UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

BEFORE THE ADMINISTRATOR

In the Matter of:	)	
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Bayer CropScience LP and Nichino America, Inc.,	)	FIFRA-HQ-2016-0001
	)	
	)	
Petitioners.	)	

VERIFIED WRITTEN STATEMENT OF JOHN PALUMBO, PH.D. ON BEHALF OF BAYER CROPSCIENCE LP AND NICHINO AMERICA, INC.

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I. BACKGROUND AND EXPERIENCE

Q: Please state your name and address.

A: My name is John Palumbo. My business address is 6425 West 8th Street, Yuma, Arizona.

Q: What is your occupation?

A: I am a Professor of Entomology in the University of Arizona Department of Entomology, which is located at the Yuma Agricultural Center.

Q: Please describe your education background.

A: I earned my Bachelor's of Science and Masters degrees in entomology in 1982 and 1985, respectively. My Masters thesis title was "Influence of *Sphaeralcea* spp. on Survival and Reproductive Behavior of Boll Weevil, *Anthonomous grandis* Boheman, in Arizona." I earned my Ph.D. in entomology in 1989 from Oklahoma State University, and my dissertation was the "Development of Management Strategies for Squash Bug, *Anasa tristis* (De Geer) Populations in Cucurbits."

Q: Please describe your occupational history in general terms.

A: My C.V. is provided as PBNX 110. Before becoming a full Professor of Entomology in 2002, I held other positions at the University of Arizona, including as an Associate Professor and Research Scientist of Entomology from 1996 to 2002, and before that as an Assistant Professor and Research Scientist of Entomology from1990 to 1996. Throughout that entire time period, I have also held the role of Extension Specialist.

Q: Please describe your current work in further detail.

A: My primary role at the University of Arizona has been to develop and direct an applied research and extension program to investigate the management of the key pests associated with Arizona vegetable production. Thus, my work is focused on the study of insect biology and ecology and the application of that knowledge to develop innovative IPM strategies in vegetable cropping systems. This includes the study of insect feeding, reproduction, and crop-pest interactions, in the field and the laboratory, and work to quantify and statistically describe distribution patterns of insect populations.

Q: Please describe your responsibilities as an Extension Specialist.

A: My goals are to provide empirically-based information on the management of insect populations in vegetable crops that can be directly applied by growers throughout the southwestern United States. I evaluate pesticide chemistries with new modes of action and investigate alternative uses for existing insecticides and biological control tactics. Based on our laboratory and field evaluations of chemical pesticides, biological control tactics, and pest-prevention practices, the extension program provides empirical information on the management of insect populations that can be directly applied by vegetable growers throughout the southwestern United States. A fundamental goal of our work is to reduce overall pesticide usage in the production of vegetables, and the associated environmental and occupational risks. In particular, the Extension seeks to develop, validate, and deliver to growers information and economically viable methods for managing pests that reduce grower reliance on higher risk, "broadly-toxic" pesticides, such as organophosphates, carbamates, and pyrethroids, while maintaining crop yield and quality.

Q: What kind of crops do you work with?

A: My work primarily involves Leafy vegetables (lettuce, spinach, celery), Brassica (Cole) Leafy vegetable crops (broccoli, cauliflower, cabbage, Brussels sprouts, kale, collards, and kohlrabi), and melons (a subset of crops within the Cucurbit vegetable group).

Q: You indicated that part of your responsibility is to deliver to growers information and economically viable methods for managing pests. How do you do this?

A: As an Extension Specialist, I am viewed by vegetable growers and pest control advisors ("PCAs") as an unbiased, objective source of information and assist them in making informed pest management decisions. In my experience, when a new IPM technology or strategy is developed it has a much greater chance of being adopted by growers when it can be demonstrated to growers and PCAs first-hand. By working with growers and PCAs cooperatively through their participation in the experimental process, they witness the results of IPM within their own farming operations. Likewise, I learn about their practices and the pest problems that they face from their participation in this process. Many of my applied research projects are conducted in local vegetable fields in collaboration with local growers and PCAs. This allows me to interact directly with the growers and PCAs who actually face pest management issues and gain valuable insights into vegetable production and practical insect management.

Q: Dr. Palumbo, have you published in any areas pertinent to your qualifications to testify in this case?

A: Yes, I have published extensively in peer-reviewed journals on topics including insect management in vegetable and melon crops, insecticidal control and resistance management, and comparative insecticide efficacy. A representative sample of my publications is included in my C.V.

Q: Please describe the scope of the testimony that you have been asked to provide?

