Agricultural Experiment Station
Cooperative Extension

37860 West Smith-Enke Road
Maricopa, Arizona 85138
FAX: (520) 568-2556

Aerial Applicator & Scientific Stakeholder Input on Pyriproxyfen Spray Applications:
Comments on EPA Registration Review, Case no. 7424
Prepared by Alfred Fournier & Peter Ellsworth
Comments submitted by the Arizona Pest Management Center
University of Arizona

EPA Docket ID: EPA-HQ-OPP-2011-0677
June 4, 2018

Issue:

Based on risk assessment and potential risks to terrestrial and aquatic invertebrates, EPA is considering label changes to minimize spray drift for aerial applications of pyriproxyfen. EPA is open to grower's concerns and wants to be flexible in how they implement any label changes. They need to understand more about aerial application methods in Arizona and requested that we reach out to aerial applicators to better understand current aerial application practices.

Aerial Application Methods

We spoke with applicators at two major aerial operations in Arizona that work out of Yuma County and central Arizona. Both applicators indicated that they have great flexibility with their aerial rigs to make adjustments in order to manage droplet size to control for spray drift. They are very familiar with strict drift requirements for many herbicide applications and both applicators indicated knowledge of new drift management requirements on some EPA product labels. They are mindful of wind speed and direction and only make applications under favorable conditions or as directed by the label.

For pyriproxyfen applications, they generally use a standard boom with nozzles that can be easily adjusted for the desired droplet size. For example, one applicator, representing one of the largest operations in the state, indicated that they use CP aerial application flat fan nozzles (http://www.translandllc.com/wp-content/uploads/2017/05/Aerial-Catalog-2017.pdf). They are typically directed backward at a 40-degree angle. Applications are made at 45 to 50 psi. This is done to equalize the application to the speed of the airplane, which causes the spray to hang in the air before dropping straight down onto the target crop. This also controls droplet size so that driftable fine spray droplets do not occur or are greatly minimized. This technology enables them

to easily control droplet size by making adjustments as needed with minimal time or effort. According to a major aerial applicator, pyriproxyfen is typically applied at medium size droplet size. Nozzle selection depends on how many gallons per acre are going out. In Yuma, most applications are made at 10 gal/acre; 5 to 7 gal/acre is more typical in central Arizona. If there are new drift requirements, the applicators expressed confidence that they would be able to respond easily.

Pyriproxyfen Efficacy

Efficacy of pyriproxyfen is based on the chemical's ability to mimic juvenile hormone and to reach target insects through contact or ingestion. Eggs exposed prior to blastokinesis (often on day 2 under Arizona summer field conditions) or in utero will fail to hatch. When female adults are exposed to the excess juvenile hormone in their environment, they will lay eggs that will fail to hatch. Note, once that exposure is stopped, the female will again lay eggs capable of normal development and hatching. Nymphs exposed to pyriproxyfen will continue to grow until they begin to metamorphose to adults. As a pharate adult (i.e., while still within the exoskeleton of the 4^{th} instar nymph), the insect will die, failing to emerge as an adult.

Whitefly adults fly actively within the canopy, moving from leaf to leaf, landing and feeding on many surfaces of leaves. In the process of this movement, adults are exposed to pyriproxyfen no matter how it is deposited on leaves. Cotton grows rapidly in mid-summer, expanding by 2 nodes per week. Because pyriproxyfen is not systemic, this new growth is not dosed with pyriproxyfen. Our research, however, has shown that some eggs will perish even on new growth. This is because adults are moving in and out of dosed zones of the plant and can maintain sufficient contact with pyriproxyfen that laid eggs will not hatch. This effect declines over time and as the plant continues to produce new, undosed vertical growth.

Eggs and nymphs are effectively immobile life forms of this insect, but still gain access to pyriproxyfen residues. Both life stages live exclusively on the undersides of leaves, generally less exposed to sprayed residues of all kinds without special nozzle architecture and position only possible through ground sprays. However, pyriproxyfen delivered by aerial sprays is still very effective, even if only the uppersides of the leaves are contacted. This is because pyriproxyfen is strongly translaminar. This lipophilic compound binds with the waxy layer of the leaf and then slowly diffuses through the leaf, making it accessible to the insects feeding on the undersides. Eggs are laid with a pedicel inserted into leaf tissue where they actively absorb fluids from the leaf, including those loaded with pyriproxyfen. This is another reason why egg control is so strong with pyriproxyfen. Nymphs insert their mouthparts into the leaf and remove pyriproxyfen-dosed fluids, ultimately arresting development prior to adult emergence.

As a result of this plant-pest-pesticide interaction, the control dynamic of pyriproxyfen with *Bemisia tabaci* is relatively less sensitive to specific application conditions. As long as the product is deposited on leaf surfaces, leaf undersides directly beneath the deposits on the upperside will effectively absorb the chemical, which will reach deposited eggs and feeding nymphs. Adults circulating through the canopy should achieve sufficient contact with residues as to effectively sterilize females. As long as coverage is good, whether that is with fine or medium sized droplets, pyriproxyfen should continue to perform as intended. It should be noted here,

however, that there is little to no lateral or horizontal movement of residues within the leaf. Most of the translaminar action is directly down from dosed areas of the uppersides of the leaves. Coverage therefore remains important.

Efficacy of pyriproxyfen, however, is most enduring in the Arizona cotton IPM system because of its excellent safety to beneficials there. By selectively targeting whiteflies and conserving the many predators present in the cotton system, predator to whitefly ratios support extended periods of suppression known as "bioresidual". While registrants and EPA actively measure and assess the chemical residual of any pesticide, bioresidual refers to the extended suppressive interval possible when a selective agent is used that supports conservation biological control and other natural mortality factors (Ellsworth & Martinez-Carrillo 2001; Naranjo & Ellsworth 2009a,b). Because pyriproxyfen is so selective and safe to beneficials in the Arizona cotton system, it has been successfully used as a key part of the IPM system there for more than 22 years (Ellsworth et al. 2006; Ellsworth 2014). Usage patterns and benefits of pyriproxyfen will be the subject of additional comments from the Arizona Pest Management Center.

References

Ellsworth, P.C. & J.L. Martinez-Carrillo. 2001. IPM for Bemisia tabaci in North America: A Case Study. Crop Protection 20: 853–869. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.485.6712&rep=rep1&type=pdf

Ellsworth, P.C., J.C. Palumbo, S.E. Naranjo, T.J. Dennehy, R.L. Nichols. Whitefly Management in Arizona Cotton 2006. IPM Series No. 18. University of Arizona Cooperative Extension Bulletin, AZ1404, 5/2006. URL: *https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1404.pdf*

Ellsworth, P.C. 2014. Whitefly Management & Prevention of Excess Sugars in Cotton. Focus on Cotton Webinar Series. Plant Management Network. August, 2014. 36 min. http://www.plantmanagementnetwork.org/edcenter/seminars/cotton/whiteflymanagement/

Naranjo, S.E. & P.C. Ellsworth. 2009a. The contribution of conservation biological control to integrated management of *Bemisia tabaci* in cotton. *Biological Control*, 51(3): 458–470.

Naranjo, S.E. & P.C. Ellsworth. 2009b. 50 years of the integrated control concept: moving the model and implementation forward in Arizona. *Pest Management Science*, 65: 1267–1286.