



Diuron Use and Benefits in Arizona Agriculture
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Summary

- The EPA is seeking public comments in response to published risk assessments for diuron, a systemic herbicide and defoliant registered for use on for several crops and non-agricultural areas.
- EPA risk assessments have identified potential chronic dietary risks of concern for infants, stemming primarily from drinking water exposures, based on risk models that presume that all crops with established tolerances will be treated with diuron. Several ecological risks were identified, including risks to non-target plants in aquatic and terrestrial habitats, and chronic risk concerns for several taxa of animals, including freshwater fish, freshwater invertebrates, birds, mammals and bees.
- Our goal at this time is to inform the EPA about specific crop practices and diuron use patterns on Arizona crops that may have a bearing on estimated levels of potential worker exposure and risk, drinking water contamination, and ecological risks.
- Diuron is a flexible and important herbicide and defoliant for weed management in Arizona. Diuron use is almost entirely limited to cotton and alfalfa. A large percentage of cotton acres and a small percentage of alfalfa acres are reportedly treated annually. In addition, diuron is used for weed management on ditch banks and fallow fields.
- Diuron provides layby weed control in cotton, and is an active ingredient in the two most frequently used defoliants in cotton, Ginstar and Redi-Pik. Both products are pre-mixes with thidiazuron, and are the go-to approach for cotton defoliation, generally the first, and sometimes the only application needed.
- 94.6% of reported diuron uses in cotton (2010-2019) are for defoliation with pre-mix products that contain only 6% diuron. Applications are made to the foliage and are not followed by irrigation. The remaining 5.4% of applications in cotton are of 4L formulations of herbicides containing 40.7% diuron. These applications are made to the soil and watered in.
- Diuron is used for winter weed control in alfalfa. Its unique properties make it effective and well suited for control of weeds during alfalfa's "semi-dormant" period in the winter months.

Diuron Use in Arizona Agriculture

Diuron is a systemic herbicide that controls both broadleaf and grassy weeds. It is registered for use across a variety of crops and is commonly used as a defoliant on cotton. According to the Arizona Pest Management Center (APMC) Pesticide Use Database (Fournier et al. 2017), diuron use is reported mainly on cotton and alfalfa in Arizona. Between 2015 and 2019, an average of 43,558 acres were reportedly treated in cotton and 5,379 acres in alfalfa. Based on 2018 use reports (a recent year with higher use of diuron) and USDA data, reported acres represent about 40% of cotton acres and about 1.7% of alfalfa acres. However, because Arizona growers are not required to report certain applications made by growers using their own equipment, this is expected to be an underestimate of actual use. Dr. William McCloskey, University of Arizona Associate Professor and Extension Specialist in Weed Science, estimates up to about 75% of Arizona cotton acres receive a diuron defoliation treatment most years.

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 2012). In 2020, Arizona produced 123,000 acres of upland cotton with a value exceeding \$142 million for cotton and cotton seed production combined (USDA- NASS 2021).

The primary use of diuron in Arizona is as a cotton defoliant. Diuron is an active ingredient (along with thidiazuron) in Ginstar and Redi-pik, the main defoliants used throughout Arizona's cotton growing regions. The introduction of Ginstar greatly reduced use of and dependence on sodium chlorate, a more hazardous chemical for cotton defoliation. One pest control advisor (PCA) reports, "Diuron was a game-changer for us, because it delays the re-growth of the cotton plant." This property of diuron reduced the number of applications needed for complete defoliation, from several applications to, in some cases, a single application. Use rates vary according to temperature. In hot temperatures, growers apply the 8 oz rate of Ginstar. As the weather cools down, growers apply 10 to 12 oz. A single application of a diuron-based defoliant is used. If necessary, this is followed-up with an application of a different defoliant/ desiccant, such as Aim (carfentrazone-ethyl), ET (pyraflufen ethyl) or Sharpen (saflufenacil). One PCA estimates that about 80% of diuron defoliations in his region (Pima and southern Pinal Counties) are done by ground rig, to ensure adequate coverage. (This is noteworthy in part because ground applications that are grower-applied do not require reporting to the state, so their use is underestimated in the APMC pesticide use database, which records over 61% of cotton applications being done by air over the past ten years.)

According to Blase Evancho, Assistant in Extension with University of Arizona stationed in Pinal County, one of the most cotton-productive counties in the nation, diuron is a highly effective herbicide used for layby weed control. Diuron is useful because it provides a broad range of weed control with a long residual, reducing the need for additional herbicide applications. It controls a broad range of yield-limiting weeds including glyphosate-resistant weeds like Palmer Amaranth. It is applied using a hooded sprayer, prior to canopy closure. Use rate varies according to soil texture. The maximum rate is used on heavier soils, but lower rates are applied on sandier soils, which are more common in Arizona.