A: I was asked to testify in my position as an entomologist and IPM specialist and opine on the following topics: (1) Integrated Pest Management and Insect Resistance Management generally; (2) flubendiamide's attributes; (3) an overview of Leafy vegetable crops and the benefits that flubendiamide provides for growers; (4) an overview of the benefits that flubendiamide provides for melon growers; (5) EPA's assessment of flubendiamide's benefits; and (6) the consequences to southwestern growers of flubendiamide's cancellation and EPA's existing stocks provision.

Q: Bayer and Nichino offer Dr. Palumbo as an expert in the areas of entomology; insect pest management; and insecticide efficacy and best practices, with a focus on Leafy vegetables, Brassica (Cole) Leafy vegetable crops, and melons.

II. IPM AND IRM

Q: You mentioned that your work involved developing innovative IPM strategies in vegetable cropping systems. Please elaborate on what you mean by IPM and what role it plays in your work?

A: IPM stands for Integrated Pest Management. IPM is a scientifically-based, worldwide standard for managing pests. It encourages the use of multiple and flexible strategies for the control of insects, weeds, rodents and other vertebrates and plant, animal and human diseases. An IPM approach favors the use of biological pest control methods and management practices aimed at avoiding or preventing pest outbreaks where these methods can be feasible and effective. With respect to IPM for insect pests, the use of chemical insecticides remains necessary to allow the production of vegetables at the level of quality and affordability expected and demanded by consumers in the United States. A key goal of my IPM work is to reduce and optimize the use of chemical insecticides, through development and implementation of practices such as insect pest sampling, "action thresholds," selection of appropriate products, resistance management, and other methods derived from an understanding of the biological, ecological, and environmental interactions occurring within cropping systems. Because of my expertise in IPM, I am frequently called upon by local growers and PCAs to discuss their pest problems and offer potential solutions. Overall, these experiences have provided me with a unique and in-depth knowledge of the management practices used by the vegetable industry to control insect pests in Arizona and southern California.

Q: You referred to resistance management as a means of optimizing the use of chemical insecticides. What is resistance management?

A: Resistance management is a means of combatting the development of pest resistance to insecticides. Resistance management includes avoiding misuse or over-use of a product. A resistance management program is an important component of an IPM program. Insecticide resistance is a constant threat to local IPM programs that the leafy vegetable industry takes seriously. A good example of a crop and pest specific IRM strategy is the IRM Guidelines for Beet Armyworm in Lettuce that we published on August 20, 2014 (PBNX 111). The guidelines include: (1) applying insecticides only when needed; (2) avoiding consecutive applications of the same insecticide on the same field, and instead rotating Mode of Actions ("MOAs"); (3) where a product/MOA is required more than once, limiting the total usage of that product to 2 applications per field per crop season; (4) using only recommended products and rates necessary to accomplish desired control; and (5) applying insecticides by ground sprays to optimize spray deposition and coverage.

III. OPINIONS REGARDING FLUBENDIAMIDE'S ATTRIBUTES

Q: What experience, if any, do you have studying flubendiamide and its use to control insect pests?

A: Since its introduction into the market, I have studied and evaluated flubendiamide's efficacy in controlling Lepidopteran pests that feed on leafy vegetable crops and melons, and its role in IPM and IRM programs. I have, for example, conducted numerous field studies comparing the efficacy of various insecticides, including flubendiamide, in controlling specific pests on specific crops, a number of which are appended to PBNX 22, Bayer's benefits submission to EPA. I have communicated my findings and my recommendations regarding flubendiamide to growers in Arizona. Critically, because of the frequency with which I meet and engage with growers and PCAs regarding the pest management issues they face, I have also gained valuable insight into the real-world benefits that flubendiamide provides in growers' fields. This work has also provided me a detailed understanding of the key role that pesticide costs play in driving grower decision-making regarding which compounds to use.

Q: What is flubendiamide?

A: Flubendiamide is the active ingredient for the product Belt®. It is an insecticide designed to target Lepidopteran larval complex (commonly referred to as caterpillar) pests of agricultural crops.

Q: Which of the crops that you study are treated with Belt®?

A: I study Leafy vegetables, Brassica (Cole) Leafy vegetable crops, and melons, and growers in Arizona and southern California use Belt® on all of these crops.

Q: Please describe Belt®'s efficacy in controlling pests on the crops that you study?

A: Based on over 10 years of experience documenting flubendiamide's activity (including during pre-registration field trials), and my understanding of its toxicological profile, I have found that flubendiamide is one of the more efficacious and therefore valuable insecticide alternatives presently available for managing Lepidopteran pests in Leafy vegetables, Brassica (Cole) Leafy vegetable crops and melons.

