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Mancozeb Use and Benefits in Arizona and Southeastern California

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The EPA is seeking public comments in response to published human health and ecological risk assessments for the fungicide mancozeb. We wish to respond to the Agency's open comment period for mancozeb on behalf of agricultural stakeholders working in Arizona and Southeastern California. Our goal is to inform the EPA about specific use patterns of mancozeb and its crop-specific benefits in our region. Our comments combine stakeholder input received from University of Arizona Extension Specialists and Agents, licensed pest control advisors, and reported pesticide use data from the Arizona Pest Management Center Pesticide Use Database. We also support comments submitted on Mancozeb by the Arizona Farm Bureau.

Summary

- Mancozeb is used to control downy mildew in lettuce, onions and brassica crops in Arizona, and also to control Alternaria on brassicas, as well as purple blotch, botrytis leaf blight, and neck rot in onions.
- A very high percentage of Arizona's lettuce and onion crops are treated with mancozeb once to twice per season. It is used in mixtures and rotations with other fungicides for resistance management.
- Downy mildew is a significant and regular disease of lettuce crops in Arizona. Control of downy mildew 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, mancozeb is an effective preventative control option for downy mildew.
- Mancozeb is used in production of Arizona onions, including seed onions, for prevention and control of downy mildew, botrytis leaf blight, neck rot and purple blotch. Downy mildew and purple blotch, two key diseases impacting seed onion production in Arizona, have become more prominent and challenging to manage in recent years.
- Mancozeb is used on golf course turf to control rapid blight and Pythium. Mancozeb is one of the two most-utilized active ingredients for rapid blight chemical control. Rapid blight has become problematic in recent years and is perhaps linked to increased use of reclaimed water for irrigation.

- Mancozeb is classified by the Fungicide Resistance Action Committee (FRAC) as a mode-of-action group M, multi-site, fungicide. As a Group M fungicide, mancozeb has a low risk of resistance development due to its multi-site activity on fungal pathogens. It is often tank mixed with single-site fungicides to help with resistance management.

Mancozeb 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), mancozeb is used consistently on a significant portion of acres of lettuces and onions, and to a lesser extent on cabbage and other brassica crops, with more occasional reported uses across a variety of vegetable crops, including beets, fennel, garlic and potatoes. Uses are noted on lettuce, onions and brassica crops grown for seed in Arizona. Mancozeb is used to control downy mildew in lettuce, brassicas and onions. It is also used to control Alternaria on brassicas, as well as purple blotch, botrytis leaf blight, and neck rot 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 crops, including onions and brassica crops. The conditions conducive to pathogen development are present every year in Arizona, and active controls and prevention tactics are deployed by growers to control 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 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

Arizona supplies about 90% of winter lettuce to the United States (Satran 2015). 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 valued at over $725 million (USDA-NASS 2021).

According to the Arizona Pest Management Center Pesticide Use Database (Fournier et al. 2017), an annual average of about 23,000 acres of lettuce (all types) reported mancozeb sprays between 2015 and 2019. This is likely a conservative estimate of use, because grower-applied sprays typically do not require reporting in Arizona.

Mancozeb is one of several fungicides used in tank mixes and rotations to control downy mildew and other disease issues on lettuce. Fungicide evaluation trials conducted in Arizona and in other states have shown a statistically significant reduction in downy mildew disease by application of fungicides, including products like Dithan and Manzate, which contain mancozeb (Matheron 2015, 2017a). According to Dr. Bindu Poudel-Ward, Extension Plant Pathologist at University of Arizona specializing in vegetable crop diseases, rotations of Tanos (a mixture of famoxadone and cymoxanil) with Dithane (mancozeb) have provided good preventative control of downy mildew on lettuce in chemical trials. As an older and less expensive material, mancozeb is often a tank-mix partner with other fungicides with different modes of action, such as Tanos or Aliette (Aluminum tris (O-ethyl phosphonate)).

