Request for Section 18 emergency use of Sulfoxaflor (Transform® WG Insecticide) to control western tarnished plant bug (*Lygus hesperus*) in cotton fields in the state of Arizona

(a) General information required in an application for a specific exemption.

Type of Exemption - Arizona Section 18; Specific Exemption Request; April 1, 2017
This is an application for a specific exemption to authorize the use of sulfoxaflor (Transform® WG Insecticide EPA Reg. No. 62719-625) to control western tarnished plant bug in cotton. The following information is submitted in the format indicated in the proposed rules for Chapter 1, Title 40 CFR, Part 166.

SECTION 166.20(a) 1: IDENTITY OF CONTACT PERSONS

i. Identify of contact person:

Jack Peterson
Arizona Department of Agriculture
1688 West Adams Street
Phoenix, Arizona 85007
Phone: 602.542.3575
Fax: 602.542.0466
Email: jpeterson@azda.gov

ii. Name and telephone numbers of qualified experts:

University Representative
Dr. Peter Ellsworth
Extension Specialist in Integrated Pest Management / Professor of Entomology; Director, Arizona Pest Management Center
University of Arizona, Cooperative Extension
37860 W. Smith-Enke Rd., Maricopa, AZ 85138
Phone: 480.331.APMC
Cell: 480.363.7185
Email: peterell@cals.arizona.edu

Registrant Representatives
Brian Bret
State Regulatory Manager
Dow AgroSciences
9330 Zionsville Road
Indianapolis IN, 46268
Tel: 916.780.7477
Email: blbret@dow.com

Jamey Thomas
US Regulatory Manager
Dow AgroSciences
9330 Zionsville Road
Tel: 317.337.4138
Indianapolis, IN. 46268

Cooperating Agency
Arizona Pest Management Center,
Maricopa Agricultural Center, University of Arizona
College of Agriculture & Life Sciences
Arizona Cooperative Extension
University of Arizona
Maricopa, AZ 85048

SECTION 166.20(a) 2: DESCRIPTION OF PESTICIDE REQUESTED

(A) Registration number and the name or the formulation requested

Trade Name: Transform® WG Insecticide
Active Ingredient: Sulfoxaflor
Formulation: 50% WG
Manufacturer: Dow Agrochemical Company
EPA Reg. No.: 62719-625

Federal Label: See Appendix I for copy of the federal label
Proposed Use Directions: See Appendix II for a copy of the draft Section 18 label

SECTION 166.20(a) 3: DESCRIPTION OF PROPOSED USE

i. Sites to be treated:

The insecticide will be restricted to use on cotton fields within the state of Arizona for the purpose of controlling the western tarnished plant bug, *Lygus hesperus* (Knight), known locally as "Lygus bugs".

Locations within the state: Graham, Greenlee, Gila, Cochise, Pima, Pinal, Maricopa, Mohave, La Paz, Yuma Counties

ii. Method of Application:

Foliar applications will be made by air or ground. Chemigation will not be allowed.

iii. Rate of Application:

1.5 – 2.25 oz product / A (0.047 – 0.071 lb ai / A). Use will not exceed 0.266 lb ai / A per season.

iv. Maximum Number of Applications:

Maximum of four applications per season.

v. Total Acreage to be Treated:

150,000 acres.

Cotton acreage inclusive of Pima cotton (i.e., *Gossypium hirsutum* & *G. barbadense*) in Arizona is projected to be ~170,000 – 175,000 acres in 2017 (Ollerton / Arizona Cotton Growers Association, pers. comm.[1]). Arizona, based on Arizona Cotton Pest Losses Survey data (2005–2016), treats on average 25.6–80.5% of its acreage for Lygus bugs (Arizona Cotton Pest Losses survey, hereafter noted as "AzCPL", 2007–2017, Ellsworth, unpubl. data; also see Williams et al. 2007–2017). The year 2005 is representative of the urgent and non-routine, emergency conditions we expect for 2017; 86.1% of acreage was treated for Lygus in that year (AzCPL, Ellsworth, unpubl. data; Williams et al. 2006). Under the anticipated emergency condition, we estimate the potential need to treat ca. 85–90% (150,000–157,500 acres) of AZ cotton acreage with sulfoxaflor for control of Lygus bugs.

vi. Total Amount of Pesticide to be used:

21,094 lbs ai.

Western tarnished plant bug, *Lygus hesperus* (Knight), infestations are likely to cause economic losses on all Arizona cotton acres, but emergency use will be restricted to 150,000 acres in Arizona during 2017. Likewise, while up to four applications of sulfoxaflor may be required on some acres to reduce the impact of this pest, we expect to average no more than 2 applications of Transform per impacted acre at no more than an average total of 4.5 oz product per acre (2.25 oz / application). The label seasonal restriction will be no more than 8.5 oz of product used per acre per season. Maximum amount of formulated product would be 4.5 oz. * 150,000 acres = 675,000 oz or 42,188 lbs of product, equivalent to 21,094 lb ai for the state of Arizona.

vii. Applicable Restrictions, Qualifications of Applicators, and Requirements:

Arizona requires that anyone wanting to use a product under a Section 18 label apply with the Arizona Department of Agriculture (ADA) to provide information on how many acres and where the product will be used. Upon application, ADA will then provide them with a copy of the label and a permit number. All applications of the product under the Section 18 must then also be reported to the ADA within 4 days of the end of the week the application occurred on a form 1080 (copy in Appendix III). Transform WG is not a restricted use pesticide so applicators do not need to be certified. However, in Arizona anyone using an agricultural use pesticide must have a grower's permit issued by ADA.

Refer to the Transform® WG container label for first aid, precautionary statements, directions for use and conditions of sale and warranty information. It is a violation of federal law to use this product in a manner that is inconsistent with all applicable label directions, restrictions and precautions found on the container label and this supplemental label. Both the container label and this supplemental Section 18 exemption label must be in the possession of the user at the time of application.

[1] Paul 'Paco' Ollerton, President, Arizona Cotton Growers Association, 520.560.6111

Applicable restrictions and requirements concerning the proposed use and the qualifications of applicators using Transform® WG are as follows:

- Pre-harvest Interval: Do not apply within 14 d of harvest.
- Minimum Treatment Interval: Do not make applications less than 5 d apart.
- Do not make more than four applications per acre per season.
- Do not apply more than a total of 8.5 oz. of Transform WG (0.266 lb AI of sulfoxaflor) per acre per year.
- Label must include a pollinator advisory statement including but not limited to the following:
    - Prior to use of Transform WG, growers and the beekeepers hosted on their farm are advised to review the Arizona Management Plan for the Protection of Pollinators at: https://agriculture.az.gov/sites/default/files/AZ%20MP3%20Jan%2016.pdf
- Before Transform WG can be used, western plant bug densities must reach or exceed thresholds published by University of Arizona Cooperative Extension at 15 total Lygus per 100 sweeps with at least 4 nymphs per 100 sweeps (notated as '15:4'). Pest managers should also review University of Arizona Cooperative Extension management guidelines. For more information, see:
  https://cals.arizona.edu/crops/cotton/insects/lygus/lygus3.pdf
  https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1404.pdf
- Growers are advised to follow University of Arizona Cooperative Extension guidelines for resistance management that include observing the first principles of resistance management and instructions for rotation of chemistries:
  1) limiting usage of any mode of action (MoA) to the lowest practical level;
  2) diversifying MoAs as much as possible; and*
  3) partitioning MoA in space or time so as to segregate their usage as much as practically possible.
  **) Limit each class of chemistry or MoA to no more than 2 non-consecutive uses per season*
  For more information, see: https://cals.arizona.edu/crop/cotton/files/1stPrinciples.pdf, and https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1319.pdf

viii. Duration of the Proposed Use:
June 1, 2017 – October 31, 2017

ix. Earliest Possible Harvest Date:
August 20, 2017 in Yuma County, Arizona; otherwise,
September 20, 2017 in all other locations.

SECTION 166.20(a) 4: ALTERNATIVE METHODS OF CONTROL IN ARIZONA

i. A detailed explanation of why the pesticides currently registered for the particular use proposed in the application is not effective to the degree needed to control the emergency. The statement must be supported by field data

which demonstrate ineffectiveness of registered pesticides, or, if such data are unavailable, statements by qualified agricultural experts, extension personnel, university personnel or other persons similarly qualified in the field of pest control

Lygus bugs and whiteflies are the two key pests of the Arizona cotton system. By definition, this means management strategies (Integrated Pest Management) are designed for their presence and their control in the system, which occurs each year (Fig. 1). Both are economic pests of Arizona cotton and are a combination of species and status that is unique in the world to Arizona. Pink bollworm has been functionally eradicated for at least 8 years now, with the last sprays made against this pest by growers or the eradication program in 2008 (Fig. 2).

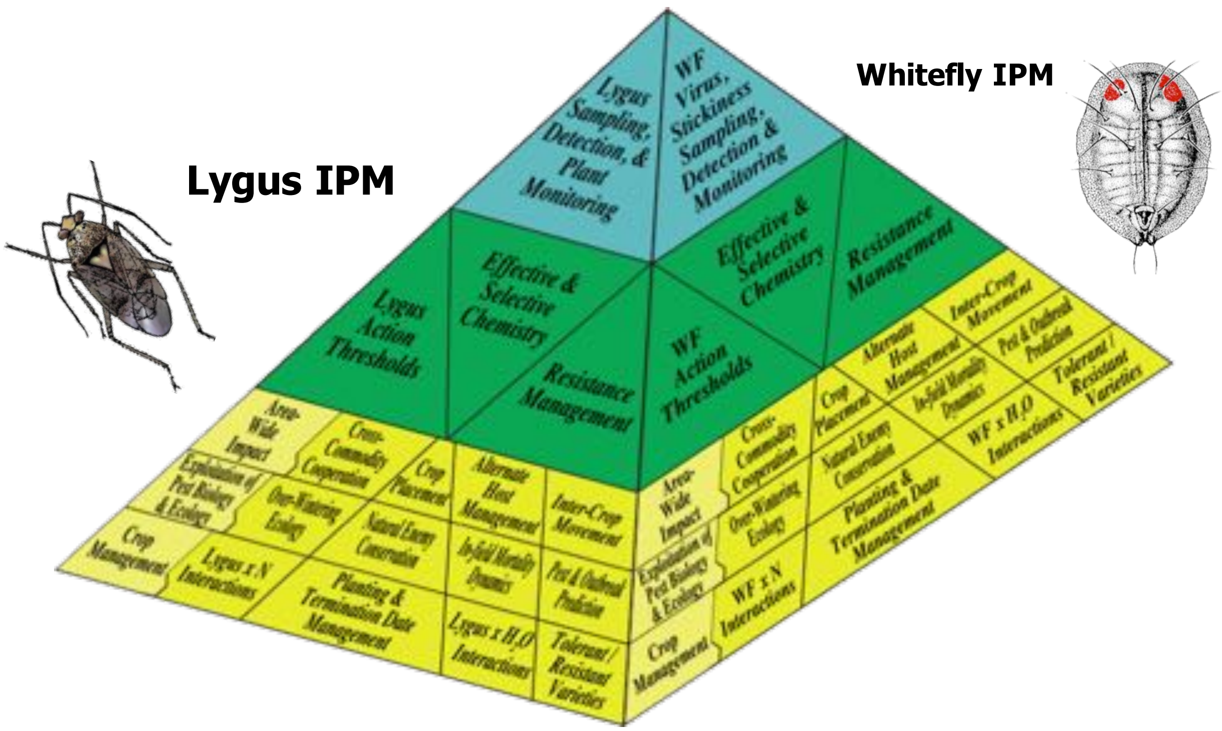

Figure 1. Depiction of Arizona cotton integrated pest management (IPM) program showing the facets that address the two remaining pests in the system after pink bollworm eradication (adapted and updated from Ellsworth & Martinez-Carrillo 2001).

Over two decades of research, integration and implementation of IPM directed at these two pests have resulted in a progressively improved IPM strategy that emphasizes natural enemy conservation through strategic and sparing use of selective chemical control tactics. The impacts of our IPM program are unprecedented with over $500,000,000 in cumulative savings to Arizona cotton growers in reduced yield loss and control cost savings since 1996 (Fig. 2). The Arizona cotton system has been a model for the successful uptake, stewardship, and integration of new knowledge and technologies, including genetically engineered (GE) plants and selective insecticides (Ellsworth & Martinez-Carrillo 2001; Tabashnik et al. 2010, 2012). As one of its major features, we have successfully integrated chemical and biological controls that prevent disruptions through the near elimination of broadly toxic insecticides (Naranjo & Ellsworth 2009a,b, 2010) (Fig. 3).

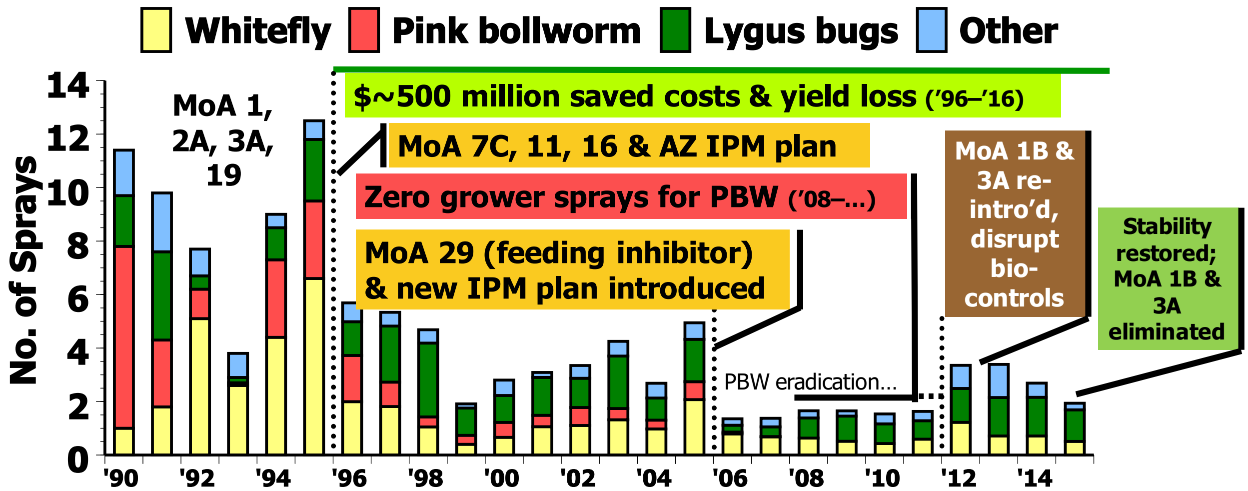

Figure 2. Statewide average number of insecticide sprays required to control the key insect pests in cotton as well as all other arthropods over the last 26 years, depicting the introduction of key technologies and insecticidal modes of action (MoA). Prior to 1996, the Arizona cotton system was dependent exclusively on broadly toxic insecticides: organophosphates, carbamates, pyrethroids, and the cyclo-diene, endosulfan. In 1996, selective control agents, pyriproxyfen and buprofezin were granted a Section 18 exemption for control of whiteflies and genetically-engineered Bt cotton was introduced. In 2006, the reduced-risk and selective feeding inhibitor flonicamid was registered for use in the control Lygus bugs and pink bollworm eradication was initiated. In 2012, all uses of endosulfan were ended, but broadly toxic organophosphates, especially acephate, and pyrethroids were re-introduced destabilizing the system's biological controls. With additional research and education, growers initiated discontinuation in 2014 of these broadly toxic insecticides once again and **sulfoxaflor was central to this recovery of stability because of its selective control of Lygus bugs and whiteflies**. All sulfoxaflor uses were cancelled after the 2015 season, jeopardizing the gains made in Arizona's advanced IPM system. Data from Arizona Cotton Pest Losses, 2017, unpubl.; Ellsworth et al. 2006).

The central layer of the IPM strategy (Fig. 1) is effective chemical use, enabled through research-based action thresholds guiding the usage of effective and selective chemistry that is protected by advanced systems of resistance management rooted in first principles (Ellsworth 2001; Ellsworth et al. 2006; Palumbo et al. 2003; Pier et al. 2016). **The other chemistries available for the purpose requested under this section 18 are absent and alternatives insufficient to overcome the emergency condition.** In the complete history of chemical control of Lygus and whiteflies in Arizona cotton, there are just 3 compounds with this specific cross spectrum of control (clothianidin, endosulfan, and sulfoxaflor) and are reviewed next.

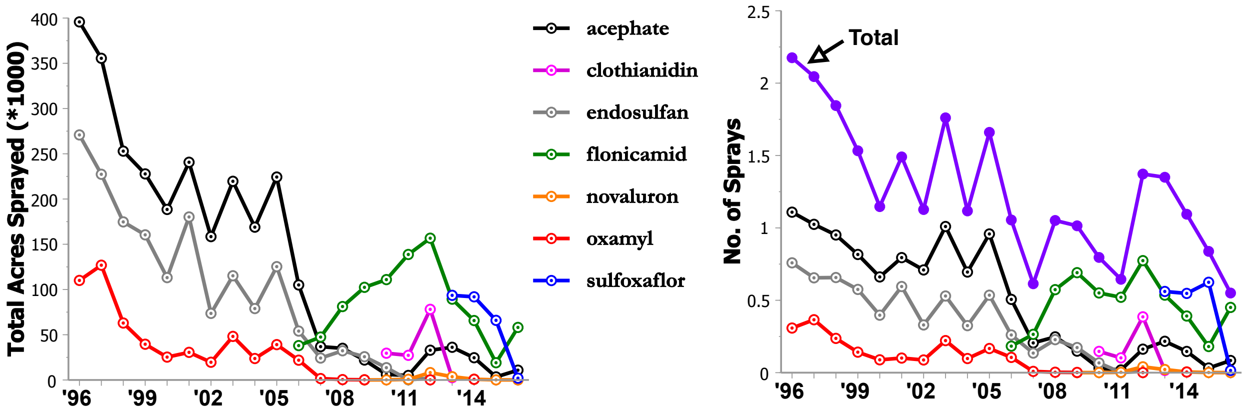

Figure 3. Statewide usage (total acres sprayed, left; number of sprays / A, right) of Lygus control chemistry, 1996–2016. Acephate, endosulfan, and oxamyl were the recommended controls, 1996–2005; endosulfan was completely phased out by 2013; flonicamid was the only fully selective control agent available for Lygus control, 2006–2011; clothianidin was only partially selective at the rates used and only partially effective but phased out commercially due to these factors and bee risks, 2010–2013, and especially once sulfoxaflor became available (2013–2015); oxamyl was unavailable for a time, but commercially phased out because of its handler risk, need for posting, and broadly toxic action, 1996–2009; novaluron has not been effective enough for control of Lygus or whiteflies; acephate (along with dicrotophos and pyrethroids) increased in 2012–2013. Data from Arizona Pest Management Center Pesticide Use Database, University of Arizona, Ellsworth, Fournier, Dixon, unpubl. data).

Sulfoxaflor (Transform)

The emergency, non-routine condition Arizona cotton is facing was caused by the discontinuation of availability of Transform due to court and USEPA action after November 2015. This action, complicated by system specific vulnerabilities caused by advancing threats of resistance in whiteflies and the return to broadly toxic chemistries to accomplish Lygus control, have imperiled one of the most successful demonstrations of the integration of chemical and biological controls in the U.S. **Transform uniquely controls Lygus and suppresses whiteflies while selectively conserving biological controls to help control these target pests and to prevent costly secondary pest outbreaks** (e.g., mites) (also see Fig. 8) (Ellsworth et al. 2012).

Only two other compounds have this spectrum of activity, each with disqualifying attributes.

Clothianidin (Belay)

Belay was registered for cotton in 2010. After some initial interest in the product, pest managers have learned what research had previously shown. It is a 2nd tier product as far as Lygus efficacy goes (Fig. 4; also see Fig. 8). And, while it suppresses whiteflies, it does this only at the highest rates. Furthermore, Belay has been shown to be damaging to natural enemies in the system (Fig. 5). Our research also shows that yields are not as well protected when using Belay and that there are increased risks for Lygus resurgence and mite outbreaks following Belay use (Fig. 4 & 6). Furthermore, there have been complaints about bee safety and now pest managers no longer use this product for any pest control need in cotton.

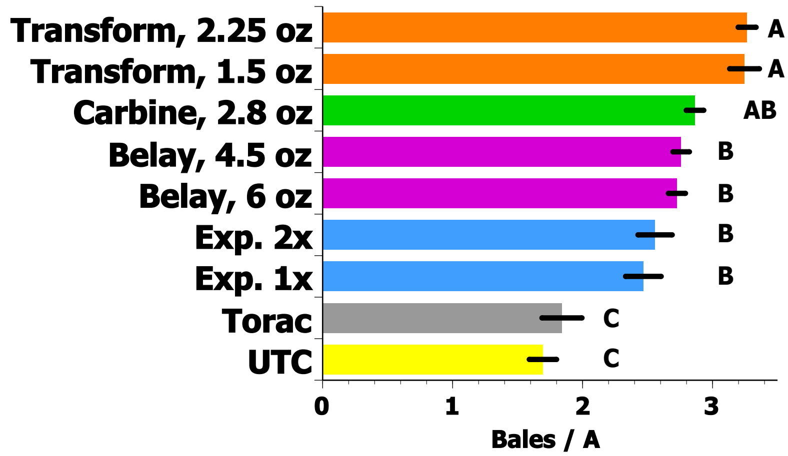

Figure 4. Cotton field trial results of a replicated Lygus control efficacy study performed at the University of Arizona, Maricopa Agricultural Center in 2012 (Ellsworth, unpubl. data, 12F3L). Maximum and reduced rates of Transform (sulfoxaflor) and Belay (clothianidin) were compared to the Lygus control standard of the time. Each compound was sprayed four times, with the first spray mixed with 8 oz of Knack (pyriproxyfen) for uniform whitefly control across the trial; all cotton contained Bt technology for lepidopteran control (DP1032B2RF). Lygus pressure was heavy, reducing yields by ca. 46% in the UTC compared to Transform. Carbine (flonicamid) at the labeled maximum rate yielded 0.4 bales / A less than the Transform treatments (or, 12.2%). While Lygus control was initially good for Belay at 6 oz / A, this higher rate destroyed natural enemies leading to Lygus resurgence at high levels. This resurgence was also noted for the broad-spectrum product, Torac (tolfenpyrad). This contributed to additional yield losses in these treatments. All products were over the seasonal limit for these products except for Transform at 1.5 oz / A.

Endosulfan (various brands)

Endosulfan uses in the U.S. were cancelled with the last usage in Arizona cotton occurring in 2012 on a very limited amount of acreage. Prior to 1996, it was a key broad-spectrum insecticide with cross spectrum control of Lygus and whiteflies when used at very high rates or as a synergist of pyrethroids to overcome pyrethroid-resistant whiteflies. Given the very few options that growers had at the time, endosulfan was very important. After 1996, endosulfan's role in our pest management system was de-emphasized in favor of safer (for handlers) and fully selective alternatives (for non-target beneficials) like Bt cotton, whitefly insect growth regulators, buprofezin and pyriproxyfen, and after 2006 flonicamid for Lygus control. Once endosulfan was phased out in 2012, Transform became the only product available to our growers with cross spectrum control of Lygus bugs and whiteflies.

