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In Response to EPA Draft Biological Evaluation for Sulfoxaflor
& Mitigations Proposed by the Registrant
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Comments submitted by the Arizona Pest Management Center,
University of Arizona

Date: September 17, 2022
EPA Docket ID: EPA-HQ-OPP-2010-0889-0597
Re: Sulfoxaflor use and value in Arizona; comments on draft biological evaluation and mitigations proposed by Corteva AgriScience, LLC.

To Whom It May Concern:

Our Data and Expert Information
The Arizona Pest Management Center (APMC) is host to the University of Arizona's expert IPM scientists, including Ph.D. entomologists, weed scientists and plant pathologists with expertise in the strategic tactical use of pesticides within Integrated Pest Management (IPM) programs that protect economic, environmental and human health interests of stakeholders and the society at large.

Through cooperative agreements with Arizona Department of Agriculture (ADA), the APMC obtains use of, improves upon, and conducts studies with ADA's Form1080 pesticide use data. Growers, pest control advisors and applicators complete and submit these forms to the state when required by statute as a record of pesticide use. These data contain information on 100% of custom-applied (i.e., for hire) agricultural pesticides used in the state of Arizona, including all aerial applications. Grower self-applied pesticide applications may be under-represented in these data. In coordination with the Western Integrated Pest Management Center, we contribute to federal comments on issues of pest management importance to stakeholders throughout the desert southwest including Arizona, New Mexico, Nevada, Colorado, Utah and the southeast desert regions of California.

Through the Crop Pest Losses and Impact Assessment program, a Signature Program of the Western IPM Center, the Arizona Pest Management Center conducts annual surveys with state-licensed pest control advisors (PCAs), who are the primary pest management decision makers, in consultation with growers. The surveys, conducted at face-to-face and virtual meetings, provide detailed information on crop yield losses to specific insect pests, weeds and diseases, control costs, and pesticide use for the key crops, cotton and lettuce. Cotton data have been collected since 1991 and lettuce data since 2005. Data are collected for all of Arizona and neighboring production regions of southern California, with typical responses representing up to 65% of acres planted in Arizona. These data provide detailed information on shifting pest trends, chemical uses and costs, and often compliment and augment pesticide use information from the APMC Pesticide Use Database, particularly for pesticide uses for which the state does not mandate reporting.

In addition, we actively solicit input from stakeholders in Arizona and adjacent production regions of southeastern California, including those in the regulated user community, to better understand use patterns, use benefits, and availability and efficacy of alternatives. These comments are based on the extensive information from the Arizona Pest Management Center Pesticide Use Database, Cotton and Lettuce Pest Losses Surveys, input from end-users, and the expertise of Arizona Pest Management Center faculty.

At this time, we wish to respond to the Agency's Draft Biological Evaluation for the insecticide sulfoxaflor, EPA Docket number EP-HQ-OPP-2010-0889-0597, on behalf of stakeholders in Arizona and adjacent regions of Imperial and Riverside Counties, California. We also wish to endorse comments submitted to this docket by the Arizona Farm Bureau Federation, which address a set of complementary issues to our comments.

Previous Comments

We wish to incorporate by reference the following comments previously submitted to this docket related to registration decisions impacting sulfoxaflor.

Ellsworth, P.C., A.J. Fournier. 2022. Sulfoxaflor Use in Arizona Cotton. Responses to National Cotton Council's Request for Information. University of Arizona Cooperative Extension, Arizona Pest Management Center. https://acis.cals.arizona.edu/docs/default-source/ipm-assessment-documents/arid-swpmc-info-requests/16epa-sulfoxaflor-in-arizonavfv2.pdf

Palumbo, J.C. 2016. Re: Docket ID No. EPA-HQ-OPP-2010-0889. Letter to EPA dated June 12, 2016. Professor and Extension Specialist, University of Arizona. https://acis.cals.arizona.edu/docs/default-source/ipm-assessment-documents/arid-swpmc-info-requests/commen_palubmo_sulfoxaflor_2016.pdf

Ellsworth P.C. 2013. Sulfoxaflor Impacts on Arizona Agriculture., University of Arizona, Arizona Pest Management Center. https://acis.cals.arizona.edu/docs/default-source/ipm-assessment-documents/arid-swpmc-info-requests/sulfoxaflor_apmc_2-12-13.pdf

Palumbo, J.C. 2013. Re: Docket ID No. EPA-HQ-OPP-2010-0889. Letter to EPA dated Feb 8, 2013. Professor and Extension Specialist, University of Arizona. https://acis.cals.arizona.edu/docs/default-source/ipm-assessment-documents/arid-swpmc-info-requests/comment_palumbo_sulfoxaflor_2011.pdf

Palumbo, J.C. 2011. Re: Docket ID No. EPA-HQ-OPP-2010-0889. Undated letter to EPA submitted to the docket Jan 31, 2011. Professor and Extension Specialist, University of Arizona. https://acis.cals.arizona.edu/docs/default-source/ipm-assessment-documents/arid-swpmc-info-requests/comment_palumbo_sulfoxaflor_2011.pdf

Sulfoxaflor Use, Utility, and Benefits
Sulfoxaflor is a key compound with detailed and rigorous research evaluations in Arizona cotton and vegetables demonstrating that it is safe and effective to use in Arizona agriculture. It provides for effective and selective control of Lygus bugs and *Bemisia* whiteflies in cotton, as well as whiteflies and aphids in produce and cucurbits (Ellsworth 2013). It controls aphids, thrips stink bugs and a variety of plant feeding insects across a broad range of crops in the Desert Southwest. Based on information from the APMC Pesticide Use Database, the most significant uses of sulfoxaflor in Arizona are in cotton, lettuces, spinach and other leafy greens, alfalfa, cole crops, and melons. It is also used to a lesser extent in sorghum, dry beans, chile peppers, peas, carrots, potatoes, wheat and barley, citrus, pecans and pistachios (Fournier et al. 2017). While some of these are small-acre crops in Arizona, sulfoxaflor often plays a critical role in insect pest management.

Sulfoxaflor provides cost-effective insecticidal activity against key sucking pests and has an excellent fit in our existing IPM and Insecticide Resistance Management (IRM) programs in both cotton and produce. Sulfoxaflor is an excellent alternative to many older, higher risk, broad-spectrum compounds, including organophosphates (Ellsworth 2016, Palumbo 2016). Sulfoxaflor uniquely controls both Lygus bugs and whiteflies without harming beneficials in cotton (Ellsworth 2016; Bordini et al. 2021). Intensive multi-year examinations in cotton and produce have demonstrated sulfoxaflor's selective activity and lack of impacts on non-target organisms. It has been successfully used for several years across hundreds of thousands of acres with no bee incidents reported (Ellsworth 2016, Palumbo 2016). Sulfoxaflor provides a key alternative to flonicamid (Carbine) that has helped stabilize and sustain our resistance management programs for Lygus and whitefly (Ellsworth 2013).

Key points from prior comments (some updated) and other sources:

Cotton

- Sulfoxaflor is ideally suited for our cotton IPM system, where we have progressively introduced highly selective and effective technologies for the control of key insect pests, while conserving the natural enemy fauna present in the field and available for suppression of all cotton arthropod pests (Bordini et al. 2021; Ellsworth 2013; Ellsworth & Fournier 2022).
- Sulfoxaflor is the only product available with very high efficacy against Lygus bugs, suppression of whiteflies — and control of cotton aphids — without negative impacts on predators and other beneficials in the Arizona cotton system. Its dual effectiveness can reduce the number of total sprays required for economic production (Figures 1–4; Ellsworth 2013; Ellsworth & Fournier 2022).
- Sulfoxaflor is among the most effective insecticides ever screened for the control of *Lygus hesperus*, a key mirid bug pest of cotton. Lygus bugs have been our number 1 yield-limiting pest of cotton since at least 1998. Given that losses of >50% are possible,

sulfoxaflor's ability to protect cotton from Lygus-related yield loss is saving our growers millions of dollars (Figure 5; Ellsworth 2013; Ellsworth & Fournier 2022).

