and frozen for later inspection and enumeration. Insect counts were transformed using square root of (X +1/2). Data were analyzed by ANOVA and means separated by LSD.

Stink bug populations were too low during the experiment for data to be presented. However, SL, GCW and VBC populations were high enough in the untreated for meaningful evaluation. At 1 DAT, Belt SC and Cobalt Advanced treatments provided good control of GCW and VBC (Table 1). At 5 and 8 DAT, all treatments provided good control of all 3 Lepidoptera species (Tables 2 and 3). At 5 and 8 DAT, Cobalt Advanced significantly reduced TCAH populations (84 and 77% fewer TCAH, respectively, compared to the untreated). In conclusion, the higher rate of Belt SC appeared to provide slightly better control of SL than the lower rate, but both rates were satisfactory. The Cobalt Advanced treatment provided the best control of all pest insects encountered in the experiment. This research was supported by industry gifts of products and research funding.

Table 1.

		No. per 10 sweeps 1 day after treatment			
Treatment/formulation	Rate amt product/acre	Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	4.0	5.25b	0.5b	9.75b
Belt SC	3 fl oz	1.75	3.25b	1.5b	6.5c
Cobalt Advanced	25 fl oz	2.0	0.25c	0b	2.25d
Untreated	---	6.5	33.0a	4.5a	44.0a

Means in a column followed by the same or no letter are not significantly different (*P* = 0.05, ANOVA and LSD).

doi: 10.4182/amt.2012.F85

Table 2.

Treatment/formulation	Rate amt product/acre	No. per 10 sweeps 5 days after treatment			
		Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	2.0b	0b	0b	2.0b
Belt SC	3 fl oz	0b	0b	0b	0b
Cobalt Advanced	25 fl oz	1.5b	0b	0.25b	1.75b
Untreated	---	8.5a	23.0a	11.75a	43.25a

Means in a column followed by the same or no letter are not significantly different (*P* = 0.05, ANOVA and LSD).

Table 3.

Treatment/formulation	Rate amt product/acre	No. per 10 sweeps 8 days after treatment			
		Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	1.25b	0b	0.5b	1.75b
Belt SC	3 fl oz	0.5b	0b	0b	0.5b
Cobalt Advanced	25 fl oz	1.75b	0.25b	0b	2.0b
Untreated	---	8.0a	49.75a	9.0a	66.75a

Means in a column followed by the same or no letter are not significantly different (*P* = 0.05, ANOVA and LSD).

(F78)

SOYBEAN: *Glycine max* (L.) Merrill, 'Pioneer 95M82'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF CORN EARWORM IN 7.5-INCH ROW SPACED SOYBEAN, 2011

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

A test was conducted to determine efficacy of foliar-applied insecticides against CEW, a major late-season pest in Virginia soybean. 'Pioneer 95M82' soybean was planted on 14 Jun 2011 at the K. Worrell farm in Suffolk, VA, using 7.5-inch row spacing. A RCBD was used with 4 replicates; plots were 6 ft by 40 ft. Treatments were broadcast (BC) on 12 Aug with a CO_2-pressurized backpack sprayer at 14.3 gpa and 17.9 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. Efficacy against CEW was determined at 3 and 6 days after treatment (DAT) by taking 10 sweeps/plot with a standard 15-in diameter sweep net (covering 2 rows per sweep) and recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Mandibular dissection of 25 larvae indicated 92% CEW and 8% *Heliothis virescens* (F.) (tobacco budworm) on 12 Aug. All treatments had significantly lower total larvae than the untreated check at both 3 and 6 DAT, with differences between treatments on both sample dates.

Treatment/ formulation	Rate/ oz acre	3 DAT				6 DAT			
		Small	Medium	Large	Total	Small	Medium	Large	Total
Fastac 100EC	4.0	1.00cd	1.25d-f	0.50d	2.75d-f	0.75bc	1.75c-e	1.50b-e	4.00d-g
Prevathon 0.43SC	9.8	0.75cd	2.50b-e	0.50d	3.75c-f	0.50c	0.50de	1.00b-e	2.00f-h
Prevathon 0.43SC	13.4	0.75cd	2.25b-f	1.00cd	4.00c-f	0.25c	0.50de	0.75c-e	1.50gh
Prevathon 0.43SC + Asana 0.44ECXL	4.0 4.5	2.00b-d	1.00d-f	0.50d	3.50c-f	0.25c	0.50de	0.25e	1.00gh
Besiege 2EC	9.0	0.25d	0.75d-f	0.25d	1.25ef	0.00c	0.25e	0.25e	0.50h
Belt 4SC	2.0	3.75b	1.00d-f	1.75b-d	6.50b-d	1.00bc	1.00de	0.75c-e	2.75e-h
Steward 1.25EC	6.0	1.00cd	0.00f	0.00d	1.00ef	0.25c	0.25e	0.50de	1.00gh
DiPel ES (Kur.)	16 (dry wt)	2.25b-d	4.00ab	3.50ab	9.75b	2.00bc	2.25b-d	2.25a-d	6.50b-d
Karate Z 2.08CS	0.96	1.50b-d	3.75a-c	2.75a-c	8.00bc	2.75b	3.75b	2.75ab	9.25b
Karate Z 2.08CS	1.6	0.00d	0.50ef	0.25d	0.75f	0.75bc	1.25de	1.75b-e	3.75d-h
DiPel ES (Kur.) + Karate Z	16(dry wt) 0.96	1.75b-d	2.25b-f	1.75b-d	5.75b-e	0.00c	1.50c-e	3.75a	5.25c-f
DiPel ES (Kur.) + Karate Z 2.08CS	16 (dry wt) 1.6	2.75bc	3.00b-d	1.50b-d	7.25b-d	2.75b	3.25bc	2.50a-c	8.50bc
Endigo 2.06 ZC	4.5	0.25d	1.50c-f	0.75cd	2.50d-f	1.00bc	2.25b-d	2.25a-d	5.50c-e
Check	-	6.75a	6.00a	4.00a	16.75a	6.00a	6.50a	4.00a	16.50a
LSD		2.42	2.50	2.24	4.87	2.14	1.86	1.83	3.50

Means within a column followed by the same letter(s) are not significantly different (Protected LSD; P=0.05).

doi: 10.4182/amt.2012.F85

(F85)

SOYBEAN: *Glycine max* (L.) Merr., 'AG6730'

EVALUATION OF BELT SC AND COBALT ADVANCED FOR SOYBEAN INSECT PEST CONTROL, 2011

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Soybean looper (SL): *Pseudoplusia includens* (Walker)
Green cloverworm (GCW): *Plathypena scabra* (Fabricius)
Velvetbean caterpillar (VBC): *Anticarsia gemmatalis* (Hübner)
Threecornered alfalfa hopper (TCAH): *Spissistilus festinus* (Say)

The experiment was designed as a RCB with 4 treatments and 4 replications. Plot size was 20 ft by 4 rows (30 inches between rows). Soybeans were drill-planted 27 May and irrigated as needed. Recommended herbicides were applied preplant. No nitrogen fertilizer was applied, but seed was inoculated with bacteria to promote nodulation. In mid-Sep, Lepidoptera pest populations were observed to be increasing. Thus, treatments were applied 15 Sep using a 2-nozzle hand-held spray rig (no. 2 cone nozzles on 30 inch centers, 20 gpa final spray volume). Soybeans were R6 at this time. Plots were sampled for insects at 1, 5 and 8 DAT with a 15-inch diameter sweep net. Ten consecutive sweeps were taken in each plot on each sample date. The contents of each 10-sweep sample were placed in a plastic bag and frozen for later inspection and enumeration. Insect counts were transformed using square root of (X +1/2). Data were analyzed by ANOVA and means separated by LSD.

Stink bug populations were too low during the experiment for data to be presented. However, SL, GCW and VBC populations were high enough in the untreated for meaningful evaluation. At 1 DAT, Belt SC and Cobalt Advanced treatments provided good control of GCW and VBC (Table 1). At 5 and 8 DAT, all treatments provided good control of all 3 Lepidoptera species (Tables 2 and 3). At 5 and 8 DAT, Cobalt Advanced significantly reduced TCAH populations (84 and 77% fewer TCAH, respectively, compared to the untreated). In conclusion, the higher rate of Belt SC appeared to provide slightly better control of SL than the lower rate, but both rates were satisfactory. The Cobalt Advanced treatment provided the best control of all pest insects encountered in the experiment. This research was supported by industry gifts of products and research funding.

Table 1.

		No. per 10 sweeps 1 day after treatment			
Treatment/formulation	Rate amt product/acre	Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	4.0	5.25b	0.5b	9.75b
Belt SC	3 fl oz	1.75	3.25b	1.5b	6.5c
Cobalt Advanced	25 fl oz	2.0	0.25c	0b	2.25d
Untreated	---	6.5	33.0a	4.5a	44.0a

Means in a column followed by the same or no letter are not significantly different (P = 0.05, ANOVA and LSD).

doi: 10.4182/amt.2012.F85

Table 2.

Treatment/formulation	Rate amt product/acre	No. per 10 sweeps 5 days after treatment			
		Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	2.0b	0b	0b	2.0b
Belt SC	3 fl oz	0b	0b	0b	0b
Cobalt Advanced	25 fl oz	1.5b	0b	0.25b	1.75b
Untreated	---	8.5a	23.0a	11.75a	43.25a

Means in a column followed by the same or no letter are not significantly different (*P* = 0.05, ANOVA and LSD).

Table 3.

Treatment/formulation	Rate amt product/acre	No. per 10 sweeps 8 days after treatment			
		Soybean looper	Green cloverworm	Velvetbean caterpillar	Total leps
Belt SC	2 fl oz	1.25b	0b	0.5b	1.75b
Belt SC	3 fl oz	0.5b	0b	0b	0.5b
Cobalt Advanced	25 fl oz	1.75b	0.25b	0b	2.0b
Untreated	---	8.0a	49.75a	9.0a	66.75a

Means in a column followed by the same or no letter are not significantly different (*P* = 0.05, ANOVA and LSD).

doi: 10.4182/amt.2011.F85

F85

SOYBEAN: *Glycine max* (L.) Merrill, 'Pioneer 95M82'

EVALUATION OF SELECTED FOLIAR INSECTICIDES FOR CONTROL OF CORN EARWORM IN SOYBEAN, 2010.

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Corn earworm (CEW): *Helicoverpa zea* (Boddie)

A test was conducted to determine efficacy of foliar-applied insecticides against CEW, a major late-season pest in Virginia soybean. 'Pioneer 95M82' soybean was planted on 31 May 2010 at the G. Reiter farm in Dinwiddie Co. using 15-inch row spacing. A RCBD was used with 4 replicates; plots were 10 ft by 40 ft. Treatments were broadcast (BC) on 10 Aug with a CO_2-pressurized backpack sprayer at 14.3 gpa and 18 psi through 8002VS nozzles spaced 18 inches apart on the spray boom. Efficacy against CEW was determined at 3, 6, and 9 d after treatment (DAT) by taking 15 sweeps/plot with a standard 15-inch diameter sweep net (covering 2 rows per sweep) and recording the number of small, medium, large, and total larvae. Data were analyzed using ANOVA and LSD statistical procedures.

Pre-treatment counts on 10 Aug indicated 14.0 small, 22.75 medium, and 12.5 large larvae per 15 sweeps (n=4). Mandibular dissection of 33 larvae collected on 13 Aug indicated 100% corn earworm. All treatments (except Karate at 6 DAT) had significantly lower total CEW larvae than the untreated check at 3 and 6 DAT, with differences between treatments. CEW populations were declining in the untreated check by 6 DAT and there were no differences by 9 DAT.
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 doi: 10.4182/amt.2011.F85

Test 1.

Treatment/ formulation	Rate (oz/acre)	3 DAT Small	3 DAT Medium	3 DAT Large	3 DAT Total	6 DAT Small	6 DAT Medium	6 DAT Large	6 DAT Total	9 DAT Small	9 DAT Medium	9 DAT Large	9 DAT Total
Prevathon 0.43SC	9.8	0.8bc	0.8bc	1.0bc	2.5bc	0.0	0.0c	0.8	0.8c	0.0	0.5	1.0	1.5
DPX-HGW86 10 OD	6.9	0.0c	1.3bc	2.3bc	3.5bc	0.0	0.0c	0.5	0.5c	0.0	0.0	0.5	0.5
Endigo	4.5	0.0c	1.3bc	1.8bc	3.0bc	0.0	0.0c	0.8	0.8c	0.0	0.3	0.3	0.5
Karate Z	1.92	0.8bc	1.3bc	2.0bc	4.0bc	0.0	3.0ab	1.5	4.5ab	0.0	0.3	0.8	1.0
Brigade 2EC	5.12	0.8bc	3.0b	3.0b	6.8b	0.0	0.5c	2.5	3.0bc	0.0	1.0	0.8	1.8
Danitol 2.4EC	10.67	0.8bc	1.0bc	0.5c	2.3bc	0.3	1.0c	1.0	2.3bc	0.0	1.0	1.8	2.8
Baythroid XL	2.8	0.3bc	0.3c	1.3bc	1.8bc	0.0	0.8c	2.0	2.8bc	0.0	0.0	1.0	1.0
Baythroid XL + Larvin	2.0 6.0	0.3bc	0.3c	1.3bc	1.8bc	0.0	0.0c	0.8	0.8c	0.0	0.0	0.8	0.8
Baythroid XL + Orthene 97	2.8 8.0	0.0c	0.3c	0.0c	0.3c	0.0	0.0c	0.8	0.8c	0.0	0.3	1.3	1.5
Larvin	10.0	0.0c	0.3c	0.0c	0.3c	0.3	0.3c	1.0	1.5c	0.0	0.0	0.8	0.8
Belt 4SC	3	0.0c	0.3c	1.0bc	1.3c	0.0	1.0c	0.0	1.0c	0.0	0.0	0.5	0.5
Steward 1.25SC	4.6	1.8b	0.8bc	1.3bc	3.8bc	0.0	1.5bc	0.3	1.8c	0.0	0.0	0.5	0.5
Success 480SC	4.0	0.0c	0.0c	0.3c	0.3c	0.3	0.5c	1.0	1.8c	0.0	0.3	0.8	1.0
Untreated check	---	4.0a	10.3a	8.3a	22.5a	0.5	4.5a	2.0	7.0a	0.0	0.5	0.8	1.3
LSD		1.62	2.31	2.38	5.08	NS	1.88	NS	2.62	NS	NS	NS	NS

Means within a column followed by the same letter(s) are not significantly different (Protected LSD, *P*=0.05).

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(F59)

SOYBEAN: *Glycine max*

EFFICACY OF SELECTED INSECTICIDES ALONE AND TANK MIXED WITH A FUNGICIDE FOR CONTROL OF LEPIDOPTERAN PESTS IN SOYBEANS, 2012 (TEST 1)

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Soybean looper: *Chrysodeixis* (*Pseudoplusia*) *includens*
Velvetbean caterpillar: *Anticarsia gemmatalis*
Green cloverworm: *Hypena scabra*

On 27 August 2012, a foliar insecticide study was conducted in soybeans on the Black Belt Branch Experiment Station in Brooksville, MS. Soybeans were at approximately R5 stage of maturity. Plots were designed in a randomized complete block with four replications. Plot size was 4 rows by 50 ft long on 38 in centers. Six insecticide treatments and one fungicide treatment (Quadris) were evaluated against the untreated control (UTC) for control of soybean looper (SBL), velvetbean caterpillar (VBC), and the green cloverworm (GCW). Insecticides were applied with a tractor-mounted sprayer calibrated to deliver 10.0 gpa at 60 psi through TX-6 Hollow Cone nozzles (2 per row). There were two sample dates following the application of treatments: 4 days after treatment (4 DAT) and 8 day after treatment (8 DAT). Plots were sampled by taking 25 sweeps per plot with a sweep net and recording the number of SBL, VBC, and GCW larvae per 25-sweep sample. Data was analyzed with ANOVA and means were separated using Fisher's Protected LSD ($P \leq 0.10$).

At 4 DAT all treatments except Quadris significantly reduced VBC numbers below the untreated control, and all treatments were significantly better than Quadris. At 4 DAT, only the four insecticide treatments containing either Belt or Besiege significantly reduced SBL populations below the untreated control and none of the four treatments were significantly different from each other. There were no GCW present at the 4 DAT sample date. At 8 DAT all treatments except Quadris significantly reduced VBC numbers below the untreated control and all treatments were significantly better than Quadris. At 8 DAT, all treatments except Quadris significantly reduced SBL populations below the untreated control while the four treatments that contained either Belt or Besiege were significantly better than the two treatments containing Dimilin. At 8 DAT, all treatments significantly reduced GCW populations below the untreated control.

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Table 1.

Product	Rate (lbs.) AI/Acre	Average SBL, VBC, and GCW Larvae/25 sweeps				
		4 DAT		8 DAT		
		VBC	SBL	VBC	SBL	GCW
Dimilin 2L	0.031	9.0b	8.5a	0.8c	5.5c	0.0b
Quadris+	0.098					
Dimilin 2L	0.031	8.0b	8.5a	0.8c	4.3cd	0.0b
Quadris	0.098	30.3a	12.8a	20.3b	13.5a	0.0b
Belt 4 SC	0.063	3.3b	0.5b	0.0c	0.3d	0.0b
Quadris+	0.098					
Belt 4 SC	0.063	6.8b	1.8b	0.0c	0.0d	0.0b
Besiege 1.25SC	0.088	1.8b	1.3b	0.0c	0.3d	0.0b
Quadris+	0.098					
Besiege 1.25SC	0.063	0.5b	0.0b	0.0c	0.0d	0.0b
UTC		29.5a	12.0a	25.5a	8.8b	3.0a
LSD (0.10)		7.98	3.76	5.06	3.06	1.65

Means within a column sharing the same letter are not significantly different (LSD; $P > 0.10$).

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(F60)

SOYBEAN: *Glycine max*

EFFICACY OF SELECTED INSECTICIDES FOR CONTROL OF LEPIDOPTERAN PESTS IN SOYBEANS, 2012 (TEST 2)

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Soybean looper: *Chrysodeixis* (*Pseudoplusia*) *includens*
Velvetbean caterpillar: *Anticarsia gemmatalis*
Green cloverworm: *Hypena scabra*

On 27 August 2012, a foliar insecticide study was conducted in soybeans on the Black Belt Branch Experiment Station in Brooksville, MS. Soybeans were at approximately R5 stage of maturity. Plots were designed in a randomized complete block with four replications. Plot size was 4 rows by 50 ft long on 38 in centers. Four insecticide treatments were evaluated against the untreated control (UTC) for control of soybean looper (SBL), velvetbean caterpillar (VBC), and the green cloverworm (GCW). Insecticides were applied with a tractor-mounted sprayer calibrated to deliver 10.0 gpa at 60 psi through TX-6 Hollow Cone nozzles (2 per row). There were two sample dates following the application of treatments: 4 days after treatment (4 DAT) and 8 day after treatment (8 DAT). Plots were sampled by taking 25 sweeps per plot with a sweep net and recording the number of SBL, VBC, and GCW larvae per 25-sweep sample. All means were log10 transformed. Data was analyzed with ANOVA and means were separated using Fisher's Protected LSD ($P \leq 0.10$).

At 4 DAT, all insecticides significantly reduced VBC populations below the untreated control, while Belt, Prevathon, and the high rate of Diamond were all significantly better than the low rate of Diamond. At 4 DAT, all treatments significantly reduced SBL populations below the untreated control, while Prevathon was significantly better than all other treatments. At 8 DAT, all products significantly reduced VBC and SBL populations below the UTC but none of the products were significantly different from each other.

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Table 1.

Product	Rate (lbs.) AI/Acre	Average SBL, VBC, and GCW Larvae/25 sweeps					
		4 DAT			8 DAT		
		VBC	SBL	GCW	VBC	SBL	GCW
Diamond 0.83 EC	0.039	10.8b	4.8bc	0.0a	4.1b	3.6b	0.9a
Diamond 0.83 EC	0.078	4.5c	7.3ab	0.0a	1.8b	2.5b	0.0a
Belt 4 SC	0.063	2.3c	1.8c	0.5a	0.5b	0.5b	0.0a
Prevathon 0.43 SC	0.067	0.5c	0.0d	0.0a	0.8b	0.5b	0.0a
UTC		43.8a	16.3a	1.3a	19.3a	14.5a	3.5a
LSD (0.10)		15.61	5.46	1.38	10.33	6.29	4.02

Means within a column sharing the same letter are not significantly different (LSD; $P > 0.10$).

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(F63)

SOYBEAN: *Glycine max* (L.) Merrill, 'HALO 4:94'

CONTROL OF THE SOYBEAN LOOPER IN SOYBEANS, 2012

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Soybean looper (SBL): *Chrysodeixis includens* (Walker)

A study was conducted at the LSU AgCenter Dean Lee Research Station in Alexandria, LA to evaluate insecticides for management of the SBL. Ten insecticide treatments, in addition to an untreated check, were assessed in a RCBD with 4 blocks and 1 replicate per block. Soybeans (HALO 4:94) were planted on 10 May on 38-inch centers (twin rows, 160,000 seeds/acre). Plots were 4 rows wide and 35 ft long. Insecticides were applied on 23 Aug, when SBL densities were approaching the LSU AgCenter recommended action threshold. All treatments were applied with the non-ionic surfactant Induce at 0.25% v/v. A CO_2-pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi was used with a 2-row boom equipped with 4 TeeJet TX VS6 nozzles spaced at 19 inches. Treatment efficacy was evaluated on the 2 center rows of each plot by estimating percent defoliation and collecting insects from a 25-sweep sample with a 15-inch diameter sweep net. The two center rows of each plot were harvested for yield on 8 Oct. Defoliation data and SBL counts were compared using repeated measures ANOVA (PROC MIXED, SAS Institute). Yields were compared using a 1-way ANOVA (PROC MIXED, SAS Institute).

All insecticide treatments decreased defoliation by 61-70% and reduced SBL densities by 67-98% 8 DAT. SBL counts 8 DAT suggest that Steward and Asana in a tank mix provided the lowest level of control; however, % defoliation did not follow this numerical trend. Subsequently, SBL densities decreased substantially in untreated and treated plots and potential differences in residual efficacy could not be detected. In addition, effects of insecticides on yield were not detected.

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Table 1:

Treatment	Rate amt (fl oz/acre)	SBL / 25 sweeps[a]				% Defoliation[a]			
		8 DAT	15 DAT	22 DAT	29 DAT	8 DAT	15 DAT	22 DAT	29 DAT
Untreated check	---	30.5a	9.0bc	0.0d	0.0d	43.1ab	46.3a	41.3b	42.5ab
Prevathon	10.0	3.0bcd	1.8cd	0.0d	0.0d	14.4c	13.8c	13.1c	13.8c
Prevathon	14.0	1.3cd	0.3d	0.0d	0.3d	13.1c	11.9c	12.5c	12.5c
Prevathon + Asana	10.0 + 7.0	0.5d	1.8cd	0.0d	0.5d	13.1c	15.6c	13.1c	13.8c
Belt	2.0	3.3bcd	1.5cd	0.0d	0.5d	13.8c	14.4c	13.1c	14.4c
Belt	3.0	1.5cd	1.8cd	0.0d	0.0d	13.8c	15.0c	11.9c	12.5c
Belt + Leverage	2.0 + 2.8	0.8d	4.0bcd	0.0d	0.3d	13.1c	14.4c	12.5c	13.8c
Intrepid	6.0	7.3bcd	5.8bcd	0.0d	0.3d	13.8c	15.6c	15.0c	14.4c
Besiege	7.0	2.3bcd	0.3d	0.0d	0.0d	15.6c	13.8c	14.4c	14.4c
Besiege	9.0	1.5cd	0.8d	0.0d	0.0d	16.3c	13.8c	16.9c	16.3c
Steward + Asana	6.7+7.0	10.0b	4.5bcd	0.0d	0.0d	16.9c	16.3c	16.3c	16.9c
Treatment (*F* value, *p* value)		16.5, <0.001				82.5, <0.001			
Date (*F* value, *p* value)		41.1, <0.001				2.4, 0.076			
Treatment*Date (*F* value, *p* value)		9.5, <0.001				1.5, 0.088			

[a]Means within rows and columns followed by the same letter are not significantly different (P > 0.05, Tukey's HSD).

Table 2:

Treatment	Rate amt (fl oz/acre)	Yield (bu/acre)[a]
Untreated check	--	35.9ab
Prevathon	10.0	38.4a
Prevathon	14.0	38.5ab
Prevathon+ Asana	10.0 + 7.0	39.3ab
Belt	2.0	36.8ab
Belt	3.0	35.7ab
Belt + Leverage	2.0 + 2.8	42.2a
Intrepid	6.0	35.4b
Besiege	7.0	39.3ab
Besiege	9.0	38.1ab
Steward + Asana	6.7 + 7.0	39.1ab
F value		2.21
p value		0.046

[a]Means followed by the same letter are not significantly different (P > 0.05, Tukey's HSD).

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(F79)

TOBACCO: *Nicotiana tabacum,* 'K 326, NC 71, NC 7'

TOBACCO BUDWORM CONTROL IN BURLEY AND FLUE CURED TOBACCO, 2008

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Tobacco budworm (TBW): *H. virescens*

Reduced risk materials were evaluated for TBW control in tobacco. This test was conducted at 3 locations, two planted in flue cured tobacco varieties (Sites 1 and 3) and 1 planted in burley tobacco (Site 2). Treatments were arranged in a RCB and replicated 4 times. Plots consisted of 100 plants in four 25 plant rows. At the time of the test, plants were in the prebutton stage. Ten plants in the center 2 rows of each plot were infested with laboratory reared 2nd instar TBW larvae. Twenty four h after infestation, insecticide treatments were applied using a CO_2 pressurized backpack sprayer fitting with a single solid cone nozzle calibrated to deliver 30 gpa at 60 psi. Spray application was directed into the bud. At 3 and 7 DAT, live larvae present in buds were counted. At 7, 14, and 21 DAT, the leaf area consumed due to budworm feeding was estimated for each of the 20 infested plants per plot. This value was expressed as proportion of an entire leaf. Data were analyzed via Proc GLM (SAS, Cary, NC) and transformed as necessary to meet the assumptions of ANOVA. Means were separated via Fisher's Protected LSD.

All of the materials performed equally well compared to the current grower standard, Tracer, with respect to larval mortality (Table 1). When differences existed between treatments, the high rates of Belt and Coragen resulted in the greatest reduction of leaf area consumed (Table 2). While leaf area loss data were collected at 21 DAT, all larvae had fully developed by this point, the plant had continued to grow, and there were no remaining differences between treatments. Therefore, these data are not presented.