Q: Is use of Belt® consistent with IPM?

A: Belt® has a number of attributes that make it suitable for IPM, including: selective efficacy, non-systemic activity, rainfastness, good residual activity, a good human health and safety profile, low toxicity to beneficial insects, and cost effectiveness.

Q: What do you mean when you describe Belt® as having selectivity?

A: Belt® is a very narrow spectrum compound selective for control of Lepidopteran species only. Other types of insects, including beneficials, are not harmed by exposure to Belt®. In contrast, broad spectrum compounds such as pyrethroids tend to kill more insects, including those that are not being targeted for control.

Q: Why is Belt®'s selectivity an attribute for IPM?

A: Selectivity is an IPM attribute because it means that growers are narrowly treating the problem pest, rather than also eliminating other non-target insects, including beneficials. A core principle of IPM is to manage each pest problem as narrowly as possible, reducing unnecessary pesticide exposure.

Q: What do you mean by non-systemic activity?

A: Systemic insecticides are those that are taken up into the plant through the root or plant foliage. Non-systemic insecticides, such as flubendiamide, are not taken up into the plant through the root or plant foliage. Note that while Belt® is non-systemic, it does have translaminar properties. This means that when applied to the leaf surface of lettuce leaves, flubendiamide penetrates the leaf surface and moves into the cuticle, epidermis and mesophyll of the leaf, providing a reservoir of the insecticide within the effected leaf.

Q: Why is Belt®'s non-systemic, translaminar activity an attribute for IPM?

A: Because Belt® is non-systemic it can be applied by growers on an as needed basis and easily rotated with other MOAs. Systemic compounds, because of their often season-long residual activity, cannot be applied in this "treatment window" approach. Once growers apply chlorantraniliprole, for example, the compound is taken up into the crop and pests will continue to be exposed to it throughout the growing season. For this reason, as reflected in PBNX 112 at

PDF p. 3, I recommend that growers "[d]o not apply a foliar [d]iamide spray prior to or following the use of a soil application of chlorantraniliprole." Otherwise, growers would risk exposing multiple generations of Lepidopteran pests to diamides, which could result in the development of Lepidopteran resistance.

Belt®'s translaminar movement is advantageous because it means that the spray coverage of flubendiamide on crops is less critical than it would be for other non-systemic insecticides such as pyrethroids. Lepidopteran insects feeding on the lower (abaxial) leaf surface will become intoxicated with flubendiamide that has been applied only to the upper (adaxial) leaf surface. In contrast, if pyrethroids are spray applied, and the bottom surface of the leaf is missed, a caterpillar feeding on the bottom surface of the leaf will not be exposed and may therefore survive treatment.

Q: You indicated that Belt® is rainfast. What does that mean?

A: It means that once applied to a crop and given a chance to dry, Belt® will remain efficacious even after a rainstorm.

Q: What is the significance to growers of Belt® being rainfast?

A: It is significant because it means that growers need not reapply Belt® after a rainstorm. Rainfastness is a particularly important attribute in Arizona because of the potentially disruptive role seasonal monsoons play in Arizona agriculture. Alfalfa or melon growers who have applied a pesticide that is not rainfast may be forced to harvest the crop early if they learn that a monsoon thunderstorm is likely. If they have applied a rainfast product like Belt®, they can wait out the monsoon to harvest the crop, knowing that it will continue to control Lepidopteran pests after the storm has passed. This attribute is described by Ken Narramore, an independent PCA in Arizona, on page 38 of Bayer's benefits submission, PBNX 22. Belt's short pre-harvest interval (abbreviated PHI) also means that it can be applied on short notice, which is another important attribute for growers facing frequent but uncertain storms during Arizona's monsoon season. It enables a grower to harvest a crop early to avoid damage from a strong storm.

Q: What do you mean by residual activity?

A: By residual activity, I refer to the period of time after application of the insecticide that the insecticide remains efficacious in controlling the targeted pest. If an insecticide is described as having little residual activity, this means that it is only effective for a period of hours after it is applied. An insecticide with long residual activity may remain efficacious for many weeks, and possibly for the entire growing season of the crop.

Q: What is the basis for your opinion that Belt® has good residual activity?

A: Based on field studies, flubendiamide provides a consistent 14 day residual control in lettuce. This is a good, modest amount of residual activity for a non-systemic compound. Compounds such as pyrethroids that are only active for hours up to a few days, often must be repeatedly reapplied throughout the growing season to adequately control crop pests.

