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Chlorantraniliprole Use and Benefits in Arizona Agriculture

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Summary

- The EPA has published a Preliminary Work Plan and opened the public docket for registration review of chlorantraniliprole, a diamide class insecticide registered for use to control moths, caterpillars, beetles, termites, and other insects.
- Chlorantraniliprole is a selective insecticide used primarily for control of lepidopteran pests across a broad range of vegetable crops and field crops.
- Our goal at this time is to inform the EPA about specific and critical use patterns of chlorantraniliprole on Arizona crops and to respond to EPA's specific guidance questions for commenters.
- Chlorantraniliprole uses are reported on a variety of crops including lettuces, cole crops and a broad range of vegetables, as well melons, alfalfa and cotton.
- Uses are documented in minor crops, such as Swiss chard, cress, kale, mustard greens, celery, sugar beets and Brussel sprouts, for which relatively few insecticides are registered for use. These registrations are important to the economic viability of growers.
- Chlorantraniliprole is efficacious against a range of lepidopteran pests, including corn earworm, beet armyworm and cabbage looper, and also provides leafminer control in lettuce.
- Chlorantraniliprole, along with other diamide insecticides, plays an important role in the control of key lepidopteran pests in lettuce, a crop valued at over $1.6bil.
- Since the loss of registrations of Belt (flubendiamide) in crops such as cotton, alfalfa and sweet corn, chlorantraniliprole has been a particularly important option for control of lepidopteran pests.
- Chlorantraniliprole (registered as Prevathon) is one of a very few selective insecticides available for lepidopteran control in Arizona cotton, and it is highly preferred in Pima and non-Bt cottons.
- Our growers and pest control advisors are very mindful of pollinator management, including good communication with bee keepers and a common practice of spraying at night or early morning, before bees are active in the field. We are unaware of any observations of harm to pollinators are a result of spiromesifen use.

- We are unaware of any seed treatment uses of chlorantraniliprole in Arizona.

Chlorantraniliprole Use in Arizona Agriculture

Chlorantraniliprole is a diamide class insecticide with reported uses across dozens of Arizona crops. Uses are documented in some very minor crops, such as Swiss chard, cress, kale, mustard greens, celery, sugar beets and Brussel sprouts, for which relatively few insecticides are registered for use. Although acreages treated in these crops tend to be small, and not necessarily every year, these registrations are certainly important to lepidopteran management and economic viability for growers. Crops with more significant and regular annual uses include lettuces, with an average of 20,060 acres reportedly treated annually (2010-2019) across all lettuce types; alfalfa, with an average 10,356 acres treated, and a sharp upward trend over the past four years; all melons, with an average 429 acres treated; and cole crops such as cabbages (avg. 1,820ac), broccoli (avg. 1,116ac) and cauliflower (avg. 879ac). All averages in the prior examples are for reported use data from 2010 through 2019. Although chlorantraniliprole does not appear to be a major insecticide used in cotton, use is increasing, with an average of 1,740 acres reportedly treated over the past four years. These numbers, from the Arizona Pest Management Center Pesticide Use Database (Fournier et al. 2017) represent conservative estimates of use, due to limitations on reporting requirements. (See "Our Data and Expert Information" section for details.)

Lettuce, melons and other vegetable crops

Arizona growers are one of the leading producers of fresh-market vegetables in the U.S., producing vegetables and melons at an estimated total economic contribution of over $2.5 billion in 2015. This includes over 90% of all fresh lettuce consumed in the U.S. in the winter (Kerna et al. 2016). In 2019, Arizona collectively harvested 71,000 acres of head lettuce, leaf lettuce and Romaine valued at $1.67 billion in the fresh market (USDA-NASS 2020).

Lettuce

Diamides play an important role in the management of lepidopterous larvae in desert produce crops. They are the third most-used class of reduced risk chemistry on head lettuce, after spinosyns and neonicotinoids. Based on data from the annual Lettuce Pest Losses survey, 92.6% of pest control advisors (PCAs) indicated they used diamides on fall head lettuce, with 70.5% of acres treated. In Spring head lettuce, 63% of PCAs reported use of diamides on 44.6% of acres (Palumbo 2019a). Chlorantraniliprole products are recommended for control of lepidopteran larvae such as corn earworm, beet armyworm and cabbage looper, and also provide leafminer control (Palumbo 2019b). The primary products used in lettuce are Coragen (chlorantraniliprole) and Besiege (chlorantraniliprole + lambda-cyhalothrin). In the 2018-2019 lettuce production year, chlorantraniliprole products were the most used among diamide insects. Other diamide active ingredients used in head lettuce include cyantraniliprole (Verimark, Exirel) and flubendiamide (Belt).