Table 1

Treatment	Rate (oz per acre)	Live Larvae[1]		
		Site 1	Site 2	Site 3*[+]
Check	---	5.92a	6.95a	1.50a
Belt	3 fl oz	1.75bc	1.85bc	0.38b
Belt	4 fl oz	1.75bc	2.20bc	0.27b
Coragen	3 fl oz	3.08b	2.15bc	0.20b
Coragen	5 fl oz	2.67bc	2.00bc	0.26b
Coragen	7 fl oz	2.17bc	0.90c	0.27b
Tracer	1.8 fl oz	1.17c	2.55b	0.20b

[1]Means followed by the same letter within the same observation period are not significantly different (Fisher's Protected LSD; P = 0.05).
*****Data were log(x+0.05) transformed prior to analysis.
[+]Site 3 data were averaged over 3 and 7 DAT counts, while data for Sites 1 and 2 were averaged over 3, 7, and 14 DAT.

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Table 2

Treatment	Rate (oz per acre)	7 DAT[1]			14 DAT[1]		
		Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Check	---	0.45a	0.48a	0.82a	0.91a	0.63a	0.75a
Belt	3 fl oz	0.26b	0. 13c	0.29b	0.20c	0.27c	0.07b
Belt	4 fl oz	0.23b	0.17bc	0.29b	0.16c	0.14d	0.10b
Coragen	3 fl oz	0.28b	0.19bc	0.25b	0.34b	0.27c	0.10b
Coragen	5 fl oz	0.23b	0.16bc	0.26b	0.21bc	0.37b	0.09b
Coragen	7 fl oz	0.32b	0.13c	0.33b	0.15c	0.29bc	0.07b
Tracer	1.8 fl oz	0.21b	0.27b	0.31b	0.25bc	0.31bc	0.14b

[1]Means followed by the same letter within the same observation period are not significantly different (Fisher's Protected LSD; P = 0.05).

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F65

TOBACCO: *Nicotiana tabacum* L. 'K326'

FOLIAR APPLICATIONS OF INSECTICIDE FOR TOBACCO BUDWORM AND TOBACCO HORNWORM CONTROL ON TOBACCO IN SOUTH CAROLINA, 2009

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm (THW): *Manduca sexta* (Linnaeus)

A tobacco trial using cultivar 'K326' was conducted in 2009 at the Pee Dee Research and Education Center in Florence, SC, to evaluate foliar applications of insecticide for TBW and THW control. An experiment with four replications arranged in a RCB was conducted with four treatments and a check. Plots were 2 rows (~26 plants per row) by 40 ft and separated by single unplanted rows. A CO_2-pressurized back pack sprayer with a Cone Jet T hollow cone nozzle size 10 (30-35 psi) was used to apply tray drench applications of imidacloprid (Admire Pro, 1.2 fl oz / 1000 plants) in ~8.5 fl oz of water/288-plant float tray on 12 Apr, 5 d before transplanting. The plants were watered lightly after insecticide application to wash the residue from the plants and into the media. Tobacco was transplanted into field plots on 17 Apr. Recommendations were followed for fertilization, cultivation, topping, weed, and sucker control. A soil nematicide (1,3-dichloropropene) was used on 6 Feb. After transplant, 10 plants per plot were randomly selected and examined on every leaf weekly for live TBW or THW larvae until 8 Jul. In each plot, plants were classified as having no larva, small hornworm, medium hornworm, large hornworm, small budworm, medium budworm, large budworm, or combinations of sizes of both species. Applications were made when 10% of plants had live larvae present, unless a majority were newly hatched first instars. Foliar applications of insecticide were made with a 3 nozzle (tip DVP 3, Core 25) per row arrangement at 23 gal/acre and 40PSI with a CO_2 tank. Crop stages were 6 to 8 leaves on 14 May, 12 leaves on 4 Jun and flowering on 30 Jun. Green leaf weight of ripe tobacco was taken on the bottom half (7 Jul) and top half (3 Aug) portion of each plant on the left row within each plot. Data were analyzed with a one-way ANOVA (PROC MIXED). Proportion of plants infested with larvae was square-root arcsine transformed prior to ANOVA to normalize their distribution.

Insecticide treatments significantly reduced the proportion of plants infested with TBW and THW compared to check plots ($P = 0.05$) in seven out of 13 sampling dates. Three applications of Tracer and Belt and two applications of Coragen at both rates were made. Data are presented in Tables 1 and 2 for each sampling date. Yield was not significantly affected by insecticide treatment ($P = 0.05$).

Table 1.

Treatment/ formulation	Rate (fl oz/acre)	Timing	Plants infested with live TBH or THW (%)						
			5/13	5/20	5/27	6/3	6/8	6/15	6/22
Check	---	---	27.3a	45a	37.5a	52.5a	57.5a	45.0a	17.5a
Tracer	2	5/14, 6/3, 6/30	14.2a	17.5ab	7.5b	57.5a	17.5b	0b	35.0a
Belt	3	5/14, 6/3, 7/6	17.1a	0b	2.5b	35.0a	5.0bc	5.0b	12.5a
Coragen	3.5	5/14, 6/3	9.1a	15ab	0b	37.5a	0c	10.0ab	10.0a
Coragen	5	5/14, 6/3	16.8a	7.5b	2.5b	35a	5.0bc	7.5b	7.5a
F^a			0.95	5.87	9.93	1.53	19.68	6.39	1.57
$P > F$			0.463	0.0055	0.0005	0.2464	< 0.0001	0.0038	0.236

For each effect, means within the same column followed by the same letter are not significantly different ($P = 0.05$; Tukey's [1953] HSD).
[a]d.f. = 4, 14.

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Table 2.

Treatment/ formulation	Rate (fl oz / acre)	Timing	Plants infested with live TBH or THW (%) 6/29	7/6	7/13	7/20	7/27	8/3
Check	---	---	32.5a	37.5a	17.5a	27.5a	15.0a	5.0a
Tracer	2	5/14, 6/3, 6/30	27.5a	2.5b	5.0a	5.0b	25.0a	5.0a
Belt	3	5/14, 6/3, 7/6	15.0a	17.5ab	0a	0b	0b	0
Coragen	3.5	5/14, 6/3	7.5a	10.0ab	0a	0b	2.5b	2.5a
Coragen	5	5/14, 6/3	10.0a	10.0ab	5.0a	5.0b	2.5b	2.5a
F[a]			1.38	3.64	3.22	10.22	14.34	0.75
P > F			0.2918	0.0311	0.0454	0.0004	< 0.0001	0.5742

For each effect, means within the same column followed by the same letter are not significantly different ($P = 0.05$; Tukey's [1953] HSD).
[a]d.f. = 2, 6.

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TOBACCO: *Nicotiana tabacum* L. Flue-cured 'NC 297'

BUDWORM AND HORNWORM CONTROL ON FLUE-CURED TOBACCO WITH FOLIAR SPRAYS, 2009:

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Tobacco budworm (TBW): *Heliothis virescens* (Fab.)
Tobacco hornworm (THW): *Manduca sexta* L.

This experiment was conducted at the Virginia Tech SPAREC, Blackstone, VA to evaluate the performance of various insecticides applied as foliar sprays for TBW and THW control on flue-cured tobacco. Nine treatments and an untreated check were established in a RCB with 4 replications. Two days before transplanting, tobacco seedlings were treated with a tray drench application of Admire Pro at 0.6 fl oz/1,000 plants for aphid and flea beetle control. On 15 May, flue-cured tobacco 'NC 297' was transplanted into experimental plots, 4 x 40 ft (2 rows x 22 plants), separated by single untreated guard rows and 5-ft fallow alleys between the blocks. Recommended production practices were followed for weed and disease control and fertilization. On 1 Jul, 20 plants in each plot were artificially infested with one 1-day-old TBW larva and one 2-day-old THW larva per plant. The test tobacco was cut back, additional fertilizer (200 lb/acre 14-0-14) was applied on 16 Jul, and a second test was conducted on the regrowth. Natural infestations of THW and TBW were utilized for the second test initiated on 14 Aug. A CO_2-pressurized backpack sprayer delivering 32 gal/acre at 60 psi through TX-12 nozzles (3 per row) was used to apply the foliar treatments on 2 Jul and on the tobacco regrowth on 14 Aug. During application, temperatures ranged from 80 to 84 ^{o}F on 2 Jul and 82 to 84 ^{o}F on 14 Aug. After the 2 Jul application, 0.99 inches of rain fell on 5 Jul, 3 DAT. On 14 Aug, 0.6 inches of rain began falling 6 hrs after application. TBW and THW were counted on 20 plants/plot at 4, 7, and 14 days after the 2 Jul applications and at 3, 7, 14, and 22 days after the 14 Aug application. Leaf loss due to THW and TBW feeding was estimated on 14 Sep, 31 DAT. The test was irrigated with 1 inch of water on 13 Jul, and 5 and 10 Aug. TBW and THW count and leaf loss injury were transformed to the square root (x+0.5), analyzed by ANOVA, and significantly different means were separated by WD (k-ratio=100). Actual means are presented in the tables.

On 6 Jul, 4 DAT, none of the treatments gave significant control of TBW (Table 1). However, all treatments except HGW-86 gave significant control of TBW on 9 Jul, 7 DAT (Table 1). The most effective treatments on 9 Jul included the 3 fl oz/acre rate of Belt, Belt + Siltrate, Tracer, and the high rates of HGW-86 and Coragen. There was no significant effect on TBW feeding damage. In the second test, all treatments gave significant reductions in TBW populations on 17 Aug, 3 DAT (Table 1). Tracer and the 3 fl oz/acre rate of Belt with and without Siltrate were the most effective, while Orthene gave the least control (Table 1). By 21 Aug, TBW populations had dropped to very low levels for all treatments and there were no significant effects on TBW populations or leaf loss caused by TBW. In Test 1, THW control was best with the low rate of Coragen, Orthene and Tracer at 4 DAT on 6 Jul (Table 2). The low rate of HGW-86 was the least effective treatment (Table 2). On 9 Jul, all treatments gave significant control of THW. The Belt + Siltrate and Tracer treatments gave the best protection against leaf loss associated with THW feeding. No THW were found in the test at 14 DAT (Table 2). In Test 2, all treatments gave significant control of THW through 21 DAT (Table 3). On 17 Aug, 3 DAT, THW control was best in the plots treated with Orthene, Tracer, and Belt plus Siltrate (Table 3). Belt alone, HGW-86, and the low rate of Coragen were the least effective. Residual control was excellent for all treatments through 4 Sep, 22 DAT. Leaf loss associated with THW damage was significantly reduced with each insecticide treatment (Table 3).

Table 1.

Treatment/ formulation	Rate/acre	Test 1 THW/20 plants 30 Jun Pretreat	6 Jul 4 DAT	9 Jul 7 DAT	16 Jul 14 DAT	Leaves lost/ 20 plants 16 Jul 14 DAT	Test 2 TBW/20 plants 14 Aug Pretreat	17 Aug 3 DAT	21 Aug 7 DAT
Belt 1.6F	2 fl oz	7.5a	2.5a	1.3c	0.0a	1.9a	5.3a	2.0bc	0.5a
Belt 1.6F	3 fl oz	6.8a	1.5a	0.5c	0.3a	1.5a	2.5a	0.8cd	0.8a
Belt 1.6F + Siltrate	3 fl oz + 8 fl oz	8.0a	2.0a	0.3c	0.0a	1.5a	2.5a	0.3d	0.8a
Coragen 1.67SC	3.5 fl oz	7.8a	2.3a	1.8ba	1.0a	1.7a	3.0a	1.8bcd	0.0a
Coragen 1.67SC	5 fl oz	6.3a	2.0a	0.8c	0.3a	2.0a	5.3a	1.3cd	0.3a
HGW-86 0.83SE	6.75 fl oz	6.5a	4.5a	3.8ab	1.0a	3.6a	2.3a	1.5cd	0.8a
HGW-86 0.83SE	13.5 fl oz	5.0a	3.5a	0.5c	0.0a	2.5a	2.5a	2.0bc	1.0a
Orthene 97%	0.773 lb	5.0a	2.5a	1.8bc	0.8a	2.5a	3.8a	3.3b	1.0a
Tracer 4F	1.5 fl oz	6.0a	2.8a	0.8c	0.0a	4.1a	4.3a	0.5cd	0.0a
Untreated check		8.0a	3.8a	4.0a	1.5a	3.8a	5.5a	5.5a	1.0a

Means within a column not followed by the same letters are significantly different WD (k-ratio = 100).

Table 2, Test 1.

Treatment/ formulation	Rate/acre	TBW/ 20 plants 30 Jun Pretreatment	6 Jul 4 DAT	9 Jul 7 DAT	16 Jul 14 DAT	Leaves lost/20 plants 16 Jul 14 DAT
Belt 1.6F	2 fl oz	5.8a	0.5c	0.0b	0.0	7.8bc
Belt 1.6F	3 fl oz	6.0a	1.5bc	0.0b	0.0	10.8ab
Belt 1.6F + Siltrate	3 fl oz + 8 fl oz	2.8a	1.0bc	0.0b	0.0	4.8c
Coragen 1.67SC	3.5 fl oz	5.5a	0.3c	0.0b	0.0	8.4abc
Coragen 1.67SC	5 fl oz	5.5a	0.3c	0.3b	0.0	6.1bc
HGW-86 0.83SE	6.75 fl oz	6.3a	2.8b	0.0b	0.0	9.5abc
HGW-86 0.83SE	13.5 fl oz	5.0a	1.0bc	0.0b	0.0	7.6bc
Orthene 97%	0.773 lb	5.5a	0.3c	0.0b	0.0	5.9bc
Tracer 4F	1.5 fl oz	6.8a	0.3c	0.0b	0.0	4.8c
Untreated check		7.0a	4.8a	3.0a	0.0	12.8a

Means within a column not followed by the same letters are not significantly different WD (k-ratio = 100).

Table 3. TEST 2

Treatment/ formulation	Rate/acre	THW /20 Plants 14 Aug	17 Aug	21 Aug	/10 plants 28 Aug	4 Sep	Leaves lost/ 20 plants 14 Sep
Belt 1.6F	2 fl oz	28.8a	3.5bc	0.5b	0.5bc	0.5c	8.7b
Belt 1.6F	3 fl oz	37.5a	3.8bc	1.3b	2.0bc	1.0bc	8.8b
Belt 1.6F + Siltrate	3 fl oz + 8 fl oz	32.a	1.5cd	0.8b	0.3bc	1.3bc	3.7b
Coragen 1.67SC	3.5 fl oz	39.0a	3.5bcd	1.0b	0.0c	0.5c	7.6b
Coragen 1.67SC	5 fl oz	38.8a	2.3bcd	0.5b	0.3bc	0.3c	8.3b
HGW-86 0.83SE	6.75 fl oz	28.3a	4.0b	1.3b	0.0c	0.3c	10.2b
HGW-86 0.83SE	13.5 fl oz	32.5a	3.8b	3.0b	0.0c	0.5c	6.3b
Orthene 97%	0.773 lb	36.8a	1.3d	1.0b	2.5b	2.5b	5.9b
Tracer 4F	1.5 fl oz	38.8a	1.3d	1.0b	0.0c	1.0bc	6.6b
Untreated check		31.8a	11.0a	21.0a	46.0a	18.3a	31.8a

Means within a column not followed by the same letters are significantly different WD (*k*-ratio=100).

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(F69)

SOYBEAN: *Glycine max* (L.)

EFFICACY OF SELECTED INSECTICIDES AGAINST LOOPERS IN SOYBEAN, 2010C

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Cabbage looper: *Trichoplusia ni* (Hübner)
Soybean looper: *Chrysodeixis includens* (Walker)

Various insecticides were evaluated for control of loopers at the Rohwer Research Station near Rohwer, AR. Treatments were applied to R4 (full pod) soybean on 17 Aug. Plot size was 4 rows (38-inch centers) x 100 ft in length, arranged in an RCBD with four replications. Treatment applications were made with a Mudmaster® 4WD multi-purpose sprayer equipped with a rear-mounted CO_2-charged multi-boom system (R&D Sprayers®, Opelousas, LA) calibrated to deliver 10 gpa through Teejet® TX-6 hollow cone nozzles (19-inch nozzle spacing). Treatment efficacy was evaluated at 3 and 8 DAT by sampling the middle two rows of each plot (row 2 at 3 DAT and row 3 at 8 DAT) with a standard 15-inch diameter sweep net (25 sweeps per plot). Data were square root-transformed and subjected to ANOVA with means separated using DNMRT (P=0.05)

Because of the number of specimens present with black true legs, soybean looper was believed to be the predominant species in the trial. Looper numbers were extremely high in the untreated check plots at 3 DAT (238 loopers/25 sweeps). That number declined significantly by 8 DAT, due to an unidentified disease that decimated the population in a relatively short period of time. However, meaningful data were obtainable, as mean separation was apparent across treatments at both 3 and 8 DAT. While the intent was to collect residual efficacy data weekly out to 28 DAT, overall numbers were insufficient at 14 DAT to include in the analysis. At 3 DAT, Karate Z and Orthene at 0.5 and 0.75 lb ai/A were the only treatments that did not reduce looper numbers below the untreated check. Of the remaining treatments, only Belt reduced numbers of loopers below recommended university threshold of 29/25 sweeps at 3 DAT. At 8 DAT, the number of loopers in the untreated check averaged 76.5, a sharp decline due to the aforementioned disease. The only treatments whose numbers were significantly below the untreated check were the lepidopteran-specific insecticides Belt and Intrepid, resulting in 0.6 and 3.8 loopers/25 sweeps, respectively. Other treatments were similar to, or in the case of Karate, numerically higher than the untreated check. This supports extension entomologists' recommendation to avoid pyrethroids alone for control of loopers, particularly late-season when soybean loopers may be the predominant species present. This research was supported by industry gifts of products and research funding.

Treatment/ Formulation	Rate lb (AI)/acre	Total loopers (No./25 sweeps) 3 DAT	8 DAT
Karate Z 2.08CS	0.026	185.3abc	117.8a
Karate Z 2.08CS + Orthene 97WP	0.026+ 0.5	105.9bcd	72.3bc
Brigade 2EC	0.1	97.9bcd	81.5ab
Brigade 2EC + Orthene 97WP	0.1 + 0.5	109.8bcd	53.3bc
Intrepid 2F	0.0625	48.4de	3.8d
Belt 4SC	0.0625	25.4e	0.6d
Orthene 97WP	0.5	196.4ab	55.2bc
Orthene 97WP	0.75	187.7abc	82.1ab
Orthene 97WP	1.0	87.0cd	45.0c
Untreated check	-	238.4a	76.5abc
P>F (ANOVA)		<0.0001	<0.0001

Means within columns followed by a common letter are not significantly different (DNMRT; *P*=0.05).

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F99

TOBACCO: *Nicotiana tabacum* L, "NC 71"

TOBACCO AND TOMATO HORNWORM MANAGEMENT WITH REGISTERED AND UNREGISTERED INSECTICDES, 2010

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Tobacco hornworm: *Manduca sexta* (Linnaeus)
Tomato hornworm: *Manduca quinquemaculata* (Haworth)

This trial was conducted to compare recently registered and currently unregistered insecticides against HW pests in tobacco. Greenhouse grown tobacco plants were transplanted on 28 Apr into 50 ft long and 12 ft (3 rows) wide plots, equivalent to 0.014 acres. Treatments were arranged in a RCBD and replicated 4 times each. All foliar treatments were applied in 30 gal of water per acre with 60 psi pressure using a single nozzle boom fitted with a TG3 nozzle and a CO_2 pressurized backpack sprayer. No systemic or foliar insecticides were applied to plants other than those used in this trial. Rows 1 and 2 were cut back on 23 Jul and allowed to regrow to foster HW populations. Foliar treatments for tobacco/tomato hornworm larvae were applied on 26 Aug. Hornworm counts were made on 10 plants each per row, a total of 20 plants per plot, 4, 6, and 14 d after treatment. An ANOVA was conducted via Proc Mixed (SAS v. 9.3.1; Cary, NC) with replicate as a random variable and treatment as a fixed variable. Means were separated via LSD.

All 3 treatments at all rates applied significantly reduced the number of HW larvae present with respect to the untreated check (Table 1).

Table 1.

Treatment/ formulation	Rate (oz/acre)	Tobacco/tomato hornworms per plot		
		4 DAT	6 DAT	14 DAT
Coragen 1.67SC	3.5	1.00b	0.50b	0.25b
Coragen 1.67SC	5.0	0.25b	1.00b	0.25b
HGW86 10OD	6.75	0.25b	0.25b	0.00b
HGW86 10OD	13.5	0.50b	0.25b	0.50b
Belt 4SC	2.0	0.75b	0.25b	0.75b
Belt 4SC	3.0	0.00b	0.25b	0.00b
Untreated check	-	15.25a	31.75a	28.50a

Means followed by the same letter are not significantly different (α = 0.05; LSD).

 doi: 10.4182/amt.2011.F100

F100

TOBACCO: *Nicotiana tabacum* L, "NC 196"

ON FARM COMPARISON OF REGISTERED MATERIALS AGAINST LEPIDOPTERAN PESTS OF TOBACCO, 2010

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm: *Manduca sexta* (Linnaeus)

Several new active ingredients have recently been registered for lepidopteran management in tobacco. We compared these newer materials efficacy to the current grower standard, Tracer, in a commercial tobacco field in Stokes County, NC. One of these recently registered materials, Coragen, is labeled for soil application at transplant. We compared a transplant water application and a soil application at first cultivation to foliar applications of Coragen, Belt, and Tracer. Greenhouse grown tobacco plants, treated with a greenhouse tray drench of 0.6 f l oz/1000 plants Admire Pro 3 days on 30 Apr, were transplanted on 3 May. Four row plots, 50 ft in length, were established immediately after transplant. Plots were 0.018 acres each. Each treatment was replicated 4 times, and plots were arranged in an RCBD, blocked by replicate. Simulated transplant water treatments of Coragen were applied the afternoon of transplant in 2.0 fl oz of finished solution per plant (equivalent to 113 gpa). The first cultivation treatments of Coragen were applied on 27 May to both sides of the plant bed, which was immediately cultivated along with the rest of the plots. Seven weeks after transplant, the natural populations of TBW infested plants and HW damaged plants were assessed. After this natural infestation was assessed, 10 plants each in rows 2 & 3 of each plot were infested with laboratory reared 2^{nd} instar TBW larvae, purchased as eggs from Chesapeake PERL (Savage, MD). Foliar treatments were applied 3 h after larval infestation using a single nozzle boom fitted with a TG3 solid cone tip and powered by a CO_2 pressurized backpack sprayer in 30 gpa water using 60 psi pressure. TBW larval survival and leaf area consumed were rated 4, 7, and 14 d after foliar treatments were applied. An ANOVA was conducted via Proc Mixed (SAS v. 9.3.1; Cary, NC) with replicate as a random variable and treatment as a fixed variable. Means were separated via LSD.

Pretreatment TBW populations were low, but not significantly different between any of the treatments (Table 1). There were significantly fewer HW damaged plants in the systemically treated Coragen plots prior to foliar applications (Table 1). Tomato hornworm was the only HW species present at the time of assessment, but most had already pupated. Significantly fewer TBW larvae were present in the foliar treated plots 4 and 7 d after treatment compared to the systemically treated Coragen plots and the untreated control (Table 2). This same pattern was consistent for leaf area consumed 4, 7, and 14 d after treatment (Table 3).

Table 1.

Treatment/formulation	Rate/ acre	Application method	Proportion of TBW infested plants	Proportion of HW damaged plants
Coragen 1.67SC	7.0 fl oz	Transplant water	0.07a	0.09b
Coragen 1.67SC	7 fl oz	First cultivation	0.06a	0.05b
Untreated check	NA	NA	0.07a	0.70a

Means followed by the same letter are not significantly different (α = 0.05) via LSD.

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Table 2.

			TBW larvae/plot		
Treatment	Application method	Rate/acre	4 DAT	7 DAT	14 DAT
Tracer 4 SC	Foliar treatment	1.8 fl oz	0.50a	0.00a	0.00a
Belt 4SC	Foliar treatment	3.0 fl oz	0.75a	0.00a	0.00ab
Coragen 1.67SC	Foliar treatment	5.0 fl oz	0.50a	0.25a	0.25ab
Coragen 1.67SC	Transplant water	7.0 fl oz	6.75b	4.75b	2.50ab
Coragen 1.67SC	First cultivation	7.0 fl oz	9.00b	6.00b	1.75b
Untreated check	-	-	6.75b	6.75b	2.25b

Means followed by the same letter are not significantly different (α = 0.05; LSD).

Table 3.

			Proportion of a single leaf consumed per plant		
Treatment	Application method	Rate/acre	4 DAT	7 DAT	14 DAT
Tracer 4SC	Foliar treatment	1.8 fl oz	0.12a	0.09a	0.05a
Belt 4SC	Foliar treatment	3.0 fl oz	0.12ab	0.16a	0.07b
Coragen 1.67SC	Foliar treatment	5.0 fl oz	0.07b	0.05a	0.03b
Coragen 1.67SC	Transplant water	7.0 fl oz	0.36c	0.48b	0.65c
Coragen 1.67SC	First cultivation	7.0 fl oz	0.54c	0.64b	0.91c
Untreated check	-	-	0.33c	0.54b	0.70c

Means followed by the same letter are not significantly different (α = 0.05; LSD).

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F102

TOBACCO: Nicotiana tobacum L., 'K 326'

TRAY DRENCH, TRANSPLANT WATER AND FOLIAR INSECTICIDE TREATMENTS FOR SUPPRESSING INSECT PESTS AND TOMATO SPOTTED WILT IN FLUE-CURED TOBACCO, 2010

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Tobacco budworm: *Heliothis virescens* (Fabricius)
Tobacco hornworm: *Manduca sexta* (Linnaeus)
Tomato spotted wilt virus (TSWV): None

The objective of the test was to determine the efficacy of selected insecticide application techniques for suppressing TSWV symptomatic plants and season-long suppression of TBW and THW population densities on flue-cured tobacco. The trial was conducted at the University of Georgia Bowen Research Farm in Tift County, Georgia. Plots were 3 rows wide (44-in row spacing) by 30 ft long and were separated on each side with an untreated border row and on each end with a fallow alley 6 ft wide. The experiment was designed in a RCB with 13 treatments and 3 replications. The tobacco was transplanted on 14 April into Tift sandy loam soil at a rate of 7000 transplants per acre. A pre-plant application of Prowl and Spartan herbicides and Lorsban Advanced insecticide (for soil insect pest control) was applied several days prior to transplanting. No other pesticides were applied except the selected insecticide treatment options evaluated in this study. The plots were irrigated twice during the season. Plots were periodically inspected for insect pest infestation throughout the season by observing each plant (54 plants per plot) for live insects. The plots were observed weekly for symptomatic TSWV plants, a disease that is vectored by certain thrips species. Forty-eight hours prior to transplanting, five insecticide treatments were applied as tray drench treatments (TD) in the greenhouse using 6.7 oz of water per 242 cell tray and then rinsed off the foliage and into the root zone with water. Four additional insecticide treatments were applied in the transplant water (TPW) in 2 oz of water per transplant (109 gpa). On 18 May and 3 Jun, three foliar insecticide treatments were applied using a CO_2 pressurized sprayer with 3 TX-12 nozzles down a single row delivering 22.8 gpa at 40 psi. All plants in each plot (54 plants per plot) were sampled weekly for TSWV symptomatic plants and on 18 and 25 May and 1, 10, and 15 June for TBW and THW densities. The TSWV and insect count data were subjected to ANOVA and means were separated using the Waller-Duncan K-ratio t Test at P = 0.05.

