



**Sulfoxaflor Impacts on Arizona Agriculture**  
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**Comments submitted by the Arizona Pest Management Center**  
**University of Arizona**

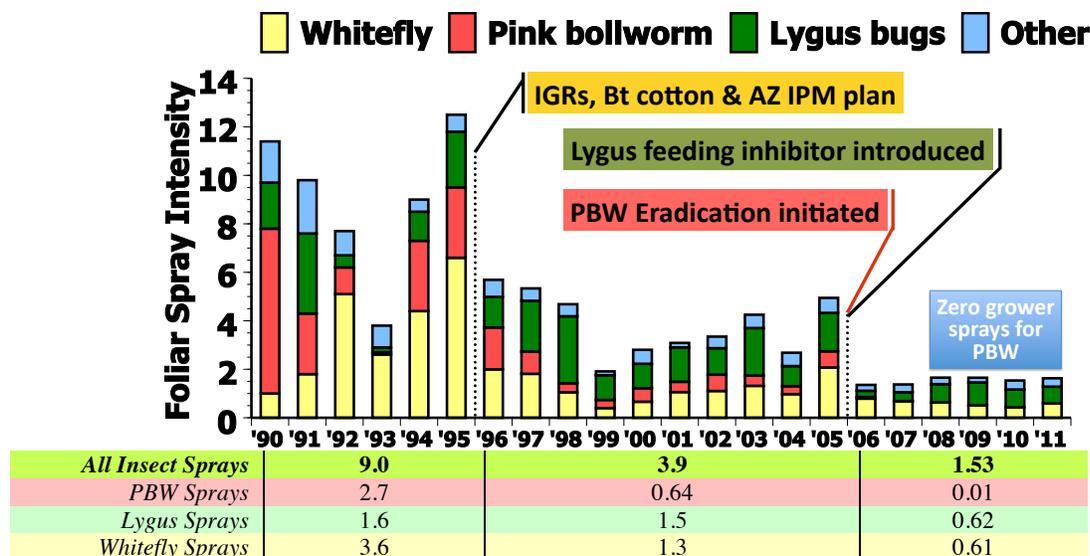
EPA Docket ID: EPA-HQ-OPP-2010-0889

***Summary***

*Sulfoxaflor is a key, selective compound with detailed and rigorous research evaluations in Arizona cotton and vegetables showing that its safe and effective use in Arizona agriculture. It provides for effective and selective control of Lygus bugs and Bemisia whiteflies in cotton as well as whiteflies and aphids in produce and cucurbits. The main crops grown in Arizona that would benefit from a sulfoxaflor registration include cotton, melons of all types, lettuces of all types and cole crops. Conservation of natural enemies (beneficial arthropods) has become a central aspect to the ongoing cotton IPM program. Sulfoxaflor provides for one more tool that will uniquely control both Lygus bugs and whiteflies without harming beneficials in cotton. With the elimination of all uses of endosulfan in 2012, this is the only compound available to growers with this specific spectrum of activity and utility. Unlike cotton grown throughout the U.S., indeed worldwide, this two-pest combination uniquely drives our cotton IPM system. As a unique class of chemistry with no demonstrated cross-resistance with neonicotinoids, sulfoxaflor also provides for a critically needed rotation for Lygus control, reducing grower dependence on flonicamid, and for Bemisia whitefly control, helping to mitigate progressive resistances to imidacloprid, acetamiprid and pyriproxyfen, key active ingredients in the produce and cotton industries. Therefore, we are especially pleased that such a compound has been developed and supported by over 5 years of scientific research and hope that US-EPA will support its timely registration so that growers may access this important tool in the 2012 crop-year.*