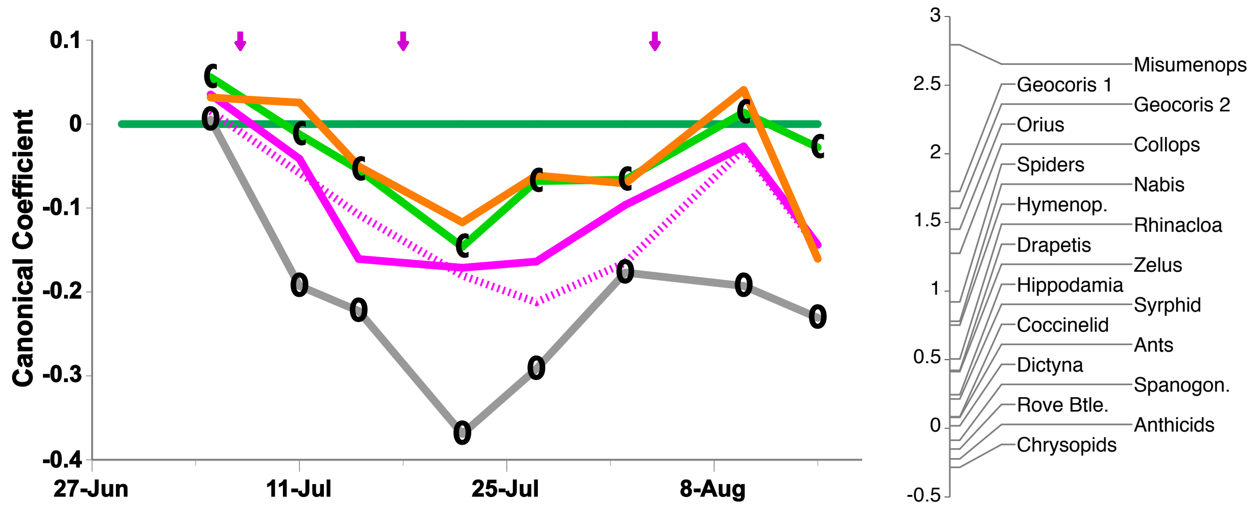

Figure 5. Principal Response Curves (PRC, left) and associated species weights (right) for a non-target large scale, replicated cotton field trial performed at the University of Arizona, Maricopa Agricultural Center Demonstration Farm in 2011, where 3 sprays of Carbine (flonicamid, 2.8 oz /A = maximum rate; light green line), Orthene97 (acephate, 1.1 lbs / A; gray line), Belay (clothianidin, 4.5 oz – solid purple; and 6.0 oz / A – dashed magenta line) and Transform (sulfoxaflor, 1.5 oz / A, orange line) were made irrespective of specific pest pressures and compared to the UTC (no sprays, Y=0 line) (Ellsworth, unpubl. data; 11F32NTO). These PRCs test for density effects across an entire community of >20 predators in the cotton system. Carbine is our fully selective standard, meaning that the current and other studies demonstrate that applications of Carbine are completely safe to the community of predators present in Arizona cotton and produce a curve of canonical coefficients (~ predator densities) not significantly different from the UTC ($P > 0.10$). Acephate is our standard, broad-spectrum insecticide where the natural enemy community is severely depressed for extended durations after treatment at levels well below the UTC ($P = 0.002$). A region in between where a compound produces results variably different from the UTC and/or the broad-spectrum standard are considered “partially selective”. Both rates of Belay (magenta lines) have some damaging effects on beneficials in this region between the UTC and broad-spectrum acephate, i.e., “partially selective”. Transform (orange line) is not significantly different from Carbine or the UTC ($P > 0.12$), indicating that it, too, is a fully selective insecticide in our cotton system.

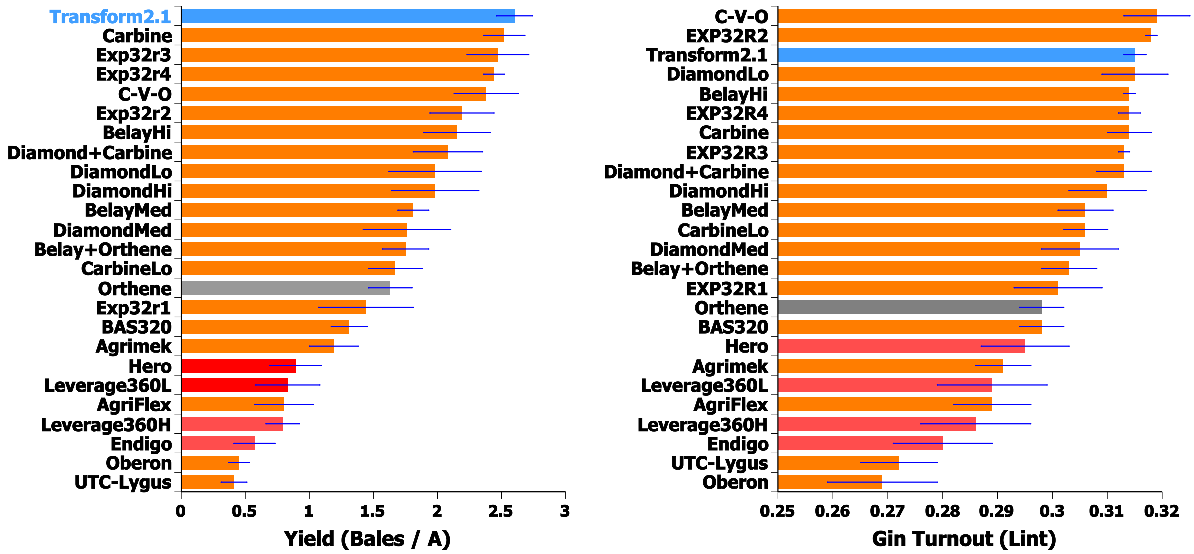

Figure 6. Replicated cotton field efficacy trial results for yield (left) and gin turnout (right), University of Arizona, Maricopa Agricultural Center, 2009 (Ellsworth, unpubl. data, 09F4L). Transform (2.1 oz / A) led the trial in yield, a 6-fold increase over the UTC, 23.8% higher than the full rate of Diamond (novaluron) and 17.1% higher than the full rate of Belay (clothianidin). Orthene97 (acephate) yields were 37.3% lower than Transform because of less efficacy on Lygus bugs as well as a secondary outbreak of mites. Sprays were made at Lygus threshold: Transform, Belay and Carbine treatments required 3 sprays, Diamond treatments required 4 sprays and started 1 week sooner than the rest, and pyrethroid containing treatments (red bars) required 5 sprays. Courier (12.4 oz/A; buprofezin) was sprayed for uniform whitefly control across the trial; all cotton contained Bt technology for lepidopteran control (DP161B2RF). Lygus pressure was heavy, reducing yields by ca. 84% in the UTC compared to Transform.

Other Lygus Control Chemistries

Acephate is a good Lygus control chemistry; however, efficacy has declined in recent years, likely due to resistance (Fig. 6). As well, the product is very disruptive to our system, leading to whitefly resurgence and secondary outbreaks, especially of mites. The mechanism for this is through the destruction of natural enemies that have become so central to our management system. Acephate is our standard “negative control” for non-target organism studies (e.g., see Fig. 5, 7 & 9).

Novaluron is a molting inhibiting insect growth regulator with some known efficacy against Lygus, whiteflies and some other insects. Unfortunately, it is not efficacious enough to support commercial use against either target pest. Our efficacy trials routinely measure yield reductions of ca. 25% or more relative to the best performing treatments (e.g., Fig. 6). Furthermore, our non-target organism assessments have shown that novaluron, despite being an IGR, is broadly toxic to other insects including predators in our cotton system, as disruptive as acephate (Fig. 7). Novaluron is disruptive enough that we have measured both Lygus and whitefly resurgences after its use, as well as aphid and cotton leaf crumple (a whitefly vectored virus) secondary outbreaks. Because of all of these limitations (lack of efficacy and selectivity), novaluron has hardly been used by Arizona cotton growers (Fig. 3).

Pyrethroids, as premixes with other pyrethroids, neonicotinoids or alone, are ineffective against Lygus bugs or whiteflies (Fig. 6 & 8), and are highly damaging to natural enemies (Fig. 9).

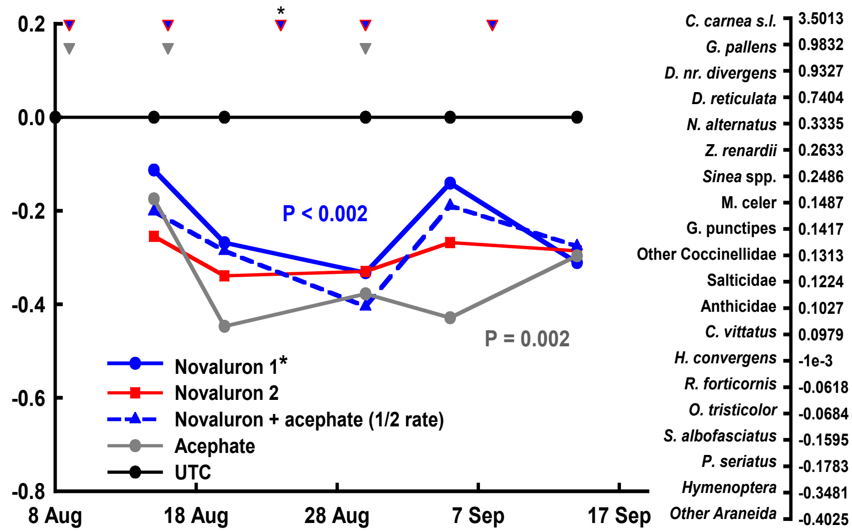

Figure 7. Principal Response Curves (left) and associated species weights (right) for a non-target organism, replicated cotton field trial where 3 sprays of acephate (at maximum rate; gray line) was compared to 3, 4 or 5 sprays of novaluron (Diamond) at two different rates and in mixture with a half rate of acephate. Each was tested against the UTC (no sprays, Y=0 black line), University of Arizona, Maricopa Agricultural Center, 2011, (Ellsworth, unpubl. data; 11F32NTO). Novaluron was as damaging to the community of >20 predators examined as our negative control, acephate, and significantly more damaging than the UTC (P < 0.002).

Carbine (flonicamid) is an excellent Lygus control chemical, functioning as a feeding inhibitor. While it has cross spectrum control of aphids and it is very safe to beneficials in our system (Fig. 5 & 9), it provides no control of whiteflies whatsoever even at its maximum labeled rate used repeatedly (Ellsworth, unpubl. data) (Fig. 8). Furthermore, while a critical rotation partner to Transform to prevent resistance to either chemistry, it generally does not control Lygus as quickly or as well as Transform, resulting in yield disadvantages of ca. 15%) (Fig. 4 & 10). As a feeding inhibitor, Carbine acts more slowly in controlling Lygus, whereas Transform provides rapid knockdown and mortality of Lygus. Furthermore, many field trials compare repeated uses of Carbine vs. Transform, inconsistent with resistance management Extension recommendations that stipulate no more than two, non-consecutive used of any MoA or class of chemistry should be used (see **SECTION 166.20(a) 3, vii**). Rotations of Lygus control chemistry excluding Transform perform no better (still at least 10% off, Fig. 6) and worse must include broad spectrum chemistry like oxamyl and acephate, which place the system at greater risk of yield losses and control costs associated with pest resurgence and secondary outbreaks. Even rotations not initiated with Transform, but including it in a 3-spray regime with Carbine and Belay, are nearly 10% off in yields (Fig. 10). Lastly, Carbine is constrained to 3 uses per season and a 30 d PHI. More than 3 sprays are often needed (average 3.5 sprays in Lygus trials, see Table 1) and control within 30 d of harvest is also sometimes required in our long season system. Transform has a 14 d PHI.

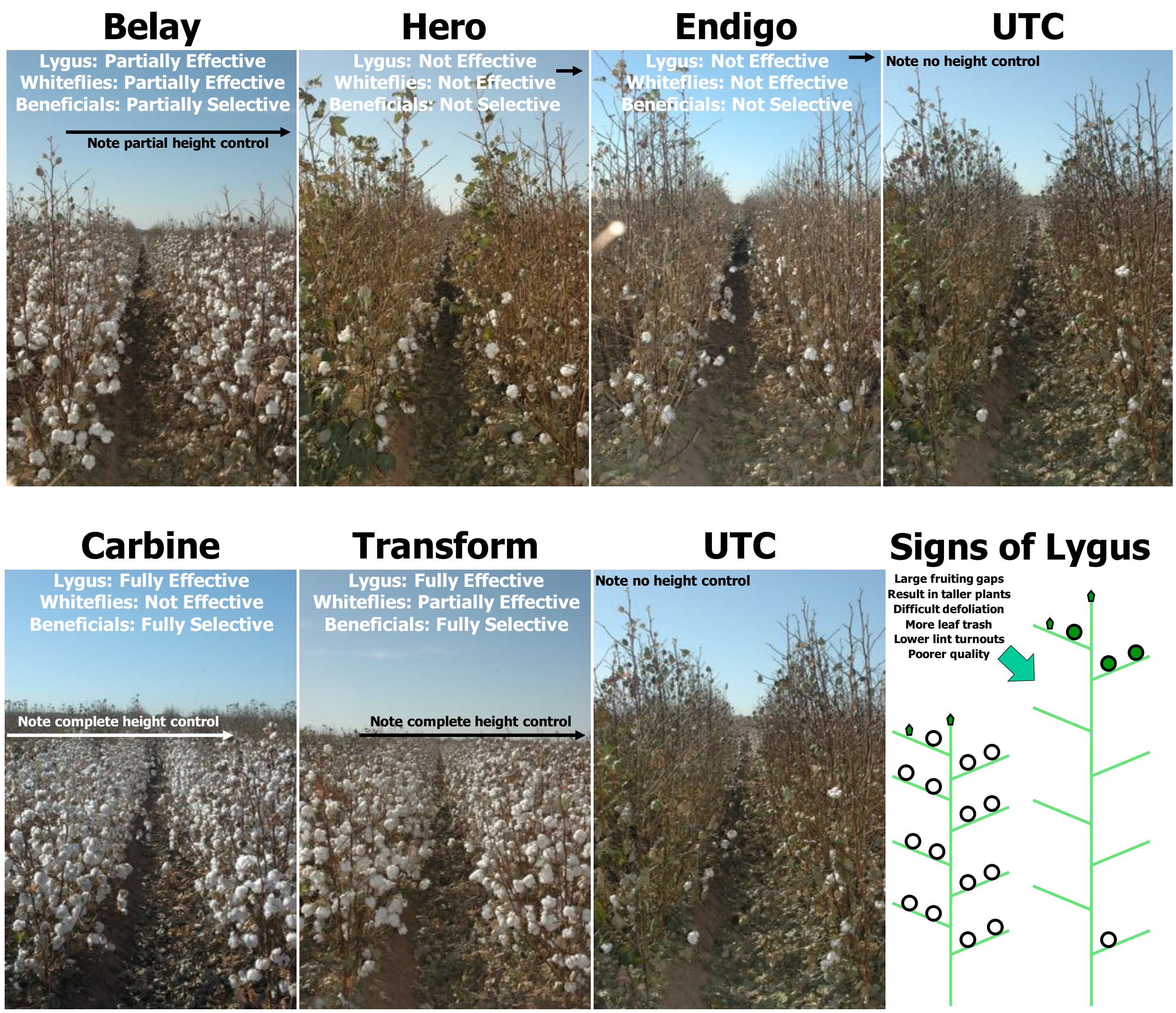

Figure 8. Photos from a replicated, Lygus field efficacy trial showing the central 2 (of 12) rows of a representative plot from each of 6 treatments: Belay (6 oz / A, clothanidin), Hero (10.3 oz / A, zeta-cypermethrin + bifenthrin), Endigo (3.4 oz / A, lambda-cyhalothrin + thiamethoxam), UTC, Carbine (2.8 oz / A, flonicamid), and Transform (2.1 oz / A), each sprayed on threshold 3 times, except Hero and Endigo which had to be sprayed 5 times; University of Arizona, Maricopa Agricultural Center, 2009 (Ellsworth, unpubl. data, 09F4L). Lygus damage is evident not only in yield but in plant growth (lower right), which is impacted by the re-distribution of carbohydrates from boll sinks, because of missing fruit, to stem and leaf growth, resulting in tall plants and poor fruit load and concomitant increases in defoliation costs and reductions in fiber uniformity and quality. **Transform is the only product available with very high efficacy against Lygus bugs, suppression of whiteflies, and without negative impacts on predators in the Arizona cotton system.**

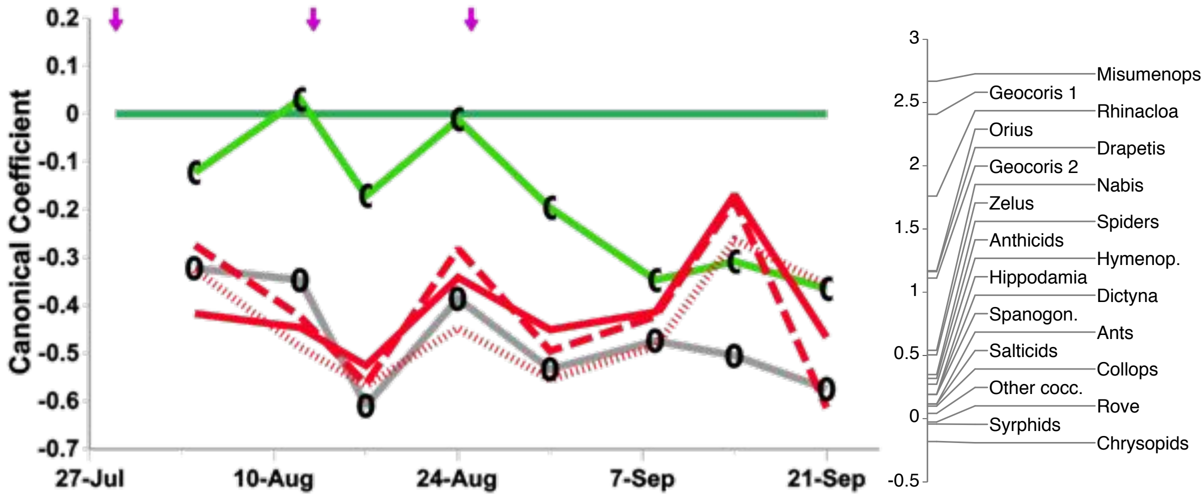

Figure 9. Principal Response Curves (left) and associated species weights (right) for a non-target organism, replicated cotton field trial where 4 sprays of acephate (at maximum rate; gray line; broad-spectrum standard) was compared to 3 sprays of Carbine (2.8 oz / A; bright green line; flonicamid, selective standard), and 5 sprays of pyrethroid-containing mixture products (zeta-cypermethrin + bifenthrin; cyfluthrin + imidacloprid; lambda-cyhalothrin + thiamethoxam). Each was tested against the UTC (no sprays, Y=0 dark green line), University of Arizona, Maricopa Agricultural Center, 2009 (Ellsworth, unpubl. data; 09F4L) (See Fig. 6 for yield results). Pyrethroids here and in other studies were as damaging to the community of >20 predators examined as our negative control, acephate, and significantly more damaging than the UTC ($P < 0.10$).

Other Whitefly Control Chemistries

There are a number of whitefly control chemistries available to growers of cotton in Arizona (Ellsworth et al. 2006). However, none of these are effective on Lygus, and 3 of 6 MoAs are threatened by existing resistances, despite restricted use (Palumbo et al. 2003) over the last 20 years: **pyriproxyfen** (Knack), **acetamiprid** (Intruder), and **pyrethroids** synergized with **organophosphates** (Fig. 11). This puts a premium on those products that can contribute to whitefly control without disruption of natural enemies, which Intruder and pyrethroids are unable to do and Knack is compromised by resistances (Crowder et al. 2006–2008; Carrière et al. 2012a). Transform was providing this attribute prior to its cancellation and the emergency condition we are now under. As a result, whitefly resistances advanced significantly between 2015 (routine) and 2016 (emergency).

In our two-key pest system, Lygus are often the first pest threat in cotton to reach threshold levels. And, Lygus control chemistry is often deployed prior to whiteflies reaching threshold. Therefore, Transform use at this stage of whitefly population development has often been sufficient to suppress whiteflies for an extended period of time such that natural enemies were conserved in sufficient numbers to keep whiteflies below threshold for many weeks, if not season-long, without the need for additional whitefly control chemistry.

This period of extended control that includes but exceeds the chemical residual of a selective chemical control is termed “bioresidual” as coined by Ellsworth & Martinez-Carrillo (2001) and reviewed by Naranjo & Ellsworth (2009a). The phenomenon was originally described and measured for selective whitefly control agents, pyriproxyfen and buprofezin, but applicable to any chemical control technology where integration with conserved biological controls is a prominent feature of the management system (Horowitz et al. 2009). Furthermore, as predicted by research, growers have reported a reduced need to deploy chemical controls for whiteflies after Transform has been used earlier in the season (Ellsworth, unpubl. data).

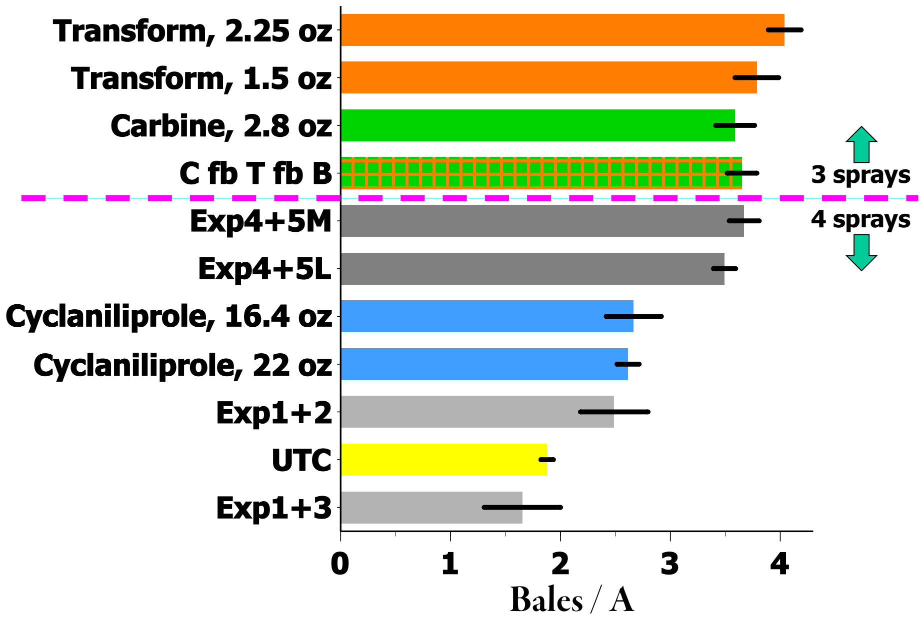

Figure 10. Replicated cotton field Lygus efficacy trial yield results, University of Arizona, Maricopa Agricultural Center, 2014 (Ellsworth, unpubl. data, 14F4L). Transform (2.25 oz / A) led the trial in yield, a 53.4% increase over the UTC, 11.2% higher than the full rate of Carbine (flonicamid) and 9.6% higher than a 3-spray rotation of Carbine followed by Transform followed by Belay (clothianidin). Sprays were made on Lygus threshold 3 or 4 times as indicated. All cotton contained Bt technology for lepidopteran control (DP1359B2RF). Lygus pressure was moderate, but growing conditions were excellent with very high yield potential.