Based on feedback from licensed pest control advisors (PCAs) in Arizona and adjacent areas of California, mancozeb continues to provide effective preventative control of downy mildew on lettuce in the field. It is applied in fungicide tank mixtures on a preventative basis. Once downy mildew occurs, PCAs report switching to Reason or Dupont Tanos, which offer better control in outbreak situations. It is recommended to tank-mix a contact-fungicide material, like mancozeb, with a systemic material, such as famoxadone. Some PCAs estimate nearly every acre of lettuce receives one to two applications of mancozeb by air or ground, in rotation with other fungicides. It is often applied early in the growth season, at thinning or just after. A range of use rates are reported in the pesticide use database, which vary by product. The most commonly used product, Manzate Pro-Stick, representing about 72% of reported uses of mancozeb on lettuce, has a median application rate of 1.47 lbs. a.i./A on all lettuce types combined over the past five years.

Brassica Crops

There is far less use of mancozeb on brassica crops, because downy mildew affects the foliage and not the head. Most of the use is on cabbage and broccoli, with a small percent of acres treated annually. Mancozeb is also is used to control Alternaria on 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.

Mancozeb is used in production of Arizona onions, including seed onions, for prevention and control of downy mildew, botrytis leaf blight, neck rot and purple blotch. It is used in tank mixtures with another fungicide, for resistance management. One PCA familiar with production practices in seed onions applies Manzate at 3 lb./A (maximum rate), typically by air. Mancozeb is generally applied twice per season in rotation with other fungicides (typically 6 to 8 fungicide sprays overall).

Potato

Between 2012 and 2016, growers reported regular annual uses of mancozeb on potato (Fournier et al. 2017). According to one PCA, mancozeb has been an important and useful seed treatment for potatoes in Arizona to control fusarium. However, potato production has dropped off greatly in recent years due to market forces. Should potato production resume in Arizona, this fungicide seed treatment would likely be used again.

Turfgrass

Mancozeb is registered for use on turfgrass, including golf courses, sod farms and municipal turf. Since 2014, the Arizona Department of Agriculture has required reporting of certain pesticide uses on golf courses, including restricted use products and products on the Arizona Department of Environmental Quality groundwater protection list. Some turf managers submit use reports even when it is not required. Since 2015, there have been a small number of reports of mancozeb applications to turf.

According to informed industry sources, mancozeb use is limited almost exclusively to golf course turf applications in Arizona. There is very little to no mancozeb use on ornamentals in landscape settings. It is applied to greens in the low desert for control of rapid blight, and to fairways and roughs in the middle elevations (e.g., Sedona, Payson), primarily for control of Pythium, but also for other diseases. For control of Pythium and rapid blight, the typical

application rate is between 6-8 oz./1000 sq. ft. of the product Fore 80WP Rainshield. For courses that struggle with rapid blight, one expert estimated an average of two applications per year.

Rapid blight was first noted in California in 1995, and has since spread to at least eleven states. Rapid blight is caused by *Labyrinthula terrestris*, a species of eukaryote previously only known to be associated with marine systems. The appearance of the disease in turf seemed to coincide with increased levels of salinity in reclaimed water, which is increasingly used in irrigation. Rapid blight often starts as dark patches in otherwise healthy turfgrass. As the disease develops, orange-brown necrotic lesions that start at the crown or on cut blade tips eventually spread over the entire blade. Small symptomatic patches of affected turfgrass can enlarge rapidly, coalesce, and result in large areas of dead turfgrass (Kerrigan et al. 2012).

As a multi-site inhibiting contact fungicide in FRAC M3, with little risk of resistance, mancozeb is a key rotational partner in an effective IPM program for both rapid blight and Pythium control. Mancozeb is one of the two most-utilized active ingredients for rapid blight chemical control. The other is in the FRAC 11 (QoI/Strobilurin group). In total, there are only five fungicides, over four FRAC groups, labelled for rapid blight control. Besides mancozeb, the remaining four are systemic with the potential to develop resistance. Climatic, environmental and regulatory pressures related to both water quantity and quality are expected to increase the prevalence of this disease in Arizona and likely throughout the region in the future.

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. Kai Umeda is Area Extension Agent in Turfgrass Science for University of Arizona, at Maricopa County Cooperative Extension. He works extensively in golf and recreational turf management. 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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