TBW densities were significantly lower in all the TD and TPW treatments, except Admire TD, than in the untreated control on 18 May, the date of the first application of the 3 foliar treatments (Table 1). On 25 May, all the insecticide treatments except Admire TD were effective in reducing TBW populations. On all three June sampling dates, most treatments were effective in reducing TBW (Table 1). THW populations were effectively suppressed below the untreated control by all the insecticide treatments, except Admire TD, on each sampling date (Table 2). On 18 May, the 3 foliar treatments were applied immediately after the counts were taken, thus these counts served as pre-treatment counts for the foliar treatments. The cumulative percentages of TSWV symptomatic plants were low in all plots at this test site in 2010. On 15 Jun, the percentages ranged from 5.5% to 11.2%, and there were no differences in TSWV symptoms between the treatments (Table 3).

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Table 1.

Treatment, formulation and rate/ acre	18 May	25 May	1 June	10 June	15 June
	# Budworms per plot (54 plants)				
Coragen 1.67SC 5.0 oz TPW	0.0b	0.0b	0.3cd	2.3ab	6.7bcd
Coragen 1.67SC 7.0 oz TPW	0.0b	0.7b	0.0cd	1.3b	3.0cd
HGW 86 SC 10.3oz TPW	0.0b	1.0b	2.3ab	0.7b	12.0ab
Coragen 1.67SC 3.57oz TD	0.0b	0.7b	0.3cd	2.3ab	7.0bcd
Coragen 1.67SC 4.76oz TD	0.0b	0.0b	0.3cd	2.7ab	6.0bcd
HGW 86 SC 9.45 oz TD	0.0b	1.3b	2.0abc	3.3ab	10.7abc
Admire Pro 3.15oz TD	1.7a	4.3a	2.7a	5.7a	16.7a
Durivo 10.0 oz TD	0.0b	1.0b	1.0a-d	2.0ab	11.7ab
Durivo 10.0 oz TPW	0.0b	0.0b	0.3cd	1.3b	7.3bcd
Coragen 1.67SC 5.0 oz Foliar	1.3ab	0.0b	0.3cd	1.3b	0.7d
Belt 4 SC 2.0 oz Foliar	2.0a	0.7b	0.7bcd	1.0b	1.3d
Durivo 10.0 oz Foliar	1.0ab	0.3b	0.7bcd	0.7b	0.7d
Untreated	2.0a	4.0a	2.7a	5.7a	17.0a

Column means followed by the same letter are not significantly different, Waller-Duncan K-ratio t Test, P > 0.05.

Table 2.

Treatment, formulation and rate/acre	18 May	25 May	1 June	10 June	15 June
	# Hornworms per plot (54 plants)				
Coragen 1.67SC 5.0 oz TPW	0.0c	0.0c	0.3b	0.3bc	0.0b
Coragen 1.67 SC 7.0 oz TPW	0.0c	0.0c	0.0b	0.3bc	0.0b
HGW 86 SC 10.3oz TPW	0.0c	0.0c	0.0b	0.0c	1.0b
Coragen 1.67SC 3.57oz TD	0.0c	0.0c	0.7b	0.0c	0.0b
Coragen 1.67SC 4.76oz TD	0.0c	1.0bc	0.3b	0.3bc	0.0b
HGW 86 SC 9.45 oz TD	0.0c	0.3c	0.3b	0.3bc	1.3b
Admire Pro 3.15oz TD	0.0c	1.7ab	1.0ab	1.0ab	4.0a
Durivo 10.0 oz TD	0.0c	0.3c	0.3b	1.0ab	0.0b
Durivo 10.0 oz TPW	0.0c	0.0c	0.0b	0.3bc	0.0b
Coragen 1.67SC 5.0 oz Foliar	2.0a	0.0c	0.0b	0.0c	0.0b
Belt 4 SC 2.0 oz Foliar	1.7a	0.0c	0.3b	0.0c	0.0b
Durivo 10.0 oz Foliar	2.0a	0.0c	0.0b	0.0c	0.0b
Untreated	1.3ab	2.7a	2.0a	1.7a	4.0a

Column means followed by the same letter are not significantly different, Waller-Duncan K-ratio t Test, P > 0.05.

Table 3.

Treatment, formulation, and rate/acre	24 May	1 June	8 June	15 June
	Cumulative TSW symptomatic plants			
Coragen 1.67SC 5.0 oz TPW	1.7a	3.5a	4.7a	7.1a
Coragen 1.67SC 7.0 oz TPW	4.0a	4.7a	4.7a	7.2a
HGW 86 SC 10.3oz TPW	2.4a	4.8a	6.0a	8.4a
Coragen 1.67SC 3.57oz TD	2.6a	3.8a	4.4a	5.5a
Coragen 1.67SC 4.76oz TD	4.2a	6.0a	6.0a	9.1a
HGW 86 SC 9.45 oz TD	5.3a	7.1a	9.5a	11.2a
Admire Pro 3.15oz TD	2.4a	3.6a	4.9a	6.1a
Durivo 10.0 oz TD	1.2a	3.0a	3.7a	6.1a
Durivo 10.0 oz TPW	2.9a	4.7a	5.8a	8.2a
Coragen 1.67SC 5.0 oz Foliar	2.4a	6.6a	7.2a	9.5a
Belt 4 SC 2.0 oz Foliar	2.0a	6.0a	8.4a	9.5a
Durivo 10.0 oz Foliar	4.9a	7.3a	8.5a	9.1a
Untreated	4.2a	6.0a	9.7a	10.9a

Column means followed by the same letter are not significantly different, Waller-Duncan K-ratio t Test, P > 0.05.

doi: 10.4182/amt.2011.F103

F103

TOBACCO: *Nicotiana tabacum* L. 'NC196'

FOLIAR APPLICATIONS OF INSECTICIDE FOR TOBACCO BUDWORM AND TOBACCO HORNWORM CONTROL ON TOBACCO IN SOUTH CAROLINA, 2010

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Tobacco budworm: *Heliothis virescens* (Fabricius)
Tobacco hornworm: *Manduca sexta* (Linnaeus)

A tobacco trial using cultivar 'NC196' was conducted at the Pee Dee Research and Education Center in Florence, SC, to evaluate foliar applications of insecticide for TBW and THW control. The test included untreated and tobacco treated with chlorantraniliprole, flubendiamide, chlorantraniliprole + lambda-cyhalothrin, chlorantraniliprole + thiamethoxam and spinosad. An RBD experiment with four replications was conducted with four treatments and a check. Plots were 2 rows (~26 plants per row) by 40 ft and separated by single unplanted rows. A CO_2-pressurized back pack sprayer with a Cone Jet T hollow cone nozzle size 10 (30-35 psi) was used to apply tray drench applications of imidacloprid (Admire Pro, 1.2 fl oz / 1000 plants) in ~8.5 fl oz of water/288-plant float tray on 15 Apr, 6 d before transplanting. The plants were watered lightly after insecticide application to wash the residue off the plants and into the media. Tobacco was transplanted into field plots on 21 Apr. Recommendations were followed for fertilization, cultivation, topping, weed, and sucker control. A soil nematicide (1,3-dichloropropene) was used on 10 Feb. After transplant, 10 plants per plot were randomly selected and examined on every leaf weekly for live TBW or THW larvae until 13 Jul. In each plot, plants were classified as having no larva, small hornworm, medium hornworm, large hornworm, small budworm, medium budworm, large budworm, or combinations of sizes of both species. Applications were made when 10% of plants had live larvae present, unless a majority were newly hatched first instars. Foliar applications of insecticide were made with a 3 nozzle (tip DVP 3, Core 25) per row arrangement at 23 gal/ac and 40PSI with a CO_2 tank. Crop stages were 6 to 8 leaves on 5 May, 10 leaves on 6 Jun and 12 leaves 14 Jun. Green leaf weight of ripe tobacco was taken on the bottom third (20 Jul), middle third (9 Aug) and top third (24 Aug) portions of each plant on the left row within each plot. Data were analyzed with a one-way ANOVA (PROC MIXED). Proportion of plants infested with larvae was square-root arcsine transformed prior to ANOVA to normalize their distribution.

Four applications of Tracer, three applications of Voliam Xpress (7 and 9 oz/ac), Voliam Flexi (both rates), Belt (3 oz/ac), two applications of Belt (2 oz/ac), and Coragen (both rates) were made. Data are presented in Tables 1 and 2 for each sampling date. Yield was not significantly affected by insecticide treatment ($P > 0.05$).

doi: 10.4182/amt.2011.F103

Table 1.

Treatment/ formulation	Rate, fl oz / acre	Timing	Plants infested with live TBH or THW (%) 5/19	5/25	6/2	6/7	6/14
Check	-		7.5a	22.5ab	10ab	27.5a	57.5a
Tracer	2	5/27, 6/2, 6/7, 6/14	7.5a	17.5ab	2.5b	17.5a	20b
Belt	2	5/20, 6/14	22.5a	2.5ab	0b	5a	75ab
Belt	3	5/20, 6/7, 6/14	10a	0b	0b	22.5a	47.5ab
Coragen	3.5	5/27, 6/14	7.5a	10ab	2.5b	0a	37.5ab
Coragen	5	5/27, 6/14	5a	22.5a	0b	5a	52.5ab
Voliam Xpress	5	6/2, 6/14	2.5a	12.5ab	25a	0a	45ab
Voliam Xpress	7	5/20, 6/7, 6/14	12.5a	0b	0b	10a	20ab
Voliam Xpress	9	5/20, 6/7, 6/14	10a	5ab	2.5b	15a	20ab
Voliam Flexi	2.5	5/27, 6/7, 6/14	5a	25a	2.5b	12.5a	25ab
Voliam Flex	4	5/20, 6/7, 6/14	10a	7.5ab	0b	17.5a	20ab
F[a]			0.97	3.83	3.35	2.42	3.08
P > F			0.4848	0.0018	0.044	0.0285	0.0075

For each effect, means within the same column followed by the same letter are not significantly different (*P* > 0.05; Tukey's [1953] HSD).
[a] d.f. = 10, 32.

Table 2

Treatment/ formulation	Rate, fl oz/ acre	Timing	Plants infested with live TBH or THW (%) 6/22	6/29	7/8	7/8
Check	-		12.5a	5a	0	0
Tracer	2	5/27, 6/2, 6/7, 6/14	0a	0a	0	0
Belt	2	5/20, 6/14	7.5a	0a	0	0
Belt	3	5/20, 6/7, 6/14	12.5a	5a	0	0
Coragen	3.5	5/27, 6/14	5a	0a	0	0
Coragen	5	5/27, 6/14	5a	0a	0	0
Voliam Xpress	5	6/2, 6/14	7.5a	0a	0	0
Voliam Xpress	7	5/20, 6/7, 6/14	0a	0a	0	0
Voliam Xpress	9	5/20, 6/7, 6/14	5a	0a	0	0
Voliam Flexi	2.5	5/27, 6/7, 6/14	0a	2.5a	0	0
Voliam Flex	4	5/20, 6/7, 6/14	0a	0a	0	0
F[a]			1.07	2.04	-	-
P > F			0.4093	0.0612	-	-

For each effect, means within the same column followed by the same letter are not significantly different (*P* > 0.05; Tukey's [1953] HSD).
[a] d.f. = 10, 32.

doi: 10.4182/amt.2011.F104

F104

TOBACCO: *Nicotiana tabacum* L. Flue-cured 'NC 297'

BUDWORM AND HORNWORM CONTROL WITH FOLIAR SPRAYS ON FLUE-CURED TOBACCO IN VIRGINIA, 2010:

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Tobacco budworm: *Heliothis virescens* (Fabricius)
Tobacco hornworm: *Manduca sexta* (Linnaeus)

This experiment was conducted at the Virginia Tech SPAREC, Blackstone, VA to evaluate the performance of various insecticides applied as foliar sprays for TBW and THW control on flue-cured tobacco. Ten treatments were established in a RCB design with 4 replicates. Single row plots 40 ft long (22 plants) with 4-ft row spacing and plants spaced 22 inches apart were separated by single untreated buffer rows. Blocks were separated by 5-ft unplanted buffers. The plots were transplanted into 'CC 27' flue-cured tobacco on 5 May. All plots were maintained according to standard production practices. After an unsuccessful test was completed, the buffer rows were cut back on 16 Jul and single suckers were turned out on each plant on 31 Jul, and additional fertilizer (200 lb/acre 14-0-14) was applied on 13 Aug. On 16 Aug, 20 plants/plot were artificially infested with 3-day-old TBW larvae. Natural infestations of THW were utilized. On 17 Aug, insecticide treatments were applied as foliar sprays using a CO_2-pressurized backpack sprayer calibrated to deliver 32 gpa through three TX-12 nozzles per row at 60 psi. TBW and THW larvae were counted on 20 plants/plot on 20, 24, and 31 Aug, and 9 and 16 Sep (3, 7, 14, 23, and 30 DAT). The number of missing leaves associated with TBW damage was estimated for 20 plants per plot on 21 Sep (35 DAT). Data were analyzed by ANOVA, and significantly different means were separated by SNK. TBW, missing leaf, and THW data were transformed to SQRT (x + 0.5). Actual means are presented in the tables.

After the artificial infestation, TBW populations were at excellent levels for the experiment and natural infestations built up as well. All treatments gave significant reductions in TBW populations 3 and 7 DAT (Table 1). Coragen, Tracer, and the 3 fl oz/acre rate of Belt gave the best control at 14 and 23 DAT. Orthene, HGW86, and Capture were the least effective treatments at 14 DAT (Table 1). Differences among the treatments at 23 and 30 DAT were not significant due to natural TBW infestations late in the trial. . On 21 Sep, tobacco treated with the two rates of Coragen and the high rate of HGW86 had the lowest numbers of missing leaves (Table 1). The Belt and Tracer treatments also had low numbers of missing leaves. Tobacco treated with the low rate of HGW86 and Orthene had significantly more missing leaves than the most effective treatments. THW populations were extremely low in the test until 23 and 30 DAT. All treatments gave significant control of THW through 30 DAT (Table 2). Very few THW occurred in the treated plots at 23 DAT, but populations were beginning to build up in plots treated with the 2 fl oz/acre rate of Belt and Tracer on 16 Sep.

 doi: 10.4182/amt.2011.F104

Table 1.

Treatment	Rate Form/Acre	TBW/20 plants [a] 3 DAT 20 Aug	7 DAT 24 Aug	14 DAT 31 Aug	23 DAT 9 Sep	30 DAT 16 Sep	Missing leaves per 20 plants 21 Sep
Coragen 1.67SC	3.5 fl oz	4.5b	3.5bcd	6.3cd	5.3a	2.3a	1.5c
Coragen 1.67SC	5.0 fl oz	5.0b	3.0bcd	4.8d	5.5a	2.0a	3.5bc
HGW86 10OD	6.75 fl oz	3.0b	7.5bc	16.0abc	7.8a	3.5a	11.5b
HGW86 10OD	13.5 fl oz	5.3b	4.5bcd	9.5abcd	8.5a	3.0a	4.8bc
Belt 4SC	2.0 fl oz	4.0b	3.8bcd	8.0bcd	5.5a	3.3a	6.3bc
Belt 4SC	3.0 fl oz	6.8b	1.3d	3.8d	5.3a	2.5a	7.8bc
Tracer 4F	2.0 fl oz	1.5b	2.3cd	6.0cd	8.3a	3.3a	7.0bc
Capture 2EC	6.4 fl oz	6.3b	6.0bcd	12.3abcd	7.0a	3.3a	10.0bc
Orthene 97SG	0.773 lb	6.8b	8.3b	16.8ab	6.5a	3.0a	11.3b
Untreated check		15.8a	20.8a	19.0a	9.3a	4.8a	85.8a

[a] Means within a column not followed by the same letter(s) are significantly different ($P \leq 0.05$) SNK.

Table 2.

Treatment	Rate (amt form/acre)	THW/20 plants [a] 23 DAT 9 Sep	30 DAT 16 Sep
Coragen 1.67SC	3.5 fl oz	0.0b	0.8b
Coragen 1.67SC	5.0 fl oz	0.0b	1.0b
HGW86 10OD	6.75 fl oz	0.0b	1.3b
HGW86 10OD	13.5 fl oz	0.0b	0.5b
Belt 4SC	2.0 fl oz	0.3b	3.0b
Belt 4SC	3.0 fl oz	0.0b	0.5b
Tracer 4F	2.0 fl oz	0.0b	4.3b
Capture 2EC	6.4 fl oz	0.0b	1.0b
Orthene 97SG	0.773 lb	0.0b	2.3b
Untreated check		4.5a	25.0b

[a] Means within a column not followed by the same letter(s) are significantly different ($P \leq 0.05$) SNK.

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(F91)

TOBACCO: *Nicotiana tabacum* L. ‘K326’

FOLIAR APPLICATIONS OF INSECTICIDE FOR TOBACCO BUDWORM AND TOBACCO HORNWORM CONTROL ON TOBACCO IN SOUTH CAROLINA, 2011

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm (THW): *Manduca sexta* (Linnaeus)

A tobacco trial using cultivar ‘K326’ was conducted in 2011 at the Pee Dee Research and Education Center in Florence, SC, to evaluate foliar applications of insecticide for TBW and THW control. The test included untreated and tobacco treated with chlorantraniliprole, flubendiamide, emamectin benzoate, or spinosad. An RBD experiment with four replications was conducted with six treatments and a check. Plots were 2 rows (~26 plants per row) by 40 ft and separated by single unplanted rows. A CO_2-pressurized back pack sprayer with a Cone Jet T hollow cone nozzle size 10 (30-35 psi) was used to apply tray drench applications of imidacloprid (Admire Pro, 1.2 fl oz / 1000 plants) in ~8.5 fl oz of water/288-plant float tray on 14 Apr, 6 d before transplanting, in all plots except Denim treatments, which received tray drench applications of thiamethoxam (Platinum, 1.3 fl oz / 1000 plants) on the same day. The plants were watered lightly after insecticide application to wash the residue off the plants and into the media. Tobacco was transplanted into field plots on 19 Apr. Recommendations were followed for fertilization, cultivation, topping, weed, and sucker control. A soil nematicide (1,3-dichloropropene) was used on 10 Feb. After transplant, 10 plants per plot were randomly selected and examined on every leaf weekly for live TBW or THW larvae until 8/22/2011. In each plot, plants were classified as having no larva, small hornworm, medium hornworm, large hornworm, small budworm, medium budworm, large budworm, or combinations of sizes of both species. Applications were made when 10% of plants had live larvae present, unless a majority were newly hatched first instars. Foliar applications of insecticide were made with a 3 nozzle (tip DVP 3, Core 25) per row arrangement at 23 gpa and 40PSI with a CO_2 tank. Crop stages were 7 to 10 leaves on 26 May, and 12 leaves on 10 Jun. Green leaf weight of ripe tobacco was taken on the bottom quarter (18 Jul), second quarter (1 Aug), third quarter (16 Aug), and top quarter (5 Sep) portions of five plants on the left row within each plot. Data were analyzed with a one-way ANOVA (PROC MIXED). Proportion of plants infested with larvae was square-root arcsine transformed prior to ANOVA to normalize their distribution. Three applications of Tracer and Denim, two applications of Belt (both rates) and Coragen (both rates) were made.

Data are presented in Tables 1 and 2 for each sampling date. Yield was not significantly affected by insecticide treatment ($F = 1.50$; d.f. = 6, 20; $P = 0.2288$).

Table 1.

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%) 5/11	5/18	5/25	5/31	6/6
Check	-	-	0.0a	5.0a	5.0a	10.0a	30.0a
Tracer	2	5/25, 6/14, 6/27	0.0a	7.5a	15.0a	2.5a	2.5bc
Belt	2	5/25, 6/14	2.5a	2.5a	7.5a	2.5a	2.5bc
Belt	3	5/25, 6/14	2.5a	5.0a	15.0a	0.0a	2.5bc
Coragen	3.5	5/25, 6/14	2.5a	2.5a	20.0a	2.5a	0.0c
Coragen	5	5/25, 6/14	0.0a	5.0a	15.0a	2.5a	7.5abc
Denim	10	5/25, 6/6, 6/27	5.0a	7.5a	37.5a	2.5a	20.0ab
F[a]			0.43	0.18	1.62	1.27	5.98
P > F			0.8225	0.9802	0.1929	0.3131	0.0010

For each effect, means within the same column followed by the same letter are not significantly different ($P = 0.05$; Tukey's [1953] HSD).
[a] d.f. = 6, 20.

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Table 2

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%)				
			6/14	6/21	6/27	7/5	7/10
Check	-	-	17.5ab	5.0a	12.5a	5.0a	2.5a
Tracer	2	5/25, 6/14, 6/27	37.5a	0.0b	10.0a	5.0a	5.0a
Belt	2	5/25, 6/14	25.0ab	0.0b	2.5a	0.0a	0.0a
Belt	3	5/25, 6/14	30.0a	0.0b	0.0a	0.0a	0.0a
Coragen	3.5	5/25, 6/14	17.5ab	0.0b	2.5a	0.0a	0.0a
Coragen	5	5/25, 6/14	15.0ab	0.0b	0.0a	0.0a	0.0a
Denim	10	5/25, 6/6, 6/27	0.0b	0.0b	17.5a	2.5a	0.0a
F[a]			3.44	3.23	1.87	1.13	1.97
P > F			0.0169	0.0221	0.1371	0.3826	0.1184

For each effect, means within the same column followed by the same letter are not significantly different (*P* = 0.05; Tukey's [1953] HSD).
[a] d.f. = 6, 20.

(F92)

TOBACCO: *Nicotiana tabacum* L. Flue-cured 'NC 297'

BUDWORM AND HORNWORM CONTROL WITH FOLIAR SPRAYS ON FLUE-CURED TOBACCO IN VIRGINIA, 2011

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm (THW): *Manduca sexta* (Linnaeus)

This experiment was conducted at the Virginia Tech SPAREC, Blackstone, VA to evaluate the performance of various insecticides applied as foliar sprays for TBW and THW control on flue-cured tobacco. Ten treatments and an untreated check were established in a RCB design with 4 replicates (Table 1). Single row plots 40 ft long (22 plants) with 4-ft row spacing and 22 inch plant spacing were separated by single untreated buffer rows. Blocks were separated by 5-ft unplanted buffers. The test was transplanted with 'NC 297' flue-cured tobacco on 3 May. All plots were maintained according to standard production practices. After an unsuccessful test was completed, the buffer rows were cut back on 16 Jul, single suckers were turned out on each plant on 27 Jul, and additional fertilizer (200 lb per acre 14-0-14) was applied on 5 Aug. On 12 Aug, 20 plants/plot were artificially infested with 3-day-old TBW larvae. Natural infestations of THW were utilized. On 15 Aug, insecticide treatments were applied as foliar sprays using a CO_2-pressurized backpack sprayer calibrated to deliver 25 gpa through three TX-10 nozzles per row at 60 psi. TBW and THW were counted on 12, 18, 22, and 29 Aug, and 7 and 15 Sep, 3 days before treatment, and 3, 7, 14, 23, and 31 DAT. TBW were counted on 20 plants per plot and THW were counted on 10 plants per plot. The number of plants damaged by TBW were counted on 29 Aug, 14 DAT. The number of missing leaves associated with THW damage was estimated for 20 plants per plot on 7 Sep, 23 DAT. Data were analyzed by ANOVA, and significantly different means were separated by SNK (P=0.05). TBW, THW and missing leaf data were transformed to SQRT (x + 0.5). Actual means are presented in the tables.

Coragen, Blackhawk, Brigadier, HGW-86, Tracer, and the 3 fl oz/acre rate of Belt gave significant control of the TBW on 22 Aug, 7 DAT (Table 1). Orthene, Dipel, Xentari, and the 2 fl oz rate of Belt were the least effective treatments. All treatments gave significant control of THW through 31 DAT (Table 2). However, Assail was less somewhat less effective than the other treatments. At 23 DAT, all treatments including Assail gave significant reductions in the number of leaves lost. This research was supported by industry gifts of pesticide and research funding.

doi: 10.4182/amt.2012.F92

Table 1.

Treatment	Rate amt form/acre	Pretreatment Aug 12	TBW/20 plants[a] 3 DAT Aug 18	TBW/20 plants[a] 7 DAT Aug 22	TBW/20 plants[a] 14 DAT Aug 29	TBW damaged plants/ 20 plants[a] 14 DAT Aug 29
Coragen 1.67SC	3.5 fl oz	3.3a	1.5a	0.8b	0.8ab	1.5cd
Coragen 1.67SC	5.0 fl oz	1.0a	1.8a	0.5b	0.5ab	1.8cd
HGW-86 200SC	6.75 fl oz	2.3a	2.0a	1.3b	0.3b	1.3cd
Assail 30WG	4 oz	1.5a	4.3a	3.8ab	0.8ab	2.8bcd
Belt 1.6F	2 fl oz	3.0a	3.8a	2.3ab	1.3ab	2.3cd
Belt 1.6F	3 fl oz	1.8a	1.8a	1.0b	1.0ab	1.0cd
Tracer 4F	2 fl oz	2.3a	1.8a	0.5b	0.5ab	1.3cd
Brigadier 2SC	6.4 fl oz	2.0a	2.8a	0.8b	1.3ab	2.0cd
Blackhawk WG	3.2 oz	2.5a	1.5a	0.3b	0.3b	0.8d
Orthene 97WSG	0.773 lb	2.8a	5.0a	2.8ab	2.8ab	4.0abc
Dipel WG	1 lb	3.3a	3.0a	3.0ab	1.8ab	2.3cd
Xentari WG	1 lb	1.8a	3.5a	3.5ab	3.0a	5.0ab
Untreated check		3.0a	4.5a	5.5a	2.8ab	6.0a

Means within a column not followed by the same letter(s) are significantly different as indicated by SNK (p=0.05).
[a] In addition to TBW in pretreatments, all plants were artificially infested with 2 second instar budworms/plants.