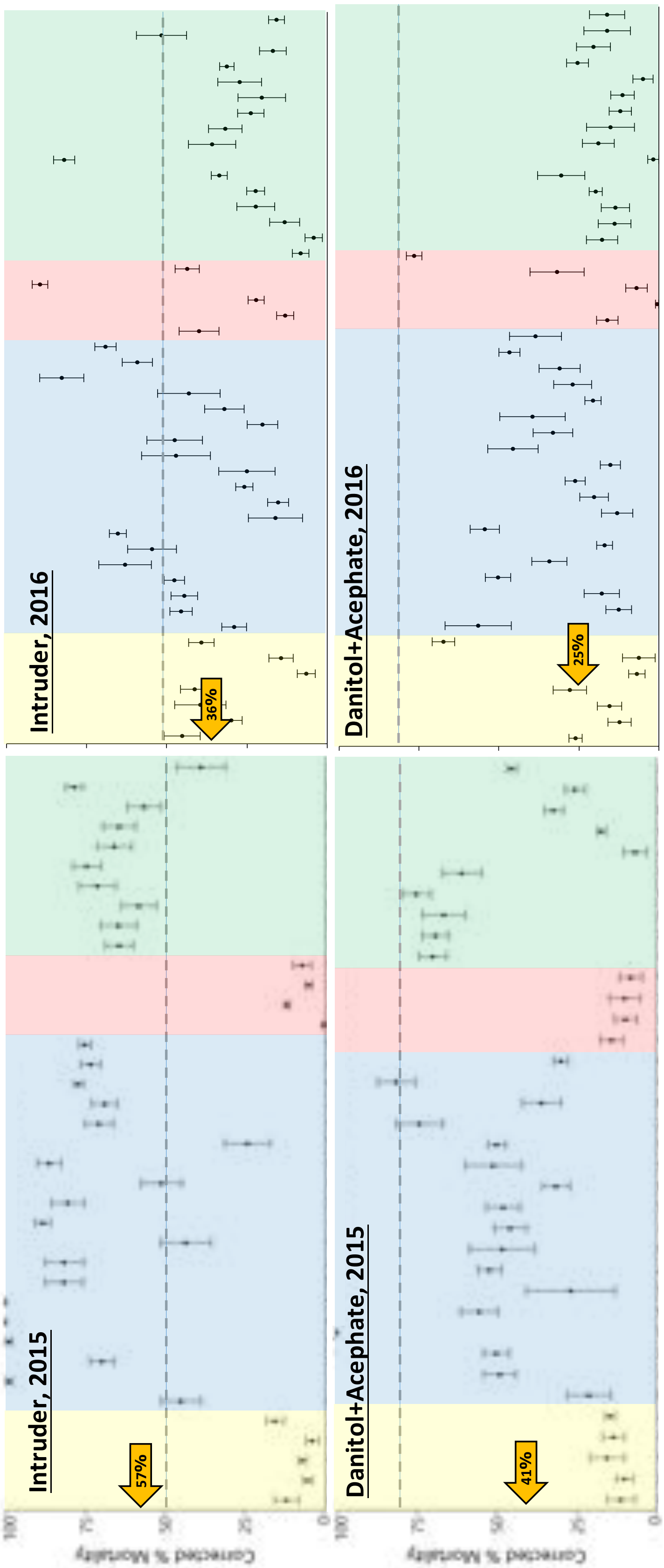

Figure 11. Whitefly mean mortalities (±SE) for 2015 (left, N = 36–38 populations) & 2016 (right, N = 46–47 populations) from resistance bioassays of 2 modes of action, represented by acetamiprid (10 ppm, Intruder, top) and synergized pyrethroids (10ppm + 2ppm, Danitol+acephate, bottom). In both cases, the mean mortalities statewide have decreased between 2015 (routine) and 2016 (emergency condition). In addition, more populations fall below the diagnostic level for resistance detection (dotted lines): 81% and 100% of populations in 2016 compared to 34% and 94% of populations in 2015 for acetamiprid and Danitol+acephate, respectively. I.e., resistance has worsened in 2016. Field efficacy complaints were received in 2016 for both modes of action, despite 2016 being one of the lowest whitefly pressure years ever reported. Furthermore, 23% of populations showed resistance to pyriproxyfen (1 ppm, Knack, not shown) in 2016.

ii. A detailed explanation of why alternative practices, if available, either would not provide adequate control or would not be economically or environmentally feasible

The Arizona cotton IPM plan focuses on the two key pests of the system (Fig. 1). The strategy depends on multiple chemical and non-chemical tactics for accomplishing efficient management of pest threats (i.e., Lygus bugs, whiteflies, and secondary arthropod pests) while protecting human and environmental health. Technologies that are safe to the large and diverse suite of predators and parasitoids in the system are key to its overall success. This successful integration of chemical and biological controls has enabled a sustainable cotton IPM system in Arizona. Genetically-engineered, Bt cotton selectively controls any lepidopteran threat without harming beneficials. Whitefly control chemistries discussed in the former section are also key to conservation biological control; however, those chemistries (except for Transform) have no direct impact on Lygus bugs and several are threatened by increasing resistances. And while these conserved biological controls are adequate to hold back many secondary pests like mites, aphids, thrips, cotton leafperforator, saltmarsh caterpillar and more, they are not sufficient on their own to control whiteflies and especially Lygus without the addition of selective chemical controls. This, in part, is what defines a "key" pest of the system.

Aside from "Exploitation of Pest Biology & Ecology", which is driven by natural enemy conservation and in-field mortality dynamics, what remains in the non-chemical, foundational layer of "avoidance" in our IPM system is of limited effect without chemical controls (Fig. 1). "Crop Management", the base layer to avoidance or prevention is based on several cultural controls for Lygus. Each is inadequate to "control" Lygus economically and each only helps provide conditions less hospitable for Lygus (and whiteflies). Water management in this irrigated system can have impacts on Lygus, making cotton less attractive to Lygus when it is deficit irrigated. However, those conditions lead to major yield penalties on their own; as well, those conditions unfavorable to Lygus (water-stressed cotton) are the very same conditions that favor whitefly population development (Asiimwe et al. 2013, 2014). There are no truly resistant varieties either. Hairy leaf cultivars are sometimes touted as tolerant to plant bug damage (i.e., Mirids, including *Lygus lineolaris*). However, the effects, if any, are extremely limited in our system, and likewise to water inputs the reverse effect occurs for whiteflies. I.e., Whitefly population development is very much favored by hairy leaf cultivars.

Planting date management can help reduce the impacts of Lygus and whiteflies in area plantings. However, there is no measure of planting or termination date management that eliminates the risk of these pests reaching threshold levels that require intervention with chemical controls.

The remaining layer of avoidance or prevention tactics is "Area-Wide Impact" (Fig. 1). These tactics all have a spatial component to them that is based in risk to subject cotton fields relative to the position of other hosts including cotton (sinks) and other sources (Carrière et al. 2006, 2012b; Ellsworth 2013). While it is known that certain crops serve as sinks, that information currently is only of limited value and requires broad-scale cooperation across landscapes. One sink is cotton itself. So, while a subject field can be "insulated" from the effects of moving Lygus across a landscape by buffering cotton, the buffered cotton likely only serves as such if it is managed for Lygus with chemical controls. Another possible sink is guayule, which remains in a pre-commercial status as the industry continues to develop this promising crop that is ostensibly insensitive to Lygus presence in it. There are too few acres of this crop to make area-wide use of this for all growers of cotton.

Safflower and alfalfa if managed specifically for Lygus bugs can serve as important and effective sinks for Lygus, protecting nearby cotton. Very little safflower is produced in Arizona, so this option is insufficient to stem the emergency condition. Alfalfa, on the other hand, is a major crop in Arizona. With aggressive cultural management of strip and block-cutting, it is possible to limit migrations of Lygus bugs to nearby cotton (Ellsworth 2013). However, alfalfa is insensitive to Lygus damage and therefore alfalfa growers often (i.e., usually) have insufficient incentive to manage their crop in this way to benefit cotton growers. Furthermore, much of this crop is custom harvested and the alfalfa grower has little control over the precise timing (and availability) of the custom harvest operation. In addition, the key timing of this practice is during the middle of the summer period when alfalfa is in summer slump (low production, low quality and low value) and the monsoon rainfall patterns interfere with harvest operations (e.g., cutting, raking, baling, etc.). Lastly, alfalfa is not grown in all cotton communities or within specific spatial requirements of this cultural control (within 3 km) to be useful to all. Until new breakthroughs are made in cross-commodity cooperation, the utility of this approach remains largely theoretical for many cotton growers.

Source reduction (~ "Alternate Host Management) is therefore quite limited except in terms of effective chemical controls areawide in cotton. Thus, even the non-chemical approaches of our system are heavily dependent on the availability of effective and selective controls, like Transform. No other non-chemical tactics exist for managing Lygus in our cotton system.

SECTION 166.20(a) 5: EFFECTIVENESS OF PROPOSED USE

> **The application shall contain data, a discussion of field trials, or other evidence which provide the basis for the conclusion that the proposed pesticide treatment will be effective in dealing with the emergency.**

Lygus Bug Management

Because of the nature of the cause of our emergency condition — a regulatory action that led to the removal from the market of Transform use for Arizona cotton — much of the data needed to show the effectiveness of the proposed use already exists in this application under **SECTION 166.20(a) 4: ALTERNATIVE METHODS OF CONTROL IN ARIZONA**, especially with respect to Lygus management. In particular, Figures 4, 6, 8 and 10 provide important information on the efficacy of the proposed use in dealing with the emergency. Relative to UTCs in each trial, the proposed use prevented 46% (Fig. 4), 84% (Fig. 6), and 53% (Fig. 10) yield loss to Lygus bugs. Furthermore, Transform led all three trials shown including a 12.2% (Fig. 4) and 11.2% (Fig. 10) yield advantage over the next closest treatment, and a 9% yield advantage over an alternative rotation of chemistries (Fig. 6). In each of these studies, whiteflies were either managed uniformly across the trials or were not at damaging levels. Thus, the potential for yield and quality losses was even greater than measured in these comparisons. As well, commercial alternatives to Transform include broad-spectrum chemistries like acephate, which is a known threat for secondary outbreaks like mites that also causes yield and quality losses (e.g., see Fig. 6 where acephate lost 37% yield compared to Transform). In addition, there is ample data and other documentation to support this use pattern in EPAs docket for this active ingredient, EPA Docket ID: EPA-HQ-OPP-2010-0889.

In Table 1, we have summarized the performance of Transform at various rates averaging 0.066 lbs ai / A over the course of 7 years of replicated small and commercial scale testing against Lygus bug populations of moderate to large intensity at the University of Arizona (Ellsworth, unpubl. data). In all cases, the studies were constructed so as to examine the control of Lygus and consequences of that control (e.g. secondary outbreaks of mites or other pests; see Fig. 12). Bt cotton was used in each case, as the most popular type of cotton grown in Arizona, which eliminated any confounding effects of lepidopteran populations. When needed in some cases, whiteflies were selectively controlled over the entire experiment [including on the Transform treatment(s)] to eliminate confounding effects of whitefly populations or their lack of control, because the products tested in comparison to Transform do not provide commercial level control of whiteflies. In most cases, the maximum rates of comparison products were used. In all but one case (see next), Transform was sprayed the same or fewer number of times as comparison products. Trials were set-up so that individual treatments could be sprayed when and only when they exceeded the recommended threshold (≥ 15 total Lygus with 4 nymphs per 100 sweeps).

Table 1. Summary of Transform use (proposed use pattern) in the control of Lygus from controlled field experiments: year, rate and number of sprays of Transform tested, and comparison product performance, expressed as % reduction in yield of the candidate treatments from the Transform treatment for each year, 2008–2014, Ellsworth, unpubl. data. Maximum rates used for all products unless specified otherwise. Blue numbers, treatments significantly different from UTC within a year, Dunnett's, P < 0.05. Gray cells, treatments significantly lower than the maximum treatment (Transform) by Hsu's MCB, P < 0.05.

Transform Use Pattern			acephate	clothianidin	flonicamid	novaluron	oxamyl	Non-Transform rotations	Average (% yield loss)
Year	Rate (lbs ai / A)	No. Sprays							
2008	0.067	5*	-59	-32	-29		-41		**-40.3**
2008	0.088	4*	-45	-19	-16		-27		**-26.9**
2009	0.067	3**	-34	-17	-3	-23		-10	**-17.4**
2011	0.07	3***	-66	-45	-30	-47		-23	**-42.4**
2011n	0.047	3	-35	-13	-6				**-18.2**
2012	0.07	4		-17	-12				**-14.4**
2013	0.047	3†		-8	-13				**-10.7**
2014	0.07	3			-11				**-11.2**
Ave	**0.066**	**3.5**	**-47.9**	**-21.6**	**-15.2**	**-35.5**	**-33.9**	**-16.4**	**-28.4**

*Comparison products sprayed 3 times + 3 whitefly over-sprays; 0.075 lbs ai Belay.
**Novaluron sprayed 2 weeks earlier; Rotation of flonicamid fb oxamyl fb acephate; Sulfoxaflor sprayed 3 times; novaluron or acephate sprayed 4 times.
***Rotation of flonicamid fb flonicamid fb bifenthrin+abamectin (Athena, 0.115 lbs ai / A).
†Only Transform was significantly different from the UTC; Clothianidin at 0.075 lbs ai / A.

In the 2008 study, one Transform treatment (0.067) was not over-sprayed for whitefly control. Instead, Transform was used for the dual purpose of Lygus and whitefly control resulting in 1 less spray than in the comparison products, which required 3 over-sprays for whitefly control. Whiteflies were over-sprayed on all treatments twice in 2009, once in 2012, and not at all in 2011, 2013 and 2014. In the 2009 study, novaluron treatments were initiated 15 d earlier than the others and sprayed one additional time; acephate also had to be sprayed one additional time. All other treatments were sprayed on the same timings. The 2011–2014 trials observed identical Lygus spray timings for all treatments.

In all cases, the Transform treatment led the trial in yield with comparison products averaging 28.4% less yield than Transform (range: -15.2 – -47.9%; Table 1). The closest product (Carbine, flonicamid) yielded 15.2% less than Transform. Most of the time Transform yielded significantly higher than the next best performing treatment (Hsu's MCB). Our resistance management guidelines would suggest using rotations to prevent or manage resistance. However, without Transform, there are no good choices and those non-Transform containing rotations suffered a 16.4% loss compared to Transform.

Furthermore, Transform plots had no whitefly damage, no whitefly or Lygus resurgence, and no complications from secondary outbreaks of mites or other pests, which were issues for many of the comparison treatments (see Fig. 12). Partial or complete defoliation due to mite pressures were observed at times in acephate, novaluron, and clothianidin treatments. Whitefly resurgences have been observed in novaluron, clothianidin, and thiamethoxam treatments. Cotton leaf crumple, a whitefly-vectored disease has been observed as a result, especially in novaluron plots. Resulting honeydew interferes with photosynthesis, lowers lint quality, and disrupts efficient defoliant uptake leading to excessive leaf trash in the harvest. Lygus resurgences have also been observed in novaluron and clothianidin treatments.

Whitefly Management

The preceding sections amply demonstrate the superior Lygus control possible with the proposed use pattern. However, it is Transform's cross spectrum effects on Lygus <u>and</u> whiteflies that make it so uniquely fitted to our system and necessary to stabilizing our IPM and IRM systems in cotton. While Transform is not a standalone curative for whitefly infestations, it is capable of important suppression of whiteflies when growers are often first deploying chemistry for Lygus control. This "early" treatment for whiteflies has demonstrated itself as being hugely helpful in restricting whitefly population development and ostensibly resistance. Often times, growers can forgo any further whitefly sprays season-long. Alternatively, when they do finally see whitefly populations exceed threshold, they do so much later in the cropping cycle, the rate of increase is much less severe, and control is accomplished much more easily with standard whitefly control chemistry.

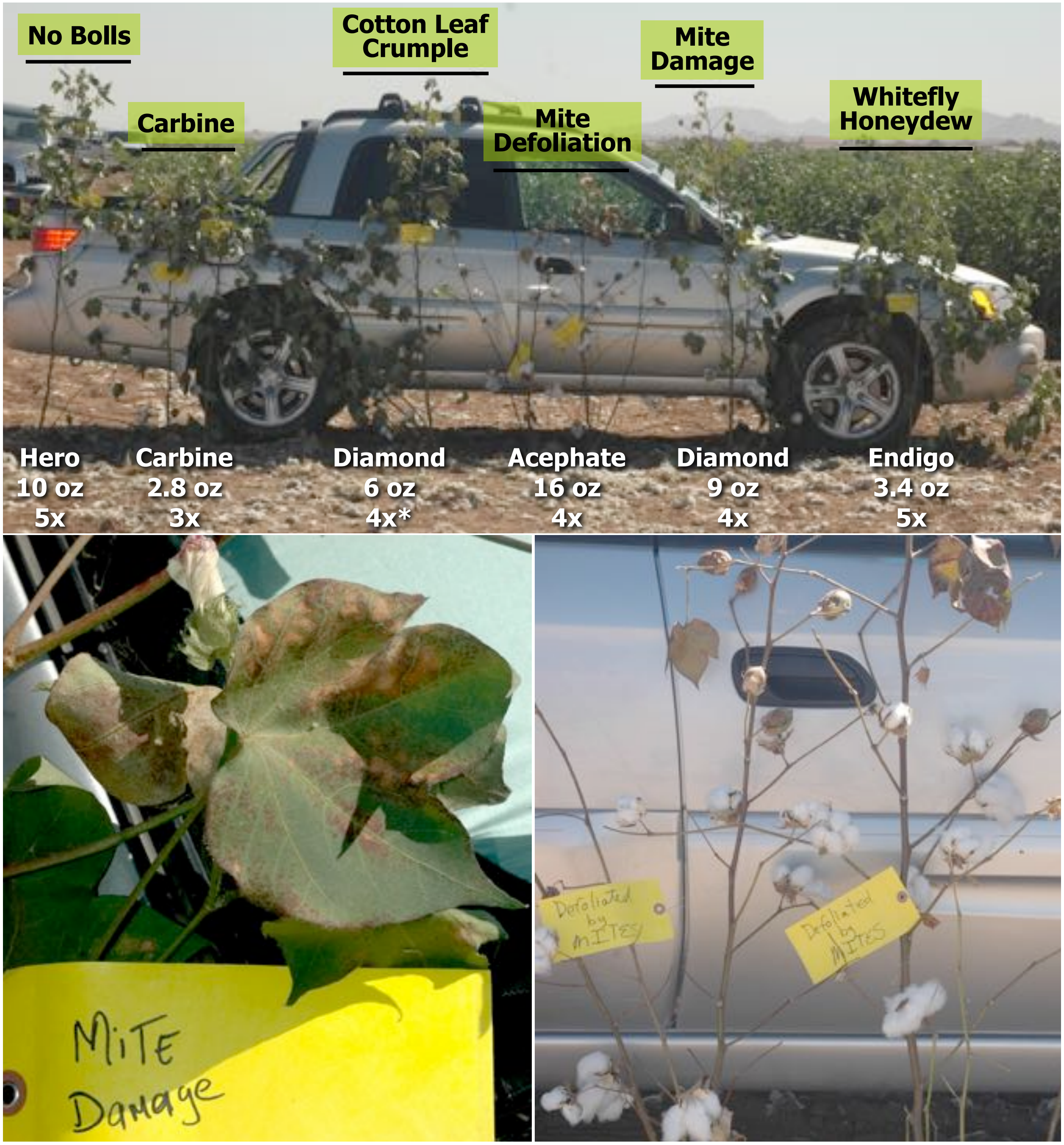

Figure 12. Example negative outcomes of non-Transform use patterns in Lygus control studies, 2009 (Ellsworth, unpubl. data, 09F3L). Pyrethroids are ineffective on Lygus bugs (e.g., Hero) producing excessively tall and rank plants, because there were no bolls to use the carbohydrates produced. Whitefly resurgences due to natural enemy destruction occur where novaluron (Diamond) or pyrethroid + thiamethoxam mixtures (Endigo) are used, leading to excessive honeydew that interferes with defoliation and lowers lint quality, as well as cotton leaf crumple, a whitefly-vectored disease. Elimination of beneficials by novaluron or acephate use can lead to secondary outbreaks of mites that damage leaves and, under severe pressure, leads to premature defoliation and lowered yields. Repeated use of flonicamid (Carbine sprayed 3 times sequentially) violates resistance management guidelines.

Whitefly Resistance

Transform's role in limiting whitefly population development with another unique mode of action (MoA) may have been key in limiting the expansion of known whitefly resistances to 3 of the 6 MoA available to growers (Fig. 11 & 13). Arizona makes large investments to monitor resistance in whiteflies for research and IRM purposes. For acetamiprid, the primary adulticiding agent for whitefly control in our system, populations that average below 50% mortality in standard adult bioassays conducted at 10 ppm are known to be significantly resistant to this compound (X. Li, pers. comm). This diagnostic measure is very conservative for these determinations. In 2013, the first routine period of use for Transform, 93% of tested populations were below 50%, meaning that they were resistant to acetamiprid. There were many grower complaints about efficacy. However, in 2014 and 2015, these levels of resistance improved substantially. Resistance monitoring was dramatically expanded to over 40 locations statewide in 2015 and 2016. The 2015 levels were the lowest levels of resistance seen in many years, the last year in which Transform was approved for use in cotton. Conversely, resistance levels more than doubled in 2016 when Transform was no longer available for use in Arizona. Having Transform, a new MoA, keep whitefly populations low, reduces the need for use of other whitefly compounds and expands the role for natural enemy conservation that helps control whiteflies. Transform may well be keystone to our whitefly IRM program, which is threatened now by dramatic expansions of resistances (see. Fig. 11, 2015 vs. 2016).

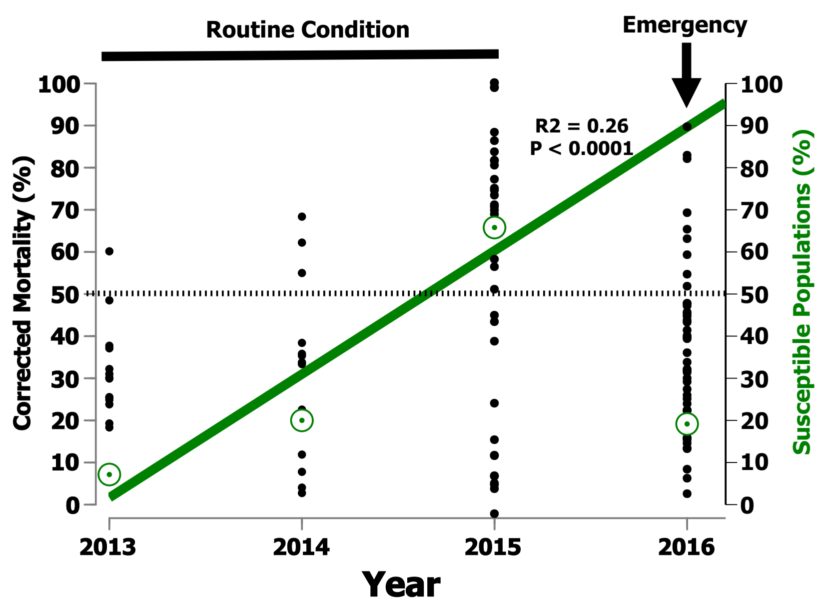

Figure 13. Multi-year results for statewide whitefly resistance monitoring for acetamiprid (at 10 ppm), corrected mortality (%, left axis) and populations that remain susceptible (% of populations above the diagnostic level of 50% mortality, dotted line; right axis, green dots). Susceptibility progressively improved during the routine use period of 2013–2015 ($R^2 = 0.26$; $P < 0.0001$; N = 67), but precipitously declined in 2016 during the emergency period when Transform was no longer available as a unique MoA for whitefly control (19.1% of populations susceptible; N = 47) (2013–2014, X. Li, unpubl. data; 2015–2016, Pier et al., unpubl. data).

Direct Whitefly Control

As already stated, our system is contingent on the key ecosystem service of biological control supplied by existing natural enemies conserved by selective control practices. These "indirect" effects of strategic use of chemical controls cannot be overestimated. However, there are direct insecticidal effects of Transform in the control of whiteflies, too, which make this use pattern unique among whitefly control chemicals (i.e., control of both whiteflies and Lygus bugs).

Transform supplies whitefly suppressive effects that are quite evident in controlled, field experiments. Pest managers do not have the benefit of seeing untreated portions of their fields adjacent to Transform-treated areas. As well, Transform is often deployed at very early stages of whitefly development, "pre-threshold" so to speak, because they are generally addressing the earlier onset of Lygus populations. At these low levels, it is even more challenging to identify the specific effects of Transform on whitefly populations. This is why testing at very high whitefly densities is so instructive.

In 2008, we initiated a trial under extremely challenging conditions of large and rapidly expanding whitefly populations (Fig. 14). In this large trial of commercial and experimental candidates for whitefly control, we tested Transform initially deployed for whitefly control (but also later deployed for Lygus control). Conditions at the start of the trial were already well beyond threshold, which is 3–5 adults per leaf plus 1 live, large nymph per disk in a 30-leaf sample (Ellsworth et al. 2006). Prior to the first spray, there were 15 adults per leaf and 0.7 large nymphs per disk. This put adult populations well above threshold and large nymph populations within the range of the threshold. Moreover, small nymphs per disk (measured for research) is a predictor of subsequent week's large nymph counts and these were at 14 per disk. It was estimated at the time of the trial that initial applications were already 5–7 days late; note, generation time at this time in the season can be as little as 15 days. Transform was compared to all available "fully selective" options for whitefly control [buprofezin (Courier), pyriproxyfen (Knack), spiromesifen (Oberon)] as well as the most popular "partially selective" adulticide, acetamiprid (Intruder).