I serve as both Director of the Arizona Pest Management Center and State IPM Coordinator at the University of Arizona, where I have been an IPM Specialist / Professor for the past 22 years. My role requires that I research, develop, and extend integrated pest management programs that protect citizens from economic, environmental and human health risks associated with pests or pest management tactics. My individual research and Extension thrusts have been in the development of sustainable IPM programs for Arizona cotton growers, where we have made major gains over the last 17 years. Since the introduction of key technologies and IPM programs to support their use in 1996, we estimate cotton growers in our state have cumulatively saved over \$388 million (Fig. 1). These gains are related to major reductions in the number and amounts of insecticides used as well as in the deployment of selective technologies that address target pest needs without harm to non-target arthropod beneficials (Naranjo & Ellsworth, 2009a,b). The resulting gains in stability and sustainability of our system due to improved natural enemy conservation are difficult to measure but very significant and important to the future of

this industry. Upland cotton in Arizona produces per acre yields larger than that of any other state or region of the world, while contributing over \$700M to our state’s economy. Major gains have also been made in IPM for melons and leafy vegetables in Arizona, where we produce >90% of the fresh lettuce consumed in the U.S. during the winter months. I direct you to the comments provided by my colleague, Dr. John Palumbo, Vegetable Entomologist for the University of Arizona, at EPA Docket ID: *EPA-HQ-OPP-2010-0889-0007* for further information on the utility of sulfoxaflor in our vegetable systems.



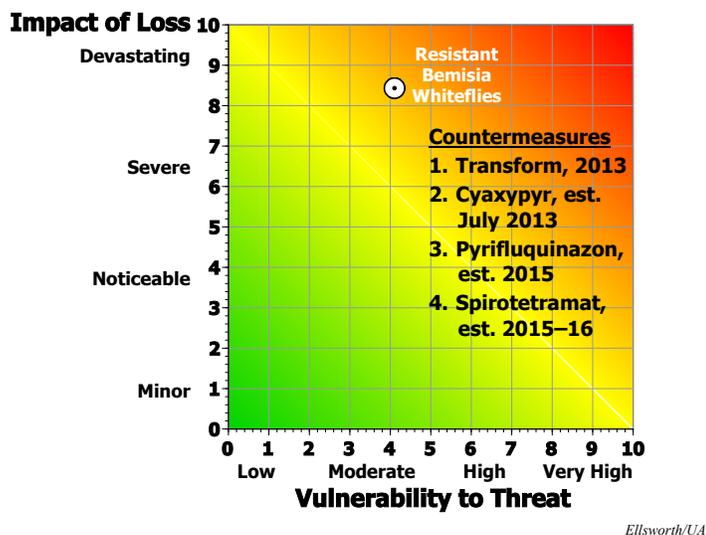
**Figure 1. Statewide average cotton insecticide use patterns in Arizona, 1990–2011, by key pest.** Over 1.6 million lbs a.i. annual reduction in the last 6 yrs compared to the 34-yr high in 1995; estimated cumulative savings in control costs & yield in excess of \$388M. Number of sprays and foliar insect control costs are at a 34-yr low. Between ¼ and 1/3 of all cotton acreage is never sprayed for arthropod pests. *Source: Cotton Insect Losses Database, Arizona Pest Management Center, Ellsworth et al. 2012; Figure adapted from Naranjo & Ellsworth, 2010.*

Since 2008, I have researched the efficacy, utility, crop safety and non-target effects of sulfoxaflor in cotton. Sulfoxaflor is among the most effective insecticides ever screened for the control of *Lygus hesperus*, our key mirid bug pest of cotton. Lygus bugs have been our number 1 yield-limiting pest of cotton since at least 1998. They are indigenous to North America including Arizona, where they can feed and reproduce on dozens of native, wild, and cultivated plants. Prior to 2006, there were three, very broad-spectrum insecticides recommended by Arizona Cooperative Extension for the control of this perennial pest: acephate (1 lb ai / A), oxamyl (1 lb ai / A), or endosulfan (1.5 lbs ai / A). Endosulfan has since been phased out. Acephate and oxamyl remain options for Lygus control, but with significant risks to non-target arthropods including beneficials, pollinators and bees, as well as presenting significant occupational risks. Other products in use in other parts of the U.S. or abroad for mirid control are ineffective, inviable or unavailable options for Arizona cotton (e.g., neonicotinoids, dicotophos, novaluron). Since 2006, flonicamid (0.088 lbs ai / A) was registered as an effective Lygus feeding inhibitor. Since that time, most growers elect the use of this compound when confronted with threshold-level Lygus populations. Sulfoxaflor has often equaled or exceeded flonicamid in Lygus control performance and led or co-led trials in terms of yield. **Given that losses of >50% are possible,**