Q: Why is Belt®'s residual activity an attribute for IRM?

A: Belt®'s modest residual activity is an important attribute for IRM because it only remains efficacious long enough to expose a single generations of a Lepidopteran population to the active ingredient and control that pest, reducing selection pressure on flubendiamide to the population. Insecticides with longer residual activity expose multiple generations of crop pests, increasing selection pressure on those populations with the potential for resistance to develop.

Q: What do you mean when you say that Belt® has a good human health and safety profile?

A: Flubendiamide has essentially no human health concerns, and its use on Leafy vegetables therefore significantly reduces health risks to growers, applicators, PCAs, field workers and consumers. This is extremely important for the production of Leafy vegetables and Brassica (Cole) Leafy vegetable crops destined for the fresh market. The production of lettuce and other Leafy vegetables is very labor intensive and requires significant use of field workers, leading to significant worker exposure to applied insecticides. It is common to find workers in fields any given day of the week, performing irrigation, thinning, cultivation, weeding, and harvest. PCAs also scout fields intensively (on average 4 times per week) to make insect management decisions. Thus the probability of exposure to insecticides on lettuce is very high.

Q: What do you mean by Belt® having low toxicity to beneficial insects and pollinators?

A: I mean that flubendiamide is a very narrow spectrum compound selective for control of Lepidopteran species only, and has been found to be safer for natural insect enemies of those pests and for pollinators compared with many of the alternatives. This is in part due to its selectivity and also to the fact that it has minimal contact activity. Flubendiamide's low toxicity to beneficials is demonstrated in a series of figures in Bayer's benefits submission, on pages 33-37 of PBNX 22.

Q: Why is low toxicity to beneficial insects and pollinators an attribute for IPM?

A: The selective activity of flubendiamide's mode of action (MOA) allows growers to apply the compound at any time during the crop season without fear of disrupting natural enemy populations important for keeping secondary pests (i.e., *Liriomyza* leafminers) suppressed. In addition, flubendiamide's safety to pollinators has made it an important alternative in all desert crops. Melon crops, for example, require pollination services for fruit production, so it is critical that applied insecticides do not harm pollinators.

Q: What do you mean by Belt® being cost effective?

A: Flubendiamide (Belt® and Vetica®) is the least expensive alternative that provides excellent control of Beet Armyworm, Cabbage looper and Diamondback moth in a single application. Flubendiamide provides Lepidopteran efficacy as good as or better than the other alternatives, but at a lower cost to the grower. This is important in the production of Leafy vegetables, where growers may spend 20-30% of their growing costs on insect management. Thus, growers and PCAs prefer to use a product that is a) effective, b) inexpensive, c) easy to apply (translaminar), and d) safe to use. In my opinion, flubendiamide's cost effectiveness is a major reason why flubendiamide use has grown in Arizona lettuce.

Q: What is the basis for your opinion that Belt® is a competitively priced IPM option?

A: My opinion is based on years of observation and conversations with local PCAs and insecticide distributers. Based on grower and PCA surveys (as described in PBNX 113) that I have reviewed, while spinetoram has been and remains the most commonly used insecticide, it is now followed by flubendiamide, chlorantraniliprole, methomyl and acephate.

IV. FLUBENDIAMIDE'S USE ON LEAFY VEGETABLE AND BRASSICA (COLE) LEAFY VEGETABLE CROPS

Q: Please provide an overview of the major pests targeting leafy vegetable crops in Arizona and its surroundings.

A: This varies somewhat by crop, but lettuce is a good representative crop to discuss for the Leafy vegetable crop group. There are four major pests of lettuce in the American Southwest: Lepidopteran pests, sweet potato whitefly, western flower thrips, and aphids. The four pests dominate in different growing seasons. Lepidopteran pests (which include beet army worm, cabbage looper, and corn earworm, among others) are present in the highest numbers in the fall. Of the four major pests, the Lepidopteran pests are consistently the most damaging to crops and therefore require the most control. When plants are small, feeding damage from worms can cause severe reduction to stand establishment, dramatically diminishing the number of plants in the field. As harvest nears, the risk of loss increases as worms feed on or contaminate the marketable product.

Q: Describe, based on your experience and observation, how growers control Lepidopteran pests on lettuce?

A: Lepidopteran larvae require multiple pesticide applications to prevent losses in yield and quality. Growers treat lettuce 5 to 6 times (sometimes more under heavy pressure) for Lepidopteran control on fall lettuce and 4 to 5 times on spring lettuce. The average number of applications is down considerably from 25 years ago when growers predominately relied on pyrethroids, organophosphates and carbamates for Lepidopteran control, and therefore were making 12 to14 applications per season. This change shows the importance of the development of new and effective insecticide alternatives to protect Leafy vegetables and produce high-quality lettuce destined for the fresh market.