Because of the complexity of the experimental design, the best head-to-head comparisons can be made at 12 d after the first treatment (DAT) (Fig. 14, left). Transform (at 2.1 oz / A) significantly reduced whitefly population levels comparable to all of the commercial standards, resulting in > 60 and 70% reduction in large nymph and adult levels, respectively. A season-long assessment (Fig. 14, right) confirmed that Transform was able to reduce whitefly populations under these challenging conditions, equivalent to the commercial selective and partially selective standards. Conversely, none of the other treatments are able to control Lygus bugs whatsoever. **Thus, the proposed use pattern for Transform singularly performs in the economic control of Lygus bugs and whiteflies. There is no currently registered, single insecticide that replaces this function so critical to our system, while also conserving the beneficials in the system and contributing positively to whitefly resistance management** (see Fig. 5, where Transform demonstrates complete safety towards our suite of arthropod predators present in our system, and Fig. 13 where Transform use is correlated with extraordinary recovery of acetamiprid susceptibility in whiteflies).

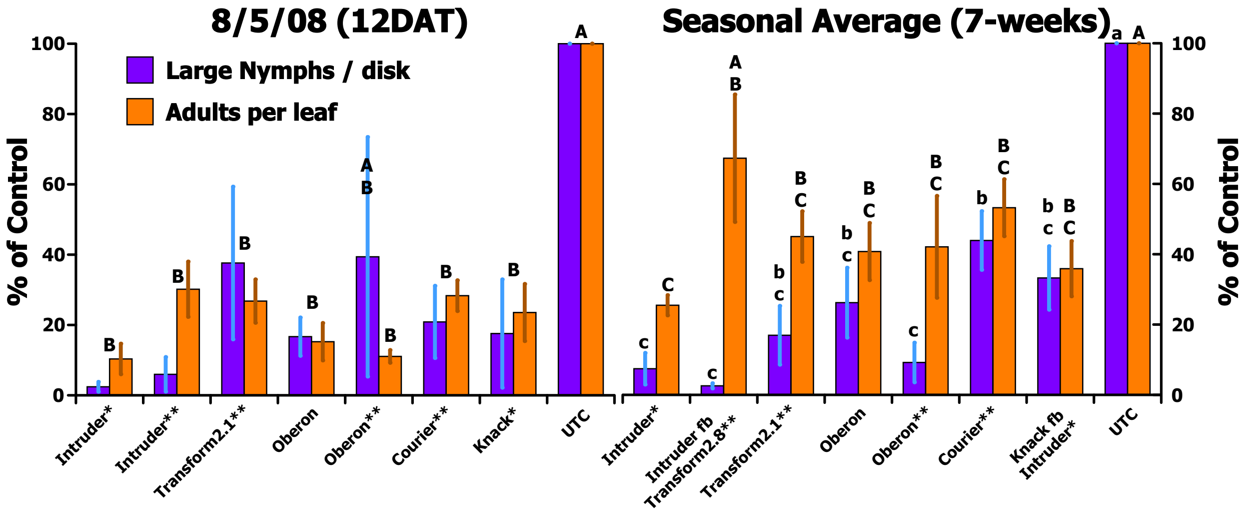

Figure 14. Whitefly efficacy results at 12 days after treatment (DAT) (left) and over the entire season (right) for selective and partially selective control chemistry. Whitefly populations were extremely high: adults averaged 145 adults / leaf and large nymphs averaged 7.9 / disk in the UTC on 8/5/08. The recommended threshold is 3–5 adults / leaf and 1 large nymph / disk. Intruder* (acetamiprid), Oberon (spiromesifen), Oberon**, Courier** (buprofezin), were each sprayed 2 times; Transform2.8, 4 times; Transform2.1**, 5 times. (2008, Ellsworth, unpubl. data); *, 1% Agridex added; **, 0.5% Dyne-Amic + 2.5% UAN added; fb, followed by. Means not sharing a letter are significantly different, Tukey's HSD ($P < 0.05$).

The 2008 experiment is summarized along with 2009 and 2010 whitefly efficacy trials, which were simpler experimental designs where all whitefly control chemistry was sprayed the same number of times and on the same dates (Table 2). Transform significantly reduced egg, small nymph, large nymph, and adult counts relative to the UTC (average over 3 trials and 4 whitefly stages of about 57%), while also controlling Lygus bugs. The comparison whitefly products provided overall 39–87% control of whiteflies, but did nothing to control Lygus bugs.

In summary, Transform use for the control of Lygus bugs without risk of primary pest resurgences or secondary pest outbreaks is well demonstrated by all available data in the Arizona cotton system.

Table 2. Summary of seasonal average control of whiteflies (% control) comparing Transform to standard, fully selective and partially selective chemistries. 2008 was a trial under very high whitefly pressure and initiated 5–7 d after threshold was reached; averages of 7 sampling dates. 2009 was a trial under moderate whitefly pressure; averages of 8 sampling dates. 2010 was a trial with lower whitefly pressure; averages of 6 sampling dates. None of the comparison products had (or have since demonstrated) any efficacy against Lygus bugs.

Year	Product	Rate (lbs ai / A)	No. Sprays	% Egg Control	% Small Nymph Control	% Large Nymph Control	% Adult Control	Average Control (%)
2008	Transform	0.067	5	66	78	83	55	71
2008	Knack fb Intruder	0.54 fb 0.35	1 + 1	50	76	67	64	64
2008	Oberon	0.125	2	70	63	91	58	70
2008	Courier	0.25	2	32	56	56	47	48
2008	Intruder	0.1	2	83	89	93	75	85
2008	UTC-wf	n/a	0	0	0	0	0	0
2009	Intruder	0.1	2	85	82	91	89	87
2009	Oberon	0.125	2	70	75	85	69	75
2009	Transform	0.056	2	53	45	57	54	52
2009	Knack fb Courier	0.054 fb 0.35	2	59	65	56	68	62
2009	UTC-wf	n/a	0	0	0	0	0	0
2010	Intruder	0.1	1	75	80	89	61	76
2010	Venom	0.132	1	62	64	82	56	66
2010	Knack	0.054	1	0	64	53	41	39
2010	Oberon	0.125	1	74	46	71	65	64
2010	Oberon**	0.125	1	68	44	79	45	59
2010	Transform	0.045	1	37	26	41	26	32
2010	Transform	0.067	1	50	36	55	48	47
2010	Transform	0.089	1	47	65	64	40	54
2010	UTC-WF	n/a	0	0	0	0	0	0

Blue-colored numbers denote treatments that are significantly different from the UTC-wf within a year, Dunnett's, $P < 0.05$.

SECTION 166.20(a) 6: DISCUSSION OF RESIDUES FOR FOOD USES

If the proposed use is expected to result in residues of the pesticide in or on food, the application shall list the food likely to contain such residues and shall contain an estimate of the maximum amount of the residue likely to result from the proposed use, together with the information on which such estimates are based.

The anticipated residue levels can be found in previous applications approved for this same use by the EPA. Applications made in accordance with the Arizona cotton Section 18 provisions are not expected to result in combined residues of sulfoxaflor, including its metabolites and degradates, in or on cotton commodities in excess of the following USEPA previously established tolerances in the 40 CFR at §180.668:

Cotton, gin byproducts	6.00 ppm
Cotton, hulls	0.35 ppm

Cottonseed subgroup 20C 0.20 ppm

Sulfoxaflor does not share a common mechanism of toxicity with any other substances, and does not produce a toxic metabolite produced by other substances. Thus, sulfoxaflor does not have a common mechanism of toxicity with other substances.

There is a reasonable certainty that no harm will result to the general population, or to infants and children from aggregate exposure to sulfoxaflor as used in this emergency exemption request. The USEPA has determined that these residue levels are adequate to protect the public health.

SECTION 166.20(a) 7: DISCUSSION OF RISK INFORMATION

The application shall address the potential risks to human health, endangered or threatened species, beneficial organisms, and the environment expected to result from the proposed use, together with references to data and other supporting information.

Table 3. Selectivity or safety on beneficials of insecticides field-tested in the Arizona cotton system. Products are either fully (green), partially (yellow), or non-selective (red). Transform is the only single compound on this list that can control Lygus bugs directly as well as whiteflies. It has the additional, critical benefit of being fully selective to the suite of predators and other beneficials in the Arizona cotton system. **Bolded compounds** are recommended for first use to address pest threat and in rotation with one another. Compounds in parentheses are tentative determinations based on preliminary research results only. Compounds below dotted lines are currently not registered for use in cotton. Adapted from Ellsworth et al. 2011.

Selectivity	Whitefly	Lygus
Full safety to cotton beneficials	**Courier**	**Carbine**
	Knack	**(Transform)**
	Oberon[1]	
	(cyazypyr)	
	(spirotetramat)	
	(Transform[2])	
Partial safety to cotton beneficials	Centric	Belay[2]
	Intruder	
	Oberon[3]	
	Venom	
	(pyrifluquinazon)	
Not selective; broadly toxic	pyrethroid + organophosphate	acephate
	pyrethroid + carbamate	Vydate C-LV

1, at 0.125–0.156 lbs ai / A rate only

2, suppression only; use when treating for Lygus bugs

3, at 0.188–0.25 lbs ai / A rate only

We have done extensive non-target organism testing directly in cotton to establish the full safety of Transform for a suite of more than 20 arthropod predator species (Ellsworth et al. 2011–2012a; Table 3). Also, see Figure 5 and associated text and narrative on results of non-target testing.

The following information was provided in the approved Section 18 application for use of Transform in cotton by Mississippi Department of Agriculture.

Human Health Effects – Michael Hare, Ph.D.
Ecological Effects – David Villarreal, Ph.D.
Environmental Fate – David Villarreal, Ph.D.

Human Health

Toxicological Profile

Sulfoxaflor is a member of a new class of insecticides, the sulfoximines. It is an activator of the nicotinic acetylcholine receptor (nAChR) in insects and, to a lesser degree, mammals. The nervous system and liver are the target organs, resulting in developmental toxicity and hepatotoxicity.

Developmental toxicity was observed in rats only. Sulfoxaflor produced skeletal abnormalities likely resulting from skeletal muscle contraction due to activation of the skeletal muscle nAChR in utero. Contraction of the diaphragm, also related to skeletal muscle nAChR activation, prevented normal breathing in neonates and increased mortality. The skeletal abnormalities occurred at high doses while decreased neonatal survival occurred at slightly lower levels.

Sulfoxaflor and its major metabolites produced liver weight and enzyme changes, and tumors in subchronic, chronic and short-term studies. Hepatotoxicity occurred at lower doses in long-term studies compared to short-term studies.

Reproductive effects included an increase in Leydig cell tumors which were not treatment related due to the lack of dose response, the lack of statistical significance for the combined tumors, and the high background rates for this tumor type in F344 rats. The primary effects on male reproductive organs are secondary to the loss of normal testicular function due to the size of the Leydig Cell adenomas. The secondary effects to the male reproductive organs are also not treatment related. It appears that rats are uniquely sensitive to these developmental effects and are unlikely to be relevant to humans.

Clinical indications of neurotoxicity were observed at the highest dose tested in the acute neurotoxicity study in rats. Decreased motor activity was also observed in the mid- and high-dose groups. Since the neurotoxicity was observed only at a very high dose and many of the effects are not consistent with the perturbation of the nicotinic receptor system, it is unlikely that these effects are due to activation of the nAChR.

Tumors have been observed in rat and mouse studies. In rats, there were significant increases in hepatocellular adenomas in the high-dose males. In mice, there were significant increases in hepatocellular adenomas and carcinomas in high dose males. In female mice, there was an increase in carcinomas at the high dose. Liver tumors in mice were treatment-related. Leydig cell tumors were also observed in the high-dose group of male rats, but were not related to treatment. There was also a significant increase in preputial gland tumors in male rats in the high-dose group. Given that the liver tumors are produced by a non-linear mechanism, the Leydig cell tumors were not treatment-related, and the preputial gland tumors only occurred at the high dose in one sex of one species, the evidence of carcinogenicity was weak.

Ecological Toxicity

Sulfoxaflor (N-[methyloxido[1-[6-(trifluoromethyl)-3-pyridinyl]ethyl]-lambda 4-sulfanylidene]) is a new variety of insecticide as a member of the sulfoxamine subclass of neonicotinoid insecticides. It is considered an agonist of the nicotinic acetylcholine receptor and exhibits excitatory responses including tremors, followed by paralysis and mortality in target insects. Sulfoxaflor consists of two diastereomers in a ratio of approximately 50:50 with each diastereomer consisting of two enantiomers. Sulfoxaflor is systemically distributed in plants when applied. The chemical acts through both contact action and ingestion and provides both rapid knockdown (symptoms are typically observed within 1-2 hours of application) and residual control (generally provides from 7 to 21 days of residual control). Incident reports submitted to EPA since approximately 1994 have been tracked via the Incident Data System. Over the 2012 growing season, a Section 18 emergency use was granted for application of sulfoxaflor to cotton in four states (MS, LA, AR, TN). No incident reports have been received in association with the use of sulfoxaflor in this situation.

Sulfoxaflor is classified as practically non-toxic on an acute exposure basis, with 96-h LC_{50} values of >400 mg a.i./L for all three freshwater fish species tested (bluegill, rainbow trout, and common carp). Mortality was 5% or less at the highest test treatments in each of these studies. Treatment-related sublethal effects included discoloration at the highest treatment concentration (100% of fish at 400 mg a.i./L for bluegill) and fish swimming on the bottom (1 fish at 400 mg a.i./L for rainbow trout). No other treatment-related sublethal effects were reported. For an estuarine/marine sheepshead minnow, sulfoxaflor was also practically non-toxic with an LC_{50} of 288 mg a.i./L. Sublethal effects included loss of equilibrium or lying on the bottom of aquaria at 200 and 400 mg a.i./L. The primary degradate of sulfoxaflor is also classified as practically non-toxic to rainbow trout on an acute exposure basis (96-h LC_{50} >500 mg a.i./L).

Adverse effects from chronic exposure to sulfoxaflor were examined with two fish species (fathead minnow and sheepshead minnow) during early life stage toxicity tests. For fathead minnow, the 30-d NOAEC is 5 mg a.i./L based on a 30% reduction in mean fish weight relative to controls at the next highest concentration (LOAEC=10 mg a.i./L). No statistically significant and/or treatment-related effects were reported for hatching success, fry survival and length. For sheepshead minnow, the 30-d NOAEC is 1.3 mg a.i./L based on a statistically significant reduction in mean length (3% relative to controls) at 2.5 mg a.i./L. No statistically significant and/or treatment-related effects were reported for hatching success, fry survival and mean weight.

The acute toxicity of sulfoxaflor was evaluated for one freshwater invertebrate species, the water flea and two saltwater species (mysid shrimp and Eastern oyster). For the water flea, the 48-h EC_{50} is >400 mg a.i./L, the highest concentration tested. For Eastern oyster, new shell growth was significantly reduced at 120 mg a.i./L (75% reduction relative to control). The 96-h EC_{50} for shell growth is 93 mg a.i./L. No mortality occurred at any test concentration. Mysid shrimp are the most acutely sensitive invertebrate species tested with sulfoxaflor based on water column only exposures, with a 96-h LC_{50} of 0.67 mg a.i./L. The primary degradate of sulfoxaflor is also classified as practically non-toxic to the water flea (EC_{50} >240 mg a.i./L).

The chronic effects of sulfoxaflor to the water flea were determined in a semi-static system over a period of 21 days to nominal concentrations of 6.25, 12.5, 25, 50 and 100 mg a.i./L. Adult mortality, reproduction rate (number of young), length of the surviving adults, and days to first brood were used to determine the toxicity endpoints. No treatment-related effects on adult mortality or adult length were observed. The reproduction rate and days to first brood were significantly ($p<0.05$) different in the 100 mg a.i./L test group (40% reduction in mean number of offspring; 35% increase in time to first brood). No significant effects were observed on survival, growth or reproduction at the lower test concentrations. The 21-day NOAEC and LOAEC were determined to be 50 and 100 mg a.i./L, respectively.

The chronic effects of sulfoxaflor to mysid shrimp were determined in a flow-through system over a period of 28 days to nominal concentrations of 0.063, 0.13, 0.25, 0.50 and 1.0 mg a.i./L. Mortality of parent (F_0) and first generation (F_1), reproduction rate of F_0 (number of young), length of the surviving F_0 and F_1, and days to first brood by F_0 were used to determine the toxicity endpoints. Complete F_0 mortality (100%) was observed at the highest test concentration of 1.0 mg a.i./L within 7 days; no treatment-related effects on F_0/F_1 mortality, F_0 reproduction rate, or F_0/F_1 length were observed at the lower test concentrations. The 28-day NOAEC and LOAEC were determined to be 0.11 mg and 0.25 mg a.i./L, respectively.

Sulfoxaflor exhibited relatively low toxicity to aquatic non-vascular plants. The most sensitive aquatic nonvascular plant is the freshwater diatom with a 96-h EC_{50} of 81.2 mg a.i./L. Similarly, sulfoxaflor was not toxic to the freshwater vascular aquatic plant, *Lemna gibba*, up to the limit amount, as indicated by a 7-d EC_{50} for frond count, dry weight and growth rate of >100 mg a.i./L with no significant adverse effects on these endpoints observed at any treatment concentration.

Based on an acute oral LD_{50} of 676 mg a.i./kg bw for bobwhite quail, sulfoxaflor is considered slightly toxic to birds on an acute oral exposure basis. On a subacute, dietary exposure basis, sulfoxaflor is classified as practically nontoxic to birds, with 5-d LC_{50} values of >5620 mg/kg-diet for mallard ducks and bobwhite quail. The NOAEL from these studies is 5620 mg/kg-diet as no treatment related mortality of sublethal effects were observed at any treatment. Similarly, the primary degradate is classified as practically nontoxic to birds on an acute oral exposure basis with a LD_{50} of >2250 mg a.i./kg bw. In two chronic, avian reproductive toxicity studies, the 20-week NOAELs ranged from 200 mg/kg-diet (mallard, highest concentration tested) to 1000 mg/kg-diet (bobwhite quail, highest concentration tested). No treatment-related adverse effects were observed at any test treatment in these studies.

For bees, sulfoxaflor is classified as very highly toxic with acute oral and contact LD_{50} values of 0.05 and 0.13 μg a.i./bee, respectively, for adult honey bees. For larvae, a 7-d oral LD_{50} of >0.2 μg a.i./bee was determined (45% mortality occurred at the highest treatment of 0.2 μg a.i./bee). The primary metabolite of sulfoxaflor is practically non-toxic to the honey bee. This lack of toxicity is consistent with the cyano-substituted neonicotinoids where similar cleavage of the cyanide group appears to eliminate their insecticidal activity. The acute oral toxicity of sulfoxaflor to adult bumble bees (*Bombus terrestris*) is similar to the honey bee; whereas its acute contact toxicity is about 20X less toxic for the bumble bee. Sulfoxaflor did not demonstrate substantial residual toxicity to honey bees exposed via treated and aged alfalfa (i.e., mortality was <15% at maximum application rates).

At the application rates used (3-67% of US maximum), the direct effects of sulfoxaflor on adult forager bee mortality, flight activity and the occurrence of behavioral abnormalities is relatively short-lived, lasting 3 days or less. Direct effects are considered those that result directly from interception of spray droplets or dermal contact with foliar residues. The direct effect of sulfoxaflor on these measures at the maximum application rate in the US is presently not known. When compared to control hives, the effect of sulfoxaflor on honey bee colony strength when applied at 3-32% of the US maximum proposed rate was not apparent in most cases. When compared to hives prior to pesticide application, sulfoxaflor applied to cotton foliage up to the maximum rate proposed in the US resulted in no discernible decline in mean colony strength by 17 days after the first application. Longer-term results were not available from this study nor were concurrent controls included. For managed bees, the primary exposure routes of concern include direct contact with spray droplets, dermal contact with foliar residues, and ingestion through consumption of contaminated pollen, nectar and associated processed food provisions. Exposure of hive bees via contaminated wax is also possible. Exposure of bees through contaminated drinking water is not expected to be nearly as important as exposure through direct contact or pollen and nectar.

In summary, sulfoxaflor is slightly toxic to practically non-toxic to fish and freshwater water aquatic invertebrates on an acute exposure basis. It is also practically non-toxic to aquatic plants (vascular and non-vascular). Sulfoxaflor is highly toxic to saltwater invertebrates on an acute exposure basis. The high toxicity of sulfoxaflor to mysid shrimp and benthic aquatic insects relative to the water flea is consistent with the toxicity profile of other insecticides with similar MOAs. For birds and mammals, sulfoxaflor is classified as moderately toxic to practically non-toxic on an acute exposure basis. The threshold for chronic toxicity (NOAEL) to birds is 200 ppm and that for mammals is 100 ppm in the diet. Sulfoxaflor did not exhibit deleterious effects to terrestrial plants at or above its proposed maximum application rates.

For bees, sulfoxaflor is classified as very highly toxic. However, if this insecticide is strictly used as directed on the Section 18 supplemental label, no significant adverse effects are expected to wildlife. Of course, standard precautions to avoid drift and runoff to waterways of the state are warranted. As stated on the Section 3 label, risk to managed bees and native pollinators from contact with pesticide spray or residues can be minimized when applications are made before 7 am or after 7 pm or when the temperature is below 55°F at the site of application.

Environmental Fate

Sulfoxaflor is a systemic insecticide which displays translaminar movement when applied to foliage. Movement of sulfoxaflor within the plant follows the direction of water transport within the plant (i.e., xylem mobile) as indicated by phosphor translocation studies in several plants. Sulfoxaflor is characterized by a water solubility ranging from 550 to 1,380 ppm. Sulfoxaflor has a low potential for volatilization from dry and wet surfaces (vapor pressure= 1.9×10^{-8} torr and Henry's Law constant= 1.2×10^{-11} atm m^3 $mole^{-1}$, respectively at 25 °C). Partitioning coefficient of sulfoxaflor from octanol to water (K_{ow} @ 20 C & pH 7= 6; Log K_{ow} = 0.802) suggests low potential for bioaccumulation. No fish bioconcentration study was provided due to the low K_{ow}, but sulfoxaflor is not expected to bioaccumulate in aquatic systems. Furthermore, sulfoxaflor is not expected to partition into the sediment due to low K_{oc} (7-74 mL/g).

Registrants tests indicate that hydrolysis, and both aqueous and soil photolysis are not expected to be important in sulfoxaflor dissipation in the natural environment. In a hydrolysis study, the parent was shown to be stable in acidic/neutral/alkaline sterilized aqueous buffered solutions (pH values of 5, 7 and 9). In addition, parent chemical as well as its major degradate, were shown to degrade relatively slowly by aqueous photolysis in sterile and natural pond water ($t^{½}$= 261 to >1,000 days). Furthermore, sulfoxaflor was stable to photolysis on soil surfaces. Sulfoxaflor is expected to biodegrade rapidly in aerobic soil (half-lives <1 day). Under aerobic aquatic conditions, biodegradation proceeded at a more moderate rate with half-lives ranging from 37 to 88 days. Under anaerobic soil conditions, the parent compound was metabolized with half-lives of 113 to 120 days while under anaerobic aquatic conditions the chemical was more persistent with half-lives of 103 to 382 days. In contrast to its short-lived parent, the major degradate is expected to be more persistent than its parent in aerobic/anaerobic aquatic systems and some aerobic soils. In other soils, less persistence is expected due to mineralization to CO_2 or the formation of other minor degradates.