- As one of only two active ingredients that is both effective against Lygus and selective for cotton arthropods, sulfoxaflor plays a key role in resistance management by relieving selection pressure from exclusive use of flonicamid (Carbine) for Lygus control (Ellsworth 2016).
- Conservation of natural enemies (beneficial arthropods) is a central aspect to the ongoing cotton IPM program. 95% and 94% of all sprays made for whiteflies and Lygus, respectively, are fully selective and safe to the beneficials in the system (Figure 1; Ellsworth & Fournier 2022). Our research shows that Transform use in cotton is not significantly different from unsprayed controls when it comes to impact on non-target organisms, including beneficial predators relied on in this system for conservation biological control (Ellsworth 2013, 2016; Bordini et al. 2021).
- After 9 years of commercial use on hundreds of thousands of acres in Arizona where there is a significant honeybee industry and crops requiring pollination services, there have been no reported bee incidents associated with that use (Ellsworth 2016).
- Once the cotton canopy closes, most acreages are inaccessible by ground. Aerial application is required in our system (Ellsworth & Fournier 2022).

<u>Vegetables and Melons</u>

- In both the coastal and desert growing regions of Arizona and California, insect management is one of the primary constraints to economic production. In particular, aphids are a major threat to produce crops and require multiple pesticide applications to prevent losses in yield and quality (Palumbo 2011).
- Melon growers in the southwestern U.S. have become heavily dependent on the availability of effective insecticides such as sulfoxaflor for the control of adult sweet potato whiteflies, *Bemisia tabaci* (b-biotype) because of the establishment of a whitefly-vectored virus, Cucurbit Yellows Stunting Disorder Virus (CYSDV). Without effective management of the whitefly vector, CYSDV can cause yield losses in excess of 70% (Palumbo 2016).
- Effective control of most aphid species can be achieved at low use rates of sulfoxaflor, while comparable control of *Bemisia* whiteflies often requires considerably higher use rates. Maintaining a flexible rate structure for sulfoxaflor products will be critical if we expect to replace older, "less IPM friendly" products with newer, reduced risk active ingredients like sulfoxaflor (Palumbo 2013).
- Based on the most recent Lettuce Pest Losses survey, sulfoxaflor (class, Sulfoxamines) was applied to 3,602 acres (7.3%) of Fall 2021 head lettuce, with an average or 1.3 applications. In Spring 2022, 18,002 head lettuce acres (46.4%) received an average of 1.1 applications (Palumbo 2022).

Non-target Effects of Transform Use in Cotton
Sulfoxaflor is remarkably effective against Lygus bugs in cotton (Figure 6; Bordini et al. 2020). However, it's popularity in the Arizona cotton IPM strategy is because of its high degree of safety towards non-target arthropods. These non-target invertebrates include generalist predators that are important in the natural control of whiteflies, aphids, mites and many other secondary pests. As a result of this and other selective technologies used in the Arizona cotton IPM plan, growers now have access to whitefly control thresholds based on conserved predators (Ellsworth et al. 2019).

Bordini et al. (2021) specifically examined the impact of repeated sulfoxaflor use in cotton on the community of non-target arthropods found in cotton. There were about 27 species representing very diverse taxonomic groups spanning insects and spiders. They evaluated three biweekly sprays at the maximum cotton use rate over the course of two years of field studies. Transform proved to be effective against the target pests, as expected. However, **Transform was not significantly different from the untreated check in terms of impacts on the non-target arthropod community present**. This included a suite of eight species of cotton predators determined to be key conservation targets to support biological control of whiteflies (Vandervoet et al. 2018). In so doing, Bordini et al. (2021) showed that Transform use supported improved predator to prey ratios that favor continued biological control of whiteflies in cotton (Figure 7).

Given the large margins of safety in the use of Transform in cotton for non-target invertebrates, we find it unlikely that sulfoxaflor is contributing to any increased risks for threatened or endangered species or their habitat. On the contrary, the use of fully selective Lygus insecticides, Transform and Carbine, has all but eliminated the need for and use of acephate for the control of Lygus in Arizona cotton. Acephate is broadly toxic to invertebrates. Notably, acephate was the number one active ingredient in use in Arizona cotton in 2005; today it is used on less than 4% of cotton acres.

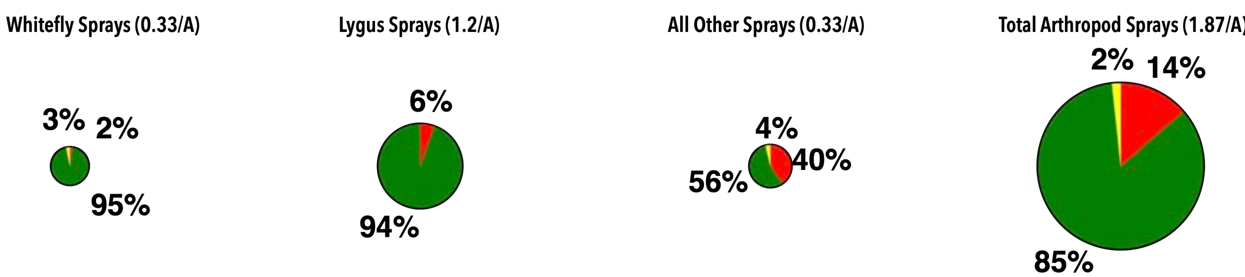

Figure 1. Percentage of sprays made to cotton in 2021 that are fully, partially, or non-selective (green, yellow, red, respectively) by pest and overall insecticide sprays. Sulfoxaflor and flonicamid are represented by the 94% of sprays made targeting Lygus bugs. Pies are scaled to the number of sprays made. The percentage adoption of fully selective insecticides is at a high-water mark in 2020–2021, reflecting advances in industrial development as well as high uptake of the Arizona cotton IPM strategy. Source: *Cotton Pest Losses Database.*