Table 2.

Treatment	Rate amt form/acre	THW/20 plants Pretreatment [a] Aug 12	THW/10 plants 3 DAT Aug 18	THW/10 plants 7 DAT Aug 22	THW/10 plants 14 DAT Aug 29	THW/10 plants 23 DAT Sep 7	THW/10 plants 31 DAT Sep 15	Total leaves lost/20 plants 23 DAT Sep 7
Coragen 1.67SC	3.5 fl oz	13.5a	0.0b	0.0c	0.0c	0.0a	9.3a	3b
Coragen 1.67SC	5.0 fl oz	14.3a	0.3b	0.0c	0.0c	0.0a	3.5a	2b
HGW-86 200SC	6.75 fl oz	12.3a	1.0b	0.0c	0.0c	0.0a	3.3a	3b
Assail 30WG	4 oz	12.5a	8.3a	8.5b	3.3b	1.5a	8.5a	5b
Belt 1.6F	2 fl oz	16.0a	0.8b	0.0c	0.0c	0.8a	4.0a	3b
Belt 1.6F	3 fl oz	14.3a	1.5b	0.0c	0.3c	0.8a	5.0a	2b
Tracer 4F	2 fl oz	14.5a	1.0b	0.0c	0.0c	0.8a	3.3a	2b
Brigadier 2SC	6.4 fl oz	14.3a	0.3b	0.0c	0.0c	0.0a	3.3a	3b
Blackhawk WG	3.2 oz	13.3a	0.0b	0.0c	0.0c	3.0a	3.0a	3b
Orthene 97WSG	0.773 lb	14.0a	0.0b	0.0c	0.0c	0.0a	2.3a	4b
Dipel WG	1 lb	13.8a	0.3b	0.0c	0.0c	0.0a	3.5a	4b
Xentari WG	1 lb	13.3a	0.3b	0.0c	0.0c	0.0a	2.8a	3b
Untreated check		11.3a	13.0a	18.3a	11.5a	4.5a	12.5a	45a

Means within a column not followed by the same letter(s) are significantly different as indicated by SNK (p=0.05).

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(F93)

TOBACCO: ***Nicotiana tabacum*** L., Flue-Cured 'NC 297'

SYSTEMIC INSECTICIDES APPLIED BY VARIOUS METHODS FOR INSECT CONTROL ON FLUE-CURED TOBACCO IN VIRGINIA, 2011

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm (THW): *Manduca sexta* (Linnaeus)
Tobacco flea beetle (TFB): *Epitrix hirtipennis* (Melsheimer)

Various insecticides applied as tray drench (TD), transplant water (TPW), side-dress soil drench (SDSD), and foliar (F) treatments were evaluated for TBW, THW, GPA, and TFB control on flue-cured tobacco. Eleven treatments were established in a RCB design with 4 replicates at the Virginia Tech Southern Piedmont AREC, Blackstone, VA (Table 1). Plots were 8 x 40 ft (2 rows x 22 plants) and separated by single untreated buffer rows. Standard production practices were followed. Admire Pro, Platinum, and HGW86 were applied as tray drench (TD) treatments to seedlings in 288-cell float trays on 2 May, 1 day before transplanting. Treatments were applied with a CO_2-pressurized backpack sprayer that delivered 10 fl oz of solution per tray through 8002E tips at 30 psi. 'NC 297' flue-cured tobacco was transplanted on 3 May. Immediately after transplanting, Coragen (2 rates) and HGW86 TPW treatments were applied in 4 fl oz/plant (185 gpa) with a measuring cup. The soil moisture was excellent and it rained 1.38 inches on 4 May. On May 31, Coragen SDSD treatments were applied in 20 gpa with a CO_2-pressurized backpack sprayer that delivered 60 psi through 8002E nozzles directed in 6-inch bands on each side of the row and immediately incorporated by cultivation. Soil moisture was good. On 7 Jun, Belt and Coragen S were applied with a CO_2-pressurized backpack sprayer that delivered 25 gpa through three TX-10 nozzles per row at 60 psi. TBW, THW, and damaged plants were counted on 22 plants per plot on 8, 15, 22, and 29 Jun, and 5 Jul. TFB and TFB feeding holes were counted weekly on 10 plants per plot from 18 May to 15 Jun. The numbers of missing leaves due to TBW and THW feeding damage were rated on 5 Jul and the number of plants with type 2 TBW damage (topped) was determined for 44 plants per plot on 11 Jul. Insect count and yield data were analyzed by ANOVA and significantly different means were separated by SNK (P=0.05). Counts for TBW and THW were transformed to sqrt(x+1). Data for TFB and TFB feeding holes were transformed to Log (x+1) before analysis. Actual means are presented in the tables.

The Admire Pro and Platinum TD treatments had higher TBW populations, damaged plants, and level of type 2 damage than the Coragen TPW and SD treatments (Table 1). TBW populations and damage levels were low for all other treatments. On 15 and 21 Jun, 14 and 21 DAT, Coragen SDSD at 7 fl oz per acre, and Coragen and Belt S treatments had the fewest damaged plants (Table 1). The 7 fl oz per acre rates of Coragen as TPW and SDSD treatments, and Coragen and Belt S treatments gave the greatest reductions in type 2 damage (Table 1). The Admire Pro and Platinum TD treatments and untreated check had the most THW, THW damaged plants, and missing leaves (Table 2). The remaining treatments gave excellent THW control through 29 Jun. Coragen applied at 7 fl oz per acre as TPW and SDSD and the 5 fl oz per acre S treatments gave the greatest reduction in TBW damage (Table 2). Platinum, Admire Pro, and HGW86 TD treatments were most effective against the TFB (Table 3). On 15 Jun (6 weeks after transplanting), the HGW86 and Coragen S and the Admire Pro and Platinum TD treatments had significantly lower TFB populations than the Coragen SDSD treatments (Table 3). The least TFB feeding damage occurred in the Platinum and Admire TD treatments through 1 Jun and the HGW86 TPW through 25 May. No phytoxicity was observed. This research was supported by industry gifts of pesticide and research funding.

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Table 1.

Treatment	Rate amt form/ acre	Application method [a]	TBW/22 plants			TBW damaged plants/ 22 plants			Topped plants (%) (Type 2 damage)	Missing leaves/ 22 plants
			8 Jun	15 Jun	22 Jun	8 Jun	22 Jun	29 Jun	11 Jul	5 Jul
Coragen 1.67SC	5 fl oz	TPW	2.0b	2.8ab	1.1a	3.8c	7.5abc	6.3abc	4.5bcd	3.3cd
Coragen 1.67SC	7 fl oz	TPW	1.5b	2.3ab	0.6a	3.3c	6.9abc	6.5abc	3.4cd	4.0bcd
HGW-86 200SC	1.3 fl oz	TPW	1.9b	5.3a	1.3a	3.8c	6.1abc	10.0ab	9.1abcd	8.0bcd
Coragen 1.67SC	5 fl oz	SDSD	1.9b	1.8ab	0.1a	4.8bc	4.8bcd	5.3bc	5.7abcd	4.3bcd
Coragen 1.67SC	7 fl oz	SDSD	1.3b	1.1bc	0.0a	4.5bc	2.0d	3.0cd	0.6d	5.4bcd
HGW-86 200SC	10.3 fl oz	TD	2.0b	2.4ab	1.8a	3.4c	7.8abc	9.5ab	8.5abcd	5.5bcd
Coragen 1.67SC	5 fl oz	S	1.1b	0.8b	0.5a	5.9bc	3.6cd	2.0d	2.8cd	2.0d
Belt 2SC	2 fl oz	S	0.8b	1.0ab	0.4a	5.0bc	3.4cd	1.8d	2.8cd	1.8d
Admire Pro 4.6SC	4.8 fl oz	TD	6.0a	4.8a	1.4a	9.0ab	9.8ab	11.5a	11.9ab	10.1a
Platinum 2SC	4.8 fl oz	TD	5.9a	4.0ab	1.5a	1.9a	10.6b	8.8ab	12.5a	9.0ab
Untreated			1.8b	2.0ab	1.0a	4.3c	8.3abc	7.5ab	6.3abcd	4.8bcd

Means within a column not followed by the same letter(s) are significantly different as indicated by SNK (P=0.05)
[a] Application methods: TPW = Transplant water applications on 3 May; SDSD = Soil drench side-cress on 31 May; TD = Seedling tray drench, 1 day before transplanting on 2 May; S = Foliar spray on 7 Jun.

Table 2.

Treatment	Rate amt form/ acre	Application method [a]	THW/22 plants			Leaves missing /22 plants	THW damaged plants /44 plants			Total missing leaves /22 plants
			15 Jun	29 Jun	5 Jul	5 Jul	8 Jun	15 Jun	5 July	
Coragen 1.67SC	5 fl oz	TPW	0.4b	0.0b	0.3c	6.5ab	0.9cd	1.1bc	13.3ab	6.6b
Coragen 1.67SC	7 fl oz	TPW	0.1b	0.3ab	0.8bc	5.8ab	0.9cd	2.1bc	11.0ab	5.6b
HGW-86 200SC	1.3 fl oz	TPW	0.5b	0.3ab	0.5bc	9.3ab	0.8cd	2.0bc	15.3ab	11.3b
Coragen 1.67SC	5 fl oz	SDSD	0.0b	0.3ab	1.3bc	6.5ab	1.6bcd	2.8bc	10.3ab	11.3b
Coragen 1.67SC	7 fl oz	SDSD	0.0b	0.0b	0.8bc	2.3b	1.3cd	2.3bc	4.8b	6.3b
HGW-86 200SC	10.3 fl oz	TD	0.0b	0.0b	1.5bc	8.8ab	0.1d	0.8c	15.0ab	11.8b
Coragen 1.67SC	5 fl oz	S	0.0b	0.0b	0.3c	2.5b	2.4abcd	3.4bc	5.8b	4.3b
Belt 2SC	2 fl oz	S	0.1b	0.0b	0.5bc	6.3ab	3.6ab	3.6b	7.3ab	5.8b
Admire Pro 4.6SC	4.8 fl oz	TD	4.8a	0.0ab	3.0ab	13.0a	3.4abc	11.5a	23.0a	22.9a
Platinum 2SC	4.8 fl oz	TD	3.0a	1.5a	4.3a	13.3a	2.1abcd	10.4a	23.0a	21.3a
Untreated			4.4a	0.3ab	2.5abc	9.8ab	4.8a	10.0a	17.5a	12.4b

Means within a column not followed by the same letter(s) are significantly different as indicated by SNK (P=0.05).
[a] Application methods: TPW = Transplant water applications on 3 May; SDSD = Soil drench side-cress on 31 May; TD = Seedling tray drench, 1 day before transplanting on 2 May; S = Foliar spray on 7 June.

Table 3.

Treatment	Rate amt form/ acre	Application method [a]	TFB/10 plants			TFB/feeding holes/10 plants [a]		
			18 May	25 May	15 Jun	18 May	25 May	1 Jun
Coragen 1.67SC	5 fl oz	TPW	11.5ab	10.5ab	13.6ab	283a	319a	240a
Coragen 1.67SC	7 fl oz	TPW	8.8ab	12.0a	12.8ab	293a	343a	255a
HGW-86 200SC	1.3 fl oz	TPW	4.5abc	4.8abcd	4.3b	76b	78b	155a
Coragen 1.67SC	5 fl oz	SDSD	8.8ab	8.3abc	11.7ab	380a	274a	248a
Coragen 1.67SC	7 fl oz	SDSD	12.5a	5.8abcd	16.3a	398a	319a	261a
HGW-86 200SC	10.3 fl oz	TD	2.5bc	1.8bcd	8.6ab	28c	26b	51b
Coragen 1.67SC	5 fl oz	S	7.8ab	7.8abc	4.0b	341a	266a	258a
Belt 2SC	2 fl oz	S	6.3abc	9.3ab	15.7a	339a	336a	275a
Admire Pro 4.6SC	4.8 fl oz	TD	2.0cd	1.0d	9.0ab	4e	11b	55b
Platinum 2SC	4.8 fl oz	TD	0.0d	1.3cd	6.0ab	10d	18b	26c
Untreated			7.0abc	7.0abcd	14.1ab	334a	279a	254a

Means within a column not followed by the same letter(s) are significantly different as indicated by SNK (P=0.05).
[a] Application methods: TPW = Transplant water applications on 3 May; SDSD = Soil drench side-cress on 31 May; TD = Seedling tray drench, 1 day before transplanting on 2 May; S = Foliar spray on 7 June.

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(F76)

TOBACCO: *Nicotiana tabacum* L. 'K346'

FOLIAR APPLICATIONS OF INSECTICIDE FOR TOBACCO BUDWORM AND TOBACCO HORNWORM CONTROL ON TOBACCO IN SOUTH CAROLINA, 2012

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Tobacco budworm (TBW): *Heliothis virescens* (Fabricius)
Tobacco hornworm (THW): *Manduca sexta* (Linnaeus)

A tobacco trial using cultivar 'K346' was conducted in 2012 at the Pee Dee Research and Education Center in Florence, SC, to evaluate foliar applications of insecticides for TBW and THW control. The test included untreated and tobacco treated with chlorantraniliprole and lambda-cyhalothrin, flubendiamide, emamectin benzoate, or spinosad. An RBD experiment with four replications was conducted with seven treatments and a check. Plots were 2 rows (~26 plants per row) by 40 feet and separated by single unplanted rows. A CO_2-pressurized back pack sprayer with a Cone Jet T hollow cone nozzle size 10 (30-35 psi) was used to apply tray drench applications of imidacloprid (Admire Pro, 1.2 fl oz / 1000 plants) in ~8.5 fl oz of water/288-plant float tray on 19 April, 6 d before transplanting in all plots. The plants were watered lightly after insecticide application to wash the residue off the plants into the soil media. Tobacco was transplanted into field plots on 25 April. Recommendations were followed for fertilization, cultivation, topping, weed, and sucker control. A soil nematicide (1,3-dichloropropene) was used on 10 February. After transplant, 10 plants per plot were randomly selected and examined on every leaf weekly for live TBW or THW larvae until 8/27/2012. In each plot, plants were classified as having no larva, small hornworm, medium hornworm, large hornworm, small budworm, medium budworm, large budworm, or combinations of sizes of both species. Applications were made when 10% of plants had live larvae present, unless a majority were newly hatched first instars. Foliar applications of insecticide were made with a 3 nozzle (tip DVP 3, Core 25) per row arrangement at 23 gal/ac and 40PSI with a CO_2 tank. Crop stages were 7 to 10 leaves on 5/28/2012, and 12 leaves 6/13/2012. Green leaf weight of ripe tobacco was taken on the bottom third (11 July), middle third (14 August), and top third (6 September) portions of five plants on the left row within each plot. Data were analyzed with a one-way ANOVA (JMP). Proportion of plants infested with larvae was square-root arcsine transformed prior to ANOVA to normalize their distribution.

Three to four applications of Tracer and Denim, three applications of Belt and two to three applications of Besiege were made. Data are presented in Tables 1 and 2 for each sampling date. Yield was not significantly affected by insecticide treatment ($F = 0.77$; d.f. = 7, 24; $P = 0.6160$).

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Table 1.

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%)							
			5/21	5/28	6/4	6/11	6/18	6/25	7/2	7/9
Check	---	---	2.5a	2.5a	65.0a	62.5a	57.5a	30.0a	5.0a	2.5a
Tracer	1.25	6/4, 6/11, 8/20	2.5a	2.5a	55.0a	32.5a	10.0b	5.0a	7.5a	7.5a
Tracer	1.75	5/28, 6/11, 7/23, 8/20	0a	12.5a	7.5b	22.5a	2.5b	5.0a	7.5a	5.0a
Denim	8	6/4, 6/11, 8/17	0a	2.5a	60.0a	25.0a	5.0b	5.0a	10.5a	2.5a
Denim	12	6/4, 6/11, 6/25, 8/27	0a	7.5a	55.0a	22.5a	5.0b	10.0a	0a	0a
Besiege	5	6/4, 6/11, 7/30	0a	0a	60.0a	30.0a	2.5b	7.5a	7.5a	2.5a
Besiege	9	6/4, 6/11	2.5a	0a	55.0a	37.5a	5.0b	0a	2.5a	2.5a
Belt	3	6/4, 6/11, 8/6	0a	0a	60.0a	32.5a	5.0b	2.5a	0a	0a
P > F			0.6607	0.0754	0.0022	0.1839	0.0001	0.1803	0.70	0.6139

For each effect, means within the same column followed by the same letter are not significantly different (P > 0.05; Tukey's [1953] HSD).

Table 2

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%)						
			7/16	7/23	7/30	8/6	8/13	8/20	8/27
Check	---	---	0a	2.5a	20.0a	17.5a	12.5a	10.0a	52.5a
Tracer	1.25	6/4, 6/11, 8/20	0a	7.5a	0b	0a	2.5a	12.5a	0d
Tracer	1.75	5/28, 6/11, 7/23, 8/20	0a	17.5a	2.5b	0a	5.0a	12.5a	5.0cd
Denim	8	6/4, 6/11, 8/17	2.5a	0a	0b	0a	5.0a	10.0a	15.0bc
Denim	12	6/4, 6/11, 6/25, 8/27	0a	0a	0b	0a	2.5a	5.0a	30.0ab
Besiege	5	6/4, 6/11, 7/30	0a	7.5a	17.5a	0a	0a	0a	0d
Besiege	9	6/4, 6/11	0a	0a	0b	0a	2.5a	2.5a	2.5cd
Belt	3	6/4, 6/11, 8/6	0a	10.0a	2.5b	12.5a	0a	0a	0d
P > F			0.4553	0.1729	0.0050	0.2620	0.5011	0.2313	0.0001

For each effect, means within the same column followed by the same letter are not significantly different (*P* > 0.05; Tukey's [1953] HSD).

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(F76)

TOBACCO: *Nicotiana tabacum* L. 'K346'

FOLIAR APPLICATIONS OF INSECTICIDE FOR TOBACCO BUDWORM AND TOBACCO HORNWORM CONTROL ON TOBACCO IN SOUTH CAROLINA, 2012

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Three to four applications of Tracer and Denim, three applications of Belt and two to three applications of Besiege were made. Data are presented in Tables 1 and 2 for each sampling date. Yield was not significantly affected by insecticide treatment ($F = 0.77$; d.f. = 7, 24; $P = 0.6160$).

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Table 1.

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%)							
			5/21	5/28	6/4	6/11	6/18	6/25	7/2	7/9
Check	---	---	2.5a	2.5a	65.0a	62.5a	57.5a	30.0a	5.0a	2.5a
Tracer	1.25	6/4, 6/11, 8/20	2.5a	2.5a	55.0a	32.5a	10.0b	5.0a	7.5a	7.5a
Tracer	1.75	5/28, 6/11, 7/23, 8/20	0a	12.5a	7.5b	22.5a	2.5b	5.0a	7.5a	5.0a
Denim	8	6/4, 6/11, 8/17	0a	2.5a	60.0a	25.0a	5.0b	5.0a	10.5a	2.5a
Denim	12	6/4, 6/11, 6/25, 8/27	0a	7.5a	55.0a	22.5a	5.0b	10.0a	0a	0a
Besiege	5	6/4, 6/11, 7/30	0a	0a	60.0a	30.0a	2.5b	7.5a	7.5a	2.5a
Besiege	9	6/4, 6/11	2.5a	0a	55.0a	37.5a	5.0b	0a	2.5a	2.5a
Belt	3	6/4, 6/11, 8/6	0a	0a	60.0a	32.5a	5.0b	2.5a	0a	0a
P > F			0.6607	0.0754	0.0022	0.1839	0.0001	0.1803	0.70	0.6139

For each effect, means within the same column followed by the same letter are not significantly different (P > 0.05; Tukey's [1953] HSD).

Table 2

Treatment/ formulation	Rate (oz / ac)	Timing	Plants infested with live TBH or THW (%)						
			7/16	7/23	7/30	8/6	8/13	8/20	8/27
Check	---	---	0a	2.5a	20.0a	17.5a	12.5a	10.0a	52.5a
Tracer	1.25	6/4, 6/11, 8/20	0a	7.5a	0b	0a	2.5a	12.5a	0d
Tracer	1.75	5/28, 6/11, 7/23, 8/20	0a	17.5a	2.5b	0a	5.0a	12.5a	5.0cd
Denim	8	6/4, 6/11, 8/17	2.5a	0a	0b	0a	5.0a	10.0a	15.0bc
Denim	12	6/4, 6/11, 6/25, 8/27	0a	0a	0b	0a	2.5a	5.0a	30.0ab
Besiege	5	6/4, 6/11, 7/30	0a	7.5a	17.5a	0a	0a	0a	0d
Besiege	9	6/4, 6/11	0a	0a	0b	0a	2.5a	2.5a	2.5cd
Belt	3	6/4, 6/11, 8/6	0a	10.0a	2.5b	12.5a	0a	0a	0d
P > F			0.4553	0.1729	0.0050	0.2620	0.5011	0.2313	0.0001

For each effect, means within the same column followed by the same letter are not significantly different (*P* > 0.05; Tukey's [1953] HSD).

(E41)

TOMATO: *Lyopersicon esculentum* Miller 'Solar Set'

CONTROL OF BEET ARMYWORM IN TOMATO, 2007

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Beet armyworm (BAW), *Spodoptera exigua* Hübner

'Solar Set' tomato seedlings planted on 2 Feb 2007 at TREC in Krome gravelly loam (loamy-skeletal, carbonatic hyperthermic lithic Udorthents), which consists of about 33% soil and 67% pebbles (> 2mm). Experimental plots were randomly selected 30-ft-long segments of three adjacent raised beds 3 ft wide, 0.5 ft high, 6 ft between bed centers and covered with 1.5-mil-thick black polyethylene mulch. The beds were fumigated 2 weeks prior to setting transplants with a mixture containing 67% methyl bromide and 33% chloropicrin at 220 lbs/acre. Seedlings were placed 18 inches apart within rows and drip irrigated and fertigated with 4-0-8. Plots were arranged in a RCBD with four replications. A 5-ft-long nontreated planted area separated each replicate. Treatments were made on 4, 11, 18 and 25 Mar 2007 using a CO_2 backpack sprayer with two nozzles / row delivering 70 gpa at 30 psi. Treatments were evaluated by thoroughly checking 5 randomly selected plants per treatment plot for armyworm larvae 48 h after each application. The larvae were then separated into small, medium and large categories. A prespray sample was collected on 3 Mar. Data were analyzed by performing ANOVA and means separation using the Duncan Multiple Range Test (DMRT).

Population abundance of beet armyworm was medium during this study. All insecticide treatments significantly reduced BAW small larvae on all sampling dates when compared with the nontreated control (Table 1). Similarly, insecticide treatments significantly reduced BAW medium and large larvae when compared with the nontreated control plants (Tables 2 & 3). Similar pattern of BAW control was observed when all larvae were combined (Table 4).

Table 1.

Treatments	Rate oz/acre	Mean number of small larvae/plant					
		3 Mar	6 Mar	13 Mar	20 Mar	27 Mar	Mean
Alverde 240SC + Penetrator plus	16.0 0.5% v/v	0.60a	0.00c	0.20b	0.00b	0.00b	0.05
Avaunt 30WG	3.5	0.90a	0.00c	0.00b	0.00b	0.00b	0.00
Rimon 0.83EC	12.0	0.65a	0.10bc	0.25b	0.05b	0.00b	0.10
Radiant 120SC	7.0	0.90a	0.00c	0.00b	0.00b	0.00b	0.00
Spintor 2SC	8.0	0.75a	0.00c	0.00b	00.0b	0.00b	0.00
Tesoro 4EC	6.4	0.55a	0.25b	0.30b	0.05b	0.20b	0.20
Synapse 24 WG	3.0	0.95a	0.05bc	0.05b	0.00b	0.00b	0.04
Check		0.60a	1.95a	2.35a	1.10a	0.60a	1.50

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Table 2.

Treatments	Rate oz/acre	Mean number of medium size larvae/plant					
		3 Mar	6 Mar	13 Mar	20 Mar	27 Mar	Mean
Alverde 240SC + Penetrator plus	16.0 + 0.5% v/v	0.20a	0.00c	0.15bc	0.00b	0.05b	0.05a
Avaunt 30WG	3.5	0.25a	0.00c	0.00c	0.00b	0.00b	0.00a
Rimon 0.83EC	12.0	0.30a	0.15bc	0.10bc	0.00b	0.05b	0.08a
Radiant 120SC	7.0	0.20a	0.00c	0.00c	0.00b	0.00b	0.00a
Spintor 2SC	8.0	0.20a	0.00c	0.00c	0.00b	0.00b	0.00a
Tesoro 4EC	6.4	0.25a	0.25b	0.40b	0.15b	0.15ab	0.24b
Synapse 24 WG	3.0	0.20a	0.00c	0.10bc	0.05b	0.00b	0.04a
Check		0.30a	1.25a	1.05a	0.55a	0.25a	0.77c

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Table 3.

Treatments	Rate oz/acre	Mean number of large larvae/plant					
		3 Mar	6 Mar	13 Mar	20 Mar	27 Mar	Mean
Alverde 240SC + Penetrator plus	16.0 + 0.5% v/v	0.00a	0.00b	0.00b	0.00b	0.05b	0.01b
Avaunt 30WG	3.5	0.00a	0.00b	0.00b	0.00b	0.00b	0.00b
Rimon 0.83EC	12.0	0.00a	0.00b	0.05b	0.00b	0.00b	0.01b
Radiant 120SC	7.0	0.00a	0.00b	0.00b	0.00b	0.00b	0.00b
Spintor 2SC	8.0	0.00a	0.00b	0.00b	0.00b	0.00b	0.00b
Tesoro 4EC	6.4	0.00a	0.00b	0.10b	0.05b	0.00b	0.04b
Synapse 24 WG	3.0	0.00a	0.05b	0.05b	0.00b	0.00b	0.03b
Check		0.00a	0.20a	0.40a	0.40a	0.60a	0.40a

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Table 4.