In field studies, sulfoxaflor has shown similar vulnerability to aerobic bio-degradation in nine out of ten terrestrial field dissipation studies on bare-ground/cropped plots (half-lives were <2 days in nine cropped/bare soils in CA, FL, ND, ON and TX and was 8 days in one bare ground soil in TX). The chemical can be characterized by very high to high mobility (Kf_{oc} ranged from 11-72 mL g^{-1}). Rapid soil degradation is expected to limit chemical amounts that may potentially leach and contaminate ground water. Contamination of groundwater by sulfoxaflor will only be expected when excessive rain occurs within a short period (few days) of multiple applications in vulnerable sandy soils. Contamination of surface water by sulfoxaflor is expected to be mainly related to drift and very little due to run-off. This is because drifted sulfoxaflor that reaches aquatic systems is expected to persist while that reaching the soil system is expected to degrade quickly with slight chance for it to run-off.

When sulfoxaflor is applied foliar on growing crops it is intercepted by the crop canopy. Data presented above appear to indicate that sulfoxaflor enters the plant and is incorporated in the plant foliage with only limited degradation. It appears that this is the main source of the insecticide sulfoxaflor that would kill sap sucking insects. This is because washed-off sulfoxaflor, that reaches the soil system, is expected to degrade.

In summary, sulfoxaflor has a low potential for volatilization from dry and wet surfaces. This chemical is characterized by a relatively higher water solubility. Partitioning coefficient of sulfoxaflor from octanol to water suggests low potential for bioaccumulation in aquatic organisms such as fish. Sulfoxaflor is resistant to hydrolysis and photolysis but transforms quickly in soils. In contrast, sulfoxaflor reaching aquatic systems by drift is expected to degrade rather slowly. Partitioning of sulfoxaflor to air is not expected to be important due to the low vapor pressure and Henry's Law constant for sulfoxaflor. Exposure in surface water results from the drifted parent compound, and only minor amounts are expected to run-off only when rainfall and/or irrigation immediately follow application. The use of this insecticide is not expected to adversely impact ecosystems when used according to the Section 18 label. Of course, caution is needed to prevent exposure to water systems because of toxicity issues to aquatic invertebrates. As stated on the Section 3 label, this product should never be applied directly to water, to areas where surface water is present or to intertidal areas below the mean water mark. Also, the label includes the statement "Do not contaminate water when disposing of equipment rinsate."

The above content in Section 166.20(a)(7): Discussion of Risk Information was, for the most part, prepared by Michael Hare, Ph.D. (Human Health Effects), David Villarreal, Ph.D. (Ecological Effects), and David Villarreal, Ph.D. (Environmental Fate), all with the Texas Department of Agriculture. The parts of the above content in this section, with references to Mississippi, were prepared by MDAC-BPI.

Endangered and Threatened Species in Arizona
No impacts are expected on endangered and threatened species by this very limited use of this insecticide as delineated in the Section 18 application. Sulfoxaflor demonstrates a very favorable ecotoxicity and fate profile as stated above and should not directly impact any protected mammal, fish, avian, or plant species. This product does adversely affect insects and aquatic invertebrates, especially bees, but the limited exposure to these species should not negatively affect endangered and threatened species in Arizona when all applications label precautions are followed and preformed.

SECTION 166.20(a) 8: COORDINATION WITH OTHER STATE/FEDERAL AGENCIES
If the proposed use of the pesticide is likely to be of concern to other Federal or State agencies, the application shall indicate that such agencies have been contacted prior to submission of the application, and any comments received from such agencies shall be submitted to EPA.

The Arizona Department of Game and Fish will receive a copy of this request. Any comments received will be forwarded to the U.S. EPA.

SECTION 166.20(a) 9: ACKNOWLEDGMENT BY REGISTRANT
The application shall contain a statement by the registrants of all pesticide products proposed for use acknowledging that a request has been made to the Agency for use of the pesticide under this section. This acknowledgment shall include a statement of support for the requested use, including the expected availability of adequate quantities of the requested product under the use scenario proposed by the applicant(s); and the status of the registration in regard to the requested use including appropriate petition numbers, or of the registrant's intentions regarding the registration of the use.

Dow AgroScience has been notified of this agency's intent regarding this application and has offered a letter of support (see Appendix IV). They have also provided a copy of a label with the use directions for this use (although this use is dependent upon the approval of this Section 18 by EPA) (see Appendix II).

SECTION 166.20(a) 10: ENFORCEMENT PROGRAM IN ARIZONA

Prior to approval, the applicant shall provide an explanation of the authority of the applicant or related State or Federal agencies for ensuring that use of the pesticide under the proposed exemption would comply with any special requirements imposed by the Agency and a description of the program and procedures for assuring such compliance.

The Arizona Department of Agriculture (ADA) has adequate authority for enforcing provisions of Section 18 emergency exemptions. ADA will require Dow AgroScience to prepare Section 18 labeling that complies with ADA and EPA requirements for this emergency use, if approved, to ensure that product distributed for the exemption is properly labeled. Also, please refer to requirements provided in SECTION 166.20(a) 3vii.

(b) Information required for a specific exemption. An application for a specific exemption shall provide all of the following information, as appropriate, concerning the nature of the emergency:

SECTION 166.20(b) 1: SCIENTIFIC & COMMON NAME OF THE PEST

Lygus hesperus (Knight), western tarnished plant bug

SECTION 166.20(b) 2: DISCUSSION OF EVENTS WHICH BROUGHT ABOUT THE EMERGENCY CONDITION

The emergency condition was brought about directly by the cancellation of all uses of sulfoxaflor in the U.S. Prior to this emergency condition, Arizona had successfully integrated this valuable crop chemistry into its cotton system (2013–2015; Fig. 2–3). Because Transform is the only product with cross-spectrum control of Lygus bugs and whiteflies, our producers were capable for the first time since endosulfan discontinuation to apply a product for Lygus control and get suppression of whiteflies (see Table 3). However, what made our routine condition so ideal was Transform's remarkable safety to beneficials in our system (evidence provided in prior sections of this application). **Shortly after the introduction of Transform into our IPM system, we were finally able to eliminate the last few uses of acephate and other organophosphates and pyrethroids, all broadly toxic and damaging to natural enemy populations.** In contrast, 2016 brought about the emergency condition of relying once again on broad spectrum chemistries.

Given that our cotton arthropod IPM system is driven by two key pests (Lygus bugs and whiteflies), Transform is ideally suited to their control while protecting against any secondary pest outbreaks like mites, aphids, or cotton leafperforator. Arizona has a long history of pest resurgence and secondary pest outbreaks as a result of broad spectrum insecticide use and a very long season to protect. Our history tells this story of a pesticide treadmill that simply was not sustainable (e.g., see the early 1990s spray requirements in Fig. 2). Boll weevil sprays were notoriously broad spectrum and disruptive. After official eradication in 1991, pink bollworm broad spectrum sprays were a major disruption in our system. Pink bollworm was later selectively controlled by Bt cottons (since 1996) and has since been functionally eradicated (since 2008). This reduced our system to the 2-key pest system that we have today, whiteflies and Lygus bugs. Prior to 1996, many Lygus infestations were masked by the frequent sprays that were made for pink bollworm and the newly invasive whitefly. These disruptive sprays (for boll weevil, pink bollworm, whiteflies or Lygus) throughout our history have been well correlated with additional sprays needed for primary pest resurgences and for very costly secondary pest outbreaks (Ellsworth et al. 2012b).

Starting in 1996, once Bt cotton and selective IGRs were available for whitefly control, the only disruptive, broadly toxic sprays in use were against Lygus bugs. Once again, increased spraying for all pests, but especially secondary ones like mites, was the result of broad-spectrum sprays to control Lygus. However, starting in 2006 with the introduction of the highly selective feeding inhibitor, flonicamid, growers finally had one option for effectively and selectively controlling Lygus bugs. The relationship between Lygus sprays and sprays for other secondary pests began to finally break down for the first time in our history (Fig. 15).

However, starting in 2012, broad-spectrum chemistry was re-introduced to our system. This continued into 2013 when Transform was first introduced and before farmers fully integrated its use properly into their system. Secondary problems were once again the result. By 2014, broad spectrum chemistry use was declining once again and Transform was fully integrated into our system (2014–2015). The result was dramatic. Sprays for other secondary pests precipitously declined, despite rather high Lygus pressures and the need to spray for this pest. The relationship between Lygus sprays and secondary pest sprays had once again been decoupled. I.e., Lygus sprays no longer “flared” other problems.

Subsequently 2016 was marked by exceptionally low Lygus levels regionally. This was simply a fortunate event that was driven, in part, by the drought conditions of our region. We hypothesize that had Lygus pressures been more “normal” in 2016, we would have had even greater problems and more sprays for secondary pests because of the return to broad-spectrum chemistries to control Lygus.

In Figure 15, we can actually test our hypothesis. That is, even in our more selective systems of control today, any reliance on broad spectrum insecticides, like when we have to spray for Lygus without Transform, will lead to a pesticide treadmill effect of spraying more for secondary pests. Those broad-spectrum usage years are 2012, 2013 (before full integration of Transform) and 2016 and represent our emergency condition. A significant and highly predictive relationship is shown in Figure 15 between the number of Lygus sprays made statewide and the number of other secondary pest sprays made. Without Transform, this relationship is very tight. With 2014 and 2015 years included (routine condition with Transform fully integrated into our IPM system), the relationship breaks down and is no longer significant. However, from the relationship defined by the emergency condition when broad spectrums are used, we can predict how much more spraying would have been necessary in 2014 and 2015. In fact, an additional 0.61 sprays, on average, for other secondary pests would have been needed in 2014–2015, but for the availability and use of Transform at that time (Fig. 15) — a 57% increase in sprays avoided.

To conclude, the emergency condition was most proximally driven by the withdrawal of Transform from our system. The result of this has been a return to broad spectrum chemistries like acephate and dicrotophos to assist in Lygus control. This destabilizes our system and re-establishes the link between applied Lygus controls and a cascade of costly secondary pest problems. Further, in losing a critical and unique tool to suppress whiteflies while controlling Lygus, we have fueled increased whitefly control costs and losses, Lygus control costs and losses, and contributed to a significant acceleration of resistance in whiteflies to at least two

MoAs. Transform is needed to eliminate the emergency condition, prevent major economic losses to our growers, and restore an arthropod IPM system that is cited as exemplary around the world.

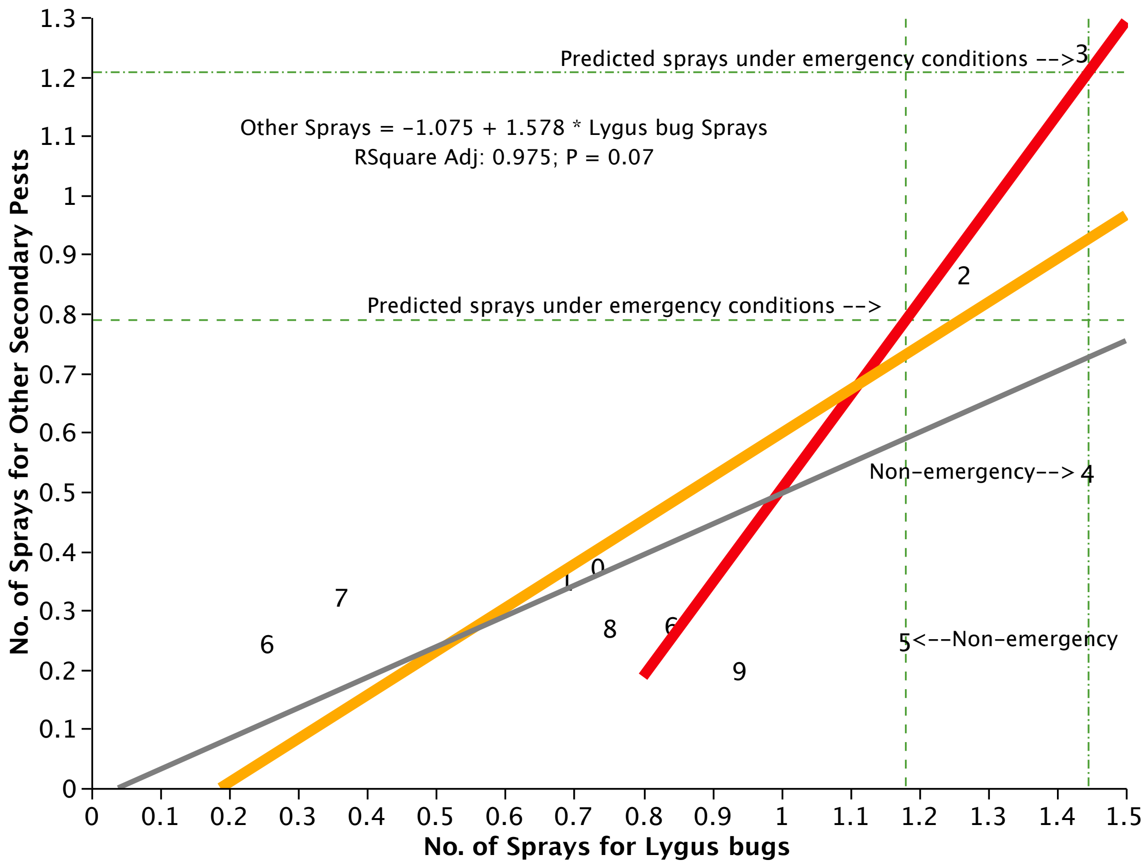

Figure 15. The relationship between statewide average number of Lygus sprays to the number of sprays made on average statewide for other secondary pests is explored through a series of regressions; numbers are the data for each year as the last digit of the year. There is a significant correlation between sprays made for Lygus and other secondary pests, 2006–2016 (gray line, N = 11; R^2 = 0.34; P = 0.03). The predictive nature of the relationship strengthens by excluding the two routine, non-emergency years (2014–2015) (orange line, N = 9; R^2 = 0.57; P = 0.01), highlighting these unique years when we had access to and fully integrated Transform use into our system. However, the most predictive relationship exists when including only years when broad-spectrum chemistry was in use (2012–13, 2016), consistent with the emergency condition (red line, N = 3; R^2 = 0.98; P = 0.07). This strongly suggests that when Transform is not used and broad-spectrum insecticides are used instead, secondary pest problems increase dramatically. And, Transform usage in 2014–2015 likely prevented a statewide average reduction in the sprays of other pests by 0.61 sprays. The savings are even larger for growers who had significant Lygus populations because statewide averages here include many acres either not infested with Lygus or with levels never reaching threshold. Growers, who average 3.5 sprays to control Lygus without Transform but under economic conditions (see Table 1), would be spraying an additional 4.4 times to control secondary pests.

SECTION 166.20(b) 3: DISCUSSION OF ANTICIPATED RISKS TO ENDANGERED OR THREATENED SPECIES, BENEFICIAL ORGANISMS, OR THE ENVIRONMENT REMEDIED BY PROPOSED USE

As previously stated, it is not anticipated that there should be any anticipated risk to endangered or threatened species, beneficial organisms, or the environment if all applications are made in accordance to the section 18 use directions. Also, see Table 2 and Figure 5 and accompanying text describing non-target testing in Arizona cotton.

- See Attachment B – Endangered and Threatened Species List 2014

SECTION 166.20(b) 4: DISCUSSION OF SIGNIFICANT ECONOMIC LOSS

Cotton production provides food, feed and fiber to society. Thus, the productive elements are the cotton lint yield and cottonseed yield. In addition, Arizona is a preferred location due to its favorable growing conditions for the production of planted seed used all over the world. As such, this is another productive element incorporated into our economic analysis (Fig. 16). In addition, there are other productive benefits to our system that are difficult to monetize, including value to our growers in crop rotation, soil health, and ecological and economic diversity. These values have not been estimated. A schema for our approach to Tier 1 and Tier 2 analyses is provided in Figure 16.

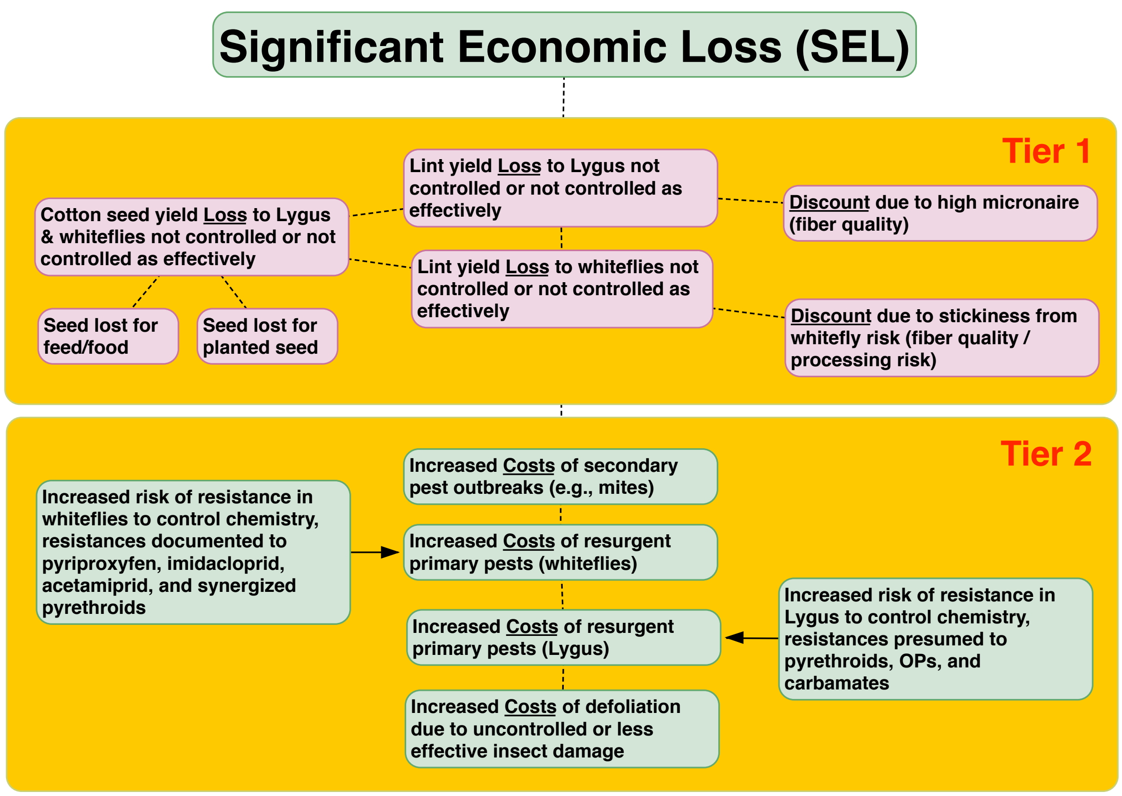

Figure 16. Schema for factors used in the Arizona cotton analysis of Significant Economic Loss for the routine (Transform registered for use in Arizona cotton) and emergency conditions (Transform withdrawn from the market due to regulatory action).

The periods under consideration are qualified as follows. Transform was first registered and used in Arizona cotton in 2013 (Fig. 3). As described in this application, **Transform completed and stabilized an IPM system that depended on its dual action of controlling both Lygus bugs and whiteflies, while also being fully selective and safe to beneficials in our system and providing additional benefits in resistance management for Lygus (as a rotation partner for Carbine, which is limited to 3 uses per season) and for whiteflies (threatened by resistances in 3 of 6 MoA). No other product fulfilled this need then or could fill this need today**. However, broad spectrum chemistry was still being used in cotton in 2013 as Transform was introduced and growers became comfortable with its efficacy on commercial acreage. Thus, 2014 and 2015 are our best baseline years for understanding the routine condition when Transform was registered and functioning in our system as intended (see Fig. 15). In late 2015, Transform use was cancelled in cotton and other crops, creating the emergency conditions experienced in 2016. This year was marked by the return of usage of acephate and other broadly toxic insecticides as a result, despite historically low insect pressures. Conditions over this past winter (2016–2017, ample rainfall in Arizona deserts) have created host material and pest harborages that will likely lead to a return of very high insect pressures, similar in dimension to what was seen in 2005. This makes our emergency condition even more urgent for 2017.

(i) TIER 1 ANALYSIS

Our schema for Significant Economic Loss (Fig. 16) is implemented through a series of calculations summarized in Table 4. The analysis depends on multiple sources of information, both published and unpublished. Much information and inference are drawn from annual cotton pest losses and impact assessment survey information gathered and analyzed annually in Arizona by Ellsworth et al., a signature program of the Western IPM Center (hereafter referenced as AzCPL, year). Some of this is published in the Proceedings of the Beltwide Cotton Conferences as annual summaries prepared by Mike Williams and cooperators each year. In Arizona, we estimate losses for both Bt and non-Bt cottons each year. When possible, all our estimates are based on Bt cotton production, the dominant acreage planted in Arizona. Other sources include the many field studies already reviewed in this application and cotton industry experts. Literature is cited, as appropriate.

Yield Potential (lbs lint/A)
Estimates of what yield would have been without insect presence are estimated each year in the AzCPL process. For 2016, the yield potential for Bt cotton without insect infestation was 1707 lbs / A (AzCPL; see Williams et al. 2017). This is a common estimate for both the routine and emergency condition since insects were not present in either scenario.

Direct yield losses to *Lygus hesperus* (lbs lint/A)
There was 3.6% loss in yield to Lygus for the routine condition, based on those average losses on infested acres in 2014–2015 (AzCPL, 2014–2015; see Williams et al. 2015–2016). For the emergency condition, we estimate from Table 1 that growers would lose, on average and very conservatively, another 15.2% over routine Lygus losses. This estimate comes from efficacy trials on losses experienced relative to Transform treatments for the next, best performing product (Carbine, flonicamid). Losses would in fact be larger because some of these studies used this product over its labeled seasonal limit of 0.267 lbs ai / A and because University resistance management guidelines would suggest rotating MoA each time.

Direct yield losses to *Bemisia tabaci* (lbs lint/A)
Yield losses to whiteflies are unusual, because their management is configured to prevent losses in quality (e.g., sticky cotton) that occur at densities lower than what typically cause yield loss (Ellsworth et al. 2006). There was 0.676% loss in yield to whiteflies for the routine condition, based on those average losses on infested acres in 2014–2015 (AzCPL, 2014–2015; see Williams et al. 2015–2016). For the emergency condition, we cite the dire conditions in whitefly resistance (see Fig. 13–14) and suggest that widespread loss of control of whiteflies due to resistance will produce conditions similar, at least, to the whitefly outbreak year of 2005. There was 3.5% yield loss / infested acre in that year (AzCPL, see Williams et al. 2006).

Direct yield losses to mites (lbs lint/A)
Like with whiteflies, yield losses to mites are unusual in Arizona cotton ever since broad-spectrum chemistries have been reduced in our system. However, without Transform, we have specific evidence to show that broad-spectrum chemistries, like acephate, will have to be used to gain control over Lygus bugs in chronically infested acreages. There was 0.493% loss in yield to mites for the routine condition, based on those average losses on infested acres in 2014–2015 (AzCPL, 2014–2015; see Williams et al. 2015–2016). For the emergency condition, we select 2011 as a year for difficult mite conditions within the last 5 years. There was 1.285% loss / infested acre in that year (AzCPL, see Williams et al. 2012). This is an extremely conservative projection based on recent losses. However, our efficacy data and non-target studies highlight the high risks for large losses possible when acephate or other disrupting chemistries are used (see large losses over Transform treatments in Table 1 for acephate, for example).

Seed cotton yield (tons/A)
In addition to the fiber, cotton growers harvest cotton seed from ginned cotton and market it as a valuable feed supplement to the dairy industry or potentially as food in the form of crushed seed for oil and meal. The majority of cotton acreage in Arizona markets seed to local dairies for incorporation into feed rations. Given the resulting net lint yields after losses annotated above, we can estimate the cotton seed yield based on estimates of ginning efficiencies. We used a very conservative (i.e., low) estimate of seed turnout of 50% for the routine and emergency conditions, even though turnouts would likely be further reduced under the emergency condition.

Market price for cotton seed used for feed ($/ton)
Estimates for recent prices received were obtained through informal grower surveys by Cheryl Goar (Arizona Crop Protection Association, Director) and Paul "Paco" Ollerton (President, Arizona Cotton Growers Association) and are placed conservatively around $260/ton. The price would be the same for both conditions.