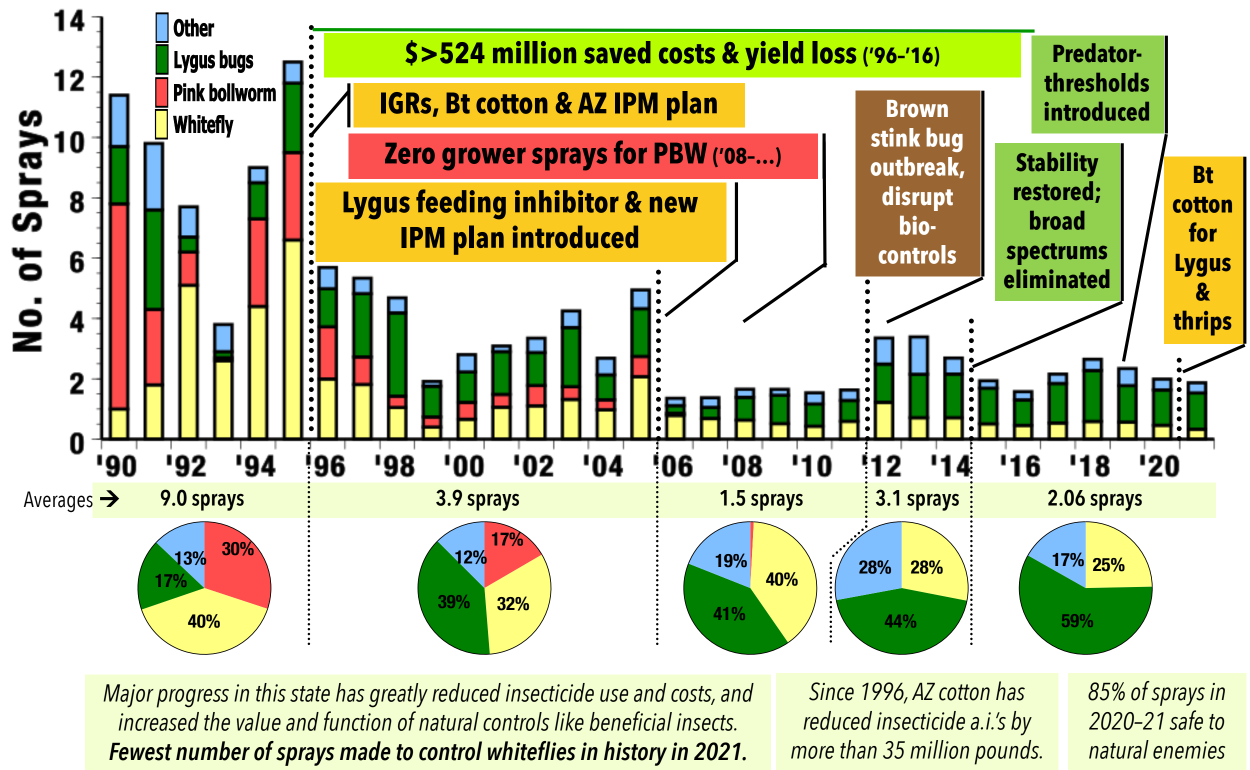

Figure 2. Average number of sprays made statewide by Arizona cotton growers to control insect and other arthropod pests. Lygus and whiteflies are targeted by 84% of the total sprays made against arthropods in Arizona cotton (2015–2021). Whiteflies are the number one quality-limiting pest. Lygus bugs are the number one yield-limiting pest. 2021 continues a trend towards fewer sprays to control arthropods. The 16-year statewide average is 2.06 ± 0.2 sprays for all arthropod pests. Source: *Cotton Pest Losses Database*, Ellsworth, unpubl.

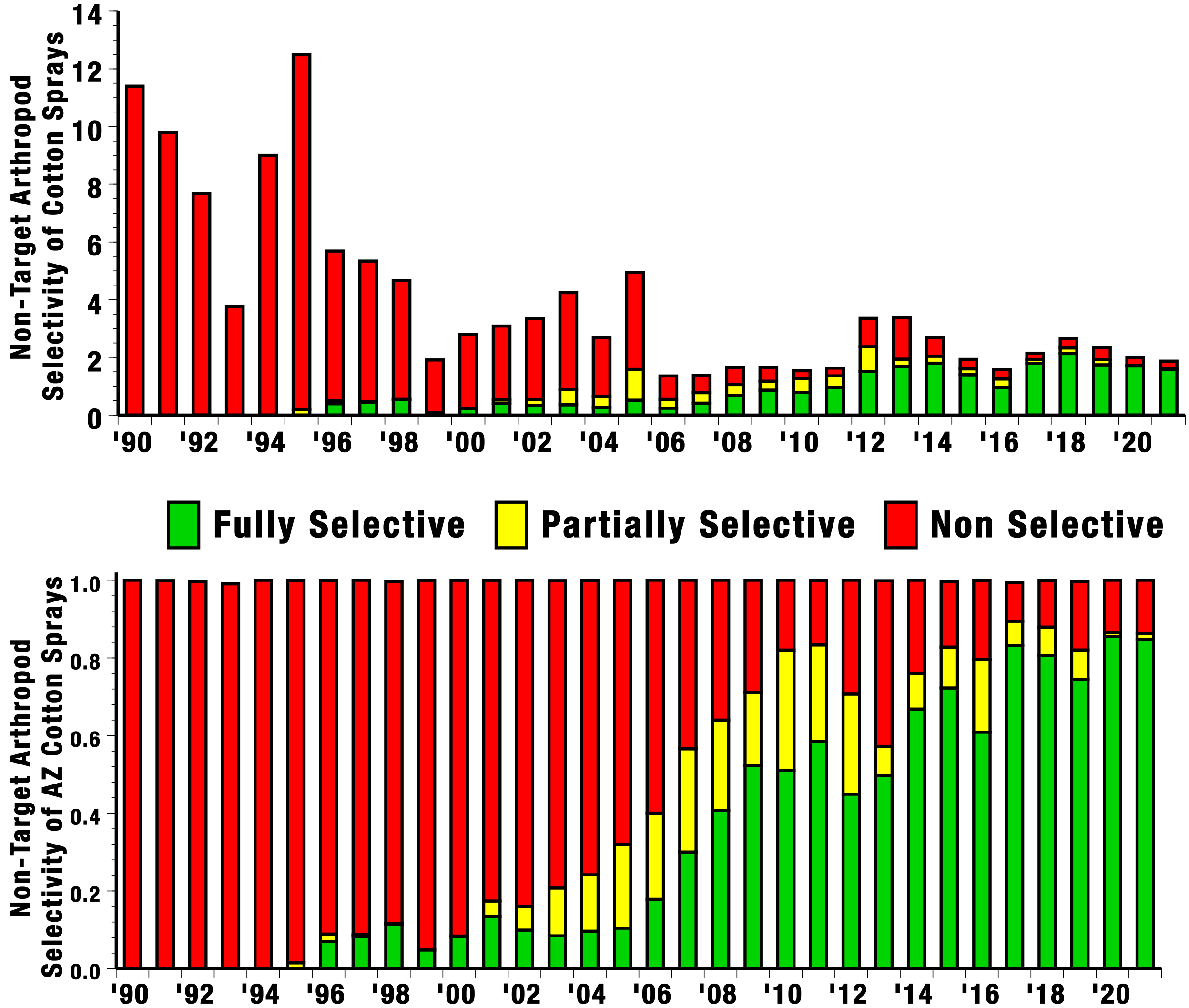

Figure 3. Longitudinal analysis of cotton insecticide use (actual spray frequency, above, and proportional use, below), as in Figure 2 but with each bar depicting proportion of sprays made that are fully (green), partially (yellow) or non-selective (red) towards non-target arthropods. The putative selectivity shows a dramatic shift toward higher selectivity to non-target arthropods in Arizona in recent years. There are concomitant reductions in spray frequencies, increases in safety towards predators that support conservation biological control, and large savings to growers (Ellsworth et al. 2017). However, when growers use non-selective insecticides, increased spraying results in significant losses. For example, in 2012–2014, as rates of non-selective insecticide use increased in Arizona to cope with a brown stink bug outbreak, the frequency of spraying doubled because of lost biological control of whiteflies, mites, and aphids. Source: *APMC Pesticide Use Database*, Ellsworth & Fournier, unpubl.

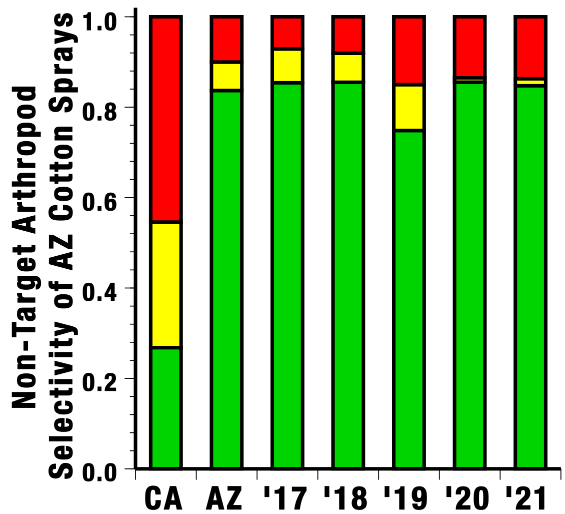

Figure 4. Comparison of measurement systems, here depicting proportional use of fully (green), partially (yellow) or non-selective (red) insecticides through time and location. CA, 2017 use pattern in California cotton based on a census of all insecticides used there. AZ, 2017 use pattern in Arizona cotton based on a survey sample of all insecticides reported to the State. ‘17–’21, Use patterns for Arizona cotton based on chemical use surveys performed as part of the Cotton Pest Losses and Impact Program workshops. Note how similar AZ and ’17 are for estimating the same behaviors in 2017. This gives us confidence that the two reporting methods are reflecting accurate behaviors of our Arizona cotton growers. Sources: *CAL-DPR Pesticide Use Database*; *APMC Pesticide Use Database*; and *Cotton Pest Losses Database,* Ellsworth & Fournier, unpubl.