Treatments	Rate oz/acre	Mean number of small + medium + large size larvae/plant					
		3 March	6 Mar	13 Mar	20 Mar	27 Mar	Mean
Alverde 240SC + Penetrator plus	16.0 0.5% v/v	0.80a	0.00d	0.35c	0.00b	0.10bc	0.11b
Avaunt 30WG	3.5	1.15a	0.00d	0.00c	0.00b	0.00c	0.00c
Rimon 0.83EC	12.0	0.95a	0.25c	0.40c	0.05b	0.05c	0.19b
Radiant 120SC	7.0	1.10a	0.00d	0.00c	0.00b	0.00c	0.00c
Spintor 2SC	8.0	0.95a	0.00d	0.00c	0.00b	0.00c	0.00c
Tesoro 4EC	6.4	0.80a	0.50b	0.80b	0.25b	0.35b	0.48b
Synapse 24 WG	3.0	1.15a	0.10cd	0.20c	0.05b	0.00c	0.09c
Check		0.90a	3.40a	3.80a	2.05a	1.45a	2.68a

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Arthropod Management Tests 2013, Vol. 38
doi: 10.4182/amt.2013.E70

(E70)

TOMATO: *Lycopersicon esculentum* Mill., 'BHN-585'

CONTROL OF SOUTHERN ARMYWORM ON STAKED TOMATO, 2011

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Southern Armyworm (SAW): *Spodoptera eridania* (Cramer)

Uncontrolled populations of SAW commonly cause defoliation, fruit damage and subsequent yield losses of tomatoes in Florida including where this trial was conducted at the Southwest Florida Research and Education Center in Immokalee. Greenhouse-raised seedlings were planted 6- Sep at 18-inch spacing in raised beds on 6-ft centers, each covered with white faced polyethylene film. A RCB design was used with 4 replications and 11 treatments. A single row in the center of the experiment was left untreated as a pest refuge. Each plot contained 20 plants with six plants left between plots as an untreated buffer. A 12-2-12 NPK granular fertilizer at a rate of 50 lb N/acre was applied preplant and soil incorporated, accounting for 25% of the seasonal application of N. The rest was fertigated daily as a 7- 2- 7 NPK liquid through drip tape with 4-inch emitter spacing. Kocide (3 lbs/acre), Manzate 75 DF (1.5 lbs/acre), and Actigard (0.5 oz acre) were applied as needed for disease control, principally bacterial spot. All plants were treated on 17-Sep with a 120 ml soil drench of a suspension of Venom at 4.0 oz per acre using an EZ-Dose® applicator at 45 psi and a flow rate of 3.7 gpm to suppress the whitefly, *Bemisa tabaci*. Foliar insecticide treatments were applied using a high clearance sprayer with two vertical booms operating at 180 psi, each fitted with horizontally directed ATR 80 ® hollow cone nozzles delivering 10 gpa each. Additional nozzles were added as plants developed to ensure coverage of the entire canopy (Table 1). Ten plants per plot were inspected weekly from 1 Nov thru 29 Nov and the number of SAW larvae observed on either side of each plant was counted. Since several recently hatched egg masses containing over 100, 1st instar larvae were observed on most samples dates, analysis was limited to 3rd thru 6th instars. Defoliation was rated as: 0 = no damage; 1=<5% damaged, 2 = between 5 and 33% damaged; 3 = between 33 and 67% damaged; and 4 = >67% damaged. Eight plants from each plot were harvested on 14 and 28 Dec. Fruit size was graded as XL, large, and medium following USDA criteria. Fruit was also culled into two categories, SAW damage and other causes including shoulder cracking, zippering etc. Data were analyzed with ANOVA and means separation by LSD contingent on a significant treatment effect (P>0.05).

All treatments except those containing one of the formulations of MBI 203 had significantly more marketable fruit and significantly less damage from SAW than the untreated check (Table 2). Least fruit damage was seen with the high rate of Exirel and Synapse followed by Avaunt although not significantly different from all other non-MBI treatments. The greatest number of marketable fruit came from plants receiving 4 applications of the low rate of Exirel or Synapse followed by Avaunt; significantly more than with the Radiant – Intrepid rotation. Greatest weight of marketable fruit was harvested from plants treated 4 applications of Exirel at 10.5 oz/acre, though not different if Avaunt was substituted for the last application or Synapse for the first 3 applications. No significant treatment effects on foliar damage rating were observed on 1 Nov. Otherwise ratings were lower than the untreated check for the low rate of MB1 203 DF1 and all other non-MBI treatments on 8 and 16 Nov and for all treatments on 29 Nov. The only difference between non-MBI-203 treatments occurred on 8 Nov, when less damage was seen with the high rate of Exirel compared to Xentari. Fewer 3rd thru 6th instar larvae compared to the untreated check were observed with the low rate of MBI-203 DF1 on all 4 sample dates and with the remaining MBI-203 treatments on the last two sample dates. There were no significant differences among the remaining treatments although fewest larvae were seen on all sample dates on plants sprayed 3 times with Synapse and once with Avaunt. No phytotoxicity was observed. This research was supported by industry gift(s) of pesticide and/or research funding.

Arthropod Management Tests 2013, Vol. 38
doi: 10.4182/amt.2013.E70

Table 1.

Product/ formulation	Rate amt product/acre	Application Date / gpa								
		28-Oct 60	2-Nov 60	9-Nov 80	15-Nov 80	23-Nov 80	30-Nov 80	6-Dec 80	12-Dec 80	23-Dec 80
Untreated check										
Synapse 24 WG	3.0 oz	x	x	X						
induce	0.25%	x	x	x						
Avaunt	3.5 oz								x	
Xentari	1.5 lb	x	x	X	x	x	x	x	x	
MBI203 DF1	2 lb	x								
MBI203 DF1	0.5 lb		x	X	x	x	x	x	x	X
hyperactive	0.25%	X	x	X	x	x	x	x	x	X
MBI203 DF1	3 lb	X								
MBI203 DF1	1.0 lb		x	X	x	x	x	x	x	X
hyperactive	0.25%	X	x	X	x	x	x	x	x	X
MBI203 DF1	4 lb	X								
MBI203 DF1	2.0 lb		x	X	x	x	x	x	x	X
hyperactive	0.25%	X	x	X	x	x	x	x	x	X
mbiAF2	2 gal	X	x	X	x	x	x	x	x	
hyperactive	0.25%	x	x	x	x	x	x	x	x	
Radiant	6.0 oz	x		X		x		x		x
Intrepid	8.0 oz		x		x		x		x	
Exirel 10 SE	6.75 oz	x	x	X						
induce	0.25%	x	x	X						
Avaunt	3.5 oz								x	
Exirel 10 SE	10.1 oz	x	x	X						
induce	0.25%	x	x	X						
Exirel 10 SE	13.5 oz	x	x	X						
induce	0.25%	x	x	x						

Mississippi State University

Department of Entomology and Plant Pathology

To Environmental Protection Agency:

I have been asked to write a letter detailing my experiences with Belt (flubendiamide) insecticide. Belt was the first chemistry to receive section 3 status in the state of Mississippi in the diamide class of chemistry. Belt and the diamide chemistry has become critically important to the producers in the state of Mississippi to manage caterpillar pests in Cotton, Soybean, Corn, Grain Sorghum, and Peanuts.

The commercial introduction of this compound occurred almost simultaneously with the onset of pyrethroid tolerant/resistant corn earworm in the Midsouth region. Starting in 2009-2010 growers began reporting erratic control and outright failures with pyrethroid insecticides targeting Helicoverpa zea, corn earworm, in soybeans and grain sorghum in Mississippi. There was numerous request by grower groups for us to push the companies for development and implementation of the use of B.t. soybeans in response to these issues.

When the first large scale field trials began to go out with Belt, growers were extremely pleased with the results and the long residual. Our university testing also has shown superior control and residual compared to any products registered or tested previously. Although Belt cost more, producers quickly adopted this product because of its benefits and safety profile.

Belt and the diamide class of chemistry have become so important to our overall caterpillar management program that it has now been said that we still need the introduction of B.t soybeans to take the pressure off this chemistry to delay resistance with this compound well into the future. Belt offers our growers a level of caterpillar control that they have never seen before while at the same time reducing the risk to pollinators compared to more disruptive products.

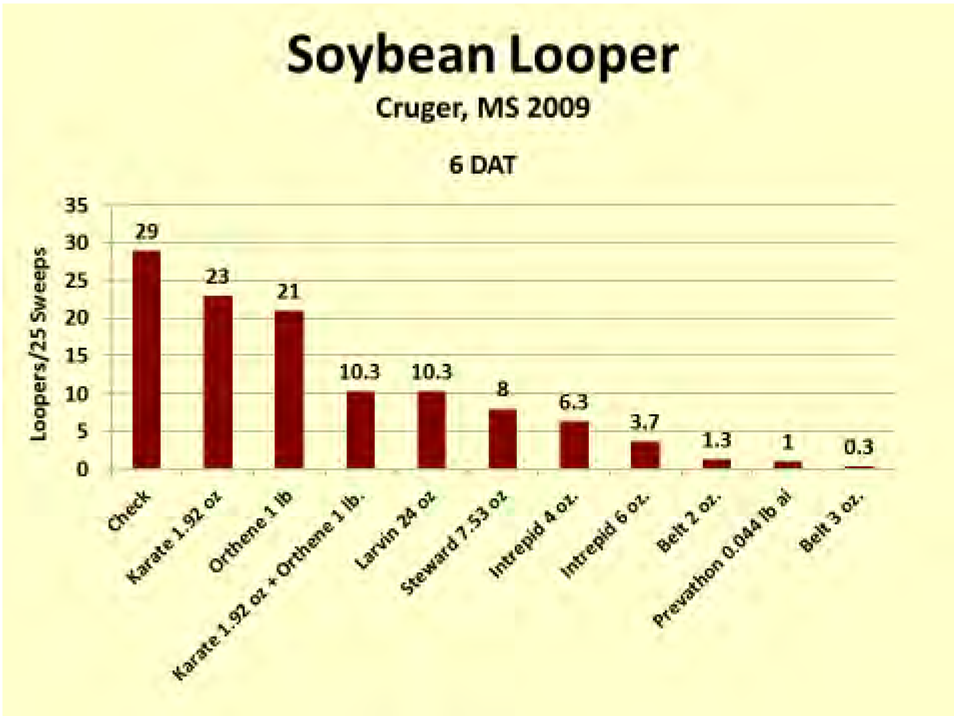
Over the last several years we have been able to successfully incorporate Belt into our IPM programs. The residual that and safety profile on beneficial insects it provides often diplaces multiple applications with harder chemistries therefore solidifying its place in our IPM toolbox in Mississippi.

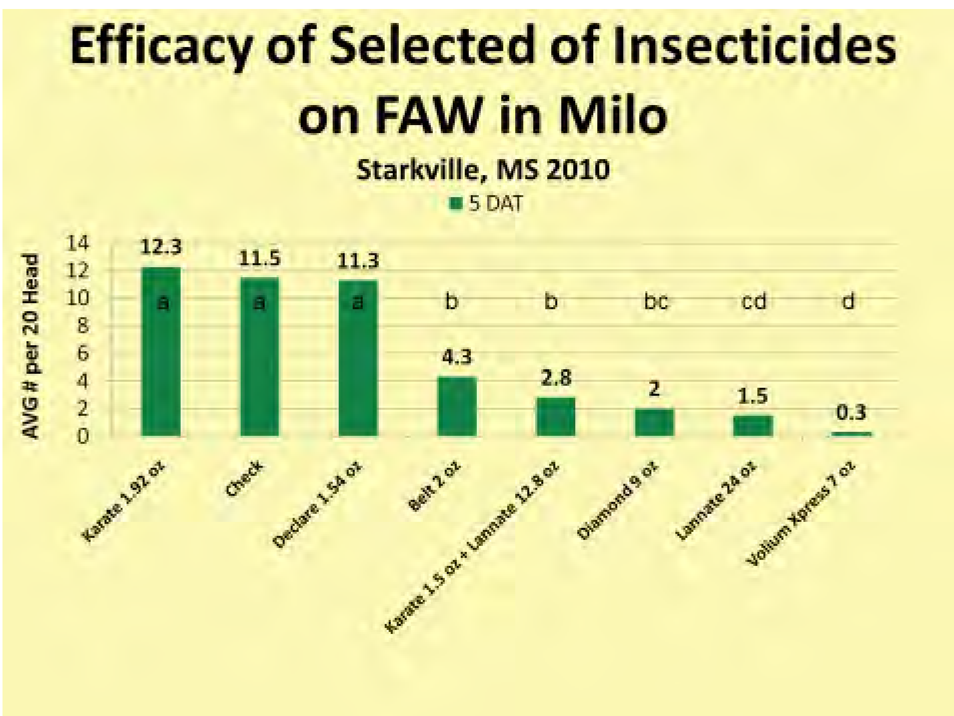
The following are a few examples from previous work showing control with Belt:

Cooperative Extension Service • Mississippi State University
Extension Entomologists: Box 9775 • Mississippi State, MS 39762-9775 • Phone (662) 325-2085 • Fax (662) 325-8837
Extension Plant Pathologists: Box 9655 • Mississippi State, MS 39762-9665 • Phone (662) 325-2146 • Fax (662) 325-8336

Mississippi State UNIVERSITY

Department of Entomology and Plant Pathology





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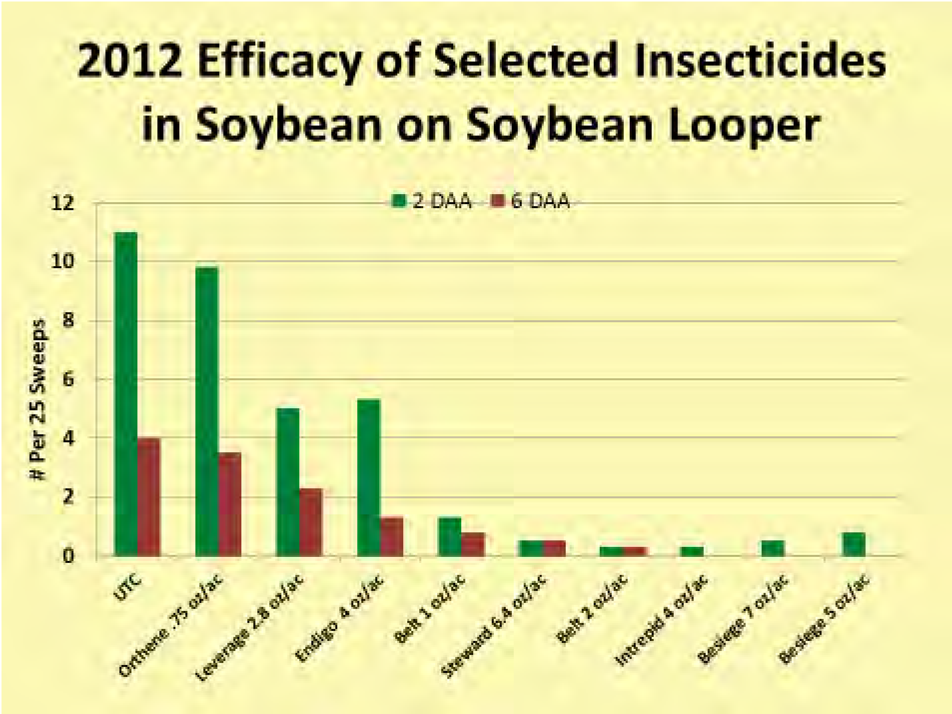

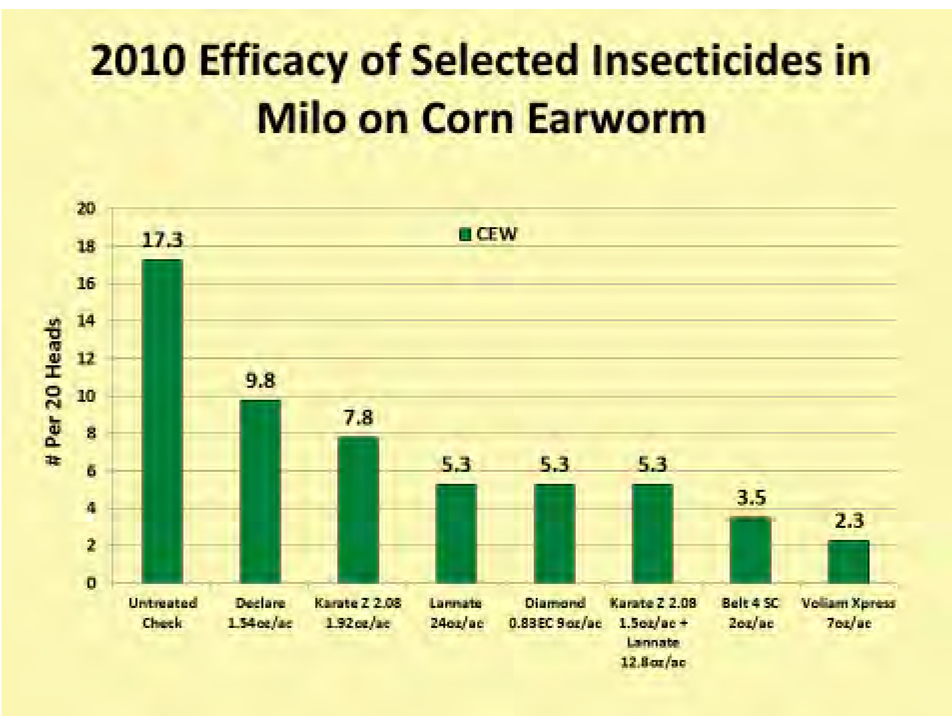

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Mississippi State UNIVERSITY

Department of Entomology and Plant Pathology

I cannot speak to anything other than efficacy and overall importance in our IPM system but you can clearly see that Belt does in fact play an important role across several key crops to manage caterpillar pests in the state of MS.

Thank you.

Sincerely,

Angus Catchot, Extension Entomologist-MSU-ES

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California Alfalfa & Forage Association

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. Environmental Protection Agency
Office of Pesticide Programs

April 30, 2015

Via Email: rodia.carmen@epa.gov

RE: Flubendiamide (BELT) Registration Review

Dear Mr. Rodia:

I am submitting these comments on behalf of the California Alfalfa & Forage Association (CAFA) to express our support for the continued registration of flubendiamide (BELT). CAFA is a non-profit trade association representing thousands of alfalfa growers in California. Between 2013 and 2014, alfalfa growers treated approximately 153,000 acres with Belt to control a number of caterpillar pests, including alfalfa caterpillar, armyworm, cutworm, looper and webworm.

Since 2008, when Belt was made available to growers, it has provided a reliable option for control of a variety of pests. In addition to being an important pest management tool for caterpillar pests, Belt has proven to be an excellent fit into integrated pest management (IPM) systems, which the alfalfa industry employs to protect our crop and the environment. Belt is a selective insecticide that has minimal impact on beneficial insects. In fact, at registration, the conclusion from the EPA after evaluating all of the available data for Belt was that "significant side effects to bumblebees and honey bees are NOT expected".

It is important that the EPA uses sound science and all data including real world monitoring residue data in making their risk assessments and regulatory decisions on this product. We believe that the higher tier monitoring shows that under typical agricultural and environmental conditions, there is no significant accumulation of flubendiamide or its degradate in the water, pore water, or sediment of farm ponds, intermittent streams, or perennial streams.

We encourage continued registration of Belt, as a key insect management tool. Thank you for the opportunity to comment; please contact me if you have any questions.

Sincerely,

Jane Townsend
Executive Director

Delta Research and Extension Center
Delta Branch Experiment Station
Mississippi Agricultural and Forestry Experiment Station
Division of Agriculture, Forestry, and Veterinary Medicine

Mississippi State UNIVERSITY

April 29, 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate and Vertebrate Branch 2

RE: Flubendiamide (Belt) letter of support

Dear Carmen;

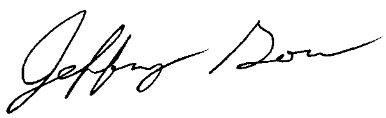
The purpose of this letter is to express my support for the continued registration of the insecticide, flubendiamide (Belt, Bayer CropScience). I am an Associate Professor of Entomology at the Mississippi State University, Delta Research and Extension Center in Stoneville, MS. My primary responsibility is to develop a diverse research and extension program to promote IPM of insect pests in all crops grown in the Mississippi Delta. I evaluated flubendiamide for several years before it was registered and have continued to evaluate it in multiple crops since it was registered. Although flubendiamide has value in many of the crops we grow in Mississippi, I would rate its greatest value in both soybean and peanut.

From a soybean standpoint, the corn earworm has become our most important insect pest in Mississippi and other areas of the Mid-South. This has been compounded by the fact that pyrethroids no longer provide adequate control of this pest. Even if pyrethroids were effective, we would still recommend the use of flubendiamide in most situations. We have multiple yield limiting insect pests of soybean in the Mid-South. However, many of those insect pests are maintained below the current economic thresholds unless natural enemy complexes are disrupted by foliar insecticide sprays. Corn earworm applications generally occur during the early flowering and pod setting stages in soybean (R2-R4). When we make an application with a broad spectrum insecticide, such as a pyrethroid, during those stages, we generally have to follow that application with additional applications from R5 to R6 to manage other pests such as soybean looper. In contrast, we rarely have to make an application for soybean looper during the later stages of soybean development when a flubendiamide application is made during the R2-R4 growth stages. Because of that, flubendiamide has been an integral component of our overall soybean IPM program in Mississippi.

In peanut, we see a similar situation. There is a large complex of caterpillar pests that infest peanut simultaneously in Mississippi. Some of the more important ones include corn earworm, tobacco budworm, granulate cutworm, fall armyworm, and several looper species. It is rare to find only one or two species in a field at any particular time. Flubendiamide provides excellent control of all of these pests in peanut. Additionally, many of these pests are no longer effectively managed with pyrethroids. There are several insecticides labeled for control of caterpillars in peanut, but most of them only control one or two species. Insecticides in the diamide class of insecticides provide good control of all of the caterpillar pests. Similar to soybean, we are also concerned with the disruption of natural enemy complexes with alternative insecticides. In particular, spider mites can be one of the most devastating arthropod pests of peanut and they occur almost exclusively in fields that have received a spray with a broad spectrum insecticide. We rarely see spider mites in peanut fields where natural enemy complexes have not been disturbed. This is especially important because there are currently no miticides labeled in peanut that will effectively manage a spider mite infestation. The only miticide labeled in peanut is propargite (Comite II, Chemtura Corp.), but we have not recommended it in any of the crops it is labeled for because of resistance. In experiments I conducted here in Stoneville, MS, two sequential applications of propargite provided less than 50% control of twospotted spider mite. With their reproductive capacity, the mites rebounded to damaging levels within 7-10 days and significant yield losses were observed. Because of that, prevention of spider mite infestations is the best management strategy and an insecticide such as flubendiamide is an ideal insecticide to fit into that plan to manage other pests.

In closing, flubendiamide is a very important insecticide for our IPM programs in many crops. The fact that it is highly effective against the target pests, but relatively soft on beneficial insects makes it the ideal choice in many situations.

Sincerely,



Jeffrey Gore
Associate Professor of Research and Extension

The University of Georgia
College of Agricultural and Environmental Sciences
Coastal Plain Experiment Station – Tifton Campus

15 April 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-0001

Dear Sir:

I am writing this letter to provide information regarding the utility of the insecticide flubendiamide (Belt) in the southeastern US peanut production system. Georgia growers produce nearly 50% of the US peanut crop annually, and insect pests can result in significant economic loss. Foliage feeding caterpillars are probably the most commonly treated pest group in peanut. Broad spectrum pyrethroid insecticides have been the standard for caterpillar control for many years, and this class of chemistry is still widely utilized. Nevertheless, problems associated with pyrethroid use in peanut are significant, and the availability of alternate chemistries like flubendiamide is important. Resistance development in tobacco budworm, *Heliothis virescens*, and fall armyworm, *Spodoptera frugiperda*, has rendered pyrethroids ineffective against these key pests. The efficacy of pyrethroids is also limited against other economically important species such as soybean looper, *Chrysodeixis includens*, and velvetbean caterpillar, *Anticarsia gemmatalis*. Another major concern associated with the use of pyrethroids and other broad spectrum insecticides is the risk of flaring secondary pests such as two spotted spider mite, *Tetranychus urticae*.

Flubendiamide is commonly used by peanut producers in Georgia as it provides good efficacy and residual activity against a broad range of foliage feeding caterpillars. Belt is highly selective for Lepidoptera species, thus conserving natural enemies and reducing the risk of secondary pest outbreaks. It also offers an alternative MOA that is important for resistance management. In short, Belt fits very well into an integrated pest management program in peanut with low risk to beneficial insects and humans, good efficacy against target pests, and an alternative MOA compared to other insecticides commonly used in the crop.

Sincerely yours,

Mark R. Abney
Peanut Entomologist
Assistant Professor and Extension Specialist

122 S. Entomology Dr.• Tifton, GA 31793-0748 • Tel 229-386-3149 • Fax 229-386-3086

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Department of Entomology

NC STATE UNIVERSITY

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Method Road, Unit 1
Box 7634
Raleigh, NC 27695-7634

919.513.4344 (Phone)
919.208.7494 (Mobile)

April 22, 2015

ATTN: Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-000

Dear Mr. Rodia:

I am writing to provide my perspective on the use and utility of flubendiamide (BELT, Bayer Crop Sciences) in the flue cured tobacco system in the southeastern United States. I am an associate professor and extension specialist in the Entomology Department at North Carolina State University. I have held my position since September 2007, and I conduct research and extension activities in tobacco and berry crops within North Carolina and surrounding states. As part of these activities, I have extensive interactions with growers. For example, since the beginning of 2015, I have presented integrated pest management information to a total of 1627 grower to date.

North Carolina is the largest flue cured tobacco producing state, and this crop is grown on over 180,000 acres annually. Tobacco is a hand labor-intensive crop, relative to other agronomic crops. Workers may come into direct contact with plants several times during the growing season. These times include mid summer, when plants are topped (the apical meristem is removed) and suckered (axial meristems are removed). While some topping and suckering is mechanized, follow up hand removal is often necessary. Topping and suckering also coincide with the periods of activity of key foliar tobacco pests, including tobacco budworm and hormworms. Because of the continued reliance on hand labor in tobacco, mammalian toxicity of insecticides is an important consideration for worker protection.

Since BELT's registration in tobacco, I have recommended it for use against our key caterpillar pests, tobacco budworm and tobacco/tomato hornworms. These two pests together account for virtually all foliar insecticide treatments in tobacco, and between 2-4 foliar treatments are made per growing season, dependent upon pest pressure. In addition to BELT, I also recommend the use of Coragen (DuPont Crop Protection) and spinosad (formerly labeled as Tracer in tobacco, now labeled as Blackhawk; Dow AgroSciences). I recommend the use of BELT for several reasons. First, it is effective. Second, I have fewer concerns about worker exposure with BELT as compared to acephate (Orthene, among other trade names), which was a commonly used

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Department of Entomology

standard before the registration of BELT. Third, BELT is narrower spectrum than the other materials I recommend for tobacco budworm and hornworms. Because BELT targets only caterpillar pests, I have fewer concerns about impacts on beneficial insects or non target pests. This is a particular concern for spinosad because it is very toxic to bees and wasps if they are contacted. Parasitism rates in budworms and hornworms can be as high as 70-80% (which include three different wasp species) and these beneficial insects provide an important measure of population reduction, reducing the number of foliar sprays that may be needed. Finally, BELT provides a different mode of action, which is important for resistance management. Tobacco budworm in particular has a history of developing resistance to insecticides when a single mode of action is overused.