Market price for cotton seed used for planted seed ($/ton)
Seed contracts in 2016 were lucrative with premiums paid to growers beyond the value of the lint and the food/feed value of the seed. Furthermore, ca. 70,000 acres were grown under seed contracts in 2016 or just over 60% of all upland cotton acres grown last year (C. Goar, pers. comm.[2]). Of these acres, ca. 19% were rejected due to all causes (seed quality, mechanical

[2] Cheryl Goar, Director, Arizona Crop Protection Association, 480.966.1610

and insect damage, market conditions). With no other data to rely on because it is either not collected or proprietary, we assume 48.6% of Arizona's cotton is marketed successfully as planted seed under the routine condition. Of the 19% rejected, ca. half is rejected for quality reasons that could be related to insect damage (P. Ollerton, pers. comm.). Based on studies of insect damage, especially by Lygus bugs, on seed development (Ellsworth, unpubl. data), we estimate another 10% could be rejected under conditions of elevated insect damage expected under the emergency conditions (i.e., 29% rejection for a net of 42.6% of Arizona's cotton marketed successfully under seed contract).

Estimates for recent prices received were obtained through informal grower and industry surveys by Paul "Paco" Ollerton (President, Arizona Cotton Growers Association) and placed conservatively around $265/ton. The price would be the same for both conditions, as long as additional insect damage under the emergency condition did not contribute to quality reductions in accepted contracts that exceed what is already estimated by rejection rates above.

Market price cotton lint ($/lb)
Cotton is a commodity subject to trends in world production, local supply, fiber quality, distance to market, and many other complex factors. We estimate $0.75/lb as an average price that might be received for the 2017 crop based on a recent forecast by Dr. O.A. Cleveland, Ag Economist, published in Cotton Grower magazine (accessed 3/21/17).

Discount due to stickiness perception & penalty for cotton lint ($/lb)
The presence of "stickiness" in the market has a chilling effect on the price given. After Arizona produced cotton with excess sugars in the 1990s, there were severe penalties imposed on the entire region. Because excess sugars are not measured in any standard way in cotton classing that translates directly into risk of processing issues (i.e., sticky cotton), buyers simply stop buying altogether or give a reduced price to a region with a reputation for having produced sticky cotton. Whiteflies are a major source for excess sugars and risks for sticky cotton (Ellsworth et al. 1999; Hequet et al. 2007). There are no published schedules or list of penalties associated with sticky cotton risk. Therefore, we relied on estimates based on prior episodes that have occurred in this region and summarized in Ellsworth et al. (1999). For an extended review of economic methodologies for estimating the impacts of sticky cotton on the price of cotton, consult Frisvold et al. (2007).

Under the emergency conditions of reduced whitefly control options and rapidly expanding resistances in whiteflies as a result, we estimate an average price erosion of 6.14% or $0.0461/lb (derived from data in Ellsworth et al. 1999). There would be no discount under the routine condition.

Discount due to high micronaire, a fiber quality of cotton ($/lb)
Cotton is classed in federal classing offices and assigned values for a wide array of fiber parameters including micronaire. Micronaire is an indirect measure of fiber fineness or thickness. High and low micronaire values are subject to a published system of discounts.

Micronaire is impacted by various plant, boll, and fiber developmental parameters. However, anything that disrupts the carbohydrate balance between sources and sinks for those carbohydrates can alter micronaire characteristics. Lygus damage results in gaps in fruiting that contribute to important changes in micronaire (see Fig. 8). Most frequently, these gaps result in carbohydrates being shunted to the fewer remaining fruiting sites, leading to "over-ripening" of the bolls and the fibers within (Ellsworth, unpubl. data). This leads to elevated micronaire levels, which given identical environmental conditions is otherwise controlled by variety.

Under the last routine conditions of 2015 (including varieties grown), 20.7% of the marketed crop was subject to high micronaire discounts (AMS 2016). For fiber ≥ 5.0 micronaire, there was a 2.3¢ / lb discount; in 2015, 18.9% of the crop was subject to this discount. As well, there is a 3.75¢ / lb discount for micronaire ≥ 5.3; 1.8% of the 2015 crop received this discount.

Under the emergency conditions of reduced Lygus control options and lost yield (i.e., fruiting gaps in the plant), we estimate that about half of the cotton infested with Lygus and treated for this pest would be subject to high micronaire discounts. This nets about 42.5% of all acres distributed as 38% receiving a 2.3¢ / lb discount and 4.5% receiving a 3.75¢ / lb discount. This nets a reduction of $0.005/lb discount under routine conditions and a $0.0104 discount under emergency conditions.

After all discounts, cotton lint under routine conditions would be priced at $0.74/lb and under emergency conditions would be priced at $0.69/lb.

Gross Revenue (GR), lint value + cotton seed value ($/A)
Cotton growers under routine conditions (similar to 2014–2015) would have gross revenue of $1662 / A. Under emergency conditions (similar to 2016 and projecting to 2017 without Transform), cotton growers would receive 24.7% less than under routine conditions or $1252/A.

This Tier 1 analysis demonstrates with wide margins that our growers are subject to ≥20% losses under emergency conditions. While this should be sufficient to support approval of this Section 18 exemption, we have generated information and data for a Tier 2 analysis as well.

(ii) TIER 2 ANALYSIS

We do not believe a Tier 2 analysis is necessary to support our request for this Section 18 exemption. However, we offer the following analysis as additional evidence of the emergency conditions growers are under and of the SEL they are suffering as a result (i.e., $410 / A lost, based on the Tier 1 analysis) (Table 4).

Cost increase to cover additional costs required to control secondary outbreaks ($/A)
We estimated the amount on average that growers under emergency conditions would lose without Transform available to them for control of Lygus and the cascading effect this has on increased spraying needed to control secondary pests (see Fig. 15 for details). On average and very conservatively, our growers would have to spray for mites and other secondary pests 0.61 more times (derived from AzCPL 2006–2016). Given that the average cost of a mite application is $33.41 / A in Arizona cotton (AzCPL, 2016; see Williams et al. 2017), we

estimate this additional cost to be $20.38 / A. This cost is above and beyond costs to control secondary pests under routine conditions.

Cost increase to cover additional costs required to control resurgent whiteflies ($/A)
When broad spectrums are deployed for Lygus control because Transform is not available, whiteflies resurge and require additional control measures that are not required under the routine condition. From detailed experiments conducted in 2015 (Brown et al. 2016, in prep.), we estimate conservatively that an additional 0.5 sprays would be needed to overcome resurgent whiteflies or $15 / A.

Cost increase to cover additional costs required to control resurgent Lygus bugs ($/A)
When certain non-selective chemicals (e.g., novaluron or clothianidin) are deployed for Lygus control because Transform is not available, Lygus bugs can resurge and require additional control measures that are not required under the routine condition. Data are difficult to obtain on this question. However, from Table 1, we know that Transform was sprayed on average 3.5 times, whereas either novaluron or clothianidin were sprayed on average 4.07 or 0.5 times more than the Transform regime. Clothianidin or novaluron are known to contribute to resurgence of both Lygus and whiteflies, the latter already estimated in the previous section as 0.5 extra sprays. We estimate by subtraction and additional 0.07 extra sprays specifically to address resurgent Lygus bugs when Transform is not available under emergency conditions. The average cost of a Lygus spray in 2016 was $21.572 / A, resulting in an additional cost of $1.51 / A. This is likely a significant underestimate of this cost.

Cost increase to cover additional defoliation costs due to less effective insect control ($/A)
Several insects can damage cotton in a way that interferes with or prevents efficient chemical defoliation. Lygus damage causes fruiting gaps, redistributing carbohydrate reserves into stem and leaf growth. This increases the density of the canopy and slows maturity of the crop (see Fig. 8). Whiteflies deposit honeydew on leaves that then host the growth of the sooty mold fungal complex. These sugars and microbial growth interfere with efficient uptake of defoliating chemicals. Mite feeding on leaves can cause conditions of interference with uniform defoliation.

Efficient growers endeavor to accomplish complete defoliation with 1 chemical application. We estimate that approximately 60% of acres would be impacted by less effective insect controls that would contribute to the need for an additional defoliation. Local estimates of the costs of defoliation chemicals (R. Noon, pers. comm.[3]) plus ground application costs in 2016 (AzCPL 2016; Williams et al. 2017) were a high of $42.91 and a low of $20.12, averaging $31.52. At 60% acres impacted, the net increased cost would be $18.91 / A.

[3] Russell Noon, Certified Applicator & Assistant in Research, Pesticide Management, University of Arizona, 520.709.5466

Table 4. Tier 1 & Tier 2 analysis of Significant Economic Loss for the routine and emergency condition of this Section 18 application. Both Tier 1 & 2 are over 20%.

Item	Routine	Emergency	Comments	Tier
Yield Potential (w/o Insects) (lbs lint / A)	1707	1707	Based on most recent 2016 Arizona Cotton Pest Losses survey (AzCPL), see Williams et al. 2017	
Loss to Lygus hesperus / resurgent L. hesperus (lbs lint / A)	61	321	3.60% (AzCPL, 2014-15, infested acres) vs. Minus an additional 15.2%, from conservative projection from efficacy studies using only flonicamid (Carbine), Ellsworth, unpubl.	
Loss to Bemisia tabaci / resurgent B. tabaci (lbs lint / A)	12	60	0.676% vs. 3.5% CPL survey (on infested acres), from AzCPL surveys (2014-15/2005)	
Loss to mites / resurgent mites (lbs lint / A)	8	22	0.493% (AzCPL, 2014-15 on infested acres) vs. 1.28% (AzCPL, 2011), from efficacy studies & NTO studies, Ellsworth, unpubl.	
Harvested Yield (lbs lint / A)	1626	1304	**19.76%**	
Seed cotton yield (tons/A)	1.16	0.93	Based on conservative seed turnout of 50% (and lint turnout of 35%); actual turnouts would be even lower under emergency conditions due to associated Lygus damage	
Market price per ton ($/ton) for feed/food uses	$ 260	$ 260	Source: Cheryl Goar, pers. comm. (AzCPA) from grower survey & Paco Ollerton, Pres. ACGA and cotton grower	
Market price per ton ($/ton) for planted seed contracts	$ 265	$ 265	Source: Paco Ollerton, Pres. ACGA and cotton grower	
Revenue, planted cotton seed ($/A)	$ 451	$ 347	Ca. 60% of acreage under contract; 19% rejection rate due to all causes; est. -10% due to insect damage under emergency conditions	
Market price per lb of lint ($/lb)	$ 0.75	0.75*	From recent forecast (3/21/17) by Dr. O.A. Cleveland, Cotton Grower magazine	
*Discount due to stickiness perception & penalty ($/lb)	$ -	$ 0.0461	Based on average historical market penalty from Ellsworth et al. 1999, 6.14%	
*Discount due to high micronaire cotton ($/lb); A 2.3¢ discount applied in 2016 to cotton ≥5.0-5.2 micronaire and 3.75¢ discount ≥5.3 mic.	$ 0.0050	$ 0.0104	Estimate that 50% of infested & treated cotton damaged by Lygus results in high micronaire, ~42.5% distributed as 38% & 4.5% vs. 20.7% distributed as 18.9% & 1.8% (2015; AMS, 2016) (≥5.0 & ≥5.3 mic, respectively)	
Net market price per lb of lint ($/lb)	$ 0.74	$ 0.69		
Revenue, lint cotton ($/lb)	$ 1,211	$ 905		
Gross Revenue (GR), lint + cotton seed ($/A)	$ 1,662	$ 1,252	**24.69%**	**Tier 1 is ≥ 20%**
Loss of GR = Routine GR - Emergency GR		$ 410		
Cost Increase (of additional costs required to control secondary outbreaks of pests, e.g., mites, $/A)		$ 20.38	Additional 0.61 sprays for mites and other secondary pests at $33.41/application (or, $20.38) (from AzCPL)	
Cost Increase (of additional costs required to control resurgent primary pests, whiteflies, $/A)		$ 15.00	Cost of using broad spectrum control chemicals, e.g., acephate, for Lygus control; From Brown et al. 2016: International Congress of Entomology presented paper & unpubl. data; 0.5 sprays or $15/A	
Cost Increase (of additional costs required to control resurgent primary pests, Lygus $/A)		$ 1.51	Cost of using broad spectrum control chemicals, e.g., novaluron or clothiandin for Lygus control; Table 1, Ellsworth, unpubl. data; 0.07 sprays, $21.57/Lygus application or $1.51/A	
Cost Increase (of additional defoliation due to less than optimal Lygus control & additional mite and whitefly damage, $/A)		$ 18.91	Additional damage by Lygus creates gaps in boll distributions, increases vegetative growth, & disrupts carbohydrate balance; whitefly damage/honeydew decreases absorption of defoliants; mite damages leaf quality reducing absorption; 60% * $31.52 / app.	
Total Loss = Loss of GR + Cost Increase		$ 466	**28.04%**	**Tier 2 is ≥ 20%**

(iii) TIER 3 ANALYSIS

n/a

(iv) Any other information explaining the economic consequences of the emergency

SUMMARY

Sulfoxaflor had been central to our system's recovery of stability because of its selective control of Lygus bugs. Shortly after the introduction of Transform into our IPM system, we were finally able to eliminate the last few uses of acephate and other organophosphates and pyrethroids, all broadly toxic and damaging to natural enemy populations. Transform completed and stabilized an IPM system that depended on its dual action of controlling both Lygus bugs and whiteflies, while also being fully selective and safe to beneficials in our system and providing additional benefits in resistance management for Lygus (as a rotation partner for Carbine, which is limited to 3 uses per season) and for whiteflies (threatened by resistances in 3 of 6 MoA). No other product fulfilled these needs then or could fill these needs today.

Cancellation of Transform use in Arizona cotton has created an emergency condition. Other chemistries available for the purpose requested under this section 18 are absent, and available alternatives are insufficient to overcome the emergency condition. Transform uniquely controls Lygus and suppresses whiteflies while selectively conserving biological controls to help control these target pests and to prevent costly secondary pest outbreaks. There is no currently registered, single insecticide that replaces this function so critical to our system, while also conserving the beneficials in the system and contributing positively to whitefly resistance management. Thus, the proposed use pattern for Transform singularly performs in the economic control of Lygus bugs and whiteflies.

A Significant Economic Loss has been amply demonstrated by using very conservative estimates of the losses associated with the emergency condition. Arizona has therefore met or exceeded all criteria set forth by US-EPA for granting a specific Section 18 emergency exemption. Under Tier 1 analysis, we have demonstrated 24.7% loss to our growers under the emergency condition. Losses grow to 28% in a Tier 2 analysis. Neither analysis attempts to estimate the additional economic value that Transform use in our system provides us in crop rotation, soil health, and ecological and economic diversity. Since Transform was in fact registered for this use pattern previously in Arizona cotton, growers and the Arizona IPM system have already shown major benefits by Transform's availability. Our data presented here further show that Arizona producers will benefit greatly again both in terms of gross revenue and increased yield protection and environmental protection under this proposed Section 18. During the 3-year period that Transform was used in Arizona cotton, there have been no reported bee incidents associated with this product. In fact, Transform has been instrumental in returning stability to our system that was re-starting the use of broad-spectrum insecticides. Transform has contributed to measureable gains in biodiversity and conservation biological control, which is central to our arthropod IPM system (Fig. 1). Along with other progressively installed selective technologies, Transform has become one of the foundational products in our cotton IPM program.

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APPENDIX I: Federal Label

Specimen Label

Dow AgroSciences

Transform® WG

INSECTICIDE

ISOCLAST™ ACTIVE

®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For control or suppression of aphids, fleahoppers, plant bugs, stink bugs, whiteflies and certain psyllids, scales, and thrips on: canola (rapeseed) (subgroup 20A), root and tuber vegetables (crop groups 1A and 1B), potatoes (crop groups 1C and 1D), succulent, edible podded, and dry beans, triticale, and wheat.

Group	4C	INSECTICIDE

Active Ingredient:
sulfoxaflor 50%
Other Ingredients.......... 50%
Total 100%

Contains 50% active ingredient on a weight basis.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
If swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

Precautionary Statements

Hazard to Humans and Domestic Animals

EPA Reg. No. 62719-625

DANGER

Corrosive. Causes Irreversible Eye Damage • Harmful If Swallowed

Do not get in eyes or on clothing.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:
- Long-sleeved shirt and long pants
- Shoes plus socks
- Protective eyewear

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations

Users should:
- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Environmental Hazards

Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation. Read all Directions for Use carefully before applying.

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 24 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:
- Coveralls
- Shoes plus socks

Storage and Disposal

Do not contaminate water, food or feed by storage or disposal.
Pesticide Storage: Store in original container only.
Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Nonrefillable rigid containers 5 gallons or less:
Container Handling: Nonrefillable container. Do not reuse or refill this container.
Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Nonrefillable nonrigid containers:
Container Handling: Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment. Then offer for recycling if available, or dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Refillable rigid containers larger than 5 gal:
Container Handling: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate

Storage and Disposal (Cont.)

vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Nonrefillable rigid containers larger than 5 gal:
Container Handling: Nonrefillable container. Do not reuse or refill this container.
Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times.

Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

Product Information

Carefully read, understand and follow label use rates and restrictions. Apply the amount specified in the following tables with properly calibrated aerial or ground spray equipment. Prepare only the amount of spray solution required to treat the measured acreage. The low rates may be used for light infestations of the target pests and the higher rates for moderate to heavy infestations. Transform® WG insecticide may be applied in either dilute or concentrate sprays so long as the application equipment is calibrated and adjusted to deliver thorough, uniform coverage. Use the specified amount of Transform WG per acre regardless of the spray volume used.

Use Precautions

Integrated Pest Management (IPM) Programs
Transform WG is recommended for IPM programs in labeled crops. Apply Transform WG when field scouting indicates target pest densities have reached the economic threshold, i.e., the point at which the insect population must be reduced to avoid economic losses beyond the cost of control. Other than reducing the target pest species as a food source, Transform WG does not have a significant impact on most parasitic insects or the natural predaceous arthropod complex in treated crops, including big-eyed bugs, ladybird beetles, flower bugs, lacewings, minute pirate bugs, damsel bugs, assassin bugs, predatory mites or spiders. The feeding activities of these beneficials will aid in natural control of other insects and reduce the likelihood of secondary pest outbreaks. If Transform WG is tank mixed with any insecticide that reduces its selectivity in preserving beneficial predatory insects, the full benefit of Transform WG in an IPM program may be reduced.

Insecticide Resistance Management (IRM)
Transform WG contains a Group 4C insecticide. Insect biotypes with acquired resistance to Group 4C insecticides may eventually dominate the insect population if Group 4C insecticides are used repeatedly in the same field or area, or in successive years as the primary method of control for targeted species. This may result in partial or total loss of control of those species by Transform WG or other Group 4C insecticides.

To delay development of insecticide resistance, the following practices are recommended:

- Avoid consecutive use of insecticides on succeeding generations with the same mode of action (same insecticide subgroup, 4C) on the same insect species.
- Consider tank mixtures or premix products containing insecticides with different modes of action (different insecticide groups) provided the products are registered for the intended use.
- Base insecticide use upon comprehensive IPM programs.
- Monitor treated insect populations in the field for loss of effectiveness.
- Do not treat seedling plants grown for transplant in greenhouses, shade houses, or field plots.
- Contact your local extension specialist, certified crop advisor, and/or manufacturer for insecticide resistance management and/or IPM recommendations for the specific site and resistant pest problems.
- For further information or to report suspected resistance, you may contact Dow AgroSciences by calling 800-258-3033.

Mixing Directions

Application Rate Reference Table

Application Rate of Transform WG (oz/acre)	Active Ingredient Equivalent (lb ai/acre)
0.75	0.023
1	0.031
1.5	0.047
1.75	0.055
2.25	0.071
2.75	0.086

Transform WG – Alone
Fill the spray tank with water to about 1/2 of the required spray volume. Start agitation and add the required amount of Transform WG. Continue agitation while mixing and filling the spray tank to the required spray volume. Maintain sufficient agitation during application to ensure uniformity of the spray mix. Do not allow water or spray mixture to back-siphon into the water source.

Transform WG - Tank Mix
When tank mixing Transform WG with other materials, conduct compatibility test (jar test) using relative proportions of the tank mix ingredients prior to mixing ingredients in the spray tank. If foliar fertilizers are used, the jar test should be repeated with each batch of fertilizer utilizing the mixing water source. Vigorous, continuous agitation during mixing, filling and throughout application is required for all tank mixes. Sparger pipe agitators generally provide the most effective agitation in spray tanks. To prevent foaming in the spray tank, avoid stirring or splashing air into the spray mixture.

Tank Mixing Restrictions:
DO NOT TANK MIX ANY PESTICIDE PRODUCT WITH TRANSFORM without first referring to the following website: isoclasttankmix.com

- This website contains a list of active ingredients that are currently prohibited from use in tank mixture with this product. Only use products in tank mixture with this product that: 1) are registered for the intended use site, application method and timing; 2) are not prohibited for tank mixing by the label of the tank mix product; and 3) do not contain one of the prohibited active ingredients listed on isoclasttankmix.com website.
- Applicators and other handlers (mixers) must access the website within one week prior to application in order to comply with the most up-to-date information on tank mix partners.
- Do not exceed specified application rates for respective products or maximum allowable Application rates for any active ingredient in the tank mix.
- It is the pesticide user's responsibility to ensure that all products in the mixtures are registered for the intended use. Users must follow the most restrictive directions and precautionary language of the products in the mixture (for example, first aid from one product, spray drift management from another).

Mixing Order for Tank Mixes: Fill the spray tank with water to 1/4 to 1/3 of the required spray volume. Start agitation. Add different formulation types in the order indicated below, allowing time for complete dispersion and mixing after addition of each product. Allow extra dispersion and mixing time for dry flowable products.

Add different formulation types in the following order:
1. Transform WG and other water dispersible granules
2. Wettable powders
3. Suspension concentrates and other liquids

Maintain agitation and fill spray tank to 3/4 of total spray volume. Then add:
4. Emulsifiable concentrates and water-based solutions
5. Spray adjuvants, surfactants and oils
6. Foliar fertilizers

Finish filling the spray tank. Maintain continuous agitation during mixing, final filling and throughout application. If spraying and agitation must be stopped before the spray tank is empty, the materials may settle to the bottom. Settled materials must be resuspended before spraying is resumed. A sparger agitator is particularly useful for this purpose.

Premixing: Dry and flowable formulations may be premixed with water (slurried) and added to the spray tank through a 20 to 35 mesh screen. This procedure assures good initial dispersion of these formulation types.

Application Directions

Not for Residential Use

Do not apply Transform WG in greenhouses or other enclosed structures used for growing crops.

Proper application techniques help ensure thorough spray coverage and correct dosage for optimum insect control. Apply Transform WG as a foliar spray at the rate indicated for target pest. The following directions are provided for ground and aerial application of Transform WG. Attention should be given to sprayer speed and calibration, wind speed, and foliar canopy to ensure adequate spray coverage.

Spray Drift Management

Wind: To reduce off-target drift and achieve maximum performance, apply when wind velocity favors on-target product deposition (approximately 3-10 mph). Do not apply when wind speed exceeds 10 mph as uneven spray coverage and drift may result.

Temperature Inversions: Do not make ground or aerial applications during a temperature inversion. Temperature inversions are characterized by stable air and increasing temperatures with height above the ground. Mist or fog may indicate the presence of an inversion in humid areas. The applicator may detect the presence of an inversion by producing smoke and observing a smoke layer near the ground surface.

Droplet Size: Use only medium or coarser spray nozzles (for ground and non-ULV aerial application) according to ASABE (S-572.1) definition for standard nozzles. In conditions of low humidity and high temperatures, applicators should use a coarser droplet size except where indicated for specific crops.

Ground Application

To prevent drift from groundboom applications, apply using a nozzle height of no more than 4 feet above the ground or crop canopy. Shut off the sprayer when turning at row ends. Risk of exposure to sensitive aquatic areas can be reduced by avoiding applications when wind directions are toward the aquatic area.