Control of the Lepidopteran larvae complex is critical at two key times during the production of lettuce and Brassica (Cole) Leafy vegetable crops. First, emerging seedlings during stand establishment through thinning are very susceptible to larval feeding that can severely stunt or kill seedlings by extreme defoliation. This can also slow growth enough to affect crop uniformity. Absent effective economical control of these Lepidopteran larvae, significant plant losses can occur during stand establishment (the time from crop germination to emergence of young seedling plants). I have personally observed stand reductions as high as 50% in fields where Lepidopteran control was not achieved. Damage is less serious from thinning to heading stages, but under heavy pressure can result in reduced head size. Feeding damage is economically important once cupping (when the lettuce plant initiates head formation) begins as larvae may feed on the head or heart, rendering it unmarketable. Contamination of lettuce heads, celery hearts, and Brassica (Cole) Leafy vegetable crops with either live larvae or frass (which is caterpillar excrement) will render it unmarketable. If Lepidopteran control is not achieved prior to harvest, shippers and buyers will reject an entire field. Without effective Lepidopteran control, a significant acreage of the Arizona lettuce crop would be lost to larvae contamination and could not be harvested.

Q: How does Belt®'s efficacy in controlling Lepidopteran pests compare to other commonly used compounds?

A: When Belt® is used on lettuce infested by multiple Lepidopteran species, no additional insecticides are required to achieve complete control. Many of the other alternatives used for Lepidopteran control in Leafy vegetables require the addition of a pyrethroid or organophosphate in the spray tank to achieve comparable control to flubendiamide. For example, growers using alternatives such as methoxyfenozide, emamectin benzoate, indoxacarb, methomyl, chlorpyrifos, or acephate would instead need to combine them with a pyrethroid to provide comparable control to flubendiamide.

Growers also use less active ingredient when they apply flubendiamide. On a per spray basis, growers apply lower application rates of flubendiamide than most of the competing alternatives, and in many cases, dramatically lower. For instance, at the highest labeled rate, flubendiamide (Belt®) in lettuce is applied at 0.047 lbs of active ingredient per acre (abbreviated "LAA") compared to the "broad spectrum" compounds (i.e., acephate, chlorpyrifos, methomyl) that are applied at rates at or over 1.0 lb of active ingredient per acre (LAA). The most commonly used pyrethroid (bifenthrin at 0.10 LAA) is also used at higher rates than flubendiamide. Similarly, many of the other selective, low-risk products used for Lepidopteran control are applied at higher rates than flubendiamide (i.e., methoxyfenozide at 0.19 LAA, inidoxacarb at 0.11 LAA, and spinetoram, 0.05 LAA).

Q: How do the other diamide compounds compare to Belt®?

A: Chlorantraniliprole, like flubendiamide, is also a diamide and therefore provides a number of similar attributes in managing Lepidopteran pests. However, chlorantraniliprole has broader activity than flubendiamide and it is a systemic compound, as demonstrated in a field trial that I conducted in 2007 (PBNX 114). When it is applied to soil, chlorantraniliprole is highly xylem mobile via root uptake. In practice this means that when applied to the soil, chlorantraniliprole will exhibit much longer residual activity than products applied as foliar sprays. As I have explained above, this extended residual can expose multiple generations of Lepidopteran populations to lethal and sub-lethal doses of the toxicant, increasing the risk of resistance in local populations. Because flubendiamide has more limited residual activity and is not systemic, it is a better fit for Leafy Vegetable IPM programs than is a systemic compound such as chlorantraniliprole. Growers using chlorantraniliprole also have to apply more active ingredient (0.065 LAA) than when using flubendiamide (0.046 LAA).

Q: On what do you base your opinion regarding Belt®'s role in controlling lettuce crop pests?

A: I base my opinion on field trials that I conducted, on the field trials conducted by other entomologists that I have reviewed, and on my direct observations of Belt®'s effectiveness in managing caterpillar pests in Arizona fields. I have also reviewed Bayer's benefits submission, which provides a comprehensive overview of field data and grower and entomologist testimonials regarding Belt®'s efficacy. Bayer's benefits submission includes field studies that I conducted in 2006 and 2012 evaluating the comparative efficacy of compounds including flubendiamide in controlling insect pests. Those studies can be found on pages 148-151 of PBNX 22. In the first study, which assessed flubendiamide's control of lepidopterous larvae on fall lettuce, I found that "flubendiamide treatments provided significant reductions of large larvae comparable to the other materials evaluated," and "also provided good residual control as indicated by significant reductions in small larvae late in the trial." PBNX 22 at 148. The second study assessed cross-spectrum control and therefore assessed the efficacy of Belt® as a mixture with another compound called Movento®. The Belt® mixture was one of three treatments found to have "provided the most consistent activity against [Cabbage looper] larvae." *Id.* at 150.