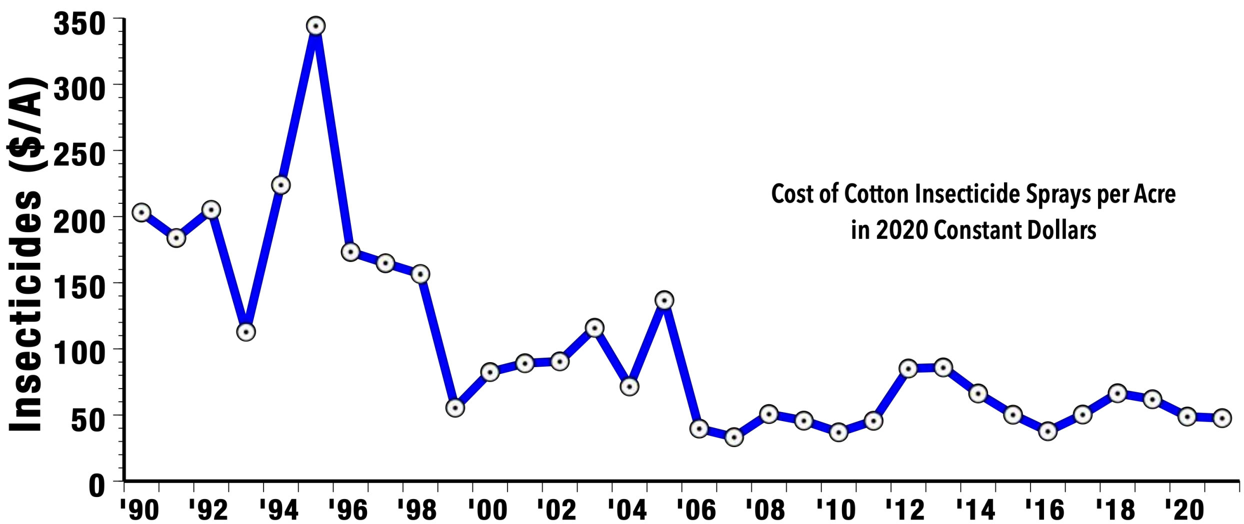

Figure 5. Growers have saved more in the last 16 years in insecticide costs than at any other time in history. Foliar insecticide costs inclusive of cost of applications in Arizona cotton since 1990. Eleven of the last 16 years are among the lowest costs in more than 40 years. Source: *Cotton Pest Losses Database*, Ellsworth, unpubl.

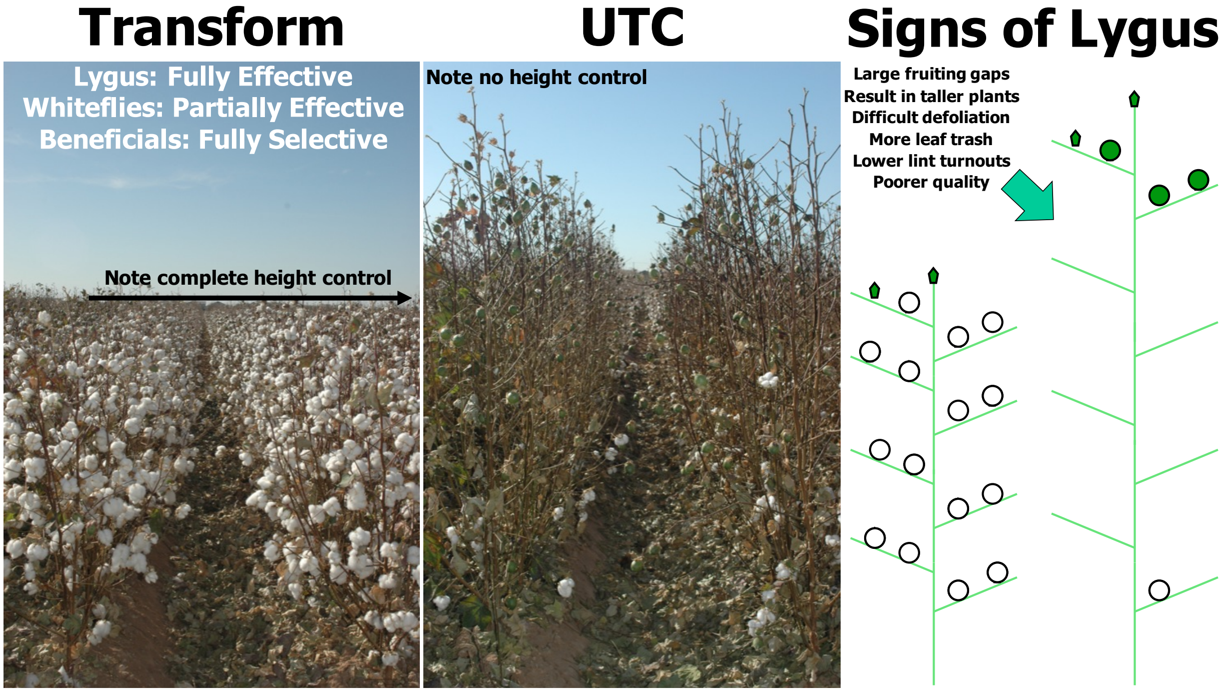

Figure 6. Photos from a replicated, Lygus field efficacy trial showing the central two (of 12) rows of a representative plot sprayed three times on threshold with Transform (2.1 oz / A, left) in comparison to the untreated check (UTC, middle) and a schematic (right) of the damage dynamic caused by *Lygus hesperus* in Arizona (modified from Ellsworth, 2020[1]). Lygus damage is evident in yield, which was 6.3 times higher in the Transform treatment compared to the UTC. Plant growth is also 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 without negative impacts on predators and other beneficials in the Arizona cotton system.**

[1] Ellsworth, P.C. 2020. Declaration on sulfoxaflor in cotton in Case No. 19-72109 & 19-72280. United States Court of Appeals for the Ninth Circuit. 57 pp.