Chlorantraniliprole products were ranked among the top insecticides used in head lettuce by respondents in the 2019 annual Lettuce Pest Losses survey. A total of 28 surveys were completed by pest control advisors representing an estimated total of 33,275 fall acres and 35,156 spring lettuce acres from Yuma County, Maricopa County and neighboring Imperial County, California.

In this survey, Coragen ranked as both the 6th most used insecticide (foliar) and 12th most used insecticide (soil applications) in Fall head lettuce, with 10,469 and 2,800 acres treated, respectively. In Spring head lettuce, use dropped to 7,915 acres for foliar applications and 169 acres for soil applications. Besiege was ranked 8th most used insecticide in the Fall, with 5,000 acres treated. This dropped to 3,850 acres in Spring head lettuce (Palumbo 2019b).

Pest control advisors (PCAs) interviewed indicated that both Coragen and Besiege are highly efficacious across a spectrum of lepidopteran pests, including corn earworm, cutworm, beet armyworm and cabbage looper. One distinction noted by PCAs is that Coragen (chlorantraniliprole on its own) is not efficacious against diamondback moth, an important pest of desert cole crops. Invasive populations of the diamondback moth in desert vegetable crops starting in 2016 were found to be very resistant to the diamide insecticides (Coragen, Beseige, Belt and Vetica) commonly used to control Lepidopterous larvae (Palumbo 2019c). Another distinction between the two products is price, with Besiege, a premix of chlorantraniliprole and lambda-cyhalothrin, being the much cheaper of the two, and having the added benefit of the pyrethroid, "for free," as one PCA put it.

Coragen and Besiege are used in rotation with Radiant (spinetoram), and potentially Intrepid (methoxyfenozide), for worm control in produce crops. A typical practice is a single soil application of Coragen at planting, which provides good residual control and protects young emerging plants for about 20 days. Reported rates vary for Coragen in lettuce, with a median rate of 4.93 fl.oz./ac and 75% of applications under 5.92 fl.oz./ac (Fournier et al. 2017). One explanation for lower than full rates (7.5 fl.oz.) for soil applications may be Coragen's high cost. This soil application is generally followed by a foliar application of Radiant, which also provides thrips control, followed by either Besiege or Intrepid. The interval between chlorantraniliprole applications is typically around 30 days, with either one or two foliar applications of chlorantraniliprole. A variation on this approach is to forego the soil application of Coragen in favor of an aerial application of Radiant, which also provides thrips control. One PCA indicated that Besiege is much more efficacious on head lettuce when applied by ground. Typically, the first spray application is applied at the 4-leaf stage, prior to heading, when it is most effective. A follow up application, if used, would be a week to 10 days before harvest. The majority of Besiege goes on at or near the top of the label (9 fl.oz./ac), with a median rate of 8.04 fl.oz./ac in head lettuce (Fournier et al. 2017).

Melons

Arizona produces fresh market cantaloupe, watermelons and honeydew. In 2019, 18,600 combined harvested acres produced fruit valued at over $115 million (USDA-NASS 2020).

Chlorantraniliprole is registered for use in watermelons and cantaloupes. Reported uses in these crops represent a relatively small portion of acres treated annually (Fournier et al. 2017). However, some pest control advisors rely on this active ingredient in melons for its efficacy against a broad range of lepidopteran larvae, including corn earworm, armyworm and cabbage looper. It is used in rotation with Radiant. A single application at netting provides excellent looper control.

Cole Crops

Arizona produces fresh market broccoli, cauliflower and other cole crops. In 2019, over 17,800 combined acres of broccoli and cauliflower were valued at $1.86 billion (USDA-NASS 2020).

Chlorantraniliprole is used for control of lepidopterous larvae in cole crops. According to the Arizona Pest Management Center Pesticide Use Database, chlorantraniliprole is used across a range of cole crops in Arizona, including broccoli, cauliflower, cabbages, kale and Brussel sprouts. Uses in cabbage, cauliflower and broccoli are consistent, with a significant portion of acres treated every year. Uses in kale and Brussel sprouts are less consistent, with fewer acres reportedly treated (Fournier et al. 2017). Importantly, for some of these crops, relatively few insecticides are registered for use against lepidopteran pests.