Row Crop Application

Use calibrated power-operated ground spray equipment capable of providing uniform coverage of the target crop. Orient the boom and nozzles to obtain uniform crop coverage. Use a minimum of 5 to 10 gallons per acre, increasing volume with crop size and/or pest pressure. Use hollow cone, twin jet flat fan nozzles or other atomizer suitable for insecticide spraying to provide a fine to coarse spray quality (per ASABE S-572.1, see nozzle catalogs). Under certain conditions, drop nozzles may be required to obtain complete coverage of plant surfaces. Follow manufacturer's specifications for ideal nozzle spacing and spray pressure. Minimize boom height to optimize uniformity of coverage and maximize deposition (optimize on-target deposition) to reduce drift.

Orchard/Grove Spraying Application

Dilute Spray Application: This application method is based upon the premise that all plant parts are thoroughly wetted, to the point of runoff, with spray solution. To determine the number of gallons of dilute spray required per acre, contact your state agricultural experiment station, certified pest control advisor, or extension specialist for assistance.

Concentrate Spray Application: This application method is based upon the premise that all the plant parts are uniformly covered with spray solution but not to the point of runoff as with a dilute spray. Instead, a lower spray volume is used to deliver the same application rate per acre as used for the dilute spray.

Aerial Application

Apply in a minimum spray volume of 3 gallons per acre. Mount the spray boom on the aircraft so as to minimize drift caused by wing tip or rotor vortices. Use the minimum practical boom length and do not exceed 75% of the wing span or 80% of the rotor diameter. Flight speed and nozzle orientation must be considered in determining droplet size. Spray must be released at the lowest height consistent with pest control and flight safety. Do not release spray at a height greater than 10 feet above the crop canopy unless a greater height is required for aircraft safety. When applications are made with a crosswind, the swath will be displaced downwind. The applicator must compensate for this displacement at the downwind edge of the application area by adjusting the path of the aircraft upwind. Do not apply when wind speed exceeds 10 mph.

Spray Adjuvants

The addition of agricultural adjuvants to sprays of Transform WG may improve initial spray deposits, redistribution and weatherability. Select adjuvants that are recommended and registered for your specific use pattern and follow their use directions. When an adjuvant is to be used with this product, Dow AgroSciences recommends the use of a Chemical Producers and Distributors Association certified adjuvant. Always add adjuvants last in the mixing process.

Chemigation Application

Transform WG may be applied through properly equipped chemigation systems for insect control in potatoes. Do not apply Transform WG by chemigation to other crops unless otherwise specified by a state-specific 24(c) label.

Use Directions for Chemigation: Transform WG may be applied through overhead sprinkler irrigation systems that will apply water uniformly, including center pivot, lateral move, end tow, side (wheel) roll, traveler, solid set, micro sprinkler, or hand move. Do not apply this product through any other type of irrigation system. Sprinkler systems that deliver a low coefficient of uniformity such as certain water drive units are not recommended.

For continuously moving systems, the mixture containing Transform WG must be injected continuously and uniformly into the irrigation water line as the sprinkler is moving. If continuously moving irrigation equipment is used, apply in no more than 0.25 inch of water. For irrigation systems that do not move during operation, apply in no more than 0.25 inch of irrigation immediately before the end of the irrigation cycle.

Chemigation Preparation: The following use directions are to be followed when this product is applied through irrigation systems. Thoroughly clean the chemigation system and tank of any fertilizer or chemical residues, and dispose of the residues according to state and federal laws. Flush the injection system with soap or a cleaning agent and water. Determine the amount of Transform WG needed to cover the desired acreage. Mix according to instructions in the Mixing Directions section above. Continually agitate the mixture during mixing and application.

Chemigation Equipment Calibration: In order to calibrate the irrigation system and injector to apply the mixture containing Transform WG, determine the following: 1) Calculate the number of acres irrigated by the system; 2) Calculate the amount of product required and premix; 3) Determine the irrigation rate and determine the number of minutes for the system to cover the intended treatment area; 4) Calculate the total gallons of insecticide mixture needed to cover the desired acreage. Divide the total gallons of insecticide mixture needed by the number of minutes (minus time to flush out) to cover the treatment area. This value equals the gallons per minute output that the injector or eductor must deliver. Convert the gallons per minute to milliliters or ounces per minute if needed. Calibrate the injector system with the system in operation at the desired irrigation rate. It is suggested that the injection pump/system be calibrated at least twice before operation, and the system should be monitored during operation.

Chemigation Operation: Start the water pump and irrigation system, and let the system achieve the desired pressure and speed before starting the injector. Check for leaks and uniformity and make repairs before any chemigation takes place. Start the injection system and calibrate according to manufacturer's specifications. This procedure is necessary to deliver the desired rate per acre in a uniform manner. When the application is finished, allow the entire irrigation and injection system to be thoroughly flushed clean before stopping the system.

Chemigation Restrictions:

- Lack of effectiveness or illegal pesticide residues in the crop can result from non-uniform distribution of treated water.
- If you have questions about calibration, contact state extension service specialists, equipment manufacturers or other experts.
- Do not connect an irrigation system used for pesticide application (including greenhouse systems) to a public water system unless the pesticide label-prescribed safety devices for public water systems are in place with current certification. Specific local regulations may apply and must be followed.
- A person knowledgeable of the chemigation system and responsible for its operation, or under the supervision of the responsible person, shall operate the system and make necessary adjustments should the need arise and continuously monitor the injection.
- Do not apply when wind speed favors drift beyond the area intended for treatment. End guns must be turned off during the application if they irrigate nontarget areas.
- Do not allow irrigation water to collect or run off and pose a hazard to livestock, wells, or adjoining crops.
- Do not enter treated area during the reentry interval specified in the Agricultural Use Requirements section of this label unless required PPE is worn.
- Do not apply through sprinkler systems that deliver a low coefficient of uniformity such as certain water drive units.

Chemigation Specific Equipment Requirements:

- The system must contain an air gap or approved backflow prevention device, or approved functional check valve, vacuum relief valve (including inspection port), and low-pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from back flow. Refer to the American Society of Agricultural Engineer's Engineering Practice 409 for more information or state specific regulations.
- The pesticide injection line must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection chemical supply.

- A pesticide injection pump must also contain a functional interlock, e.g., mechanical or electrical to shut off chemical supply when the irrigation system is either automatically or manually shut down.
- The system must contain functional interlocking controls to automatically shut off the pesticide injection when the water pressure drops too low or water flow stops.
- Use of public water supply requires approval of a backflow prevention device or air gap (preferred) by both state and local authorities.
- Systems must use a metering device, such as a positive displacement injection pump (or flow meter on eductor) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock. An electric powered pump must meet Section 675 for "Electrically Driven or Controlled Irrigation Machines" NEC 70.
- To insure uniform mixing of the insecticide in the water line, inject the mixture in the center of the pipe diameter or just ahead of an elbow or tee in the irrigation line so that the turbulence created at those points will assist in mixing. The injection point must be located after all backflow prevention devices on the water line.
- The tank holding the insecticide mixture should be free of rust, fertilizer, sediment, and foreign material, and equipped with an in-line strainer situated between the tank and the injection point.

Rotational Crop Restrictions

The following rotational crops may be planted at intervals defined below following the final application of Transform WG at specified rates for a registered use.

Crop	Re-Planting Interval
Barley, triticale, wheat, canola (rapeseed) (subgroup 20A), potatoes (crop group 1C and 1D), root and tuber vegetables (crop group 1A and 1B), succulent, edible podded and dry beans.	no restrictions
all other crops grown for food or feed	30 days

Use Directions

Barley, Triticale and Wheat

Pests and Application Rates:

Pests	Transform WG (oz/acre)
Aphids, including Russian wheat aphid andgreenbug	0.75 – 1.5 (0.023 – 0.047 lb ai/acre)

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, certified crop advisor or state agricultural experiment station for any additional local use recommendations for your area.

Application Rate: Use a higher rate in the rate range for heavy pest populations.

Restrictions:
- **Preharvest Interval:** Do not apply within 14 days of grain or straw harvest or within 7 days of grazing, or forage, fodder, or hay harvest.
- **Minimum Treatment Interval:** Do not make applications less than 14 days apart.
- Do not make more than two applications per crop.
- Do not apply more than a total of 2.8 oz of Transform WG (0.09 lb ai of sulfoxaflor) per acre per year.
- If blooming vegetation is present 12 feet out from the downwind edge of the field, a downwind 12-foot on-field buffer must be observed.

Canola (Rapeseed) (Subgroup 20A)[1]

[1]Canola (rapeseed) (subgroup 20A) including borage, canola, crambe, cuphea, echium, flax seed, gold of pleasure, hare's ear mustard, lesquerella, lunaria, meadowfoam, milkweed, mustard seed, oil radish, poppy seed, rapeseed, sesame, sweet rocket, and cultivars, varieties and/or hybrids of these

Pests and Application Rates:

Pests	Transform WG (oz/acre)
Aphids	0.5 – 0.75 (0.016 – 0.023 lb ai/acre)

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, certified crop advisor or state agricultural experiment station for any additional local use recommendations for your area.

Application Rate: Use a higher rate in the rate range for heavy pest populations.

Restrictions:
- **Preharvest Interval:** Do not apply within 14 days of grain, straw, forage, fodder, or hay harvest.
- **Minimum Treatment Interval:** Do not make applications less than 14 days apart.
- Do not make more than two applications per year.
- Do not apply more than a total of 1.5 oz of Transform WG (0.046 lb ai of sulfoxaflor) per acre per year.
- Do not apply this product until after petal fall.• If blooming vegetation is present 12 feet out from the downwind edge of the field, a downwind 12-foot on-field buffer must be observed.

Root and Tuber Vegetables (Crop Groups 1A and 1B)[1]

[1]Root and tuber vegetables (crop group 1) including bitter black salsify, carrot, celeriac, chayote (root), chicory, chufa, daikon, dasheen, edible burdock, garden beet, ginseng, horseradish, lobok, lo pak, oriental radish, parsnip, radish, red Chinese radish, red Japanese radish, rutabaga, salsify, skirret, Spanish salsify, sugar beet, turnip, turnip-rooted chervil, turnip-rooted parsley, white Chinese radish, white Japanese radish, winter radish, and other cultivars or hybrids of these

Pests and Application Rates:

Pests	Transform WG (oz/acre)
Aphids	0.75 – 1.5 (0.023 – 0.047 lb ai/acre)
Leafhoppers	1.5 – 2.75 (0.047 – 0.086 lb ai/acre)
silverleaf whitefly sweetpotato whitefly	2.0 – 2.75 (0.063 – 0.086 lb ai/acre)

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, certified crop advisor or state agricultural experiment station for any additional local use recommendations for your area. Two applications may be required for optimum control of whiteflies.

Application Rate: Use a higher rate in the rate range for heavy pest populations.

Restrictions:
- **Preharvest Interval:** Do not apply within 7 days of harvest.
- **Minimum Treatment Interval:** Do not make applications less than 7 days apart.
- Do not use on crops grown for seed.
- Do not make more than four applications per crop.
- Do not make more than two consecutive applications per crop.
- Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
- If blooming vegetation is present 12 feet out from the downwind edge of the field, a downwind 12-foot on-field buffer must be observed.

Potatoes (Crop Groups 1C and 1D)[1]

[1]Root and tuber vegetables (crop group 1) including arracacha, arrowroot, bitter black salsify, bitter cassava, chayote (root), Chinese artichoke, chufa, daikon, dasheen, edible canna, ginger, Jerusalem artichoke, leren, lobok, lo pak, potato, radish, sweet cassava, sweet potato, tanier, true yam, turmeric, yam, yam bean, and other cultivars or hybrids of these

Pests and Application Rates:

Pests	Transform WG (oz/acre)
aphids	0.75 – 1.5 (0.023 – 0.047 lb ai/acre)
Leafhoppers	1.5 – 2.25 (0.047 – 0.071 lb ai/acre)
Potato psyllid silverleaf whitefly sweetpotato whitefly	2.0 – 2.25 (0.063 – 0.071 lb ai/acre)

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, certified crop advisor or state agricultural experiment station for any additional local use recommendations for your area. Two applications may be required for optimum control of whiteflies.

Application Rate: Use a higher rate in the rate range for heavy pest populations.

Restrictions:

- **Preharvest Interval:** Do not apply within 7 days of harvest.
- **Minimum Treatment Interval:** Do not make applications less than 14 days apart.
- Do not make more than four applications per crop.
- Do not make more than two consecutive applications per crop.
- Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
- Do not apply this product until after petal fall.
- If blooming vegetation is present 12 feet out from the downwind edge of the field, a downwind 12-foot on-field buffer must be observed.

Succulent, Edible Podded and Dry Beans[1]

[1]Succulent, edible podded, and dry beans including adzuki bean, asparagus bean, bean, blackeyed pea, broad bean, chickpea, Chinese longbean, cowpea, fava bean, field bean, garbanzo bean, grain lupine, green lima bean, jackbean, kidney bean, lablab bean, lima bean, moth bean, mung bean, navy bean, pinto bean, rice bean, runner bean, snap bean, sweet lupine, sword bean, tepary bean, wax bean, white lupine, white sweet lupine, yardlong bean

Pests and Application Rates:

Pests	Transform WG (oz/acre)
aphids	0.75 – 1.0 (0.023 – 0.031 lb ai/acre)
plant bugs	1.5 – 2.25 (0.047 – 0.071 lb ai/acre)
Suppression only: brown stink bug southern green stink bug	2.0 – 2.25 (0.063 – 0.071 lb ai/acre)
thrips (suppression only)	2.25 (0.071 lb ai/acre)

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, certified crop advisor or state agricultural experiment station for any additional local use recommendations for your area.

Application Rate: Use a higher rate in the rate range for heavy pest populations.

Restrictions:

- **Preharvest Interval:** Do not apply within 7 days of harvest.
- **Minimum Treatment Interval:** Do not make applications less than 14 days apart.
- Do not make more than four applications per crop.
- Do not make more than two consecutive applications per crop.
- Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
- Do not apply this product until after petal fall.
- If blooming vegetation is present 12 feet out from the downwind edge of the field, a downwind 12-foot on-field buffer must be observed.
- Do not use on soybeans.

Terms and Conditions of Use

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies.

Warranty Disclaimer

Dow AgroSciences warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. Dow AgroSciences MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperature, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences or the seller. To the extent consistent with applicable law all such risks shall be assumed by buyer.

Limitation of Remedies

To the extent permitted by law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Dow AgroSciences' election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used

Dow AgroSciences shall not be liable for losses or damages resulting from handling or use of this product unless Dow AgroSciences is promptly notified of such loss or damage in writing. In no case shall Dow AgroSciences be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Dow AgroSciences or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or Limitation of Remedies in any manner.

Produced for
Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268

Label Code: D02-396-002
Replaced Label: D02-396-001
LOES Number: 010-02282

EPA accepted 10/14/16

APPENDIX II: Proposed Use Directions (DRAFT Section 18 Label)

Dow AgroSciences

Dow AgroSciences LLC 9330 Zionsville Road Indianapolis, IN 46268-1054 USA

Transform® WG

EPA Reg. No. 62719-625

For Control of Plant Bugs in Cotton

(For Use Only in the Counties of Mohave, La Paz, Yuma, Maricopa, Pinal, Pima, Graham, Greenlee, Gila and Cochise in the State of Arizona)

FOR USE IN ONLY IN ARIZONA UNDER SECTION 18 EMERGENCY EXEMPTION
This Section 18 Emergency Exemption is effective XXXXX and expires XXXXX

ATTENTION

- It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
- This labeling must be in the possession of the user at the time of application.
- Read this SLN labeling and the label affixed to the container for Transform® WG insecticide before applying. Carefully follow all precautionary statements and applicable use directions.
- Use of Transform WG according to this supplemental labeling is subject to all use precautions and limitations imposed by the label affixed to the container for Transform WG.

Directions for Use

Pests and Application Rates:

Pests	**Transform WG (oz/acre)**
Plant bugs	1.5 – 2.25 (0.047 – 0.071 lb ai/acre)

Advisory Pollinator Statement: This product is highly toxic to bees exposed through contact during spraying and while spray droplets are still wet. This product may be toxic to bees exposed to treated foliage for up to 3 hours following application. Toxicity is reduced when spray droplets are dry. Risk to managed bees and native pollinators from contact with pesticide spray or residues can be minimized when applications are made 30 minutes after sunset and up to sunrise, or when the temperature is below 55 degrees F at the application site. Communications between the grower / applicator and beekeeper are key to minimizing risk. Prior to use of Transform WG, growers and the beekeepers hosted on their farm are advised to implement Best Management Practices outlined in the Arizona Management Plan for the Protection of Pollinators.

Application Timing: Treat in accordance with local economic thresholds. Consult your Dow AgroSciences representative, cooperative extension service, licensed pest control advisor or state agricultural experiment station for any additional local use recommendations for your area.

Application Rate: Use a higher rate in the rate range for heavy pest populations. Two applications may be required for optimum western tarnished plant bug control under high pest pressure or heavy immigration of plant bugs from other crops. However, consider rotation with other modes of action to prevent resistance.

Restrictions:

- **Preharvest Interval:** Do not apply within 14 days of harvest.
- **Minimum Treatment Interval:** Do not make applications less than 5 days apart.
- Do not make more than four applications per acre per year.
- Do not make more than two consecutive applications per crop.
- Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.

R396-121
Accepted: __/__/__
Replaces: Initial

Page 1 of 1

APPENDIX III: Form 1080, For required reporting of pesticide applications by applicators.

Arizona Department of Agriculture

Environmental Services Division

1688 W. Adams, Phoenix, AZ 85007

Phone 602-542-0901 Fax 602-542-0466 Web-site https://agriculture.az.gov

Office Use Only

Form 1080

Seller ____________ PSP # ____________ Date ____________

Grower ____________ PGP # ____________ County ____________

Pest Conditions PMA Area ☐ Yes ☐ No

Harvest Date	Label and Worker Safety Reentry Interval				Label Days to Harvest		Pesticide Application Date		
Crop	Section	Township	Range	Acres	Crop	Section	Township	Range	Acres

Additional Field Descriptions ____________

Product/Brand Name	EPA Registration Number	Active Ingredient	Rate & Unit of Measure/Acre	Dilution/ 100 GAL	Total Chemical

Total Acres	Total Volume Per Acre	DEQ Soil Applied ☐Yes No ☐	Supplemental Label Required ☐Yes ☐ No	☐Air ☐Ground ☐Chemigation Other: ____
Ground Water BMP ☐ Yes ☐ No				

Label Restrictions/Special Instructions ____________

Custom Applicator ____________ Delivery Location ____________

Grower/Pesticide Advisor's Signature ____________ PGP/PCA Number ____________

I, undersigned certify that the above instructions comply with Arizona Revised Statutes, Title 3, Article 6 and A.A.C. R3-3-302.

A.A.C. R3-3-302 PESTICIDE APPLICATION REPORT

I, the undersigned, certify that an application of pesticides was made by the designated applicator in strict compliance with the above recommendation and instructions on the date and under the conditions specified below.

Equipment Tag #	Time(s) of Application	Wind Direction & Velocity	Date(s) Applied

Deviation From Instructions ____________

Company Name ____________ PGP/CA # ____________

Grower/Applicator Signature ____________ PUP/PUC # ____________

Print Operator(s)/Pilot Name ____________ AAP # ____________

THIS DOCUMENT MUST BE SUBMITTED TO THE ARIZONA DEPARTMENT OF AGRICULTURE NO LATER THAN THE THURSDAY FOLLOWING THE CALENDAR WEEK IN WHICH AN APPLICATION WAS COMPLETED.

Copy Distribution: Two Copies to Applicator -- One Copy to Advisor -- One Copy to Seller -- One Copy to Grower --One Copy to ADA

APPENDIX IV: Dow letter of acknowledgement, Other Stakeholder Letters Follow

Dow AgroSciences

Dow AgroSciences LLC
9330 Zionsville Road 308/3E Indianapolis, IN 46268
(317) 337-0000

www.dowagro.com

3 January 2017

Jack Peterson
Assistant Director
Arizona Department of Agriculture
Environmental Services Division
1688 West Adams Street
Phoenix, AZ 85007-2617

LETTER OF SUPPORT FOR SECTION 18 REQUEST
FOR TRANSFORM® WG INSECTICIDE IN COTTON

Dear Mr. Peterson;

Dr. Peter Ellsworth, IPM Coordinator and Director of Arizona Pest Management Center with the University of Arizona, brought to our attention a request for the use of Transform® WG insecticide (a.i. sulfoxaflor; EPA Reg. No. 62719-625) for the control of plant bugs, *Lygus hesperus,* on cotton in Arizona.

Dow AgroSciences has been asked to support a request from the cotton industry for a Section 18 Emergency Exemption registration for Transform WG for use on cotton. With this letter we acknowledge such support. Transform WG provides excellent efficacy against target pests and the active ingredient, sulfoxaflor, also represents a new sulfoximine class of chemistry with a novel mode of action. As such, sulfoxaflor controls pests resistant to other classes of chemistry. Transform is also a selective insecticide with little or no activity against beneficial predators, which makes it a strong fit for Integrated Pest Management programs that seek to preserve beneficials.

If you have further questions, please do not hesitate to contact me.

Sincerely,

Brian L Bret, Ph.D.
State Regulatory Manager
Dow AgroSciences
blbret@dow.com
916-780-7477

Cc: Dr. Peter Ellsworth, University of Arizona, peterell@cals.arizona.edu
Dr. James Thomas, DAS Federal Regulatory Manager
AZ Correspondence Files

From the Arizona Crop Protection Association

Arizona

Crop Protection

Association

December 6, 2016

To Whom It May Concern:

The Arizona Crop Protection Association represents over 200 pest control advisors, retailers and manufacturers across the state of Arizona. A healthy and economically viable cotton industry is very important to the agriculture industry in Arizona. This industry is facing a serious threat to the upcoming 2017 growing season. This is due to the lack of tools available to maintain effective lygus control. Arizona is likely to see an increase in cotton acres, as cotton seed production and double cropping have increased significantly within the state. The potential for increased cotton acreage in Arizona makes effective lygus and whitefly control even more critical at this time.

Integrated Pest Management has dramatically changed the Arizona cotton industry in the last decade. Cotton farmers in Arizona have poured significant resources into solving pest infestations issues to prevent the overuse of chemicals. Using all available technologies is key to preventing resistance issues. The professionals represented through the Arizona Crop Protection Association can't afford to risk the gains we have made using proven IPM principles of rotating effective and selective products for sustainable production.

We are concerned that Arizona cotton growers do not have the ability to rotate to Transform, while their competitors in five other cotton producing states still have the ability to use this product. The prospect of using other broad spectrum products could be devastating to pollinators. Further, not having the ability to use Transform as part of an overall lygus control strategy will be devastating to cotton growers and the communities where they live.

The Arizona Crop Protection Association is therefore requesting consideration of a Section 18 Exemption to allow the use of Transform for cotton in Arizona.

Respectfully Yours,

Andy Hancock

Andy Hancock, President
Arizona Crop Protection Association

From the a Licensed Pest Control Advisor & Grower

Dear Sir or Madam:

The Arizona cotton industry is facing a serious issue for the 2017 growing season, maintaining effective lygus control. I am a Pest Control Advisor serving growers in Maricopa, La Paz and Yuma counties. I also serve on the board of the Arizona Crop Protection Association. Additionally, I am planting approximately 140 acres of cotton on my family farm west of Buckeye next year. A healthy and economically viable cotton industry affects me and nearly everyone I know directly.

If early indications hold true, my customers' cotton acreage will likely triple and our major pest issues continue to be lygus and whitefly. A large percentage of these acres will be for planting seed production, as Arizona grown cottonseed will supply a percentage of the U. S. and world planting seed market. Planting seed production, as well as a shift to double cropped cotton with later than normal planting dates, make effective lygus and whitefly control even more critical.

In my twenty years as a PCA, Integrated Pest Management has dramatically changed the Arizona cotton industry. Multiple selective products, with differing modes of action, continue to allow safe and economic cotton production in Arizona. I began my PCA career with the introduction of Bt cotton varieties and two IGR products with differing modes of action that still provide effective worm and whitefly control without impacting beneficial populations. With the introduction of Carbine and Transform, sustainable and selective lygus control became a reality. Transform quickly became a foundational product for lygus control with its safety, selectivity and suppression of whitefly. Unfortunately, the loss of the Transform registration eliminated the ability to rotate to a fully selective lygus product with a different mode of action. Fortunately, the loss of Transform in cotton coincided with one of the lighter cotton insect years in memory and I did not have to treat for lygus in 2016. Arizona cotton growers can't rely on luck nor risk the gains we have made using proven IPM principles of rotating effective and selective products for sustainable production.