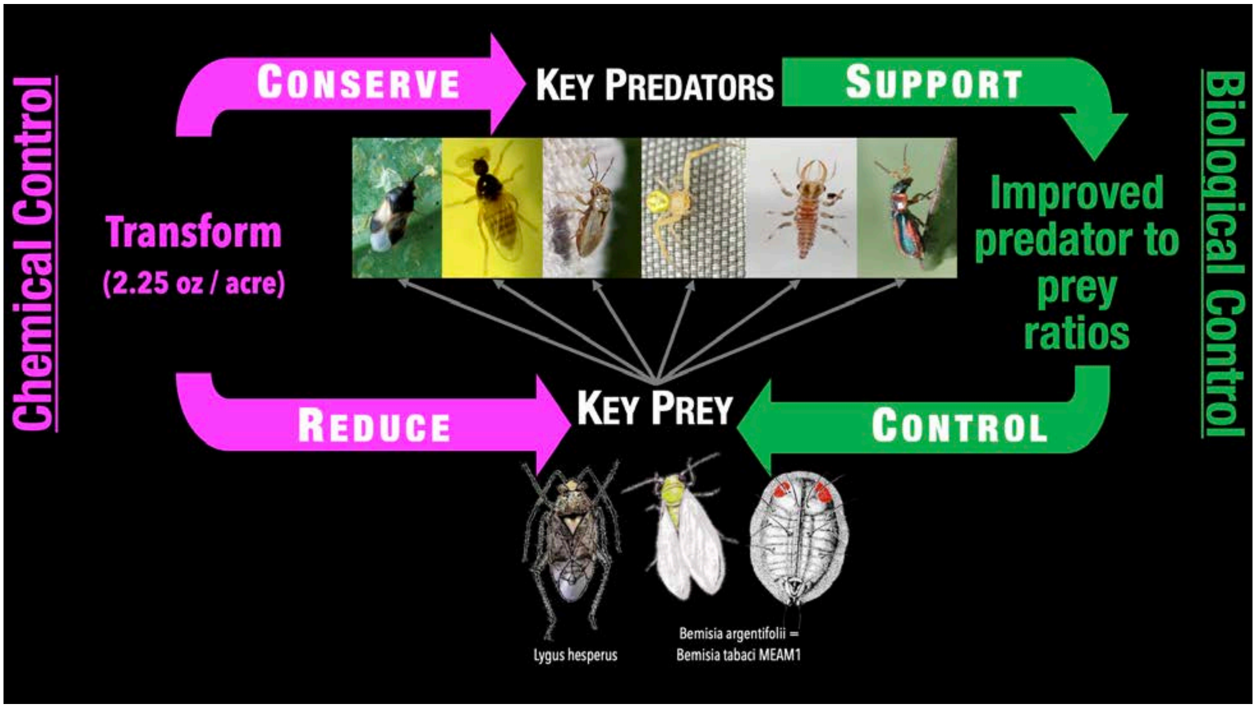

Figure 7. Transform use in cotton reduces target pests, conserves non-target arthropods including key predators, supports improved predator to prey ratios and therefore successfully integrates chemical with biological controls. Re-drawn from Bordini et al. 2021.

Geographic Distribution of Sulfoxaflor Use in Arizona

Risk to non-target threatened and endangered species is largely related to proximity to habitat potentially used by these species. The State of Arizona has a system of pesticide use reporting that includes 100% use reporting for all aerial applications. This enables the tracking of usage at a level not possible in any other jurisdiction other than California, which has 100% use reporting for all agricultural applications.

The APMC Pesticide Use Database has tracked all sulfoxaflor applications to better understand the geographic extent and intensity of use statewide, 2013–2020 or eight years of use. Maps of these uses are provided in Appendix A.

Most crop production is in low desert valleys throughout southern Arizona. Broad-acre crop production is concentrated in central Arizona, within land use Ranges 9W to 9E just above and below the State's baseline at 3N to 11S (see Figure 8). High value vegetable, melon and other specialty crops are concentrated in southwestern Arizona. Field, forage and tree crops are present in southeastern Arizona.

Most sulfoxaflor use is in central Arizona on broad-acre crops, such as cotton and alfalfa, though sulfoxaflor is important to many crops in all agricultural areas. Despite this importance, it is rarely used on more than 10% of the land mass of any given region. In fact, >10% of land mass treated with sulfoxaflor occurs only for cotton in central Arizona (Figure 8). Sulfoxaflor sprayed acreages for most other crops is well below 1% of the land mass area.

Given sulfoxaflor's remarkable safety and its limited use and distribution in the state, we therefore conclude that the sulfoxaflor use patterns in Arizona are unlikely to present any undue risk to threatened and endangered species or their habitats.

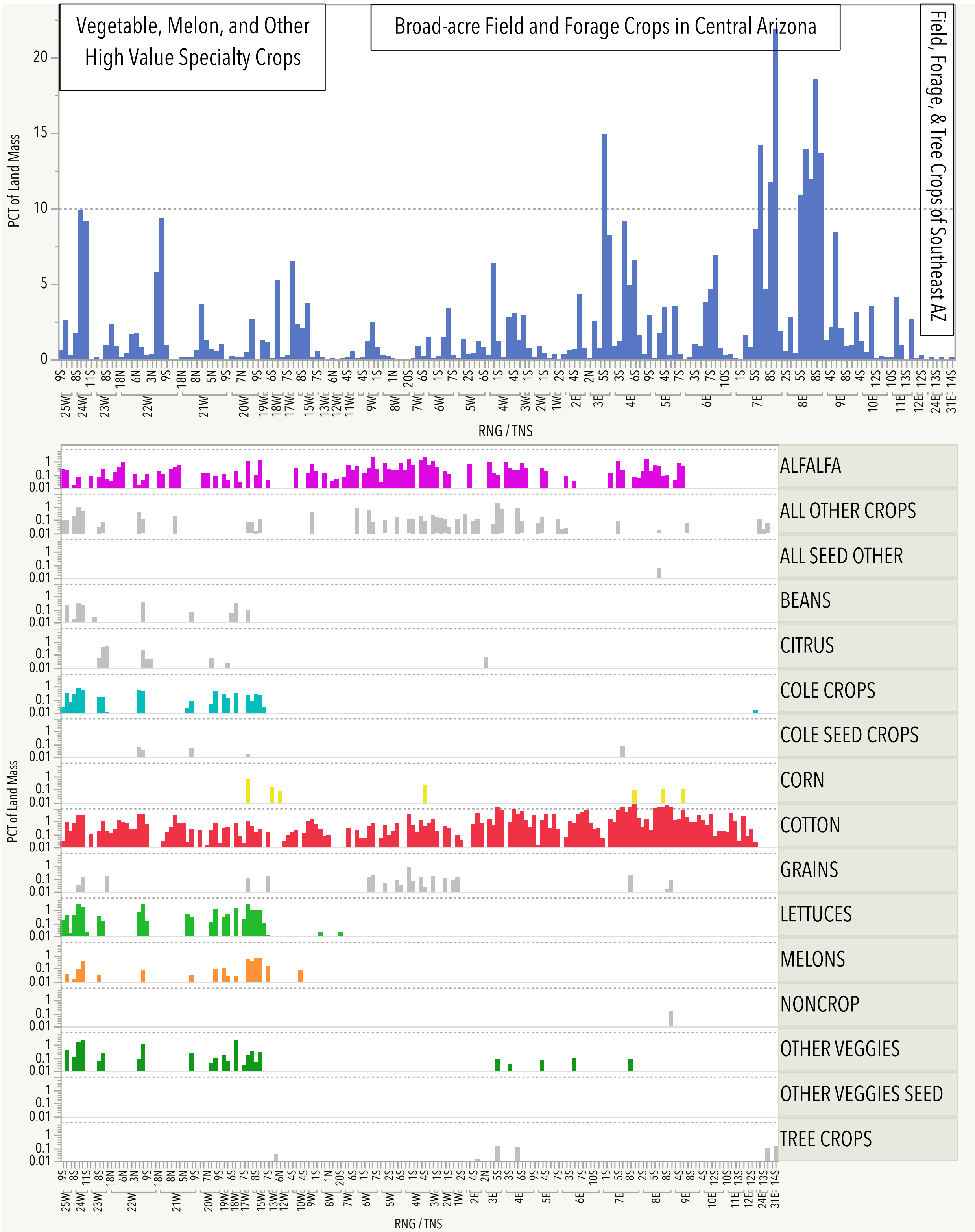

Figure 8. Percent of land mass sprayed with sulfoxaflor per year over an 8-year period in Arizona (2013 – 2020) by Township and Range (each ca. 36 square miles or 23,040 acres of land mass) for all crops sprayed (top) and by crop group (bottom). Note the log scale with grid line at 10%.

Response to Risk Mitigations Proposed by Corteva AgriScience
In its public notice, EPA requested comments from stakeholders on mitigations proposed across sulfoxaflor labels by the registrant, Corteva AgriScience. We reached out to licensed pest control advisors in Arizona and southeastern California, and to University of Arizona scientists to provide input on the proposed mitigations. Below, for each of the major crop uses of sulfoxaflor, we present an overview of use practices and specific responses to proposed mitigations.