Pest control advisors reported using Coragen on broccoli, cauliflower and kale for control of armyworm, looper, and other lepidopteran pests. A single pre-plant soil application at full rate provides excellent early worm control with good residual. For foliar applications across most cole crops, several PCAs prefer Besiege, which is considerably less expensive and also contains the pyrethroid lambda-cyhalothrin. When needed, foliar applications of Besiege are used in rotation with Radiant to manage heavier worm infestations. However, Besiege is not labeled for use on kale.

One PCA reports a single foliar use of Besiege at the 6 to 8 leaf stage, full rate, in about 60% of broccoli and cauliflower acres. An advantage of Beseige, as noted earlier, is that the lambda-cyhalotrhin component is effective against diamondback moth, a key pest of cole crops (Palumbo 2019c). Some PCAs view Besiege as a “go to product” for worm control in broccoli and cauliflower. It is reportedly affordable and efficacious, ensuring the development of undamaged heads for harvest. The strategy is to spray the worms on the foliage before they reach the head. One PCA reports multiple aerial sprays of Beseige at or near the full label rate on cauliflower and broccoli while lepidopteran pests are in the field, from mid-August to early-November, with an interval of 14 to 21 days between sprays. This is not a typical use pattern but does occur. Some PCAs discontinued the use of chlorantraniliprole in cole crops after the 2016 invasive diamondback moth population proved to be resistant (Palumbo 2019c) and have not since resumed use in these crops.

In kale, Coragen is sometimes used in rotation with Radiant, which controls both diamondback moth and thrips, in addition to lepidopteran pests (Palumbo 2019b). Thrips damage is a major concern in kale. Coragen is an excellent product in kale, but according to one PCA, is only used on a small to moderate percentage of acres, where worm infestations are heavy, due to its high cost.

Other Vegetable Crops

Chlorantraniliprole is used in several minor crops in Arizona in addition to those noted above, including Swiss chard, cress, mustard greens, celery, sweet corn and sugar beets. Relatively few insecticides are registered for Lepidoptera control in these crops. Although acreages treated in

these crops tend to be small, and chlorantraniliprole is not necessarily used every year, these registrations are important to lepidopteran management and economic viability for growers.

Swiss Chard. One growing practice for Swiss chard is to harvest the leaves very large (up to 12"), for a particular market. This is unlike the more standard practice of early harvesting for use in Spring mix. Tiny holes in young leaves become larger as leaves grow, and can make harvested product unsalable for this market. A single at-planting soil application of Coragen at 7 fl.oz./ac is used to protect Swiss chard from significant leaf damage caused by feeding of early stage Lepidoptera larvae. The product is efficacious and provides 20 days of residual control. The product is expensive, and foliar applications are less frequently used. But in heavy infestations, a small percentage of acres may also receive a single foliar application of Coragen, in rotation with Radiant.

Sweet Corn. Besiege is an important product for the control of corn earworm and other pests on sweet corn. Its use has increased since Belt (flubendiamide) is no longer registered for use in sweet corn. Over the three-week period from silking stage to harvest, 3 applications of Besiege at the full 10 fl.oz./ac rate are typically used, up to the maximum annual use rate for either chlorantraniliprole or lambda-cyhalotrhin. The application interval for Besiege is about 10 days, and it is rotated with Lannate (methomyl) and a variety of pyrethroids, on a 2-day spray schedule.

Alfalfa

Alfalfa is an integral crop of Arizona's economy. In 2020, 275,000 acres of Alfalfa were harvested, valued at over $390mil (USDA NASS 2020). Arizona alfalfa growers lead the nation in yields, averaging 8.4 tons per acre (USDA NASS 2018).

Reported use of chlorantraniliprole in alfalfa has increased dramatically in 2018 and 2019, though it has been steadily used for many years. This increase may be attributed to the loss of Belt (flubendiamide), which is no longer registered for use in alfalfa. It is used in products like Prevathon, to control alfalfa caterpillar, armyworm and cutworm. One PCA indicated that Prevathon provides good efficacy on all three species, with up to 12 days residual control. He uses 10 fl.oz/ac and typically applies it 2 to 3 times per season, June through August, at about a 30 day interval. It is effective across pest species, and provides better cutworm control than comparable materials. This comment was confirmed by another PCA, who said, apart from Intrepid (methoxyfenozide),d it is the only material we have in alfalfa that effectively controls cutworm, so it is important for resistance management. One PCA said that, in his experience, chlorantraniliprole is very soft on bees and other beneficial insects. Other PCAs report using Besiege in alfalfa, on a low percentage of acres annually, for control of leafhoppers, typically a single application.