V. FLUBENDIAMIDE'S USE ON MELONS

Q: Please describe flubendiamide's use to control pests on melon crops.

A: Flubendiamide is also used in melon production in Arizona and California, which are the primary states responsible for production of cantaloupes and honeydews. Flubendiamide is an ideal compound control of Lepidopteran pests (particularly cabbage looper and beet armyworms) on melons because of its bee safety and lack of toxicity to natural enemies important in the natural suppression of *Bemisia* whiteflies and *Liriomyza* leafminers. Furthermore, flubendiamide formulated as Vetica® (an in-can mixture of flubendiamide and buprofezin) is commonly used during flowering and pollination periods because it can provide control of both Lepidopteran pests and sweetpotato whitefly, while not harming honey bees or natural enemies of those pests.

VI. OPINIONS REGARDING EPA'S ANALYSIS OF FLUBENDIAMIDE'S BENEFITS

Q: Dr. Palumbo, are you familiar with EPA BEAD's analysis of Bayer's benefits submission?

A: Yes, in preparation for my testimony, I reviewed PBNX 23, which is EPA BEAD's July 24, 2015 memorandum reviewing Bayer's benefits submission and PBNX 30,which is EPA's Decision Memorandum.

Q: What is your assessment of BEAD's analysis?

A: In the BEAD analysis of Bayer's benefits submission, EPA largely agrees with Bayer's claims regarding flubendiamide's benefits. I note that for some high value crops such as almonds, peppers and tobacco, EPA claims that growers would transition to IPM-friendly alternatives (methoxyfenozide, other diamides and spinosyns), based on an assumption that these growers will choose to incur the higher costs of using these alternatives. While I do not study or work with these particular crops, EPA's assumption would not be valid for Leafy Vegetable growers.

With respect to alfalfa, EPA correctly acknowledges that alfalfa growers are likely to rely on pyrethroids if flubendiamide is no longer available. EPA claims, however, that since the treated acreage for flubendiamide is low, the impact of increased pyrethroid usage would be insignificant. For the alfalfa produced in the desert valleys of Arizona and California, I disagree with EPA's conclusion that the shift to pyrethroids would be insignificant. First, the aim should be to promote greater use of IPM by growers, rather than forcing growers back to IPM-disruptive compounds. Second, the "very small percent of alfalfa acres" that EPA describes may not be large from a national perspective, but from the standpoint of growers in the American Southwest, this crop is economically important and growers certainly do not consider the amount of acreage to be minor. Depriving Arizona and southern California growers of the use of flubendiamide would force many to use pyrethroids, jeopardizing important gains made in the practice of IPM in this region, which has increasingly adopted the use of selective insecticides in conjunction with natural enemy conservation to keep Lepidopteran pests under economic injury levels.

Growers who switch to pyrethroids will have to make more frequent applications to control Lepidopteran pests such as cutworm and alfalfa caterpillar. Furthermore, because honey bees and other native bees often forage un-invited in blooming alfalfa fields, risk to these pollinators will increase significantly when pyrethroids are used. BEAD appears to recognize this, but discounts its significance because of its claim that a "very small percent of alfalfa acres" will be affected. In doing so, EPA ignores important regional distinctions. Alfalfa is a major crop in Arizona and southern California, and the loss of Belt® will have significant repercussions. Alfalfa is a low-value crop relative to almonds or peppers, with slim profit margins. If growers lose access to the competitively priced flubendiamide, growers will opt instead for the less expensive broad spectrum materials available (pyrethroids, methomyl and chlorpyrifos). At the same time, the longer-term impacts of disrupting IPM programs for Lepidopteran pests in this region could prove extremely costly to agriculture and the environment.