Dr. Peter Elsworth and many other researchers have been key partners in the development of our IPM systems. In a 2014 publication titled "Be Selective" authored by Peter C. Ellsworth, Lydia Brown (University of Arizona) & Steven Naranjo (USDA-ARS), I found the following quote, "Selective chemistry is both safer to the user and environment, as well as to the predators and parasitoids that maintain secondary pests below economic levels and help control our primary pests like whiteflies and Lygus bugs."

The ability to rotate selective products from different chemical classes is essential to maintaining their efficacy. While flonicomid (Carbine & Beleaf) has been effective for lygus control in the past, it does have a 24c registration on alfalfa seed in Arizona and I have observed less than satisfactory control even with two applications. I am not comparing the challenge of lygus control in alfalfa seed to cotton, but am concerned about Arizona cotton growers not having the ability to rotate to Transform, as do cotton growers in five other cotton producing states. The prospect of using a broad spectrum product like acephate would be devastating to pollinators, our beneficial populations and flare secondary pests. I would estimate the economic impact of returning to multiple lygus control applications likely adding a minimum of $70 per acre to insect control expenses. Mite control, shorter lygus control intervals and early initiation of whitefly control would all be likely with the increased use of broad spectrum insecticides eliminating our beneficial populations. With current 2017 cotton prices below 70 cents, any increase in production costs, lint yield loss or seed quality damage would be equally devastating to cotton growers and the communities they live.

I am therefore requesting consideration of a Section 18 Exemption to allow the use of Transform for cotton in Arizona.

Respectfully Yours,

Kenneth Narramore

Verde Agricultural Service, LLC

From the Arizona Farm Bureau

Arizona Farm Bureau Federation
325 S. Higley Rd, Suite 210
Gilbert, AZ 85296

April 5, 2017

Jack Peterson
Associate Director,
Environmental Services Division
Arizona Department of Agriculture
1688 W. Adams St.
Phoenix, AZ 85007

Dear Associate Director Peterson,

Cotton farmers today face a number challenges including commodity prices being at their lowest point in years, rising input costs, and increasing global competition. Added to this are the day to day challenges of dealing with weeds, insect and disease pests, and weather. Recent EPA actions regarding sulfoxaflor has severely restricted Arizona cotton growers' ability to manage insects and diseases efficiently and cost effectively. For this reason, we support a Section 18 Exemption of sulfoxaflor for use in cotton.

Arizona may be the only place in the world where cotton growers must deal simultaneously with both Lygus bugs and *Bemisia* whiteflies. Lygus bugs have been the number one yield-limited pest of cotton since 1998. According to the Arizona Pest Management Center, sulfoxaflor is among the most effective insecticides ever screened for the control of Lygus.[1] Additionally they note, Lygus are often the first in-season cotton pest sprayed for and by using sulfoxaflor at this stage, provides collateral suppression of whiteflies and potentially delays or eliminates additional sprays.

Other products such as acephate and oxamyl are available to control Lygus bugs, but in contrast they are broadly toxic and less safe. Sulfoxaflor is the much safer alternative with respect to beneficial insects and other arthropods, as well as to those applying the pesticides. Furthermore, other alternatives to sulfoxaflor do not provide the same collateral benefits to whitefly supersession, and in the case of acephate and oxamyl tend to flare whiteflies by killing their natural enemies.[2]

[1] Arizona Pest Management Center. "Sulfoxaflor Impacts on Arizona Agriculture." Prepared by Peter C. Ellsworth. Feb. 12, 2013. Available at http://ag.arizona.edu/apmc/docs/Sulfoxaflor_APMC_2-12-13.pdf. Accessed May 25, 2016.
[2] Ibid

Another concern for Arizona cotton growers is whitefly and Lygus bug resistance. Sulfoxaflor has been an important product to use in rotation with other products to help address and prevent resistance. Access to sulfoxaflor is critical, otherwise resistance pressures will escalate.

In order to control Lygus and whiteflys effectively and efficiently, avoid the use of harsher alternatives, and keep resistance pressures minimized, we strongly support a Section 18 Exemption of sulfoxaflor for use in cotton.

Sincerely,

Kevin Rogers, President
Arizona Farm Bureau Federation

From the Arizona Cotton Growers Association

Arizona Cotton
Growers Association

April 5, 2017

Jack Peterson
Associate Director Environmental Services
Arizona Department of Agriculture
1688 W. Adams St
Phoenix, Arizona 85007

Dear Jack,

The Arizona Cotton Growers Association strongly recommends the approval for a Section 18 Exemption for the use of Transform, Sulfoxaflor, for the use in Arizona Cotton at the A.I. rate as stated on the label before the IEPA withdrew the label.

Without this chemistry, growers and their crop consultants are faced with difficult decisions as to available treatment options for plant bugs, Lygus specifically.

Growers are limited to 3 applications of Carbine and with the continued overuse, lack of rotational Chemistries we will certainly face resistance issues with Carbine. As you are aware these insect specific insecticides are very valuable tools that are vital for a safer environment.

The other options such as Orthene, with the use of this material just creates secondary insect flair ups which lead to more insecticide applications for Whiteflies and elimination of a high percentage of the beneficial insects in the field that are feeding on immature pest that are damaging to cotton.

Without Transform, Sulfoxaflor, the EPA is basically sending Agriculture in the State of Arizona back into the Stone Age as far as Integrated Pest Management is concerned and we most likely will see a decrease in yield along with an increase in cost associated with growing cotton in Arizona along with an increase in Insecticide use. This is a reversal of the trend for usage we have been able to achieve for the safety of the environment that we farm and live in. In these tough economic time's for Agriculture and the Cotton industry in Arizona we need all the tools to manage our crop as economically as possible.

I applaud the Arizona Department of Agriculture for developing and submitting this Section 18 request and await a positive review and approval by the Environmental Protection Agency.

Sincerely,

Paul "Paco" Ollerton

President
Arizona Cotton Growers Association

9885 S. Priest Drive, Suite 102 / Tempe, Arizona 85284 / (602) 437-1344
FAX (484) 414-1344

Agricultural Experiment Station

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

DATE: April 5, 2017

TO: **Jack Peterson** **(via email attachment)**
Environmental Services Division
Arizona Department of Agriculture
1688 West Adams
Phoenix, Arizona 85007

FROM: Peter C. Ellsworth, IPM Specialist / Professor, Director, APMC

SUBJECT: Support for use of Transform in Arizona cotton under Section 18 Exemption

Transform had been a transformative product in our system when it was introduced in 2013. This was because of its unique fit to the Arizona cotton insect pest spectrum. With pink bollworms eradicated, the invasive whitefly, *Bemisia tabaci* (MEAM1), and the Lygus bug, *Lygus hesperus*, are the remaining two key pests of Arizona cotton. Transform has efficacy against both Arizona cotton targets, with industry-leading control of Lygus bugs and suppression against whiteflies.

Arizona has worked progressively on improving a cotton IPM plan since the advent of Bt cotton and selective chemistries for whitefly control in 1996. We have overcome a terribly destabilized system of the early 1990s when we averaged 12–14 sprays of broadly toxic insecticides each cotton season. Today, we have a low-spray environment where we spray on average around 1.9 times to control the entire arthropod pest complex (Figure 1). This is possible only because we now depend on highly strategic, very safe, narrow spectrum, selective control agents, like Transform, which conserve natural enemy populations that serve to add important mortality to primary, secondary and occasional pests in our system.

One difficulty in such a low spray environment is that even the first spray made in the season may be the last. This places pressures on our pest managers to carefully assess key pest populations (*Lygus* and whiteflies) and make the right product choice for the situation. This is made worse by a difficult economic climate where growers are very reluctant to pay for additional passes over their fields if they can at all avoid it. Of all registered pesticides in Arizona cotton, only Transform can uniquely address both pest threats. Lygus are often the first pest treated in Arizona cotton, but incipient whitefly populations are also present. By using Transform to control Lygus, growers benefit by tamping down whiteflies to such a degree that no further sprays may be needed season-long!

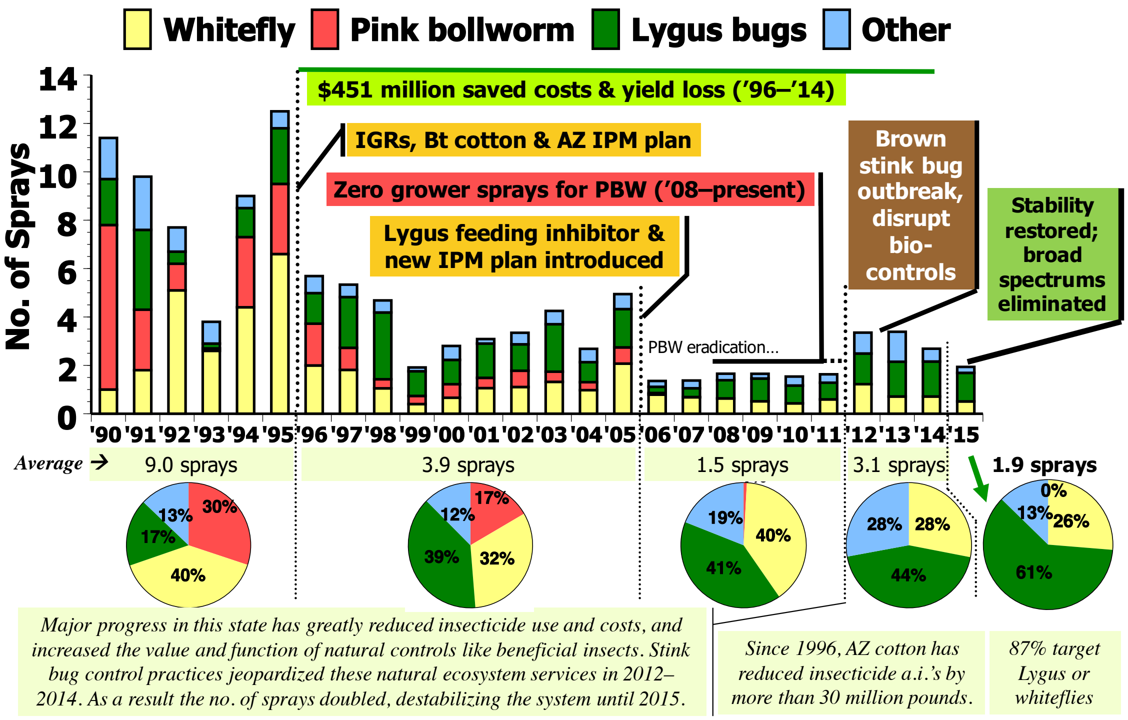

Figure 1. Statewide average cotton insecticide use patterns in Arizona, 1990–2015, by key pest. When broad spectrum insecticides are minimized or eliminated from our system (see 1996 and 2006 in contrast to 2012), our overall spray requirements go down because of natural enemy conservation and other natural mortalities that are maintained on pest populations. Without Transform in our system, we risk significant increases in usage of broad spectrum organophosphates, carbamates, pyrethroids, and neonicotinoids. Transform allows us to address the dual and Arizona-specific key pest threats of *Lygus hesperus* and *Bemisia tabaci*, and is necessary to maintain our IPM strategy, our industry-leading resistance management program, and to protect our environment. We estimate that through the advances of this program, growers have cumulatively saved over $490 million (1996–2015) and that we routinely prevent over 1.6 million lbs of active ingredient from entering the environment. *Source: Cotton Insect Losses Database, Arizona Pest Management Center, Ellsworth et al. 2012, Ellsworth, unpubl. data.*

I have been researching sulfoxaflor uses in Arizona cotton since 2008, when we first discovered the remarkable efficacy it had against *Lygus hesperus* (Figure 2). We later demonstrated through very careful, replicated field research that this product also suppresses whiteflies at the higher rates used to control Lygus. And, as part of our systematic review of each new active ingredient, we demonstrated maximum safety for the suite of beneficial arthropod species that inhabit cotton and provide key ecosystem services of biological control and pollination in our crops (Fig. 3–4).

For the reasons already given, Transform supports one of the most advanced integrated pest management (IPM) strategies in the world. But now with more than 10 years of use of flonicamid (Carbine) in Arizona cotton, we are extremely concerned about resistance buildup in Lygus populations that attack cotton as well as high valued seed crops in Arizona. Transform is therefore keystone in supporting an overall resistance management strategy in Arizona cotton that is looked upon worldwide as a model for how to best manage these critical technological resources.

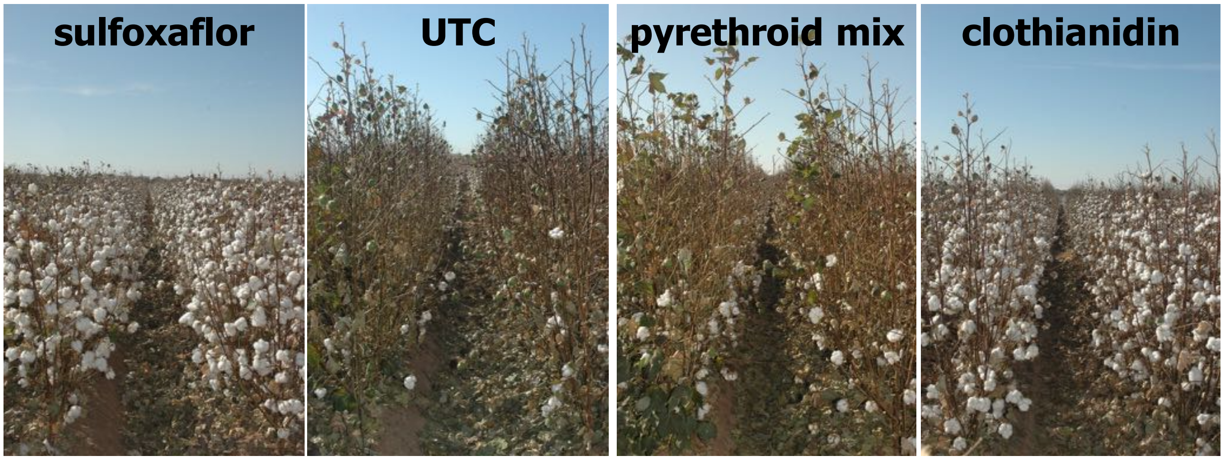

Figure 2. **Efficacy of Transform against *Lygus hesperus* in Arizona cotton, Maricopa, AZ (2009).** Left to right, Transform sprayed 3 times within label limits, the untreated check, Hero sprayed at maximum rate 5 times (a pyrethroid mixture of bifenthrin + cypermethrin) and Belay sprayed 3 times above label maximum. Transform shows excellent Lygus control and resulting yield. Note the huge difference in plant heights. When Lygus are not controlled, fruiting positions (and fruit) are lost. Then all the energy the plant produces goes into unproductive vertical growth. Tall cotton is often a telltale sign of Lygus injury, as seen in the UTC and ineffective pyrethroid plots. Belay (off label) was effective but much less so than Transform (compare crop heights). Belay had lower yields and significantly negative impacts on non-target beneficial arthropods. (Ellsworth, unpubl. data).

Figure 3. **Selectivity of Transform against *Lygus hesperus* in Arizona cotton in comparison to leading Lygus control alternative, Maricopa, AZ (2009).** Use of a broad-spectrum Lygus insecticide (acephate, Orthene; center plot) destroyed the natural enemy complex critical to the suppression of primary and secondary pests. Oftentimes whiteflies resurge, but here not nearly as much as did two-spotted spider mites. The resulting stress on the plants defoliated the entire plot right down to the row. In contrast 3 sprays of Transform at 1.5 oz / A (left plot) or no sprays at all (right plot, UTC) resulted in conserved natural enemies that were critical in maintaining natural control of spider mites. The acephate plot lost at least one third of its yield due to premature defoliation by spider mites. See figure 4 for more detailed information on non-target effects of Transform and other chemistries used for Lygus control (Ellsworth & Naranjo, unpubl. data).

Our base IRM recommendations in cotton include **using no mode of action in more than two, non-consecutive sprays**. Without Transform, in order to comply with this guideline, growers would be forced to rotate from Carbine to some other Lygus effective product, of which there are only three: acephate (Orthene97), oxamyl (Vydate C-LV), and clothianidin (Belay). Acephate and oxamyl are broadly toxic organophosphates and carbamates that can lead to resurgent, rapidly growing whitefly populations and secondary problems with mites, aphids, or cotton leafperforator (Figure 3). These “secondary” issues often become more expensive to control than the primary problem! Furthermore, Belay efficacy against Lygus is generally not as good as Transform and carries with it the added risk to beneficials and especially pollinators including honeybees. Many practitioners refuse to use Belay because of the potential risks to bees. Note, whitefly resistance to 3 modes of action have greatly increased without Transform.

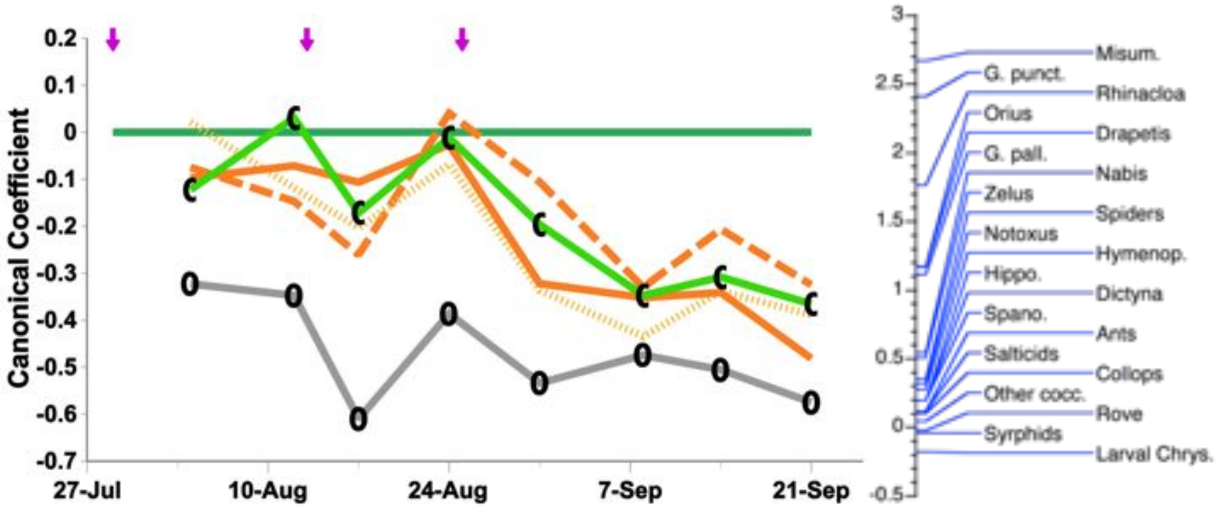

Figure 4. **Transform conserves the natural enemy and pollinator complex at levels comparable to not spraying at all.** Principal Response Curve analyses examine an entire complex or community of natural enemy / pollinator species (listed at the right) in response to stressors (3 sprays of various insecticides; purple arrows) in comparison to a standard (the unsprayed, untreated check; Y=0, green line). Transform at 3 rates (orange lines) was compared to Carbine (light green line) and Orthene (dark gray line) relative to the UTC (green line). Orthene (O) severely and permanently depressed the densities of key natural enemies relative to the UTC. Carbine (C) is not significantly different from the check suggesting safety for beneficials. Transform (2.1 oz/A, solid orange line; 1.4 oz/A, short dashed orange line; and 0.7 oz/A, long dashed orange line) each conserved the community of beneficials, similar to Carbine or the UTC. These trends are consistent with a very selective compound, especially relative to Orthene which we know is very damaging to the natural enemy community and is the major alternative for Lygus control. 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 Orthene significantly lowered their densities. (Ellsworth & Naranjo, unpubl. data).

SUMMARY

We have an Emergency Condition with the cancellation of Transform in Arizona cotton after 2015 and with existing pest problems (*Lygus hesperus* and *Bemisia tabaci* as key pests) for which there is no federally registered pesticide sufficient to control in cotton (Table 1). This pest combination is unique in the U.S. to the state of Arizona. Transform is active on both key pests. No other product works on both. Dow has established tolerances for the use pattern requested to mitigate these imminent pest problems and a full Section 3 label is in force for many crops nationwide at the rates requested. The use of Transform in cotton is highly protective of non-target, beneficial arthropod species in our system and therefore will not cause unreasonable adverse effects on man or the environment (e.g., Fig. 3–4). In fact, Transform use in cotton will prevent the use of broadly toxic and environmentally hazardous alternatives like acephate, oxamyl, clothianidin and synthetic pyrethroids. This is consistent with our goals to reduce risk for users, the environment, and beneficial arthropods (NTOs); to prevent pollution, and to maintain and stabilize a critical Integrated Pest Management strategy that includes key tactics and protections against resistance in both species (*Lygus* and *Bemisia*, with documented field resistances in Arizona) because of Transform's unique mode of action (Table 1).

Table 1. **Summary of chemistries available for control of major, key cotton pests in Arizona.** Transform is the only product with cross-spectrum control of *Lygus hesperus* and *Bemisia tabaci* (MEAM1) in cotton. It is one of only two products (with Carbine) that is fully selective and safe to beneficial arthropods. It therefore is non-disruptive to our IPM and IRM programs. There are no resistances documented for Transform in either pest (*Bemisia* or *Lygus*). There are major resistances in *Bemisia* documented in Arizona for pyriproxyfen, neonicotinoids (i.e., acetamiprid, imidacloprid and likely clothianidin) and synergized pyrethroids (i.e., pyrethroids + organophosphate mixtures). With heavy reliance on flonicamid (Carbine) and in the absence of Transform, resistance evolution in *Lygus* is possible, if not likely — some user reports reflect concern about the field efficacy of Carbine. Acephate, oxamyl and pyrethroids are seriously destabilizing to our system through their broadly toxic effects on beneficial arthropods and pollinators in our system. Resistances in whiteflies have significantly increased during this emergency condition (Pier et al., unpubl. data).

Common Name	[1]IRAC Number	Chemical Group	Primary Cotton Target	Selectivity / Safety to Beneficials	Product Name	Efficacy on Bemisia	Efficacy on Lygus	Resistance Documented
buprofezin	16	Chitin inhibitor	Bemisia tabaci only	Fully Selective / Excellent	Courier	Excellent	None	None
pyriproxyfen	7C	Juvenoid	Bemisia tabaci only	Fully Selective / Excellent	Knack	Excellent	None	Yes, mild to severe
spiromesifen	23	Lipid synthesis inhibitor	Bemisia tabaci & mites	Fully Selective / Excellent	Oberon	Excellent	None	None
acetamiprid	4A	Neonicotinoid	Bemisia tabaci only	Partially Selective / Fair	Intruder	Very Good	None	Yes, moderate to severe
flonicamid	9C	Selective feeding inhibitor	L. hesperus only	Fully Selective / Excellent	Carbine	Not effective	Excellent	Possible
sulfoxaflor	4C	Sulfoximine	L. hesperus & B. tabaci	Fully Selective / Excellent	Transform	Good	Excellent	None
clothianidin	4A	Neonicotinoid	L. hesperus only	Partially Selective / Fair	Belay	Fair	Fair	Unknown
acephate	1B	Organophosphate	L. hesperus only	Broad Spectrum / Poor	Orthene97	None	Very Good	Yes, moderate to severe
oxamyl	1A	Carbamate	L. hesperus only	Broad Spectrum / Poor	Vydate C-LV	None	Very Good	Unknown
pyrethroids	3A	Pyrethroids	No Efficacy	Broad Spectrum / Poor	Various	None	None	Yes, moderate to severe

Thank you for considering this request. Supplementary information is provided below

Quoted from EPA Docket ID: EPA-HQ-OPP-2010-0889 (Prepared by P.C. Ellsworth, 2/12/13)

"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 …. 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 neonicotoinoids, 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."

References

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: *http://cals.arizona.edu/pubs/insects/az1404.pdf*

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