Cotton

Arizona often leads the world in cotton yield per acre (>1550 lbs.), nearly twice the U.S. average, contributing 9,000 jobs and $700 million to Arizona's economy in 2011 (anonymous

2014). In 2019, Arizona upland cotton had a value exceeding $190 million for cotton and cotton seed production combined (USDA-NASS 2020).

Chlorantraniliprole reportedly has been used on low to moderate percentage of Arizona cotton acres annually since 2016 (Fournier et al. 2017). Prevathon is one of a very few selective insecticides available for lepidopteran control in Arizona cotton, and it is highly preferred among choices by growers of Pima and other non-Bt cottons. These cottons lack the transgenic trait that protects Bt cotton, more dominant in terms of statewide acres, from lepidopteran pests. This is a very important chemistry for growers, despite relatively low use in terms of acres treated.

Who We Are

The Arizona Pest Management Center is host to the University of Arizona's expert IPM scientists including Ph.D. entomologists, weed scientists and plant pathologists with expertise in the strategic tactical use of pesticides within IPM programs that protect economic, environmental and human health interests of stakeholders and the society at large.

Dr. Al Fournier is Associate Director of the APMC / Associate Specialist in Entomology, holds a Ph.D. in Entomology, and has expertise in evaluating adoption and impact of integrated pest management and associated technologies. He works with the Western IPM Center, representing stakeholders in the desert Southwest states in EPA registration reviews. Dr. Peter Ellsworth is Director of the APMC, State IPM Coordinator for Arizona and Professor of Entomology / Extension IPM Specialist with expertise in developing IPM systems in cotton and other crops and measuring implementation and impact of IPM and pest management practices. Dr. John Palumbo is a Research Scientist in Entomology and an Extension Specialist working with the Arizona vegetable industry. Mr. Wayne Dixon holds a B.S. in Computer Information Systems and develops tools and data used in IPM research, education and evaluation, including management of the APMC Pesticide Use Database.

These comments are the independent assessment of the authors and the Arizona Pest Management Center as part of our role to contribute federal comments on issues of pest management importance and do not imply endorsement by the University of Arizona or USDA of any products, services, or organizations mentioned, shown, or indirectly implied in this document.

Our Data and Expert Information

Through cooperative agreements with Arizona Department of Agriculture, the Arizona Pest Management Center obtains use of, improves upon, and conducts studies with ADA's Form1080 data. Growers, pest control advisors and applicators complete and submit these forms to the state when required by statute as a record of pesticide use. These data contain information on 100% of custom-applied (i.e., for hire) pesticides in the state of Arizona. Grower self-applied pesticide applications may be under-represented in these data. In addition, the Arizona Pest Management Center is host to scientists in the discipline of IPM, including experts in the usage of this and other compounds in our agricultural systems. We actively solicit input from stakeholders in Arizona and other Southwest states (Nevada, Colorado, New Mexico and Southeastern

California), including those in the regulated user community, particularly to better understand use patterns, use benefits, and availability and efficacy of alternatives. The comments within are based on the extensive data contained in the Arizona Pest Management Center Pesticide Use Database, collected summary input from stakeholders and the expertise of APMC member faculty.

Through the Crop Pest Losses and Impact Assessment program (WIPMC 2018), partially funded through the Western IPM Center, the Arizona Pest Management Center conducts annual surveys with state-licensed pest control advisors (PCAs), who are the primary pest management decision makers, in consultation with growers. The surveys, conducted at face-to-face meetings, provide detailed information on crop yield losses to specific insect pests, weeds and diseases, control costs, and pesticide use for the key crops, cotton and lettuce. Cotton data have been collected since 1991 and lettuce data since 2005. Data are collected for all of Arizona and neighboring production regions of California, with typical responses representing up to 65% of acres planted in Arizona. These data provide detailed information on shifting pest trends, chemical use and costs, and often compliment and augment information from the APMC Pesticide Use Database, particularly for pesticide uses for which the state does not mandate reporting.

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