As noted above, acephate was one of the standard foliar materials used prior to the registration of BELT. The extension specialists at NC State conduct an annual survey of county based extension agents. Among the questions we ask agents is what insecticides are used over what percentage of tobacco acres in their county. I have summarized the results of this survey for the three years prior to the registration of BELT as well as for the last three years. The average percentage acres treated with at least one application of acephate for the three years prior the registration of BELT was 61.9%, and after the registration of BELT was 44.8%. Similarly, the area treated with spinosad averaged 36.1% prior to BELT's registration and 20.9% after.

		Reported percentage of acres treated					
Trade name	**Active ingredient**	**2005**	**2006**	**2007**	**2012**	**2013**	**2014**
Orthene	Acephate	60.25	58.41	67.14	56.42	34.97	43
Tracer and/or Blackhawk	Spinosad	26.71	37.41	44.11	33.08	13.59	16
Belt	Flubendiamide	NA	NA	NA	53.8	19.4	43.4

I believe, based on these data and conversations with growers, that the decrease in the use of both these materials is due to a shift to BELT, and to a much lesser extent Coragen, which was registered around the same time period. If this assertion is correct, then BELT's availably in tobacco has contributed to a reduction in both the use of an organophosphate insecticide (acephate) and the use of a broader spectrum insecticide (spinosad).

BELT has become a very important tool for North Carolina tobacco growers and has positively impacted the sustainability of our pest management programs. I encourage you to continue to allow BELT usage in tobacco and other crops. Please do not hesitate to contact me if I can provide additional information.

Sincerely,

Hannah Burrack, Ph.D.
Associate Professor & Extension Specialist

April 22, 2015

Carmen J Rodia, Jr.
Rodia.Carmen@epa.gov
Office of Pesticide Programs (OPP)
Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460-0001

Re: Letter of support for Flubendiamide (Belt)

I am submitting comments on behalf of The Morning Star Company. Morning Star is the world's leading tomato ingredient processor serving food processors throughout the world. Our plant operations are located in the heart of California's tomato production in the communities of Williams and Los Banos.

Vertical integration is a key to our success at Morning Star. Morning Star and its' sister companies are involved in all aspects of tomato productions from transplanting, growing, harvesting and hauling of the tomato crops so that our factories can run efficiently with limited down times.

BELT is a key insecticide is our own farming operations and well as over half of our contracted growers IPM programs that it specifically targets armyworms and fruit worms. These worms are key pests of the tomato industry and are difficult to control. High worm damage leads to secondary problems such as mold. Deformed fruit is not acceptable for dice products such as salsa's and mold can causes problems in the production of our paste if the amounts are too high. Logistically we may have to stop harvest in a field if mold or worm damage is too high or bypass the field in its entirety.

Another benefit of BELT is as a safer alternative to replace your former product methamidophos, Brand name of Monitor, which was pulled from our approved list of products a grower can use because of customer pressure long before the EPA tolerances expired due to its chemistry.

Please consider these key Points about BELT:

- BELT is an important and outstanding pest management tool for caterpillar pests.
- BELT is a selective insecticide that has minimal impact on beneficial insects and fits into current IPM programs and does not flare mites.
- IPM programs are key to the success of USA farming, specifically California due to limited chemical options, BELT is a product that keeps IPM programs intact.
- At registration the conclusion from the US EPA after evaluating all of the available data for BELT was that "Significant side effects to bumblebees and honey bees are NOT expected".
- BELT is a key insect resistant management tool with no known cross-resistance to conventional insecticides.
- It is important that the EPA uses sound science and all data including real world monitoring residue data in making their risk assessments and regulatory decisions on this product.
- Please keep in mind California Growers and their PCA's, Pest Control Advisers, are under much regulatory oversight by the California Ag Commissioner Systems and Dept. of Pesticide Regulation as well as processors like Morning Star that are further restrictive of products used than the regulation implies.
- Morning Star stresses IPM with its growers, as well as sustainable and judicious use of pesticides and fertilizers along with our Research & Development group which examines new ways to use products to their best potential.

In closing, regardless of how much Morning Star or our contracted growers use this product in the future options are needed to ensure our growers and their PCA's have a the availability of products like this so they have a full tool chest of viable options is key to an Integrated Pest Management Approach. We need tools to do our jobs and feed an ever growing world population.

Thank you for the opportunity to voice our comments and we trust any decision regarding this issue will be based on sound science.

Sincerely,

Renee T. Rianda
Regulatory & Sustainable Compliance Officer
The Morning Star Company
724 Main Street
Woodland, CA 95695

CALIFORNIA FRESH FRUIT ASSOCIATION

978 West Alluvial, Suite 107, Fresno, California 93711-5700
PHONE 559.226.6330 FAX 559.222.8326
www.CAFreshFruit.com

April 30, 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
Office of Pesticide Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: Environmental Risk Assessment; Flubendiamide (BELT) Registration Process

Dear Mr. Rodia, Jr:

The California Fresh Fruit Association writes to communicate its support for the continued registration of flubendiamide (BELT). Our association represents California's growers and shippers of permanent fresh fruit crops, excluding avocados and citrus, and they have come to rely upon this material for pest management.

BELT is ground applied for the control of various moth, caterpillar and leafroller species in table grapes and peach twig borer, fruitworm, leafroller, and moth species in stone fruit. Within an IPM program, the material is selectively applied through well-timed treatments around bloom time, which is often times the preferred treatment time because of its impact on target pests as well as its reduced impact onto beneficials and non-target organisms[i].

As EPA continues to review the potential for environmental impacts onto water it is imperative that EPA relies foremost upon sound science and robust data, including real world monitoring residue data, to influence its judgment of environmental risk assessment findings and the resulting regulatory decision-making which can adversely impact crop health (crop damage, increased pest populations) if any new impositions are added that limit access to this important crop protection tool.

Thank you for the opportunity to provide comment and share a perspective on the importance of maintaining access flubendiamide (BELT).

Regards,

Christopher Valadez
Director, Environmental & Regulatory Affairs
California Fresh Fruit Association

[i] For example, at registration, the conclusion from EPA after evaluating all of the available data for BELT was that "Significant side effects to bumblebees and honey bees are not expected."

Arthropod Management Tests 2013, Vol. 38
doi: 10.4182/amt.2013.E70

Table 2.

Product/ formulation	Rate amt product/acre	Total of two harvests # of Fruit SAW damage	# of Fruit Marketable	Wt (lbs) Marketable	Defoliation Rating 8-Nov	16-Nov	29-Nov	# of 3rd - 6th instar SAW larvae per plant 1-Nov	8-Nov	16-Nov	29-Nov
Untreated check		44.13 a	40.8f	14.8e	1.63a	1.63a	1.68a	3.98a	5.15a	4.00a	1.60a
Synapse	3.0 oz	7.13e	109.3a	42.1ab	0.43bc	0.18c	0.05d	0.25e	0.05b	0.00c	0.00c
Avaunt	3.5 oz										
Xentari	1.5 lb	19.8bcde	98.9abc	37.0b	0.78b	0.33c	0.08d	0.98cde	0.43b	0.03c	0.00c
MBI203 DF1	2 lb	34.8abc	46.9ef	16.3de	0.88b	0.98b	0.73c	1.78bcde	1.68b	0.53c	0.70b
MBI203 DF1	0.5 lb										
MBI203 DF1	3 lb	30.5abcd	43.6f	14.2e	1.50a	1.43a	1.30b	2.78abcd	3.60a	2.05b	0.53bc
MBI203 DF1	1.0 lb										
MBI203 DF1	4 lb	37.9ab	65.1def	22.5de	1.48a	1.45a	0.95bc	2.95abc	3.68a	1.95b	0.08bc
MBI203 DF1	2.0 lb										
MBI203 AF2	2 gal	34.1abcd	73.5cde	25.1cd	1.38a	1.68a	0.88c	3.43ab	4.25a	2.48b	0.10bc
Radiant	6.0 oz	14.0de	79.9bcd	32.5bc	0.58bc	0.35c	0.13d	0.70de	0.48b	0.15c	0.10bc
Intrepid	8.0 oz										
Exirel 10 SE	6.75 oz	22.4bcde	107.6ab	40.9ab	0.58bc	0.33c	0.23d	0.98cde	0.38b	0.03c	0.28bc
Avaunt	3.5 oz										
Exirel 10 SE	10.1 oz	14.4cde	119.3a	47.7a	0.48bc	0.30c	0.10d	0.55e	0.10b	0.00c	0.00c
Exirel 10 SE	13.5 oz	6.4e	99.3abc	37.6b	0.28c	0.10c	0.03d	0.60e	0.13b	0.00c	0.00c

Means followed by same letter are not statistically different (LSD>0.05).

UNIVERSITY OF CALIFORNIA, DAVIS

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DEPARTMENT OF ENTOMOLOGY AND NEMATOLOGY
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DAVIS, CALIFORNIA 95616-8584

April 22, 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-0001

Dear Dr. Rodia:

I am writing this letter to support an extension of the conditional registration of Belt insecticide (flubendiamide) to allow sufficient time for additional studies to refine your environmental risk assessment for aquatic organisms. I can specifically speak to the benefits of Belt for control of navel orangeworm and peach twig borer on California almonds, a crop that I have worked on to develop IPM programs for over 35 years. These two Lepidoptera species are the major insect pests attacking the nut kernals resulting in direct damage to harvested nuts. In the case of navel orangeworm, direct kernel feeding subjects the nut to infection by *Aspergillis* fungi which produce dangerous aflatoxins.

I am proud of the work that my lab has done to develop and implement non-chemical cultural controls for navel orangeworm that have reduced the number of required in-season treatments substantially since 1980. Up until the early 2000's, organophosphates, in particular Guthion (azinphosmethyl) were the major insecticides applied for its control. With the restrictions on organophosphate use and the loss of some registrations (e.g. Guthion), growers turned to other insecticides, most notably pyrethroids which those of us at the university have long recommended against due to their potential side-effects. Indeed, the widespread use of pyrethroids for navel orangeworm control has destroyed our nonchemical mite management programs in some growing regions. Instead, we encourage growers to use less disruptive insecticides during the season when necessary including certain insect growth regulators such as Intrepid (methoxyfenozide) and the diamides. Where Belt differs from Intrepid in our suggested IPM Program is when peach twig borer is also a target pest. Intrepid does not provide satisfactory control of peach twig borer while diamide insecticides such a Belt provide excellent control – even better than the pyrethroids.

I have evaluated insecticides for control of navel orangeworm and peach twig borer for many years, and can attest to the efficacy of Belt supported by solid replicated data.

Also, please consider that it doesn't rain in California at any time during the growing season when Belt might be applied for navel orangeworm control and the vast majority of our almond acreage is drip or microsprinkler irrigated, so the likelihood of runoff into waterways is remote.

I urge you to consider the extension of the conditional registration for Belt until further data can be developed to evaluate potential effects on aquatic organisms. Should you wish to speak to me or to receive any of my research data involving Belt, I would be happy to cooperate.

Sincerely,

Frank G. Zalom
Distinguished Professor and Extension Entomologist

National Cotton Council OF AMERICA

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(901) 274-9030 • FAX (901) 725-0510
www.cotton.org

PRODUCERS • GINNERS • WAREHOUSEMEN • MERCHANTS • COTTONSEED • COOPERATIVES • MANUFACTURERS

April 30, 2015

Mr. Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA
Office of Pesticide Programs
1200 Pennsylvania Ave. NW.
Washington, DC 20460-0001

RE: Registration of flubendiamide.

Dear Mr. Rodia:

The National Cotton Council (NCC) appreciates the opportunity to comment on the insecticide flubendiamide marketed as Belt SC (Belt) by Bayer CropScience. The NCC urges EPA to recognize the need to retain the registration of Belt for cotton as a valuable tool that provides protection against damaging cotton insect pests.

The NCC is the central organization of the U.S. cotton industry representing producers, ginners, merchants, warehousemen, cooperatives, textile manufacturers, and cottonseed processors and merchandisers in 17 states stretching from California to the Carolinas. U.S. cotton producers historically cultivate between 10 and 14 million acres of cotton. Annual cotton production, averaging approximately 20 million 480-lb bales, is valued at more than $5 billion at the farm gate. While a majority of the industry is concentrated in the 17 cotton-producing states, the down-stream manufacturers of cotton apparel and home-furnishings are located in virtually every state. The industry and its suppliers, together with the cotton product manufacturers, account for more than 230,000 jobs in the U.S. In addition to the cotton fiber, cottonseed products are used for livestock feed and cotton-seed oil is used for food products ranging from margarine to salad dressing. Taken collectively, the annual economic activity generated by cotton and its products in the U.S. economy is estimated to be in excess of $120 billion.

BELT SC insecticide has been in the market since 2008 and has provided growers with a reliable option for control of a variety of pest control, including the difficult to manage caterpillar pest. Even with transgenic Bt crops included, the summary of damaging insect pests for the US in 2014 ranked the caterpillar pest as the fourth most damaging pest. In addition, Belt has proven to be an excellent fit with integrated pest management systems and resistance management practices. Belt provides highly effective control of the caterpillar pest while minimizing impacts on beneficial insects and does not "flare" outbreaks of mite pests. Belt is an excellent tool for resistance management without known cross-resistance to conventional insecticides. The availability of multiple Modes of Action (MOA) for rotation in resistance management plan is critical to maintaining effective pest control without over-reliance on single or few MOAs. EPA has previously acknowledged that Belt was not expected to have significant side effects on bumblebees or honey bees.

The NCC urges EPA to continue the registration and availability of Belt as a valuable tool for controlling insect pests of cotton. As the EPA considers the weight of scientific evidence for registration of flubendiamide, the NCC urges EPA to maintain scientific integrity by relying on all data without discounting actual data points in favor of simulation models. The NCC appreciates the opportunity to provide these comments in support of the continued registration of flubendiamide.

Sincerely,

Don Parker, Ph.D.
Manager, IPM

CLEMSON
UNIVERSITY

16 April 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-0001

Dear Mr. Rodia:

With this letter we would like to provide concise statements about our familiarity with the field performance of flubendiamide (Belt) as a selective insecticide used in commercial agriculture. Our experiences with flubendiamide are restricted to row crops, such as cotton, soybeans, grain sorghum, and tobacco, so we will limit our comments to those specifically.

In field trials conducted at the Edisto Research and Education Center near Blackville, SC, flubendiamide has demonstrated excellent selective activity on immature lepidopteran pests (larvae/caterpillar insect pests) of cotton and soybeans. I (J. Greene) have tested flubendiamide in various trials since 2009 and have noted very good residual control of lepidopterans in both crops. In cotton not expressing toxins from *Bacillus thuringiensis* (Bt) (i.e. non-Bt cotton), flubendiamide provides excellent control of bollworm, *Helicoverpa zea*, tobacco budworm, *Heliothis virescens*, fall armyworm, *Spodoptera frugiperda*, beet armyworm, *Spodoptera exigua*, soybean looper, *Pseudoplusia includens*, and numerous other caterpillar pests. In soybeans, flubendiamide provides good control of the aforementioned species in addition to velvetbean caterpillar, *Antcarsia gemmatalis*, green cloverworm, *Hypena scabra*, and other minor caterpillar pests. Many of the species mentioned above are resistant to older classes of insecticide chemistry, such as the organophosphates and the pyrethroids, so the diamide class of chemistry is an essential tool for pest managers. In grain sorghum, I (F. Reay-Jones) have tested flubendiamide in trials at the Pee Dee Research and Education Center near Florence, SC, since 2013, and results show good residual activity against corn earworm, *H. zea*, and sorghum webworm, *Nola sorghiella*. Trials in tobacco with flubendiamide since 2008 also at the Pee Dee REC have shown that Belt provides good control of tobacco budworm and excellent control of tobacco hornworm, *Manduca sexta*.

The selective nature of flubendiamide helps conserve many species of beneficial arthropods that naturally help regulate pest populations. While organophosphates and pyrethroids are broad-spectrum insecticides, the selectivity of flubendiamide helps conserve species of predaceous and parasitic arthropods that aid in regulating populations of pest insects. This natural control is very much desired and a great benefit of using available selective insecticides, such as Belt.

Control of lepidopteran pests is very good with flubendiamide, but, most importantly, the extended residual control of this selected group of pests functionally limits the number of applications because of the effectiveness. In other words, we use fewer applications of diamides, such as Belt, because they are so effective. This is good for the environment in at least a couple of ways. First of all, it reduces the amount of active ingredient released into the environment. Secondly, it cuts down on other application inputs and use of natural resources, such as fuel for spray equipment.

CLEMSON
UNIVERSITY

In summary, we support the re-registration of flubendiamide (Belt) and continued use for selective control of lepidopteran pests in row crops. Our data indicate that flubendiamide is an effective insecticide that is relatively safe to natural enemies of insect pests and to the environment in general.

Sincerely,

Dr. Jeremy K. Greene
Professor of Entomology
Clemson University
Department of Agricultural and Environmental Sciences
Edisto Research & Education Center
64 Research Rd.
Blackville, SC 29817
E-mail: GREENE4@clemson.edu
Phone: 803-284-3343 ext. 245

Dr. Francis Reay-Jones
Associate Professor of Entomology
Clemson University
Department of Agricultural and Environmental Sciences
Pee Dee Research & Education Center
2200 Pocket Rd.
Florence, SC 29506
E-mail: freayjo@clemson.edu
Phone: 843-519-0480

April 23, 2015

Carmen J. Rodia, Jr.,
Office of Pesticide Programs (OPP)
Environmental Protection Agency
Washington, DC Via Email: rodia.Carmen@epa.gov

RE: User comments on flubendiamide (Belt Insecticide)

Dear Mr Rodia,

On behalf of the California Tomato Research Institute, Inc. a non-profit crop improvement association, and the California Tomato Growers Association we submit these comments to the U.S. Environmental Protection Agency regarding the use of flubendiamide on processing tomatoes in California.

Effective insecticides are critical to the production of mid and late season processing tomatoes in California. Flubendiamide is considered of primary importance as both as a key larvicide and as a resistance management tool. Flubendiamide is a selective insecticide that has minimal impact on beneficial insects and fits into University of California IPM programs. With low worker re-entry and PHI requirements it is a flexible and valuable production tool. It has gained widespread reliance among advisors and growers.

It is important that the EPA use sound science and all data, including real world monitoring residue data in making their risk assessments and regulatory decisions on this product. I've had zero inquiries from the Agency regarding our cultural practices or confirmation of actual field runoff or sediment movement, and that concerns me.

Current practices must be applied to the risk analysis, as California processing tomato culture has changed considerably in the last 10 years. Over 80% of the nearly 300,000 acres grown annually is under drip irrigation. This is important to note, as practically zero farms have irrigation water runoff. Also note that typical use periods seldom overlap with rain events, another exception from the remainder of the US, making stormwater runoff also unlikely.

We support the USEPA effort to assure environmental safety, however we stress that the use of sound science, transparency and outreach be used to achieve that goal.

Sincerely,

Charles J. Rivara
Director CTRI

Mike Montna
President CTGA

PBN0356

The IR-4 Project
Pest Management Solutions
for Specialty Crops and
Minor Uses

IR-4 Headquarters
Rutgers, The State University of New Jersey
500 College Road East, Suite 201W
Princeton, NJ 08540
732.932.9575 fax 609.514.2612
www.ir4.rutgers.edu

May 5, 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-0001

Dear Mr. Rodia;

The IR-4 Project appreciates the opportunity to provide comment on the importance of flubendiamide insecticide for the management of numerous pests in specialty crop agriculture.

IR-4 Project has received requests from the specialty crop stakeholders requesting IR-4 assistance for beets (garden), blueberry, cranberry, cucumber, grape, melon, summer squash, turnip greens and watercress. It is our understanding that flubendiamide is a very powerful insecticide with specific activity on many of the problem pest of the Lepidoptera family. In many of the specialty crops, the proposed use of flubendiamide was intended as a unique tool to effectively control the crop's primary pest issue.

For many of these crops, including the cucurbit vegetable crop group, Bayer Crop Science took direct action and developed the supporting data to support the registration. This saved IR-4 resources to work on other priority pest issues. For other crops, registration was limited based on company's stewardship decisions.
IR-4 did participate in a NAFTA blueberry study under a Canadian protocol. The study was completed and provided a U.S. and Canadian data set sufficient for registration in both countries. IR-4 submitted a petition to EPA and anticipates approval sometime in the near future. The use is needed for control of cranberry and cherry fruitworms infesting the crop.

Thank you again for the opportunity to comment. We hope EPA considers these benefits when making future regulatory decisions.

Sincerely yours,

Jerry J Baron

Jerry J. Baron
Executive Director
The IR-4 Project

CC: Keith Dorschner
Dan Kunkel
John Bell

Major funding for IR-4 is provided by Special Research Grants and Hatch Act Funds from USDA-NIFA, in cooperation with the State Agricultural Experiment Stations, and USDA-ARS.

The IR-4 Project
Pest Management Solutions
for Specialty Crops and
Minor Uses

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www.ir4.rutgers.edu

Major funding for IR-4 is provided by Special Research Grants and Hatch Act Funds from USDA-NIFA,
in cooperation with the State Agricultural Experiment Stations, and USDA-ARS.

TIDEWATER AGRONOMICS, INC.

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Mailing Address: P.O. Box 310, Camden, NC 27921

Stan's cell: 252-333-0212 Matt's cell: 252-312-8495
Website: www.tidewaterag.com

ATTN: Carmen J. Rodia, Jr.

Environmental Protection Specialist

U.S. EPA, Office of Pesticide Programs,

Registration Division, Invertebrate & Vertebrate Branch 2

1200 Pennsylvania Avenue, NW (7504P)

Washington, DC 20460-0001

Dear Mr Rodia,

I am writing in support of continuing the registration for Flubendiamide (Belt) for use in row crops. As an agricultural consultant advising 100 + growers annually, I need products which work and are cost effective. Belt has proven itself on both counts. We use Belt for corn earworm and soybean looper control in soybeans. At 2-2.5 oz/acre we get excellent control and have never needed a second treatment for escapes or later hatching larvae. Cost is in the $10-12.50/acre, which is an affordable price range for our growers.

An effective product saves money and protects the environment. Before Belt was available, we were experiencing partial control of corn earworm due to pyrethroid resistance. In heavy pressure seasons this resulted in a second treatment using different chemistry. Farmers had to pay for the second insecticide + the second application (now $8-9/ac for aerial). Additionally more insecticide was released into the environment due to a second application. I will emphasize again that we have never had to treat a second time following an application of Belt.

Please feel free to contact me if you need further information.

Email: stan@tidewaterag.com Cell: 252-333-0212

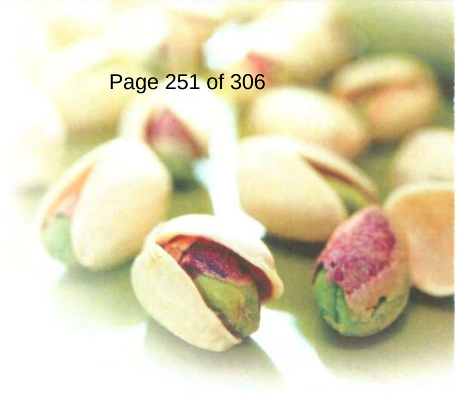
Best Regards,

Stan

Stanley J. Winslow

President - Tidewater Agronomics, Inc.

AMERICAN
PISTACHIO GROWERS



April 29, 2015

Carmen J. Rodia, Jr.
Environmental Protection Specialist
Office of Pesticide Programs
U.S. Environmental Protection Agency
Washington, DC

Dear Mr. Rodia,

We write to you today in support of the full registration of flubendiamide, also known as Belt.

We believe that it is important for the EPA to use sound science and all data, including a real world monitoring residue data in making their risk assessments and regulatory decisions on this product. It is our understanding that the higher tier monitoring study shows that under typical agricultural and environmental conditions, there is no significant accumulation of flubendiamide or its degradate in the water, pore water or sediment of farm ponds, intermittent streams or perennial streams. Additionally, it has been found that Belt has minimal impact on beneficial insects. Likewise, side effects to bumblebees and honey bees are not expected.

The U.S. pistachio industry, along with other tree nut crops, have found Belt, produced by Bayer CropScience, to be a useful tool in our arsenal against pest diseases particularly the navel orangeworm, which are not beneficial. In 2014, the U.S. pistachio industry treated approximately 10,000 acres with Belt to combat navel orangeworm, a pest that causes pistachios to be susceptible to contamination that results in aflatoxin. Aflatoxin contamination is detrimental to our industry; therefore, we must protect our crop from the navel orangeworm in order to prevent aflatoxin contamination.

Aflatoxin causes significant problems for U.S. pistachio exports. All of our export markets follow Codex maximum standards for aflatoxin. Pistachios that test above the Codex standard are subject to be destroyed, returned to the U.S. or shipped to another country. Belt has shown its ability to minimize the occurrence of naval orangeworm and other hard to manage caterpillar pests.

Please open the following website to understand and gain a visual of how the naval orangeworm attacks and damages pistachios:

https://www.google.com/search?q=navel+orange+worm+in+pistachio&biw=960&bih=429&tbm=isch&tbo=u&source=univ&sa=X&ei=AZU_VYXkI8WZsAXynoDIDw&ved=0CC0QsAQ

9 RIVER PARK PLACE EAST, SUITE 410 | FRESNO, CA 93720 | TEL: 559.475.0435 FAX: 559.475.0624 | AmericanPistachios.org

A continuance of EPA's flubendiamide registration would greatly benefit the tree nut industry, especially our pistachio crop. We thank you for your attention to this letter and listening to the industry on ways these pest protection compounds are so very important to our business and farm operations.

