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Famoxadone Use and Benefits in Arizona, Southeastern California and New Mexico

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The EPA is seeking public comments in response to published human health and ecological risk assessments for the fungicide famoxadone. The Ecological Draft Risk assessment identified the potential for chronic risks to mammals and birds, acute and chronic risk to freshwater and estuarine/marine invertebrates and acute risk to freshwater fish (based on use on peppers).

We wish to respond to the Agency's open comment period for famoxadone on behalf of agricultural stakeholders working in Arizona, Southeastern California and New Mexico. Our goal is to inform the EPA about specific use patterns of famoxadone and its crop-specific benefits in our region. Our comments combine stakeholder input received from University of Arizona Extension Specialists, licensed pest control advisors, and reported pesticide use data from the Arizona Pest Management Center Pesticide Use Database.

Summary

- Famoxadone is one of two active ingredients in Dupont Tanos, a fungicide labelled for control of downy mildew in lettuce, spinach, onions and other vegetable crops. It is also labelled to control of Phytophthora blight and bacterial spot (*Xanthomonas* spp.) in peppers.
- Downy mildew is a significant and regular disease of spinach and lettuce crops in Arizona, with a combined value in 2020 of $839 million. Its control relies on preventative treatments using rotations and mixtures of effective modes of action. According to University of Arizona Plant Pathologists and local pest control advisors, Dupont Tanos is among few effective control options important in downy mildew control.
- Dupont Tanos is used to manage downy mildew and purple blotch, two key diseases impacting seed onion production in Arizona. These diseases have become more prominent and challenging in recent years.
- Dupont Tanos is an important option for control of Phytophthora blight and bacterial spot, two challenging diseases in New Mexico chile peppers production, valued at nearly $52 million in 2020.

- Famoxadone (a FRAC-11 fungicide) is among several modes of action used in rotations and mixtures to effectively control diseases in these crops while maintaining efficacy through careful deployment of resistance management tactics.

Famoxadone Use for Downy Mildew Management in Arizona Vegetable Crops

According to pesticide use data submitted by growers to the Arizona Department of Agriculture and maintained in the Arizona Pest Management Center database (Fournier et al. 2017), famoxadone is used consistently on a significant portion of acres of lettuces, spinach and onion crops, including onions grown for seed. To a lesser extent, uses are reported in arugula, kale, and other leafy green crops. Famoxadone is primarily used to manage downy mildew in all these crops, with additional disease management benefits in onions.

Downy Mildew

Downy mildew is a significant and regular disease of spinach and lettuces in Arizona, and also causes damage across a number of other vegetable crops. The conditions conducive to pathogen development are present every year in Arizona, and active controls and prevention tactics are deployed by growers to manage downy mildew. In young seedling lettuce, downy mildew symptoms appear as fluffy white growth on cotyledons and young leaves, resulting in stunting and plant death. On older lettuce plants, symptoms include yellow spots on upper sides of leaves, which later become necrotic brown or tan lesions. Under favorable conditions, fluffy white fungal growth occurs on the undersides of affected leaves. Systemic infections occur infrequently, but can cause dark discoloration of stem tissue (Matheron 2015, Koike & Turini 2017). Downy mildew causes significant cosmetic damage, making affected lettuce plants unmarketable.

According to former University of Arizona Extension Plant Pathologist, Dr. Mike Matheron, "Optimal management of downy mildew is achieved by having a fungicide in place before disease symptoms become apparent. Less than optimal control will occur when fungicide applications are not started until downy mildew symptoms are visible on plants." (Matheron 2017a). Control of downy mildew can be difficult, because of the complexity of the pathogens involved. For example, the distinct pathogens which infect lettuce and spinach each consist of multiple races, with new races emerging as the pathogens evolve. For this reason, resistant cultivars are not a stand-alone control tactic. Growers rely on fungicides for control of downy mildew, and resistance management practices are extremely important to decrease selection of fungicide-resistant components within pathogen populations (Matheron 2018, 2020).