<u>Cotton</u>
In 2021, Arizona produced 129,000 acres of upland cotton with a value exceeding $142 million for cotton and cotton seed production combined (USDA- NASS 2022). Upland cotton in Arizona produces per acre yields larger than that of any other state or region of the world, while contributing over $700M annually to our state's economy (Ellsworth et al. 2016). Since the introduction of key technologies and IPM programs to support their use in 1996, we estimate cotton growers in our state have cumulatively saved over $600 million (Ellsworth & Fournier 2022).

Cotton is the number one crop for sulfoxaflor use in Arizona, with over 494,000 acres reportedly treated between 2013 and 2020. This is a conservative estimate, as ground applications that are grower-applied do not require reporting. Cotton acres are distributed from Yuma Valley and western LaPaz County in the western part of the state, throughout central Arizona (Pinal, Maricopa and Pima Counties), and at higher elevations in the southeastern part of the state (Graham and Cochise Counties).

Sulfoxaflor is used in cotton to control Lygus and to collaterally suppress whiteflies, the two most significant pests of Arizona cotton. Lygus and whiteflies were targeted in 2021 by 82% of the total sprays made against arthropods in Arizona cotton (83%, 2015–2020), based on Cotton Pest Losses surveys. Whiteflies are the number one quality-limiting pest. Lygus bugs are the number one yield-limiting pest, with yield losses over 50% possible if they are not effectively managed. Together, Lygus and whiteflies were responsible for 89% of the arthropod related yield loss in 2021, which stood at 5%. Nearly all cotton grower's sprays made for whiteflies and Lygus are with fully selective materials that are safe to the beneficials in the system (Figure 1; Ellsworth & Fournier 2022).

In general, growers have sprayed Lygus 1.2 to 1.6 times per season over the last several years. Typically, growers rotate their sprays between Transform (sulfoxaflor) and Carbine (flonicamid), the two accounting for >95% of all Lygus-targeted sprays. In our sampling, these two products about split the market with half of the sprays being Transform and half being Carbine. Thus, on average, 0.6–0.9 sulfoxaflor sprays are deployed against Lygus, noting that this average includes all acres such as those that are not sprayed for Lygus at all. In 2022, over 22% of statewide cotton acres went unsprayed for arthropod pests. While some early-season treatments of insecticides may be applied by ground in Arizona, aerial applications are critically important. Once the canopy closes, acreages are inaccessible by ground. We estimate that in the case of sulfoxaflor, roughly 80% of applications are made by air (Ellsworth & Fournier 2022).

Because of the importance of sulfoxaflor for management of key pests in Arizona, and the need to apply by air, we are pleased that Corteva's proposed mitigations do not include any limitations on the use of sulfoxaflor in cotton, including aerial applications.

Alfalfa

Alfalfa is one of Arizona's top crops annually, in terms of acreage and value. In 2021, Arizona produced 275,000 acres of alfalfa hay valued at over $468 million (USDA-NASS 2022). Arizona growers have the highest alfalfa yields in the nation, with 8.4 tons per acre on average, compared to about 6.4 tons per acre in California. The national average is 3.4 tons per acre (Blake 2019).

Alfalfa is the number two crop for sulfoxaflor use in Arizona, with over 74,200 acres reportedly treated between 2013 and 2022[2]). Alfalfa is the largest-acreage crop in Arizona. Plantings are distributed from Yuma Valley and western LaPaz County in the western part of the state, throughout central Arizona (Pinal, Maricopa and Pima Counties), and at higher elevations in the southeastern part of the state (Graham and Cochise Counties).

The primary target pest of sulfoxaflor applications in alfalfa is aphids. A number of aphid species can cause significant yield losses in alfalfa, including blue alfalfa aphid, pea aphid, spotted alfalfa aphid, and cowpea aphid (Knowles 1998, Palumbo & Tickes 2015). Aphids are often controlled with broad-spectrum insecticides, destructive to natural enemy populations which could otherwise help control pest populations in alfalfa and the wider agricultural landscape. Sulfoxaflor, as a selective, reduced risk insecticide, is an important alternative to broad-spectrum materials, including pyrethroids and organophosphates.

We are pleased that Corteva's proposed mitigations would allow continued use of aerial applications on alfalfa, be it at a reduced maximum single use rate. Based on reported sulfoxaflor uses in the Arizona Pest Management Center Pesticide Use Database, about 82% of sulfoxaflor applications are made by air (Fournier et al. 2017).

Lettuce and other Vegetable Crops

Arizona growers are one of the leading producers of fresh-market vegetables in the U.S., producing vegetables and melons at an estimated total economic contribution of over $2.5 billion in 2015 (Kerna et al. 2016). This includes about 90% of all fresh lettuce consumed in the U.S. in the winter (Satran 2015). In 2021, the combined value of production for head lettuce, leaf lettuce and romaine exceeded $651 million, with production on 63,900 acres (USDA-NASS 2022).

Lettuce is the number three crop for sulfoxaflor use in Arizona, with over 35,800 acres of head, leaf and Romaine lettuce combined reportedly treated between 2013 and 2020. Other vegetable crops with a significant footprint in Arizona include spinach (11,500 acres harvested in 2021), melons (14,200 acres), broccoli (11,200 acres), cauliflower (5,800 acres) and other cole crops (USDA-NASS 2022). Each of these crops rely on sulfoxaflor on only a small percentage of acres annually. A wide range of other vegetables grown on a smaller scale also make use of sulfoxaflor for insect control, including chile peppers, celery, peas, arugula, Swiss chard, mustard greens and

[2] 2021 and 2022 data are included but known to be incomplete for those years.

many others. Again, acreage of sulfoxaflor use is very limited for these crops. The majority of vegetable crops, and nearly all lettuce in Arizona, are produced in Yuma County, although there is some production (much of it organic) in central Arizona.

A number or Corteva's proposed mitigations could potentially impact our producers, as summarized below.

Elimination of Aerial Applications

According to Dr. John Palumbo, Professor, Extension IPM Specialist, and Endowed Chair in Integrated Pest Management at University of Arizona, growers and Pest Control Advisors understand sulfoxaflor's performance on produce and melons is optimal when applied by ground, particularly for control of aphids in lettuce/brassicas and whiteflies on melons. While prohibition of aerial applications would be a setback to produce and melon growers (for reasons explained below), at least they would still have the product available to them. So sulfoxaflor is likely to continue to be used for aphid and whitefly control in the desert.

Some of the main reasons why sulfoxaflor is often applied in vegetable crops by air include:

(1) For many crops, growers risk damage to produce when making applications with ground equipment after a certain growth stage of the plants. This is especially true for certain lettuces (e.g., Romaine), cauliflower, broccoli and peppers.
(2) For critical pests such as aphids, whiteflies or lygus, PCAs follow established thresholds and treatment guidelines. Regardless of which crop, sprays must be timely in order for them to effectively reduce pest populations and to avoid additional follow up sprays. Depending on other farm activities or weather conditions (rain), or how recently a field was irrigated, treatment by ground might not be feasible.
(3) For some crops, after a certain growth stage fields may be kept too wet with frequent irrigations for ground applications feasible. One example of this is celery.

There are alternative insecticides for management of aphids and whiteflies, some of which allow for aerial applications on some crops. That being said, as a translaminar material which is selective and effective against several key pests, sulfoxaflor has played an important role in vegetable IPM programs. While aerial applications are less effective than those made by ground, because of coverage issues, growers still find aerial applications to be effective enough to make them economically viable in several of these crops. As the only insecticide in the 4C IRAC group, sulfoxaflor also provides a good rotational partner in integrated resistance management programs.