**sulfoxaflor’s ability to protect cotton from Lygus-related yield loss will save our growers millions of dollars.**

Current over-reliance on flonicamid as our sole, selective Lygus control agent is placing this unique class of chemistry at greater risk for resistance. We received grower reports this year for the first time suggesting difficulties in controlling Lygus with flonicamid. While follow-up resistance bioassays failed to detect anything unusual (Mostafa & Ellsworth, unpubl. data), we are very concerned resistance could develop to flonicamid if we do not obtain the use of new, equally safe compounds for Lygus control. **Sulfoxaflor would provide a key alternative to flonicamid (and acephate or oxamyl) that would help stabilize and sustain our resistance management programs for Lygus.**

We have also been studying sulfoxaflor’s role in the management of *Bemisia* whiteflies. At higher rates ( $\geq 2.25$  oz /A Transform), sulfoxaflor provides significant suppression of whitefly adults and immatures, our number 1 quality-limiting pest of cotton. Arizona is almost unique worldwide in this distinct combination of these two cotton pests (Lygus bugs & *Bemisia* whiteflies), and **sulfoxaflor in uniquely positioned to help us protect our crops against both of these pests simultaneously, potentially reducing the number of total sprays required for economic production.**

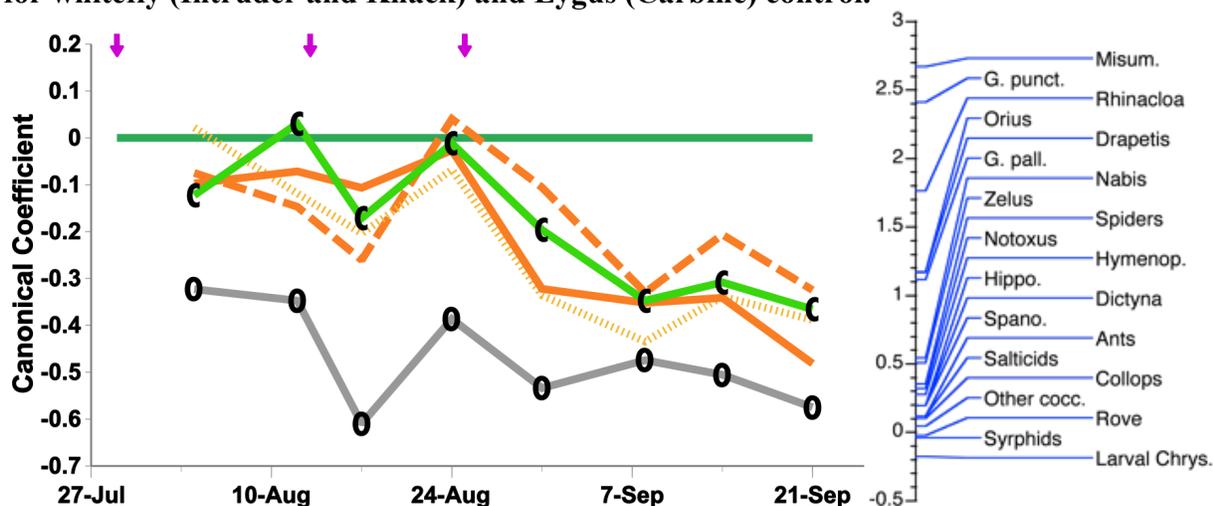


**Figure 2. Risk Assessment for Resistant Bemisia Whiteflies.** The impact of a loss related to whiteflies developing intractable resistances to products used would be devastating to the industry in Arizona. Markets might be irreparably lost to an episode that resulted in widespread excesses of sugars on lint (a.k.a. “sticky” cotton). The vulnerability to this threat is only moderate, because of existing alternatives to the resistance-threatened chemistry (acetamiprid & pyriproxyfen usage could be partially replaced by usage of spiromesifen or buprofezin) and because of other countermeasures that may be forthcoming. Chemical countermeasures and estimated anticipated dates of their US-EPA registration are noted.