Sincerely,

Richard Matoian
Executive Director

University of California
COOPERATIVE EXTENSION
Imperial County

1050 E. HOLTON ROAD
HOLTVILLE, CALIFORNIA 92250-9615

Telephone: **(760) 352- 9474**
FAX Number: **(760) 352-0846**

April 17, 2015

To: Carmen J. Rodia, Jr.
Environmental Protection Specialist
U.S. EPA, Office of Pesticide Programs,
Registration Division, Invertebrate & Vertebrate Branch 2
1200 Pennsylvania Avenue, NW (7504P)
Washington, DC 20460-0001

From: Eric T. Natwick
Farm Advisor - Entomology
University of California, ANR Coop. Ext.
UC Desert Res. and Ext. Center
1050 E. Holton Road
Holtville, CA 92250

RE: IPM & IRM Benefits of Flubendiamide (BELT)

I conducted several insecticide efficacy research trials that included flubendiamide, on alfalfa and vegetable crops at the UC Desert Research and Extension Center, prior to flubendiamide being approved by the EPA on July 31, 2008 with a conditional registration. My past experience with flubendiamide, trade name Belt, was that is has excellent activity against lepidopteran pests while showing a minimal impact on beneficial insects, including pollinators. Flubendiamide is somewhat unique among the recent development and/or registration of diamide chemistries in that it has a narrower spectrum of activity than chlorantraniliprole, cyantraniliprole or cyclaniliprole and unlike its sister chemical compounds, flubendiamide is not systemic via root uptake and transport via the xylem within plants. These unique characteristics may be viewed by some as a detriment for flubendiamide, but actually, the narrower spectrum and non-systemic activity are of benefit for inclusion of Belt in integrated pest management (IPM) and insecticide resistance management (IRM). Although flubendiamide has good residual activity when applied as a foliar spray to vegetable crops or to alfalfa, the residual activity is short enough to not span the lifecycle of most, if not all lepidopteran pests; unlike the extended activity of the soil applied, systemic diamide insecticides. When there is extended residual activity of a specific insecticide or insecticide class, such as the diamides, due to the systemic activity, the target pest exposure can easily span two or possibly more generations of a pest insect multiplying the risk for selection of individuals within the pest population that have one or more alleles that allow escape of intoxication or to overcome/detoxify the insecticide's toxic effects allowing development of insecticide resistance within the pest population. Because flubendiamide is not systemic via soil application and root uptake, it has a better fit into IPM schemes than do the diamide compounds that are systemic. Similarly, the narrow spectrum of flubendiamide gives this diamide compound an advantage over broader spectrum diamides for inclusion into IPM schemes because flubendiamide is less likely to impact beneficial insect/arthropod populations including pollinators.

I have started inserting flubendiamide (Belt / Synapse) in to the UC IPM Pest Management Guidelines (UC IPM PMGs) for several vegetable crops and alfalfa as my colleagues and I continually update UC IPM PMGs. We include Belt because of the superior activity of flubendiamide over older lepidopteracides, because of flubendiamide's narrow spectrum of activity providing safety for beneficial arthropods and pollinators, and because of the relatively shorter exposure to target pests compared to soil applied systemic diamides. These three factors give Belt an excellent fit in our IPM and IRM programs. Therefore, I encourage the continued federal EPA registration of Belt / Synapse insecticide for use on alfalfa, cotton and vegetable crops as it is of great benefit to successful production of crops in California and other states for management of lepidopteran pests on alfalfa grown as forage, cotton and vegetable crops.

Some examples of inclusion of flubendiamide (Belt / Synapse) in the UC IPM PMGs can be found at the URLs listed below:

http://www.ipm.ucdavis.edu/PMG/selectnewpest.alfalfa-hay.html

http://www.ipm.ucdavis.edu/PMG/selectnewpest.cotton.html

http://www.ipm.ucdavis.edu/PMG/selectnewpest.cole-crops.html

Appendix D

Insecticide Label Comparison Tables
TABLE 48. Labeled Lepidopteran Pests and Crops for Flubendiamide and Insecticide Alternatives (Part 1).
a.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Alfalfa	Alfalfa caterpillar	X	N/A	2ee	X	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Armyworm / True Armyworm	X	N/A	*	*	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Army cutworm	X	N/A			N/A	N/A		N/A	N/A		N/A	N/A	N/A	N/A
	Alfalfa looper	X	N/A	X	X	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Alfalfa webworm	X	N/A			N/A	N/A		N/A	N/A	X	N/A	N/A	N/A	N/A
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Corn earworm	X	N/A	*	*	N/A	N/A	*	N/A	N/A		N/A	N/A	N/A	N/A
	Cutworms	X	N/A	*	*	N/A	N/A	X	N/A	N/A		N/A	N/A	N/A	N/A
	Fall armyworm	X	N/A	*	*	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Green cloverworm	X	N/A	*	*	N/A	N/A	*	N/A	N/A	*	N/A	N/A	N/A	N/A
	Loopers	X	N/A	*	*	N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A
	Velvetbean caterpillar	X	N/A	*	*	N/A	N/A	*	N/A	N/A	*	N/A	N/A	N/A	N/A
	Yellowstriped armyworm	X	N/A	West-ern		N/A	N/A	X	N/A	N/A	X	N/A	N/A	N/A	N/A

b.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Brassica Leafy Veg., CG5 + Turnip Greens	Alfalfa caterpillar	X	N/A	*	N/A			*			*	N/A		N/A	
	Armyworm / True Armyworm	X	N/A	*	N/A			*	*		X	N/A	X	N/A	X
	Alfalfa looper	X	N/A	*	N/A			X	X		*	N/A		N/A	*
	Beet armyworm	X	N/A	X	N/A	X	X	X	X		X	N/A	X	N/A	X
	Cabbage looper	X	N/A	X	N/A	X	X	X	X		X	N/A	X	N/A	X
	Cabbage webworm	X	N/A		N/A		X					N/A		N/A	
	Corn earworm	X	N/A	X	N/A	X	X	*	*			N/A	*	N/A	*
	Cross-striped cabbageworm	X	N/A	X	N/A							N/A		N/A	
	Cutworms	X	N/A	*	N/A			X	*		(x)	N/A		N/A	
	Diamondback moth	X	N/A	X	N/A	X	X	X	X		(x)	N/A	X	N/A	X
	Fall armyworm	X	N/A	*	N/A	X	*	X	*		X	N/A	X	N/A	X
	Garden webworm	X	N/A	*	N/A						X	N/A		N/A	
	Imported cabbageworm	X	N/A	X	N/A	X	X	X	X		X	N/A	X	N/A	X
	Saltmarsh caterpillar	X	N/A	*	N/A			*			*	N/A		N/A	*
	Southern armyworm	X	N/A	*	N/A	*	*	*	*		X	N/A	X	N/A	X
	Southern cabbageworm	X	N/A		N/A							N/A		N/A	
	Tobacco budworm	X	N/A	*	N/A			*	*			N/A		N/A	*
	Yellowstriped armyworm	X	N/A	West-ern	N/A	West-ern	West-ern	*	*		X	N/A	X	N/A	

c.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Xmas Trees	Bagworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Fall webworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Gypsy moth	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Hemlock looper	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Jackpine budworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Pine tip moth	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Redhumped caterpillar	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Spruce budworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Tent caterpillar	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A
	Tussock moths	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	N/A

d.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Corn (field, pop, sweet, seed)	Armyworm / True Armyworm	X	N/A	*	X	N/A	N/A	X	X	N/A	X	X	X	N/A	X
	Army cutworm	X	N/A			N/A	N/A		X	N/A				N/A	
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	X	N/A	*	X	X	N/A	X
	Black cutworm	X	N/A	*	*	N/A	N/A	*	X	N/A				N/A	
	Stalk borer / Common stalk borer	X	N/A			N/A	N/A			N/A				N/A	
	Corn earworm	X	N/A	X	X	N/A	N/A	X	X	N/A		X	X	N/A	X
	European corn borer	X	N/A	X	X	N/A	N/A	X	X	N/A	X	X	X	N/A	X
	Fall armyworm	X	N/A	X	X	N/A	N/A	X	X	N/A	*	X	X	N/A	X
	Green cloverworm	X	N/A	*	*	N/A	N/A	*	*	N/A	*	*		N/A	*
	Southern armyworm	X	N/A	X	X	N/A	N/A	*	X	N/A	*	*	X	N/A	X
	Southwestern corn borer	X	N/A	*	X	N/A	N/A			N/A	X	X	X	N/A	X
	Western bean cutworm	X	N/A	2ee	X	N/A	N/A	*	X	N/A	X	X	X	N/A	X
	Yellowstriped armyworm	X	N/A			N/A	N/A	*	X	N/A	*	*	X	N/A	

e.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Cotton	Beet armyworm	X	N/A	X	X	N/A	N/A	X	*		X	X	N/A	N/A	X
	Cabbage looper	X	N/A	X	X	N/A	N/A	*	X		X	X	N/A	N/A	X
	Cotton bollworm	X	N/A	X	X	N/A	N/A	X	X			X	N/A	N/A	X
	Cotton leafworm	X	N/A			N/A	N/A	X	X		X		N/A	N/A	
	Cotton leaf perforator	X	N/A			N/A	N/A	X	X		X	X	N/A	N/A	X
	Cutworms	X	N/A	*	*	N/A	N/A	*	X				N/A	N/A	
	European corn borer	X	N/A	*	*	N/A	N/A	*	*		*	X	N/A	N/A	X
	Fall armyworm	X	N/A	X	X	N/A	N/A	X	*		X	X	N/A	N/A	X
	Omnivorous leafroller	X	N/A	*	*	N/A	N/A				*		N/A	N/A	*
	Saltmarsh caterpillar	X	N/A	X	X	N/A	N/A	*			X	X	N/A	N/A	X
	Soybean looper	X	N/A	X	X	N/A	N/A	*	X		X	X	N/A	N/A	X
	Tobacco budworm	X	N/A	X	X	N/A	N/A	X	X			X	N/A	N/A	X
	Yellowstriped armyworm	X	N/A	West-ern	West -ern	N/A	N/A	*	*		X	X	N/A	N/A	

f.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Cucurbit Veg., CG9	Armyworm / True Armyworm	X	N/A	*	N/A			*	N/A		X	N/A	X	N/A	X
	Beet armyworm	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Cabbage looper	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Corn earworm	X	N/A	*	N/A	*	*	*	N/A			N/A	*	N/A	*
	Cutworms	X	N/A	*	N/A			X	N/A			N/A		N/A	
	Fall armyworm	X	N/A	*	N/A	*	*	X	N/A		*	N/A	X	N/A	X
	Melonworm	X	N/A	X	N/A	X	X	X	N/A	X	X	N/A	X	N/A	X
	Pickleworm	X	N/A	X	N/A	X	X	X	N/A	X	X	N/A	X	N/A	X
	Rindworms	X	N/A		N/A				N/A		X	N/A	X	N/A	X
	Squash vine borer	X	N/A		N/A				N/A	X		N/A		N/A	
	Tobacco budworm	X	N/A	*	N/A			X	N/A			N/A		N/A	*
	Yellowstriped armyworm	X	N/A	West-ern	N/A	West-ern		X	N/A		X	N/A	X	N/A	

g.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Fruiting Veg., CG8 + Okra	Armyworm / True Armyworm	X	N/A	*	N/A			X	N/A		X	N/A	X	N/A	X
	Beet armyworm	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Cabbage looper	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Celery leaftier	X	N/A		N/A				N/A			N/A		N/A	
	Cutworms	X	N/A	*	N/A			X	N/A			N/A		N/A	
	Diamondback moth	X	N/A	*	N/A	*	*	*	N/A			N/A	*	N/A	*
	European corn borer	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Fall armyworm	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Garden webworm	X	N/A	X	N/A				N/A		*	N/A		N/A	
	Melonworm	X	N/A	*	N/A	*	*	*	N/A	*	*	N/A	*	N/A	*
	Pickleworm	X	N/A	*	N/A	*	*	*	N/A	*	*	N/A	*	N/A	*
	Rindworms	X	N/A		N/A				N/A		*	N/A	*	N/A	*
	Saltmarsh caterpillar	X	N/A	*	N/A			*	N/A		*	N/A		N/A	*
	Southern armyworm	X	N/A	X	N/A	X	X	X	N/A		X	N/A	X	N/A	X
	Southwestern corn borer	X	N/A	*	N/A				N/A		*	N/A	*	N/A	*
	Tobacco budworm	X	N/A	*	N/A			*	N/A			N/A		N/A	*
	Tobacco hornworm	X	N/A	X	N/A	*	X	*	N/A	*		N/A	X	N/A	X
	Tomato fruitworm	X	N/A	X	N/A	X	X	X	N/A		(x)	N/A	X	N/A	X
	Tomato hornworm	X	N/A	X	N/A	X	X	X	N/A	*	X	N/A	X	N/A	X
	Tomato pinworm	X	N/A	X	N/A	X	X	X	N/A		(x)	N/A	X	N/A	X
	Western yellowstriped	X	N/A	X	N/A	X	X	*	N/A		X	N/A	X	N/A	

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
	armyworm														
	Yellowstriped armyworm	X	N/A		N/A			*	N/A		X	N/A	X	N/A	

h.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Globe artichoke	Artichoke plume moth	X	N/A	X	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A	X	N/A	X
	Cutworms	X	N/A	*	N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A	
	Painted lady butterfly	X	N/A		N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A	
	Saltmarsh caterpillar	X	N/A	*	N/A	N/A	N/A	N/A	N/A	N/A	*	N/A		N/A	*

i.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Small Fruit Vine Climbing CSG 13-07F	Cutworms	X	X	N/A	N/A	N/A	N/A	N/A	N/A			N/A		X	N/A
	European grapevine moth	X	X	N/A	N/A	N/A	N/A	N/A	N/A		X	N/A		X	N/A
	Grape berry moth	X	X	N/A	N/A	N/A	N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Grape leaf folder	X	X	N/A	N/A	N/A	N/A	N/A	N/A		X	N/A		X	N/A
	Grape leaf skeletonizer	X	West -ern	N/A	N/A	N/A	N/A	N/A	N/A	X		N/A		X	N/A
	Obliquebanded leafroller	X	X	N/A	N/A	N/A	N/A	N/A	N/A		X	N/A	*	*	N/A
	Omnivorous leafroller	X	X	N/A	N/A	N/A	N/A	N/A	N/A		X	N/A	*	X	N/A
	Orange tortrix	X		N/A	N/A	N/A	N/A	N/A	N/A		X	N/A		X	N/A
	Raisin moth	X	X	N/A	N/A	N/A	N/A	N/A	N/A			N/A			N/A
	Redbanded leafroller	X	*	N/A	N/A	N/A	N/A	N/A	N/A		X	N/A	X	X	N/A

j.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Leafy Veg., CG4	Alfalfa looper	X	N/A	*	N/A			X	X		*	N/A		N/A	*
	Armyworm / True Armyworm	X	N/A	*	N/A			X	X		X	N/A	X	N/A	X
	Beet armyworm	X	N/A	X	N/A	X	X	X	X		X	N/A	X	N/A	X
	Corn earworm	X	N/A	X	N/A	X	X	X	X			N/A	*	N/A	X
	Cutworms	X	N/A	*	N/A			X	*		(x)	N/A		N/A	
	Diamondback moth	X	N/A	X	N/A	X	X	X	*		(x)	N/A	X	N/A	X
	European corn borer	X	N/A	*	N/A	*	*	*	*		*	N/A	*	N/A	*
	Fall armyworm	X	N/A	*	N/A	X	*	X	X		X	N/A	X	N/A	X
	Green cloverworm	X	N/A	*	N/A			*	*		*	N/A		N/A	*
	Imported cabbageworm	X	N/A	*	N/A	*	*	X	*		X	N/A	X	N/A	X
	Saltmarsh caterpillar	X	N/A	*	N/A			*			*	N/A		N/A	*
	Tobacco budworm	X	N/A	X	N/A			*	*			N/A		N/A	*
	Tomato hornworm	X	N/A	*	N/A	*	*	*		*	*	N/A	*	N/A	*
	Yellowstriped armyworm	X	N/A		N/A	West-ern		X	*		X	N/A	X	N/A	

k.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Legume Veg., CG 6	Alfalfa caterpillar	X	N/A	*	*	N/A	N/A	X	N/A		*	N/A		N/A	
	Alfalfa looper	X	N/A	*	*	N/A	N/A	X	N/A		X	N/A		N/A	X
	Armyworm / True Armyworm	X	N/A	*	*	N/A	N/A	X	N/A		X	N/A	X	N/A	X
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	N/A		X	N/A	X	N/A	X
	Cabbage looper	X	N/A	*	X	N/A	N/A	X	N/A		X	N/A	X	N/A	X
	Celery looper	X	N/A			N/A	N/A	X	N/A			N/A	X	N/A	X
	Corn earworm	X	N/A	X	X	N/A	N/A	X	N/A		(x)	N/A	X	N/A	X
	Cutworms	X	N/A	*	*	N/A	N/A	X	N/A			N/A		N/A	
	European corn borer	X	N/A	X	X	N/A	N/A	X	N/A		X	N/A	X	N/A	X
	Fall armyworm	X	N/A	X	X	N/A	N/A	X	N/A		X	N/A	X	N/A	X
	Green cloverworm	X	N/A	*	*	N/A	N/A	X	N/A		*	N/A		N/A	*
	Imported cabbageworm	X	N/A	*	*	N/A	N/A	*	N/A		*	N/A	*	N/A	*
	Leaf sketetonizer species	X	N/A			N/A	N/A		N/A			N/A		N/A	
	Leaftier species	X	N/A			N/A	N/A		N/A			N/A		N/A	
	Lesser cornstalk borer	X	N/A			N/A	N/A		N/A			N/A		N/A	
	Painted lady butterfly	X	N/A			N/A	N/A		N/A			N/A		N/A	
	Saltmarsh caterpillar	X	N/A	*	*	N/A	N/A	X	N/A		*	N/A		N/A	*
	Silverspotted skipper	X	N/A			N/A	N/A	*	N/A			N/A		N/A	
	Southern armyworm	X	N/A	*	*	N/A	N/A	*	N/A		X	N/A	X	N/A	X
	Southwestern corn borer	X	N/A	*	*	N/A	N/A		N/A		*	N/A	*	N/A	*
	Soybean looper	X	N/A	*	X	N/A	N/A	X	N/A		*	N/A	X	N/A	X

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
	Tobacco budworm	X	N/A	*	*	N/A	N/A	*	N/A			N/A		N/A	*
	Velvetbean caterpillar	X	N/A	*	*	N/A	N/A	*	N/A		*	N/A		N/A	*
	Webworm species	X	N/A	*	*	N/A	N/A		N/A			N/A		N/A	
	Western bean cutworm	X	N/A	*	X	N/A	N/A	*	N/A			N/A	*	N/A	*
	Wollybear caterpillar	X	N/A			N/A	N/A		N/A			N/A		N/A	
	Yellowstriped armyworm	X	N/A			N/A	N/A	X	N/A		X	N/A	X	N/A	
	Western yellowstriped armyworm	X	N/A	*	*	N/A	N/A	X	N/A		X	N/A	X	N/A	

l.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Peanut	Armyworm / True Armyworm	X	N/A	*	*	N/A	N/A	*	N/A	N/A	X	X	N/A	N/A	X
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X
	Corn earworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A		X	N/A	N/A	X
	Cutworms	X	N/A	*	*	N/A	N/A	X	N/A	N/A			N/A	N/A	
	Green cloverworm	X	N/A	*	X	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X
	Fall armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X
	Loopers	X	N/A	*	X	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X
	Rednecked peanutworm	X	N/A			N/A	N/A		N/A	N/A		X	N/A	N/A	X
	Southern armyworm	X	N/A	*	X	N/A	N/A	*	N/A	N/A	X	X	N/A	N/A	X
	Tobacco budworm	24c	N/A	*	X	N/A	N/A	*	N/A	N/A		X	N/A	N/A	*
	Velvetbean caterpillar	X	N/A	*	X	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X

m.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Pome Fruit CG 11	Codling moth	X	X	N/A	N/A	X	N/A	X	N/A	X	(x)	N/A	X	X	N/A
	Eyespotted bud moth	X		N/A	N/A		N/A		N/A		X	N/A			N/A
	Fall webworm	X		N/A	N/A		N/A		N/A		*	N/A	*	*	N/A
	Fruittree leafroller	X		N/A	N/A		N/A	X	N/A		X	N/A	*	X	N/A
	Green fruitworm	X	X	N/A	N/A	X	N/A	X	N/A		*	N/A	*	*	N/A
	Lacanobia fruitworm	X		N/A	N/A		N/A		N/A		X	N/A		X	N/A
	Lesser appleworm	X		N/A	N/A		N/A	X	N/A	X	X	N/A		X	N/A
	Obliquebanded leafroller	X	X	N/A	N/A	X	N/A	X	N/A		X	N/A	X	X	N/A
	Oriental fruit moth	X	X	N/A	N/A	X	N/A	*	N/A	X	X	N/A	X	X	N/A
	Pandemis leafroller	X	X	N/A	N/A		N/A		N/A		X	N/A	X	X	N/A
	Redbanded leafroller	X	X	N/A	N/A	X	N/A	X	N/A		X	N/A	*	X	N/A
	Spotted tentiform leafminer	X	X	N/A	N/A	X	N/A	X	N/A	X	X	N/A	X	X	N/A
	Tufted apple bud moth	X	X	N/A	N/A	X	N/A	X	N/A		X	N/A	X	X	N/A
	Variegated leafroller	X	X	N/A	N/A	X	N/A	X	N/A		X	N/A	*	X	N/A
	Western tentiform leafminer	X	X	N/A	N/A		N/A	X	N/A	X	X	N/A	X	X	N/A

n.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Soybean	Alfalfa caterpillar	X	N/A	*	*	N/A	N/A	*		N/A	*		N/A	N/A	
	Armyworm / True Armyworm	X	N/A	*	*	N/A	N/A	*	X	N/A	X	X	N/A	N/A	X
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	X	N/A	X	X	N/A	N/A	X
	Cabbage looper	X	N/A	*	X	N/A	N/A	*	X	N/A	*	*	N/A	N/A	X
	Corn earworm	X	N/A	X	X	N/A	N/A	x	X	N/A		X	N/A	N/A	X
	Cutworms	X	N/A	*	*	N/A	N/A	*	X	N/A			N/A	N/A	
	European corn borer	X	N/A	*	*	N/A	N/A	*	*	N/A	*	*	N/A	N/A	*
	Fall armyworm	X	N/A	X	X	N/A	N/A	x	X	N/A	X	X	N/A	N/A	X
	Green cloverworm	X	N/A	*	X	N/A	N/A	x	X	N/A	X	X	N/A	N/A	X
	Imported cabbageworm	X	N/A	*	*	N/A	N/A	*	*	N/A	*		N/A	N/A	*
	Leaf sketetonizer species	X	N/A			N/A	N/A			N/A			N/A	N/A	
	Lesser cornstalk borer	X	N/A			N/A	N/A			N/A			N/A	N/A	
	Painted lady butterfly	X	N/A			N/A	N/A			N/A			N/A	N/A	
	Saltmarsh caterpillar	X	N/A	*	*	N/A	N/A	X		N/A	X	X	N/A	N/A	X
	Silverspotted skipper	X	N/A			N/A	N/A	X		N/A			N/A	N/A	
	Southern armyworm	X	N/A	*	X	N/A	N/A	*	X	N/A	X	X	N/A	N/A	X
	Soybean looper	X	N/A	*	X	N/A	N/A	*	X	N/A	X	X	N/A	N/A	X
	Tobacco budworm	X	N/A	*	X	N/A	N/A	*	X	N/A		*	N/A	N/A	*
	Tobacco hornworm	X	N/A	*	*	N/A	N/A	*		N/A		*	N/A	N/A	*
	Tomato hornworm	X	N/A	*	*	N/A	N/A	*		N/A	*		N/A	N/A	*
	Velvetbean caterpillar	X	N/A	*	X	N/A	N/A	X	X	N/A	X	X	N/A	N/A	X

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
	Webworm species	X	N/A	*	*	N/A	N/A			N/A		*	N/A	N/A	
	Wollybear caterpillar	X	N/A			N/A	N/A		X	N/A			N/A	N/A	
	Yellowstriped armyworm	X	N/A			N/A	N/A	*	X	N/A	X	X	N/A	N/A	

o.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Sorghum	Armyworm / True Armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	N/A	X	N/A	N/A	N/A
	Beet armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	N/A	X	N/A	N/A	N/A
	Cutworms	X	N/A	*	*	N/A	N/A	*	N/A	N/A	N/A		N/A	N/A	N/A
	European corn borer	X	N/A	X	X	N/A	N/A	*	N/A	N/A	N/A	*	N/A	N/A	N/A
	Fall armyworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	N/A	X	N/A	N/A	N/A
	Mexican rice borer	X	N/A			N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	Sorghum headworm	X	N/A			N/A	N/A	X	N/A	N/A	N/A	X	N/A	N/A	N/A
	Sorghum webworm	X	N/A	X	X	N/A	N/A	X	N/A	N/A	N/A	X	N/A	N/A	N/A
	Southern armyworm	X	N/A	*	*	N/A	N/A	*	N/A	N/A	N/A	X	N/A	N/A	N/A
	Southwestern corn borer	X	N/A	X	X	N/A	N/A		N/A	N/A	N/A	X	N/A	N/A	N/A
	Stalk borer / Common stalk borer	X	N/A			N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	Sugarcane borer	X	N/A	X	X	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	Webworm species	X	N/A	*	*	N/A	N/A		N/A	N/A	N/A	X	N/A	N/A	N/A
	Yellowstriped armyworm	X	N/A			N/A	N/A	*	N/A	N/A	N/A	X	N/A	N/A	N/A

p.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Low-growing Berry CSG 13-07G	Armyworm / True Armyworm	X		Beet	N/A	N/A	N/A	N/A	N/A		X	N/A	X	N/A	X
	Corn earworm	X	*	X	N/A	N/A	N/A	N/A	N/A		(x)	N/A	*	N/A	*
	Cutworms	X	*	*	N/A	N/A	N/A	N/A	N/A		(x)	N/A		N/A	
	Lesser cornstalk borer	X			N/A	N/A	N/A	N/A	N/A			N/A		N/A	
	Omnivorous leafroller	X	X	*	N/A	N/A	N/A	N/A	N/A		*	N/A	X	N/A	X
	Strawberry leafroller	X			N/A	N/A	N/A	N/A	N/A			N/A	X	N/A	X

q.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Stone Fruit CG 12	Codling moth	X	X	N/A	N/A	X	N/A	*	N/A	*	(x)	N/A	*	*	N/A
	Cherry fruitworm	X		N/A	N/A		N/A		N/A		X	N/A			N/A
	Eyespotted bud moth	X		N/A	N/A		N/A		N/A		X	N/A			N/A
	Fruittree leafroller	X		N/A	N/A		N/A	*	N/A		X	N/A	X	X	N/A
	Green fruitworm	X	*	N/A	N/A	*	N/A	*	N/A		X	N/A	X	X	N/A
	Lesser appleworm	X		N/A	N/A		N/A	*	N/A	*	X	N/A		*	N/A
	Obliquebanded leafroller	X	X	N/A	N/A	X	N/A	*	N/A		X	N/A	X	X	N/A
	Omnivorous leafroller	X	X	N/A	N/A	X	N/A		N/A		X	N/A	X	X	N/A
	Oriental fruit moth	X	X	N/A	N/A	X	N/A	X	N/A	X	X	N/A	X	X	N/A
	Pandemis leafroller	X	*	N/A	N/A		N/A		N/A		X	N/A	X	X	N/A
	Peach twig borer	X	X	N/A	N/A	X	N/A		N/A	X	X	N/A	X	X	N/A
	Redbanded leafroller	X	*	N/A	N/A	*	N/A	*	N/A		X	N/A	X	X	N/A
	Redhumped caterpillar	X		N/A	N/A		N/A		N/A	*	X	N/A	*	*	N/A
	Spotted tentiform leafminer	X	*	N/A	N/A	*	N/A	*	N/A	*	*	N/A	X	X	N/A
	Threelined leafroller	X		N/A	N/A		N/A		N/A		X	N/A	X	X	N/A
	Tufted apple bud moth	X	X	N/A	N/A	X	N/A	*	N/A		X	N/A	*	X	N/A
	Variegated leafroller	X	*	N/A	N/A	*	N/A	*	N/A		X	N/A	X	X	N/A

r.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Sugarcane	Sugarcane borer	X	N/A	X	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mexican rice borer	X	N/A			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lesser cornstalk borer	24c	N/A			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

s.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Sunflower/ Safflower	Banded sunflower moth	X	N/A	2ee	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Cutworms	X	N/A	*	*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sunflower budmoth	X	N/A			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sunflower moth	X	N/A	2ee	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Thistle caterpillar	X	N/A			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

t.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Tobacco	Armyworm / True Armyworm	X	N/A	*	*	N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A
	Beet armyworm	X	N/A	*	*	N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A
	Cabbage looper	X	N/A	*	*	N/A	N/A	X	N/A		N/A	*	N/A	N/A	N/A
	Corn earworm	X	N/A	*	*	N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A
	Cutworms	X	N/A	*	*	N/A	N/A	*	N/A		N/A		N/A	N/A	N/A
	Fall armyworm	X	N/A	*	*	N/A	N/A	X	N/A		N/A	*	N/A	N/A	N/A
	Saltmarsh caterpillar	X	N/A	*	*	N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A
	Southern armyworm	X	N/A	*	*	N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A
	Tobacco budworm	X	N/A	X	X	N/A	N/A	X	N/A		N/A	X	N/A	N/A	N/A
	Tobacco hornworm	X	N/A	X	X	N/A	N/A	X	N/A	X	N/A	X	N/A	N/A	N/A
	Tobacco splitworm	X	N/A	X	X	N/A	N/A		N/A		N/A		N/A	N/A	N/A
	Tomato hornworm	X	N/A	X	X	N/A	N/A	X	N/A	X	N/A		N/A	N/A	N/A
	Webworm species	X	N/A	*	*	N/A	N/A		N/A		N/A	*	N/A	N/A	N/A
	Yellowstriped armyworm	X	N/A			N/A	N/A	*	N/A		N/A	*	N/A	N/A	N/A

u.