Based on crop-specific input directly from licensed pest control advisors, we offer the following observations:

Leafy Greens (lettuces and spinach). Growers make applications by ground whenever feasible, to ensure the best coverage and level of control. However, once lettuce heads get larger, and particularly for Romaine, it can be damaging to the crop to use ground equipment. While there are a number of alternative products for aphid control, such as Movento (spirotetramat), Sivanto (flupyradifurone) and Beleaf (flonicamid), aphids require a number of applications throughout the growing season, due to rapid population growth. These products are used in rotation, and sulfoxaflor can be the best option in some situations. Sequoia (and previously Closer) is a go-to product early in the season when ground applications are often still feasible, but in many cases, it may also be applied later by air.

According to one PCA, ground applications can be made throughout the season in baby spinach, as long as the ground isn't wet. This is because wider spacing of the beds makes the fields more accessible to ground equipment. When fields are wet and aphids are at threshold, applications by air may still be needed, but these applications are in a minority.

Elimination of aerial applications in leafy greens would have some negative impacts on the majority of our growers. For baby spinach, the impacts may be minimal.

Brassica (broccoli & cauliflower). A minority of brassica growers are on drip irrigation and are able to make most applications by ground. For them, the proposed mitigations would have a minor impact. Growers on furrow irrigation (more common) make early applications by ground (from planting to mid-sized plants). While most growers prefer to apply by ground any time they can, this can be a small percent of the time, usually only during the first month for most brassicas. In the later stages, insecticide applications are made by air. These are water-intensive crops, and fields are often too wet to spray by ground. Furthermore, there is the possibility of damaging the crop with ground equipment.

Elimination of aerial applications in brassica would have a negative impact on the majority of our growers.

Cucurbit Vegetables (melons). In most cases, applications in cantaloupe and other melons are made by ground. According to one PCA, aerial applications of sulfoxaflor "don't work well" for control of whitefly, the primary target pest in melons. Furthermore, sulfoxaflor typically goes on early, as it must be applied prior to bloom to prevent harm to foraging bees. In rare cases, aerial applications may be made.

Elimination of aerial applications in melons is expected to have minimal impact on our growers.

Leafy Petiole Vegetables (celery). Sulfoxaflor use in celery is occasional but important for control of aphids, thrips and whitefly. While growers will apply by ground when they can, after the earliest stages celery is heavily irrigated, and the ground stays wet throughout the remainder of the season, making access by ground impossible. An analysis of all reported aerial applications in celery from 2013 through 2022[3] shows that a range of rates are used, depending on the pest. The analysis shows that 33% of Closer applications are from 4.25 to 5.75 fl oz/A for whitefly and thrips control. The mean application rate is 3.8 fl oz/A, and the median is 3.9 fl oz/A. A Pest Control Advisor familiar with pest management practices in celery explained that, although the crop is not often treated with sulfoxaflor, the current maximum use rate of 5.75 fl oz/A is critically important for thrips control. **Elimination of aerial applications in celery, or a rate reduction, would have a negative impact on the majority of our growers.**

[3] 2021 and 2022 data are incomplete at this time.

Fruiting Vegetables (Chiles). Arizona has small but significant production of chile peppers, including both organic and conventional production. Transform is used in conventional peppers to control aphids and plant bugs. Chile peppers are typically grown on 30-inch rows. Fields are kept wet part of the year to support fruit production. Depending on the time of the year and growth stage of the plant, ground applications can be problematic. After fruiting begins, all applications are by done by air. This is to prevent damage to or loss of fruit from ground equipment, and also to prevent the spread Phytophthora within the field.

Phytophthora species are soil-inhabiting pathogens favored by wet conditions (Perry 2006). Phytophthora attacks the roots or the fruit of the pepper plant, and flourishes under high heat and wet conditions, especially during the monsoon season. The pathogen, *Phytophthora capsici*, is splashed by rain events from the soil to the fruit, and infection occurs when the fungus directly penetrates the skin, leading to lesions and unmarketable fruits (Goldberg 2001). Plants often die within a few days of showing symptoms, which include wilting or a change in color of the leaves. Phytophthora infection can cause partial to total loss of the crop (Babadoost 2005).

Given concerns about Phytophthora and damage to fruit, **Elimination of aerial applications in peppers would have a negative impact on conventional growers in Arizona.**

Onions and Garlic. Sulfoxaflor isn't currently used in these crops in Arizona.

<u>Tree Nuts</u>

In 2021, Arizona produced 22,000 acres of pecans valued at $93 million (USDA-NASS 2022). In pecans and pistachios, sulfoxaflor is effective against aphids that cause damage to young tree nuts, leading to reduced yields and potential crop destruction. Pecan production occurs mainly in the southeast portion of the state (Cochise and Graham Counties), and to a lesser extent in central Arizona and Yuma County.

Based on input from PCAs in southeast and central Arizona, up to 98% of applications of sulfoxaflor are made by ground. Aerial applications may occur when growers fall behind schedule with ground equipment, due to labor shortages or wet ground, such as after storms. There are some orchards, not the majority of acres, where plantings are close, with narrow spacing between trees. In these situations, aerial applications may be necessary to protect the crop and reduce yield loss.

Elimination of aerial applications in tree nuts, impacting pecans and pistachios, would have a negative impact on a small portion of our growers.

<u>Citrus</u>

Transform is sometimes used for control of Asian citrus psyllid in lemons and other citrus. The Asian citrus psyllid vectors the bacterium that causes citrus greening. Citrus greening, also known as HLB, is the most destructive disease of citrus. This disease can destroy all types of citrus trees, including orange, grapefruit, lemon, lime, kumquat, tangerine, and relatives like orange jasmine (TCPDMC 2022).

According to a PCA knowledgeable about practices in Arizona citrus, growers try to avoid aerial applications and deliver materials by ground as much as possible. Sulfoxaflor is not a primary insecticide for them, but it is used occasionally. For example, in 2021, nearly 2,400 acres of lemons were treated, according to the Arizona Pest Management Center Pesticide Use Database. All of these applications were by ground (Fournier et al. 2017).

Elimination of aerial applications in citrus is not expected to be problematic for our growers.

Proposed Reductions in Aerial Application Rates

<u>Root & Tuber Vegetables (beets)</u>
We have very little use of sulfoxaflor in beets. **Proposed reductions in aerial application rates for beets are not seen as problematic for our growers.**

<u>Alfalfa</u>
The current label for Transform WG lists the maximum singular use rate at 0.75 – 1.0 oz/A for aphids, and for Western tarnished plant bug at 1.5 to 2.75 oz/A. In our analysis of all reported aerial applications in alfalfa from 2013 through 2022,[4] only 3.7% of aerial applications exceeded the proposed reduced rate of 2.25 oz/A. The mean use rate is 1.25 fl oz/A, and the median rate is 1.0 fl oz/A. Most Pest Control Advisors agree that this rate is sufficient for aerial control of pests. One PCA noted that for leaf hopper control, the current maximum label rate is used, sometimes by air.

Based on input from several licensed Pest Control Advisors who work in alfalfa, from Dr. Ayman Mostafa, Extension Agent and Area Programmatic Specialist who conducts alfalfa insect management research, as well as our own rate analysis, we conclude that **the proposed reduction in the single use rate for aerial applications to 2.25 oz/A would not be problematic for Arizona alfalfa growers.**

<u>Dry Beans</u>
Based on an analysis of reported pesticide use data, nearly 98% of reported applications of Transform in dry beans were at the current maximum use rate of 2.25 fl oz/A, and all reported applications are by air. A PCA familiar with the use of Transform in dry beans indicated that the maximum use rate is critical for Lygus control and suppression of stink bugs in dry beans. Both types of insects are seed feeders and can cause substantial losses for growers. Lower use rates of sulfoxaflor are ineffective against these pests. Our overall acres of dry beans statewide, while difficult to quantify, is not very large.

Proposed reductions in aerial application rates for dry beans would have a negative impact on our growers.

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[4] 2021 and 2022 data are incomplete at this time.

Thank you for the opportunity to comment. Please feel free to contact us with any questions.