With respect to lettuce, other than acknowledging on page 4 of PBNX 23 that flubendiamide was used on 13% of lettuce crops nationally between 2011 and 2013, BEAD did not substantively respond to benefits information submitted by Bayer, growers, entomologists and IPM specialists. Based on my personal experience and my review of relevant data, Belt® has become a critical tool for lettuce growers in the American southwest. This is supported by recent survey data from the University of Arizona, PBNX 113, indicating that flubendiamide (Belt® and Vetica®) is one of the most commonly used products for Lepidopteran control in lettuce. That survey found that "[f]oliar uses of Diamides (Coragen®, Voliam Xpress®, Vetica®, Belt®) were the fourth most commonly chemistry used in lettuce in 2014-2015," that "[s]ince they were first registered in 2008, PCAs have steadily incorporated this new chemical class into their management programs," and that "[t]he use of Belt increased significantly this season, whereas soil uses of Coragen continue to decline."

I note that while Bayer also submitted data and information regarding the benefits flubendiamide provides for watermelon growers (as a representative crop), BEAD does not appear to have considered or responded to that section of Bayer's submission, beyond acknowledging, on page 4 of PBNX 23, that 14% of watermelon crops in the United States are treated with flubendiamide.

VII. OPINION REGARDING CANCELLATION AND EPA'S PROPOSED EXISTING STOCKS POLICY

Q: In your opinion, if EPA cancels flubendiamide's registrations, what compounds are growers most likely to replace it with?

A: If flubendiamide is removed from the market, I would anticipate an increase in pyrethroid usage, primarily used in combination as tank-mixtures with other selective products (methoxyfenozide, emamectin benzoate and indoxacarb). EPA's Decision Memorandum acknowledges that many growers will shift to pyrethroids, but also includes a vague and generalized claim "that there are efficacious alternatives for flubendiamide." In my opinion, the consequences of flubendiamide's cancellation will be much more complicated, particularly when focusing on particular crops and particular regions of the country.

The cancellation of flubendiamide would likely lead to increased usage of organophosphates (acephate, chlorpyrifos) and carbamates (methomyl and acephate) because of their lower costs. As noted in PBNX 115, growers applying organophosphates or carbamates all may require a pyrethroid to provide control of Lepidopteran insects comparable to flubendiamide.

I would also expect to see more use of Voliam Xpress®, which is an in-can mixture of chlorantraniliprole and lambda-cyhalothrin. It is less expensive and equally effective as Coragen®, but it would also increase pyrethroid exposure in the cropping system. Also, approximately 10% of the lettuce grown in Arizona is destined for export markets (including Japan, Canada and the European Union). These global markets provide desert lettuce growers with niche opportunities to sell fresh-market and value-added produce, but not without trade regulations that can influence pest management decisions made by the grower. Many of the buyers in these countries are prohibiting the local shippers from using certain pyrethroids (bifenthrin, lambda-cyhalothrin, zeta-cypermethrin) on crops destined for foreign markets. Because growers cannot always predict which fields will be harvested for the export market, some shippers prohibit the use of certain pyrethroids from their entire growing operation. This has eliminated the use of certain products such as Voliam Xpress®, methoxyfenozide, indoxacarb, emamectin benzoate and methomyl for Lepidopteran control. Belt®, in contrast, can be applied without resulting in any complications for export to foreign markets.

Q: What is the basis for your opinion that growers are most likely to replace Belt® with organophosphates and pyrethroids?

A: The number one driver of the shift back to organophosphates and pyrethroids is likely to be cost. Flubendiamide is a very competitively-priced IPM-friendly compound. Based upon my experience and knowledge of grower practices, many growers will not be willing to spend more on insecticides, particularly for low-margin crops like lettuce, which means that growers will likely look to less expensive alternatives (e.g. pyrethroids) rather than more expensive IPM-friendly alternatives.

Q: What impact would a shift back to pyrethroids, organophosphates and carbamates have on agriculture and the environment?

A: These compounds are generally IPM-disruptive. They are more likely to result in pest resistance and they are more likely to kill beneficial insects because of their broad spectrum of activity. These compounds lack residual activity, which means that they often have to be reapplied, resulting in more pesticides ending up in the natural environment. These compounds also generally present comparatively heightened health risks to farm workers.

Q: What impact, if any, would the cancellation of flubendiamide registrations have on IPM and IRM in Arizona?

A: Flubendiamide plays an important role in the region's IRM. Because of its unique MOA, flubendiamide provides growers with an additional MOA with which to rotate throughout the crop season. Flubendiamide is not cross resistant with any of the other classes of chemistry being used to control Lepidopteran insects in leafy vegetables, so there is no threat of hidden selection pressure. Our current University of Arizona IRM program for the Lepidopteran complex therefore recommends rotations of flubendiamide, spinetoram, emamectin benzoate, or chlorantraniliprole throughout the crop season. Flubendiamide's cancellation would make it more difficult for growers to adequately rotate through MOAs to avoid the development of pest resistance.