Whitefly resistance is a serious concern of Arizona cotton growers, who requested a formal risk assessment in 2012 (Figure 2). Imidacloprid resistance continues to advance and compromise efficacy of this key active ingredient in nearby melons and vegetables. Despite a very active neonicotinoid resistance management plan for over 10 years (Palumbo et al. 2003; Ellsworth et al. 2006), we are now documenting significant reductions in the susceptibility of *Bemisia*

whiteflies to acetamiprid, another neonicotinoid (X. Li et al., unpubl. data). Furthermore, susceptibilities to pyriproxyfen, our key insect growth regulator in use since 1996, are also declining (X. Li et al., unpubl. data). Evidence of the difficulties that growers are having in whitefly control is in the elevating rates used of two key products threatened by resistance. Intruder (acetamiprid) is labeled nationally at a maximum use rate of 2.3 oz per acre. In 2012, Gowan Company sought and received a Special Local Needs (SLN, 24c) to increase the maximum use rate by 50% to 3.5 oz per acre. As a result in 2012, the **average** use rate exceeded the formal label limit to > 2.5 oz per acre (Ellsworth, Fournier & Dixon, unpubl. data). Similarly, Knack (pyriproxyfen) has been recommended for use at the 8 oz per acre rate. Historically, the statewide average use rates have been very close to this recommended rate. However, in 2012 the average use rate for Knack was over 9.1 oz per acre, just shy of the maximum-labeled rate of 10 oz per acre (Ellsworth, Fournier & Dixon, unpubl. data). These are signs that growers are struggling to maintain the efficacy of these key products in their system.

Since Lygus are often the first in-season cotton pest sprayed for, the usage of sulfoxaflor, even at lower Lygus targeted rate, will help in the collateral suppression of whiteflies, perhaps delaying or eliminating sprays while slowing the in-field increases in whitefly populations mid-summer. As a distinct IRAC subclass (4C), different from the neonicotinoids and where cross-resistance studies in whiteflies and aphids have shown great safety, **we believe that sulfoxaflor can play an important role in relieving selection pressure from the current products we depend on for whitefly (Intruder and Knack) and Lygus (Carbine) control.**



**Figure 3. Principal Response Curve for Transform (sulfoxaflor at 3 rates) sprayed 3 times (purple arrows) in contrast to the UTC (dark green line), Carbine (light green line) and Orthene (dark gray line); dark green line (Y = 0) indicates relative levels of a community of natural enemies for the untreated check (UTC). Orthene (O) severely and permanently depresses the densities of key natural enemies relative to the UTC. Carbine (C) is not significantly different from the check suggesting safety for beneficials. The high rate of Transform (2.1 oz/A, solid orange line) does tend to very slightly lower natural enemies more than the ‘standard’ Lygus Transform rate (1.4 oz/A, short dashed orange line), which also seems slightly lower than the lowest rate of Transform (0.7 oz/A, long dashed orange line). These trends seem to be consistent with a very selective compound, especially relative to Orthene which we know is very damaging to the natural enemy community. Species weights are shown in blue on the right. Weights in excess of 0.5 tend to indicate species that most influence or drive the trends depicted. Weights below -0.5 tend to indicate species that reflect the trends depicted in the inverse direction of the relationship shown. For this study, crab spiders (*Misumenops spp.*), big-eyed bugs (*Geocoris punctipes* & *G. pallens*), minute pirate bugs (*Orius spp.*), an empidid predaceous fly (*Drapetis spp.*), a mirid predator (*Rhinacloa spp.*), and the large bug predators (*Zelus* & *Nabis spp.*) were most influential and reflective of the trends depicted. I.e., Carbine or Transform usage conserved these**

species and *Orthea* significantly lowered their densities. (Ellsworth & Naranjo, unpubl. data).

The prospects for safe and effective use of Transform (sulfoxaflor) in cotton are great; however, our interest in this product would have been reduced if not for the high degree of safety towards non-target arthropods, documented thus far in our studies of the cotton system. We are now completing a multi-year assessment of non-target effects of sulfoxaflor. The preliminary results show great safety for our key natural enemies that we depend on for biological control (Fig. 3).

**This makes Transform ideally suited for our cotton IPM system where we have progressively introduced highly selective and effective technologies for the control of our key insect pests, while conserving the natural enemy fauna present in the field and available for suppression of all cotton arthropod pests.**

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