Diuron's use as a layby herbicide for weed control was once a standard industry practice. However, following broad adoption of glyphosate-resistant cotton, this practice was all but discontinued throughout the state. According to Dr. William McCloskey, a small number of growers in certain regions of the state have resumed use of layby weed control practices, at least in part due to the evolution of glyphosate-resistant weeds, such as Palmer Amaranth. However, diuron is not generally the preferred herbicide for layby applications. Although it provides highly effective control for even the most difficult weeds, it cannot be used in areas where growers rotate into wheat or other monocot crops following cotton. Products containing prometryn offer similar levels of control without concern for growers rotating into wheat (William McCloskey, personal communication).

It seems important to point out the impact of Arizona's use pattern for diuron (mainly for defoliation) on potential for groundwater risks related to runoff. The defoliant formulations (Ginstar, Redi-pik, and generics) contain only 6% diuron (along with 12% thidiazuron). Products used for layby weed control in cotton, such as Dupont Diurex 4L (and generic equivalents) contain 40.7% diuron. According the Arizona Pest Management Center Pesticide Use Database, 94.6% of reported diuron sprays on cotton between 2010 and 2019 were with defoliation products (6% diuron). These products are applied directly to the full-canopy foliage after the final irrigation, and are largely intercepted and absorbed by the cotton plant. Only a very small fraction of applied defoliant has the potential to reach the soil. Typically, there is no irrigation following defoliant applications. For these reasons, we would anticipate very minimal if any runoff of diuron residues for these uses. The remaining 5.4% of reported diuron sprays over the same time period (2010-2019) were with diuron 4L formulations, containing 40.7% diuron. These products are used for layby weed control, applied with hooded sprayers, directed at the soil and watered in. These applications presumably pose a higher risk of diuron residue runoff, but represent only a small fraction of use. Ginstar and generics contain 0.5 lb of diuron per gallon. The typical use rate of 8 to 12 oz per acre results in an active ingredient application rate of 0.03125 to 0.04688 lb of diuron per acre. In contrast, diuron use rates for weed control in Arizona cotton and alfalfa (see next section) are at most in the range of 0.8 to 1.2 lb a.i./A.

Finally, it is worth noting that, due to concerns with glyphosate resistance, diverse and preventative weed practices, including layby applications, are being recommended to growers. Diuron 4L applications are well-suited to this use, as long as growers do not plan to rotate into wheat or a similar, susceptible crop. Sustaining availability of this diuron use in the future could be important for a portion of Arizona growers dealing with glyphosate resistant weed management.

Alfalfa

Alfalfa is one of Arizona's top crops annually. In 2020, Arizona produced 260,000 acres of alfalfa hay valued at over \$397 million (USDA- NASS 2021). Arizona growers have the highest alfalfa yields in the nation with 8.4 tons per acre on average, compared to about 6.4 tons per acre in California. The national average is 3.4 tons per acre (Blake 2019).

Diuron's broad spectrum of activity against many key weeds, combined with long residual control with minimal irrigation makes it very useful for winter weed control in Arizona alfalfa. It

is typically applied in late fall, when alfalfa is expected to grow slowly (i.e, become semi-dormant). During the winter in Arizona, alfalfa grows slowly and transpires less, and therefore absorbs less chemical from the soil, allowing selective use of diuron in alfalfa. By contrast, alfalfa requires much more irrigation during summer months. Use of diuron at that time is not recommended, as it results in plant injury.

According to pest control advisors, a single application of Alfamax Gold (55.4% diuron + 23.1% hexazinone) generally provides excellent weed control through the winter. It kills existing weeds, including difficult weeds, and creates a barrier for about three to four months of control. Generally, only a single application is needed. Diuron works well without irrigation, or with minimal water, which makes it well-suited for weed control during alfalfa semi-dormancy. Based on reported uses, about 90% of diuron applications in alfalfa are by ground (Fournier et al. 2017). For the most popular product reported, Velpar Alfamax Gold, rates range between 0.80 lbs. a.i. /A to 1.25 lbs. a.i. /A, well below maximum label rate of 3 lbs. a.i. /A.

Ditch-bank Weed Control

Diuron is also used for ditch bank weed control, to prevent the spread of weeds into crop fields. Growers sometimes will mix the diuron product with Roundup, which provides contact control of the weeds that are present, while the diuron provides long term residual control of weeds that germinate later.

Nearly all water district canals throughout Arizona are concrete-lined. It is the road/berm and upper shoulder of the canals that are treated with diuron. These applications are not irrigated in. Diuron is well-suited to these uses, given that it is effective without irrigation. Earthen canals, where they exist, are not treated with diuron, since that inevitably causes crop injury. Water districts flush their canals prior to delivering water to customers, to ensure no diuron reaches customers. Failure to do so has resulted in lawsuits in Arizona.

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. William McCloskey is an Associate Professor and Extension Specialist in Weed Science, with experience in field crops, including alfalfa, cotton, and tree fruit and nut crops. Mr. Blase Evancho is an Assistant in Extension with University of Arizona, stationed in Pinal County, who works extensively with central Arizona cotton and alfalfa growers. 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. 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 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 and other compounds 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.

References

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