The goals of our IPM programs for Leafy vegetables, Brassica (Cole) Leafy vegetable crops and melons in Arizona are to implement innovative pest management strategies that reduce the industry's reliance on broadly-toxic pesticides without sacrificing yield, quality and profitability, and while minimizing dietary and environmental risks. As described in PBNX 113, our IPM programs appear to be achieving our goal, with insecticide use data indicating that the usage of compounds such as flubendiamide has significantly reduced the vegetables industry's reliance on organophosphates and carbamates. EPA's decision to cancel flubendiamide risks undoing those important gains.

An active ingredient such as flubendiamide provides an ideal alternative for growers due to its selective activity against all of their major Lepidopteran pests, and it fits in existing IPM and IRM programs for leafy vegetable, Cole crops and melons. It is my opinion that without the availability of insecticides like flubendiamide, economic production of Leafy vegetables in Arizona and California may not be sustainable.

Q: What is your understanding of EPA's proposed existing stocks provision for flubendiamide?

A: My understanding of EPA's proposal is based on my review of PBNX 20, which is EPA's Notice of Intent to Cancel. According to that Notice, beginning on the date of cancellation, flubendiamide in the hands of the growers or applicators (the "end users") could continue to be used. However, beginning on that same date, the Registrants could no longer manufacture flubendiamide, nor could flubendiamide products continue to be sold or distributed by dealers or distributors. Only flubendiamide already in the hands of growers or applicators could continue to be applied in the field.

Q: What is your opinion regarding how the existing stocks provision would impact growers in your region?

A: My opinion is that this provision would be disruptive to growers in Arizona and southern California. To explain why, it is first necessary to provide some background on pest control purchasing and management in this region. The PCAs have a more active role in pesticide purchasing in this region than they may have in other parts of the country. The growers either employ the PCAs directly or hire the PCAs on a contract basis to consult. The PCAs typically scout the growers' fields and determines when insect management is needed and what insecticide should be used. Depending on the state, the PCAs submit a recommendation to either the Arizona Department of Agriculture or the California Department of Pesticide Regulation prior to applying the insecticide, and the recommendation, once approved, is then sent to a distributor or dealer who maintains the insecticide inventory. The dealer or distributor then sells the product to the growers, delivering the product to certified applicators who actually apply the product to the growers' fields.

Because, under this system, neither the grower nor the pesticide applicator generally stores substantial quantities of insecticides, permitting them to exhaust their existing stocks would be a largely meaningless gesture. EPA's proposed existing stocks policy would effectively prevent growers from applying flubendiamide from the date of cancellation forward. This is because the pesticide dealers and distributors that actually possess significant supplies of flubendiamide would be prohibited from selling or distributing those remaining supplies for use by the pesticide applicators hired by the growers. As a result, when lepidopteran pest numbers hit their peak this fall (as described above), the PCAs who would normally recommend treatment of fall lettuce with flubendiamide will suddenly no longer be able to obtain the product for their growers. This policy would also deprive growers of the use of flubendiamide right in the middle of the monsoon season (which runs from mid-June through the end of September) when its rainfastness and short PHI are most needed.

Q: What, in your opinion, would be a less disruptive approach to existing stocks for growers in Arizona and southern California?

A: If the flubendiamide registrations are to be cancelled, a far less disruptive approach to existing stocks would be to permit distributors and dealers to sell their existing inventories, such that growers will have the benefit of flubendiamide's lepidopteran control through the monsoon season and the end of the fall growing season. In addition, allowing Registrants to sell the limited existing stocks they may have on hand at the time of cancellation will allow for a more gradual and less disruptive phase-out of the product, and provide growers and PCAs with time to adopt new strategies and find alternative sources of products after flubendiamide is cancelled. If EPA's existing stocks policy is instead adopted as proposed, growers will lose access to flubendiamide just as they are likely to need it the most.

VIII. EXHIBITS

Q: Dr. Palumbo, in your testimony you referenced the following exhibits: PBNX 20, 22-23, 30, and 110-115. PBNX 20, 22-23, and 30 previously were produced as attachments to Bayer and Nichino's Motion for Accelerated Decision and Exhibits 110-115 are being produced as part of Bayer and Nichino's Prehearing Submission. Are these exhibits true and correct copies of the documents you referenced?

A: Yes.

Q: Thank you, Dr. Palumbo. Bayer and Nichino move to enter PBNX 110-115 into evidence.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 21st day of April, 2016.

Dr. John C. Palumbo