Crop	Pest	BELT (Flubendiamide)	Altacor (Chlorantraniliprole)	Coragen (Chlorantraniliprole)	Prevathon (Chlorantraniliprole)	Exirel (Cyantraniliprole)	Verimark (Cyantraniliprole)	Lannate LV (Methomyl)	Larvin (Thiodicarb)	Assail 30SG (Acetamiprid)	Intrepid (Methoxyfenozide)	Tracer (Spinosad)	Spintor (Spinosyn)	Delegate (Spinetoram)	Radiant (Spinetoram)
Tree Nut CG 14 plus pistachio	Codling moth	X	X	N/A	X	X	N/A	N/A	N/A	X	(x)	N/A	*	X	N/A
	Fall webworm	X		N/A			N/A	N/A	N/A		X	N/A	X	X	N/A
	Filbertworm	X		N/A			N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Fruittree leafroller	X		N/A			N/A	N/A	N/A		X	N/A	*	*	N/A
	Hickory shuckworm	X	X	N/A	X	X	N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Navel orangeworm	X	X	N/A	X	X	N/A	N/A	N/A		X	N/A	X	X	N/A
	Obliquebanded leafroller	X	X	N/A	X	X	N/A	N/A	N/A		X	N/A	X	X	N/A
	Omnivorous leafroller	X	*	N/A	*	*	N/A	N/A	N/A		X	N/A	*	*	N/A
	Peach twig borer	X	X	N/A	X	X	N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Pecan nut casebearer	X	X	N/A	X	X	N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Redhumped caterpillar	X		N/A			N/A	N/A	N/A	X	X	N/A	X	X	N/A
	Walnut caterpillar	X		N/A			N/A	N/A	N/A		X	N/A	X	X	N/A

Source: Product labels.
Key:
N/A = Product not labeled on a given crop.
X = Pest labeled on a given crop.
Blank = Product labeled on a given crop but pest not labeled.
* = Pest not labeled on a given crop but labeled on another crop.

TABLE 49. Labeled Lepidopteran Pests and Crops for Flubendiamide and Insecticide Alternatives (Part 2).
a.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Alfalfa	Alfalfa caterpillar	X	N/A	N/A	N/A		X	N/A	X	X
	Armyworm / True Armyworm	X	N/A	N/A	N/A		X	N/A	X	X
	Army cutworm	X	N/A	N/A	N/A		X	N/A	X	X
	Alfalfa looper	X	N/A	N/A	N/A		X	N/A	X	X
	Alfalfa webworm	X	N/A	N/A	N/A		X	N/A	X	X
	Beet armyworm	X	N/A	N/A	N/A		X	N/A	X	X
	Corn earworm	X	N/A	N/A	N/A		X	N/A	*	X
	Cutworms	X	N/A	N/A	N/A		X	N/A	X	X
	Fall armyworm	X	N/A	N/A	N/A		X	N/A	X	X
	Green cloverworm	X	N/A	N/A	N/A		X	N/A	X	X
	Loopers	X	N/A	N/A	N/A		X	N/A	X	X
	Velvetbean caterpillar	X	N/A	N/A	N/A		X	N/A	X	X
	Yellowstriped armyworm	X	N/A	N/A	N/A		X	N/A	X	X

b.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Brassica Leafy Vegetables, CG5 + Turnip Greens	Alfalfa caterpillar	X			N/A	N/A	*	*	*	*
	Armyworm / True Armyworm	X	X		N/A	N/A	X	X	X	X
	Alfalfa looper	X			N/A	N/A	X	X	X	X
	Beet armyworm	X	X	X	N/A	N/A	X	X	X	X
	Cabbage looper	X	X	X	N/A	N/A	X	X	X	X
	Cabbage webworm	X	X	X	N/A	N/A	X		X	X
	Corn earworm	X		*	N/A	N/A	X	*	X	X
	Cross-striped cabbageworm	X	X	X	N/A	N/A				
	Cutworms	X	*		N/A	N/A	X	X	X	X
	Diamondback moth	X		X	N/A	N/A	X		X	X
	Fall armyworm	X	X	*	N/A	N/A	X		X	X
	Garden webworm	X	X		N/A	N/A	*			
	Imported cabbageworm	X	X	X	N/A	N/A	X	X	X	X
	Saltmarsh caterpillar	X			N/A	N/A	*	*	X	*
	Southern armyworm	X	X	*	N/A	N/A	*	*	X	X
	Southern cabbageworm	X			N/A	N/A	X		X	X
	Tobacco budworm	X			N/A	N/A	*	*	X	*
	Yellowstriped armyworm	X	X		N/A	N/A	X		X	X

c.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Christmas Trees	Bagworm	X	X	N/A	N/A		X		N/A	24c
	Fall webworm	X	X	N/A	N/A	*	X		N/A	
	Gypsy moth	X	X	N/A	N/A	X	X		N/A	24c
	Hemlock looper	X	X	N/A	N/A				N/A	
	Jackpine budworm	X	X	N/A	N/A				N/A	
	Pine tip moth	X	X	N/A	N/A	X	X	X	N/A	24c
	Redhumped caterpillar	X	*	N/A	N/A	*			N/A	
	Spruce budworm	X	X	N/A	N/A		X	X	N/A	
	Tent caterpillar	X	X	N/A	N/A		X		N/A	
	Tussock moths	X	X	N/A	N/A		X		N/A	24c

d.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Corn (field, pop, sweet, seed)	Armyworm / True Armyworm	X	N/A		N/A	N/A	X	X	X	X
	Army cutworm	X	N/A		N/A	N/A	X		X	*
	Beet armyworm	X	N/A	*	N/A	N/A	X	X	X	*
	Black cutworm	X	N/A		N/A	N/A	X	X	X	X
	Stalk borer / Common stalk borer	X	N/A		N/A	N/A	X	X	X	X
	Corn earworm	X	N/A	X	N/A	N/A	X	X	X	X
	European corn borer	X	N/A	X	N/A	N/A	X	X	X	X
	Fall armyworm	X	N/A	X	N/A	N/A	X	X	X	X
	Green cloverworm	X	N/A		N/A	N/A	X		X	
	Southern armyworm	X	N/A	*	N/A	N/A	X	*	X	X
	Southwestern corn borer	X	N/A		N/A	N/A	X	X	X	X
	Western bean cutworm	X	N/A		N/A	N/A	X	X	X	X
	Yellowstriped armyworm	X	N/A		N/A	N/A	X		X	X

e.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Cotton	Beet armyworm	X	X	N/A	X	N/A	X	X	X	X
	Cabbage looper	X	X	N/A	(x)	N/A	X	X	X	X
	Cotton bollworm	X		N/A		N/A	X	X	X	X
	Cotton leafworm	X		N/A		N/A	X	X		X
	Cotton leaf perforator	X		N/A		N/A	X	X	X	X
	Cutworms	X	*	N/A		N/A	X	X	X	X
	European corn borer	X	*	N/A		N/A	X	*	X	X
	Fall armyworm	X	X	N/A	X	N/A	X		X	X
	Omnivorous leafroller	X		N/A	*	N/A	*	*	*	*
	Saltmarsh caterpillar	X		N/A	(x)	N/A	X	X	X	X
	Soybean looper	X		N/A	(x)	N/A	*		*	X
	Tobacco budworm	X		N/A	*	N/A	X	X	X	X
	Yellowstriped armyworm	X	X	N/A	X	N/A	*		X	X

f.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Cucurbit Vegetables CG9	Armyworm / True Armyworm	X	N/A		N/A	N/A	X	*	*	X
	Beet armyworm	X	N/A	X	N/A	N/A	*	*	X	*
	Cabbage looper	X	N/A	X	N/A	N/A	X	X	X	X
	Corn earworm	X	N/A	*	N/A	N/A	X	X	X	X
	Cutworms	X	N/A		N/A	N/A	X	X	X	X
	Fall armyworm	X	N/A	*	N/A	N/A	*	*	*	*
	Melonworm	X	N/A	X	N/A	N/A	X		X	X
	Pickleworm	X	N/A	X	N/A	N/A	X	X	X	X
	Rindworms	X	N/A		N/A	N/A	X	X	X	X
	Squash vine borer	X	N/A		N/A	N/A	X	X	X	
	Tobacco budworm	X	N/A		N/A	N/A	X	*	*	X
	Yellowstriped armyworm	X	N/A		N/A	N/A	*		*	*

g.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Fruiting Vegetables CG8 + Okra	Armyworm / True Armyworm	X	X		X	N/A	*	*	X	*
	Beet armyworm	X	X	X	X	N/A	X	X	X	X
	Cabbage looper	X	X	X	X	N/A	X	X	X	X
	Celery leaftier	X			X	N/A	*		X	X
	Cutworms	X	X			N/A	X	X	X	X
	Diamondback moth	X		*	X	N/A	*		*	*
	European corn borer	X	X	x		N/A	X	x	X	x
	Fall armyworm	X	X	*	X	N/A	X		X	*
	Garden webworm	X	*		X	N/A	*		X	X
	Melonworm	X		*		N/A	*		*	*
	Pickleworm	X		*		N/A	*	*	*	*
	Rindworms	X				N/A	*	*	*	*
	Saltmarsh caterpillar	X			X	N/A	*	*	*	*
	Southern armyworm	X	X	X	X	N/A	X	X	X	X
	Southwestern corn borer	X				N/A	*	*	X	*
	Tobacco budworm	X			X	N/A	X	*	X	*
	Tobacco hornworm	X	X	X	X	N/A	X	X	X	
	Tomato fruitworm	X		X	X	N/A	X	X	X	X
	Tomato hornworm	X	X	X	X	N/A	X	X	X	X

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
	Tomato pinworm	X		X		N/A	X	X	X	X
	Western yellowstriped armyworm	X		X	X	N/A	*	X	*	X
	Yellowstriped armyworm	X	X		X	N/A	X		X	*

h.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Globe artichoke	Artichoke plume moth	X	N/A	N/A	N/A	N/A	N/A	X	X	
	Cutworms	X	N/A	N/A	N/A	N/A	N/A			N/A
	Painted lady butterfly	X	N/A	N/A	N/A	N/A	N/A	*	*	
	Saltmarsh caterpillar	X	N/A	N/A	N/A	N/A	N/A	*	*	*

i.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Small Fruit Vine Climbing CSG 13-07F	Cutworms	X	N/A		N/A		N/A	N/A	X	X
	European grapevine moth	X	N/A		N/A		N/A	N/A		
	Grape berry moth	X	N/A	X	N/A	X	N/A	N/A	X	X
	Grape leaf folder	X	N/A	X	N/A	X	N/A	N/A		X
	Grape leaf skeletonizer	X	N/A	X	N/A	X	N/A	N/A		X
	Obliquebanded leafroller	X	N/A		N/A	*	N/A	N/A	*	*
	Omnivorous leafroller	X	N/A	X	N/A	X	N/A	N/A	*	X
	Orange tortrix	X	N/A		N/A		N/A	N/A		X
	Raisin moth	X	N/A		N/A		N/A	N/A		
	Redbanded leafroller	X	N/A	*	N/A	X	N/A	N/A	*	*

j.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Leafy Vegetables CG4	Alfalfa looper	X			N/A	N/A	X	X	X	X
	Armyworm / True Armyworm	X	X		N/A	N/A	X	*	X	*
	Beet armyworm	X	X	X	N/A	N/A	X	X	X	X
	Corn earworm	X		X	N/A	N/A	X	X	X	X
	Cutworms	X	*		N/A	N/A	X		X	X
	Diamondback moth	X		*	N/A	N/A	X		X	X
	European corn borer	X	*	*	N/A	N/A	X	*	*	X
	Fall armyworm	X	X	*	N/A	N/A	X	*	X	X
	Green cloverworm	X			N/A	N/A	X	*	*	X
	Imported cabbageworm	X	X	*	N/A	N/A	X	*	X	X
	Saltmarsh caterpillar	X			N/A	N/A	X	*	X	X
	Tobacco budworm	X			N/A	N/A	X	*	X	*
	Tomato hornworm	X	*	*	N/A	N/A	*	*	*	*
	Yellowstriped armyworm	X	*		N/A	N/A	*		X	X

k.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Legume Vegetables CG 6	Alfalfa caterpillar	X	N/A		N/A	N/A	X	X	X	*
	Alfalfa looper	X	N/A		N/A	N/A	X	X	*	*
	Armyworm / True Armyworm	X	N/A		N/A	N/A	X	X	X	*
	Beet armyworm	X	N/A	*	N/A	N/A	X	X	X	X
	Cabbage looper	X	N/A	*	N/A	N/A	X	X	X	X
	Celery looper	X	N/A		N/A	N/A	X	X	X	
	Corn earworm	X	N/A	X	N/A	N/A	X	X	X	X
	Cutworms	X	N/A		N/A	N/A	X	X	X	X
	European corn borer	X	N/A	X	N/A	N/A	X	X	X	X
	Fall armyworm	X	N/A	*	N/A	N/A	X		X	X
	Green cloverworm	X	N/A		N/A	N/A	X	X	X	X
	Imported cabbageworm	X	N/A	*	N/A	N/A	*	X	X	*
	Leaf sketetonizer species	X	N/A		N/A	N/A	X		X	
	Leaftier species	X	N/A		N/A	N/A	X		*	*
	Lesser cornstalk borer	X	N/A		N/A	N/A	X		X	*
	Painted lady butterfly	X	N/A		N/A	N/A	X	X	X	
	Saltmarsh caterpillar	X	N/A		N/A	N/A	X	X	X	X

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
	Silverspotted skipper	X	N/A		N/A	N/A	*		X	X
	Southern armyworm	X	N/A	*	N/A	N/A	*	*	X	X
	Southwestern corn borer	X	N/A		N/A	N/A	*	*	X	*
	Soybean looper	X	N/A		N/A	N/A	X		X	X
	Tobacco budworm	X	N/A		N/A	N/A	X	*	X	X
	Velvetbean caterpillar	X	N/A		N/A	N/A	X	X	X	X
	Webworm species	X	N/A		N/A	N/A	X		X	X
	Western bean cutworm	X	N/A		N/A	N/A	X	X	X	*
	Wollybear caterpillar	X	N/A		N/A	N/A	*	*	X	X
	Yellowstriped armyworm	X	N/A		N/A	N/A	X		X	X
	Western yellowstriped armyworm	X	N/A	*	N/A	N/A	X	*	*	*

l.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Peanut	Armyworm / True Armyworm	X	N/A	N/A	X	N/A	*	*	*	X
	Beet armyworm	X	N/A	N/A	X	N/A	X	X	X	X
	Corn earworm	X	N/A	N/A		N/A	X	X	X	X
	Cutworms	X	N/A	N/A		N/A	X	X	X	X
	Green cloverworm	X	N/A	N/A	X	N/A	X		X	X
	Fall armyworm	X	N/A	N/A	X	N/A	X	X	X	X
	Loopers	X	N/A	N/A		N/A	X		X	X
	Rednecked peanutworm	X	N/A	N/A		N/A	X	X	X	X
	Southern armyworm	X	N/A	N/A	X	N/A	*	*	*	X
	Tobacco budworm	24c	N/A	N/A	*	N/A	*	*	*	*
	Velvetbean caterpillar	X	N/A	N/A	X	N/A	X	X	X	X

m.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Pome Fruit CG 11	Codling moth	X	X	X	X	X	X	X	X	X
	Eyespotted bud moth	X	X							
	Fall webworm	X	*		*	*	*			
	Fruittree leafroller	X	X			X	X			
	Green fruitworm	X	X	X		X	X	X	X	X
	Lacanobia fruitworm	X	X	X						
	Lesser appleworm	X	X	X			X	X	X	X
	Obliquebanded leafroller	X	X		*	*	X	X	X	X
	Oriental fruit moth	X		X	*	X	X	X	X	X
	Pandemis leafroller	X	X	X			X	X	X	X
	Redbanded leafroller	X	X	X		X	X	X	X	X
	Spotted tentiform leafminer	X		(x)			X	X	X	X
	Tufted apple bud moth	X	X	X			X	X	X	X
	Variegated leafroller	X	X		*		X	X	X	X
	Western tentiform leafminer	X					X	X		X

n.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Soybean	Alfalfa caterpillar	X	N/A	N/A		N/A	*		X	*
	Armyworm / True Armyworm	X	N/A	N/A	*	N/A	X		X	X
	Beet armyworm	X	N/A	N/A	X	N/A	X	X	X	X
	Cabbage looper	X	N/A	N/A		N/A	X	X	X	X
	Corn earworm	X	N/A	N/A		N/A	X	X	X	X
	Cutworms	X	N/A	N/A		N/A	X	X	X	X
	European corn borer	X	N/A	N/A		N/A	X		X	X
	Fall armyworm	X	N/A	N/A	X	N/A	X		X	X
	Green cloverworm	X	N/A	N/A	X	N/A	X	X	X	X
	Imported cabbageworm	X	N/A	N/A		N/A	*	*	X	*
	Leaf sketetonizer species	X	N/A	N/A		N/A	*		X	
	Lesser cornstalk borer	X	N/A	N/A		N/A	X		X	X
	Painted lady butterfly	X	N/A	N/A		N/A	X	*	X	
	Saltmarsh caterpillar	X	N/A	N/A	*	N/A	X	X	X	X
	Silverspotted skipper	X	N/A	N/A		N/A	X		X	X
	Southern armyworm	X	N/A	N/A	*	N/A	*	*	X	X

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
	Soybean looper	X	N/A	N/A	(x)	N/A	X		X	X
	Tobacco budworm	X	N/A	N/A	*	N/A	X	*	X	X
	Tobacco hornworm	X	N/A	N/A	*	N/A	*		X	
	Tomato hornworm	X	N/A	N/A	*	N/A	*	*	X	*
	Velvetbean caterpillar	X	N/A	N/A	X	N/A	X	X	X	X
	Webworm species	X	N/A	N/A		N/A	X		X	X
	Wollybear caterpillar	X	N/A	N/A		N/A	X	X	X	X
	Yellowstriped armyworm	X	N/A	N/A		N/A	X		X	X

o.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Sorghum	Armyworm / True Armyworm	X	N/A	N/A	N/A	N/A	X		X	X
	Beet armyworm	X	N/A	N/A	N/A	N/A	X		X	X
	Cutworms	X	N/A	N/A	N/A	N/A	X	X	X	X
	European corn borer	X	N/A	N/A	N/A	N/A	X		X	X
	Fall armyworm	X	N/A	N/A	N/A	N/A	X		X	X
	Mexican rice borer	X	N/A	N/A	N/A	N/A	X		*	
	Sorghum headworm	X	N/A	N/A	N/A	N/A	*	X	X	X
	Sorghum webworm	X	N/A	N/A	N/A	N/A	X		X	X
	Southern armyworm	X	N/A	N/A	N/A	N/A	*	*	X	X
	Southwestern corn borer	X	N/A	N/A	N/A	N/A	X	*	X	X
	Stalk borer / Common stalk borer	X	N/A	N/A	N/A	N/A	X	*	X	X
	Sugarcane borer	X	N/A	N/A	N/A	N/A	X	*	*	*
	Webworm species	X	N/A	N/A	N/A	N/A	X		X	X
	Yellowstriped armyworm	X	N/A	N/A	N/A	N/A	X		X	*

p.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Lowgrowing Berry CSG 13-07G	Armyworm / True Armyworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Corn earworm	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Cutworms	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lesser cornstalk borer	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Omnivorous leafroller	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Strawberry leafroller	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

q.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Stone Fruit CG 12	Codling moth	X	N/A	*	*	X	X		*	X
	Cherry fruitworm	X	N/A						X	
	Eyespotted bud moth	X	N/A							
	Fruittree leafroller	X	N/A			X	X	X	X	
	Green fruitworm	X	N/A	*		*	X	X	X	X
	Lesser appleworm	X	N/A	*			*	*	*	*
	Obliquebanded leafroller	X	N/A		X	*	X	X	X	X
	Omnivorous leafroller	X	N/A	*	X	X	X	X	X	X
	Oriental fruit moth	X	N/A	X	X	X	X	X	X	X
	Pandemis leafroller	X	N/A	*			X	X	X	*
	Peach twig borer	X	N/A	X	X	X	X	X	X	X
	Redbanded leafroller	X	N/A	*		X	X	X	X	X
	Redhumped caterpillar	X	N/A		X	X				
	Spotted tentiform leafminer	X	N/A				X	*	*	*
	Threelined leafroller	X	N/A				X	X	X	
	Tufted apple bud moth	X	N/A	*			*	X	X	*
	Variegated	X	N/A		X		X	X	X	*

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
	leafroller									

r.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Sugarcane	Sugarcane borer	X	X	N/A	N/A	N/A	X	X	X	X
	Mexican rice borer	X	X	N/A	N/A	N/A	X		X	
	Lesser cornstalk borer	24c		N/A	N/A	N/A	*		*	*

s.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Sunflower/Safflower	Banded sunflower moth	X	N/A	N/A	N/A	N/A	X	X	X	X
	Cutworms	X	N/A	N/A	N/A	N/A	X	X	X	X
	Sunflower budmoth	X	N/A	N/A	N/A	N/A	X			X
	Sunflower moth	X	N/A	N/A	N/A	N/A	X	X	X	X
	Thistle caterpillar	X	N/A	N/A	N/A	N/A	X	*	X	

t.

Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Tobacco	Armyworm / True Armyworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Beet armyworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Cabbage looper	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Corn earworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Cutworms	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Fall armyworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Saltmarsh caterpillar	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Southern armyworm	X	N/A	N/A	N/A	N/A	*	N/A	N/A	N/A
	Tobacco budworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Tobacco hornworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Tobacco splitworm	X	N/A	N/A	N/A	N/A		N/A	N/A	N/A
	Tomato hornworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Webworm species	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A
	Yellowstriped armyworm	X	N/A	N/A	N/A	N/A	X	N/A	N/A	N/A

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Crop	Pest	BELT (Flubendiamide)	Confirm (Tebufenozine)	Avaunt (Indoxacarb)	Dimilin (Diflubenzuron)	Imidan (Phosmet)	Warrior II / Karate (Lambda-cyhalothrin)	Asana (Esfenvalerate)	Mustang Maxx (Zeta-cypermethrin)	Baythroid XL (Cyfluthrin)
Tree Nut CG 14 plus pistachio	Codling moth	X	X	N/A	X	X	X	X	X	X
	Fall webworm	X	X	N/A	X	X	*			
	Filbertworm	X		N/A	X		X	X	X	X
	Fruittree leafroller	X	*	N/A		*	X	*		
	Hickory shuckworm	X	X	N/A	X	X	X	X	X	X
	Navel orangeworm	X	X	N/A		X	X	X	X	X
	Obliquebanded leafroller	X	*	N/A	X	X	X	X	X	X
	Omnivorous leafroller	X		N/A	X	*	X	*	*	*
	Peach twig borer	X	X	N/A	X	X	X	X	X	X
	Pecan nut casebearer	X	X	N/A	X	X	X	X	X	X
	Redhumped caterpillar	X	X	N/A	X	*				
	Walnut caterpillar	X	X	N/A	X					

Source: Product labels.
Key:
N/A = Product not labeled on a given crop.
X = Pest labeled on a given crop.
Blank = Product labeled on a given crop but pest not labeled.
* = Pest not labeled on a given crop but labeled on another crop.

Appendix E: Relative Performance Rankings

< **CBI54** text located in the Confidential Business Information **<**

< CBI55 text located in the Confidential Business Information