The Fungicide Resistance Action Committee recommends a number of resistance management strategies, including: rotation of multiple modes of action in the treatment program; limiting the number of applications of any particular mode-of-action each season; applying fungicides at the full recommended rate; targeting fungicide applications for disease prevention, not eradication; integrating fungicide use with other tactics, including biological control, disease-resistant cultivars, crop rotation, and other beneficial cultural practices (Matheron 2014). In Arizona, rotation of different fungicidal modes of action is broadly adopted by growers. We do not yet

have reliable downy mildew resistant varieties. Biologically-based fungicides which have been tested have not shown sufficient levels of efficacy against downy mildew under field conditions in Arizona (Matheron 2017b), but when combined with chemical fungicides can contribute to effective control programs.

Lettuce and Spinach

Arizona supplies 95% of winter lettuce to the United States. Southwest lettuce and spinach production is mostly limited to Yuma County, AZ with some production in adjacent areas of southeastern California along the Colorado River. In 2020, Arizona growers produced 67,000 combined acres of head lettuce, leaf lettuce and romaine value at over $725 million, as well as 10,300 acres of spinach valued at nearly $114 million (USDA-NASS 2021).

According to licensed pest control advisors (PCAs) familiar with disease management in lettuce and other crops, Dupont Tanos, a mixture of famoxadone and cymoxanil, is among the most effective fungicides for control of downy mildew in lettuces and spinach. It is used on head lettuce, leaf lettuce, romaine and spinach, typically at the full rate of 10 oz./acre. According to Dr. Bindu Poudel-Ward, an Extension Plant Pathologist at University of Arizona specializing in vegetable crop diseases, rotations of Tanos with Dithane (mancozeb) provided good control of downy mildew on lettuce in chemical trials.

Tanos is applied in rotation with other effective fungicides, either as a preventative, or as soon as early symptoms of downy mildew are apparent. Tanos is often applied in a mixture with one other fungicide, such as a phosphite salt, or mancozeb. Under conditions of lower disease pressure, some PCAs apply Tanos as a stand-alone preventative treatment for downy mildew, in rotations with other fungicides. One to two applications, often at the 10 oz. rate, are used each season, well under the 48 oz./acre seasonal maximum. Based on analysis of reported use data across all lettuces, a mean of 9.43 and a median of 9.88 oz./acre are applied. Similar application rates are seen on spinach.

Famoxadone use is limited to a moderate percentage of lettuce and spinach acres each year, but is an important component of downy mildew control and resistance management programs for growers. Famoxadone, a FRAC-11 fungicide, is among one of a set of diverse modes of action used in rotation (and mixtures) to manage downy mildew in lettuces. Our growers and PCAs follow best management practices for resistance management and make use of all effective tools at their disposal for management of this challenging disease, which can be economically devastating to growers.

In spinach, typically a single application of Tanos is used at full rate to control downy mildew / blue mold. Some growers apply Tanos in mixtures with phospite fungicides, as described for lettuces above. A majority of applications are made by air.

In addition to lettuce and spinach, famoxadone is used by some PCAs to control downy mildew on other leafy greens, including arugula, kale, mustards and endive, which are harvested for salad mix. The same general rates and application methods apply in these crops.

Onions

Arizona produces dry onions and high-quality onion seed for export. In 2017 Arizona harvested 2,154 acres of onions and 1,312 acres of vegetable seed (onion seed data not broken out). Onion seed grown in Arizona contributed to the $3.8 million in vegetable seed sales in 2017 (USDA-NASS 2019).

Downy mildew has become a major problem in recent years in onions produced for consumption and for seed. Production is impacted every year, with significant yield losses possible. In addition, purple blotch is an important disease in Arizona onions that is often associated with downy mildew. Purple blotch starts as oval-shaped lesions on the leaves which develop into purple or dark brown concentric circles. Lesions may expand and girdle and kill the leaves (Swett et al. 2019). In advanced stages, purple blotch can lead to severe crop losses. According to a Yuma-area PCA who works with onion growers, the past few years they have seen an increase in downy mildew and purple blotch, with the 2016-2017 season "the worst year for purple blotch yet." As in produce, access to multiple active ingredients across modes of action is important to avoid resistance issues.

Tanos (famoxadone + cymoxanil) is used on Arizona seed onions, in rotation with other fungicides, for prevention and control of downy mildew and purple blotch. 8 to 10 oz. of Tanos is applied twice per season, typically by air. Other fungicides used in rotations in seed onions and dry onions to control downy mildew and purple blotch include mancozeb, mefenoxam and dimethomorph.

Peppers

The region of New Mexico and Southeastern Arizona is an important production zone for chile peppers. In 2020, New Mexico produced 8,900 acres of chile peppers valued at nearly $52 million (USDA-NASS 2021b). In 2018 (latest available), Arizona produced 1,100 acre of chile peppers valued at $2.6 million (USDA-NASS 2018). Arizona acres of conventional production have recently decreased, due to competition with Mexico, shifting the majority of acres into organic production.

Phytophthora is the most significant disease issue in New Mexico Chile peppers, which are especially susceptible to the pathogen. Phytophthora attacks the roots or the fruit of the plant, and flourishes under high heat and wet conditions, especially during the monsoon season. The pathogen, *Phytophthora capsici*, is splashed by rain events from the soil to the fruit, and infection occurs when the fungus directly penetrates the skin, leading to lesions and unmarketable fruits (Goldberg 2001). Plants often die within a few days of showing symptoms, which include wilting or a change in color of the leaves. Phytophthora infection can cause partial to total loss of the crop (Babadoost 2005).

Phytophthora control relies upon rotations of effective fungicides. Effective suppression of Phytophthora is achieved with a standard preventative rotation of azoxystrobin (Quadris) and mefenoxam (Ridomil Gold SL), which also helps to suppress the pathogen that causes powdery mildew. But in furrow-irrigated peppers, growers like to say, "you are one irrigation away from a

phytophthora outbreak." If the pathogen is present in abundance, it can take off very quickly when conditions are right.

Dupont Tanos is labelled for Phytophthora blight, as well as control of bacterial spot (*Xanthomonas* spp.), another key disease issue in peppers. According to a pest management consult who works with the New Mexico chile industry, although Tanos it is not the primary fungicide treatment used, it is an important component of rotations that help growers to prevent disease development while also supporting resistance management. It is not used often or on a larger percentage of acres. Tanos is not currently used in Arizona chile production, which is mainly organic. However, famoxadone in Dupont Tanos could become important should market factors result in a shift back toward more organic production. As a small-acre specialty crop, there are relatively few effective fungicides labelled for use on chile peppers. For these reasons, we consider famoxadone to be an important option for chemical control of key diseases in southeastern pepper production.

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. In coordination with the Western Integrated Pest Management Center, we contribute to federal comments on issues of pest management importance to stakeholders throughout the desert southwest including Arizona, New Mexico, Nevada, Colorado and the southeast desert regions of California.

Dr. Alfred Fournier is Associate Director of the APMC / Associate Specialist in Entomology, and has expertise in evaluating adoption and impact of integrated pest management and associated technologies. He serves as a Southwest Region IPM Network Coordinator for the Western IPM Center, representing stakeholders in the desert Southwest states. Dr. Bindu Poudel is Extension Plant Pathologist and Plant Disease Diagnostician with University of Arizona, based at Yuma Agricultural Center. She works with vegetable producers and conducts annual fungicide efficacy trials on vegetable crops. She also manages the Yuma Plant Health Clinic, focused on disease diagnostics. 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 Form L-

1080 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 compound in our agricultural systems. We actively solicit input from stakeholders in Arizona 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.

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