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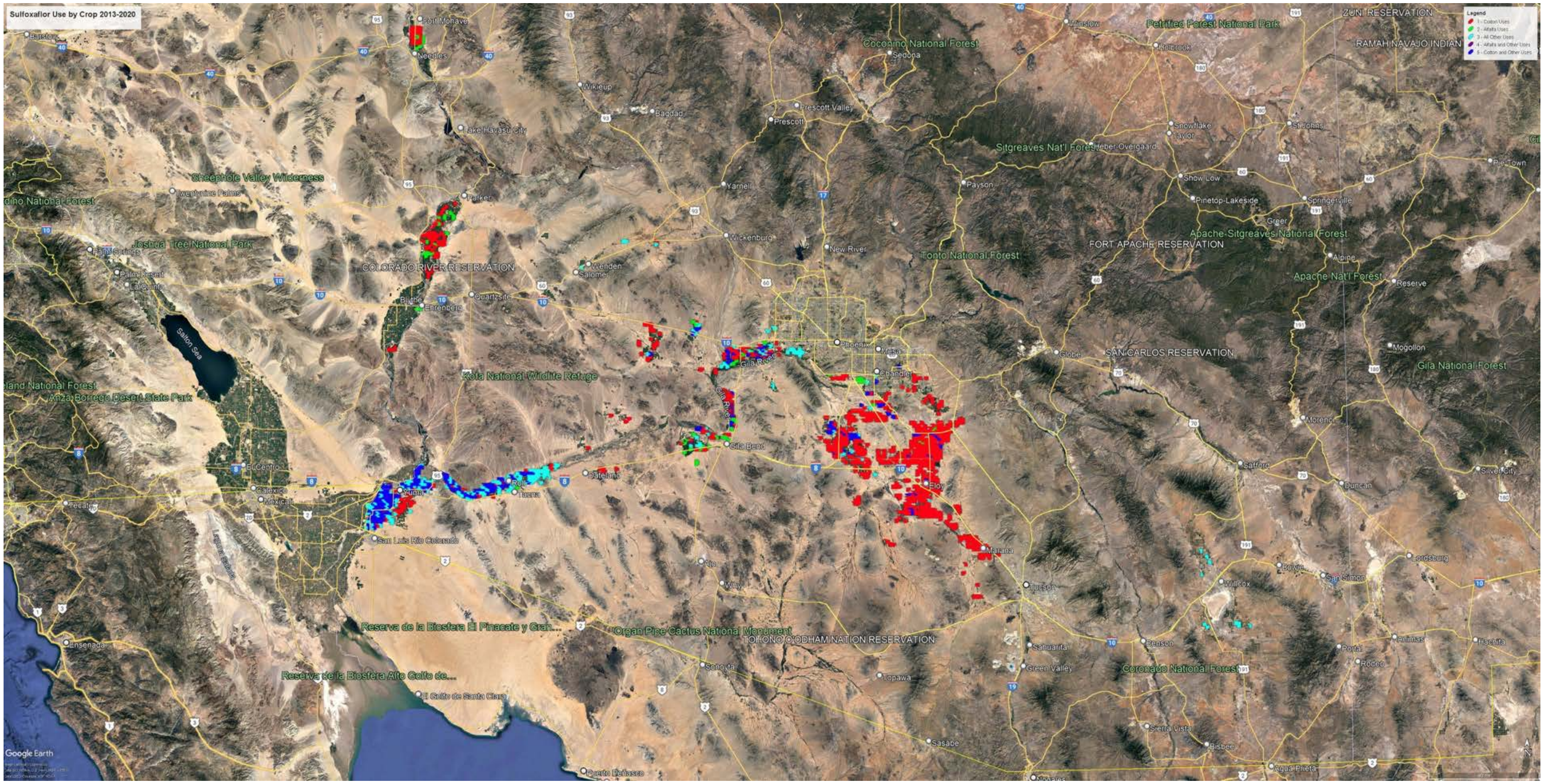
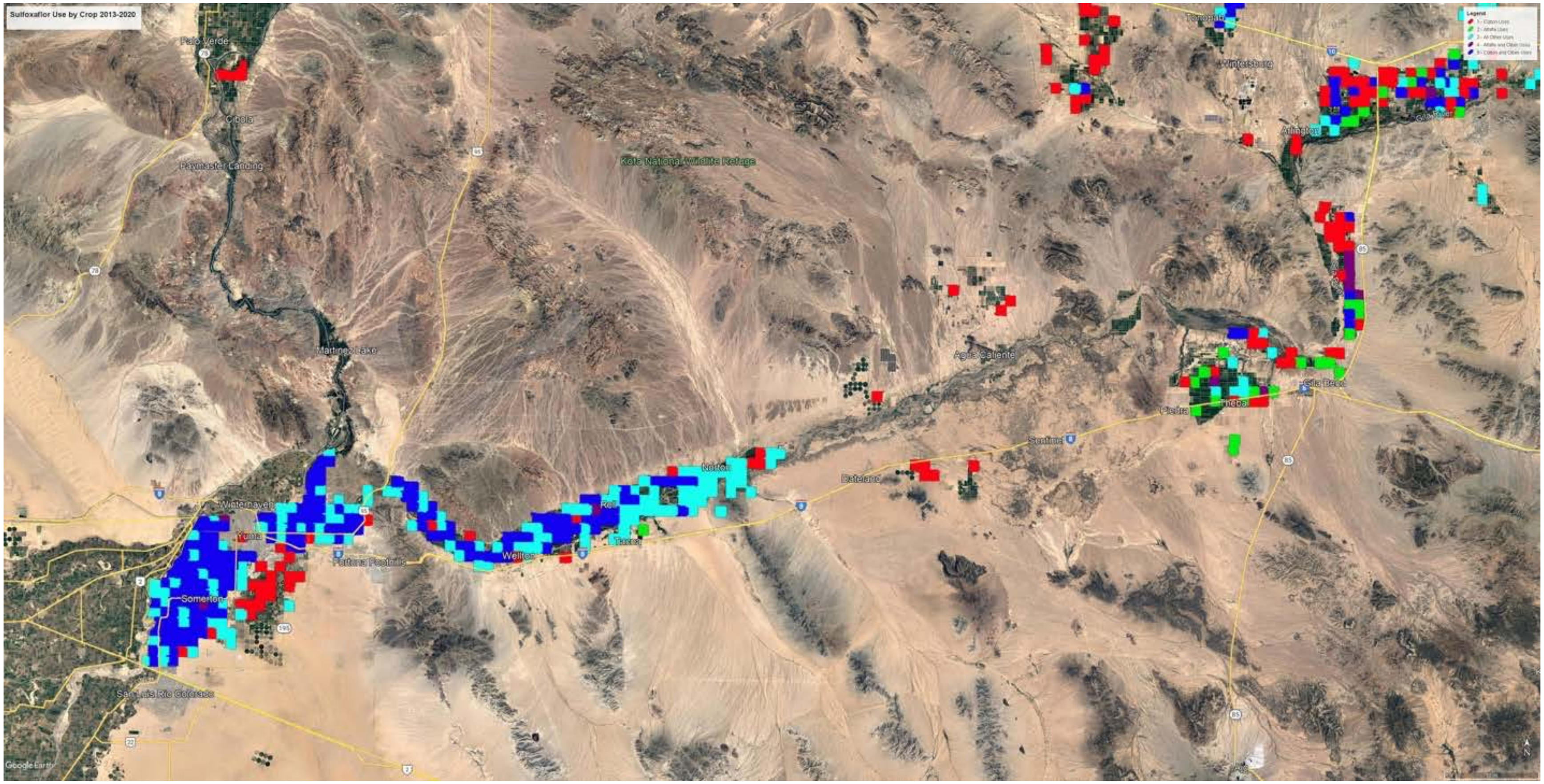
Appendix A. Geographic distributions of sulfoxaflor use in Arizona crops, 2013–2020.

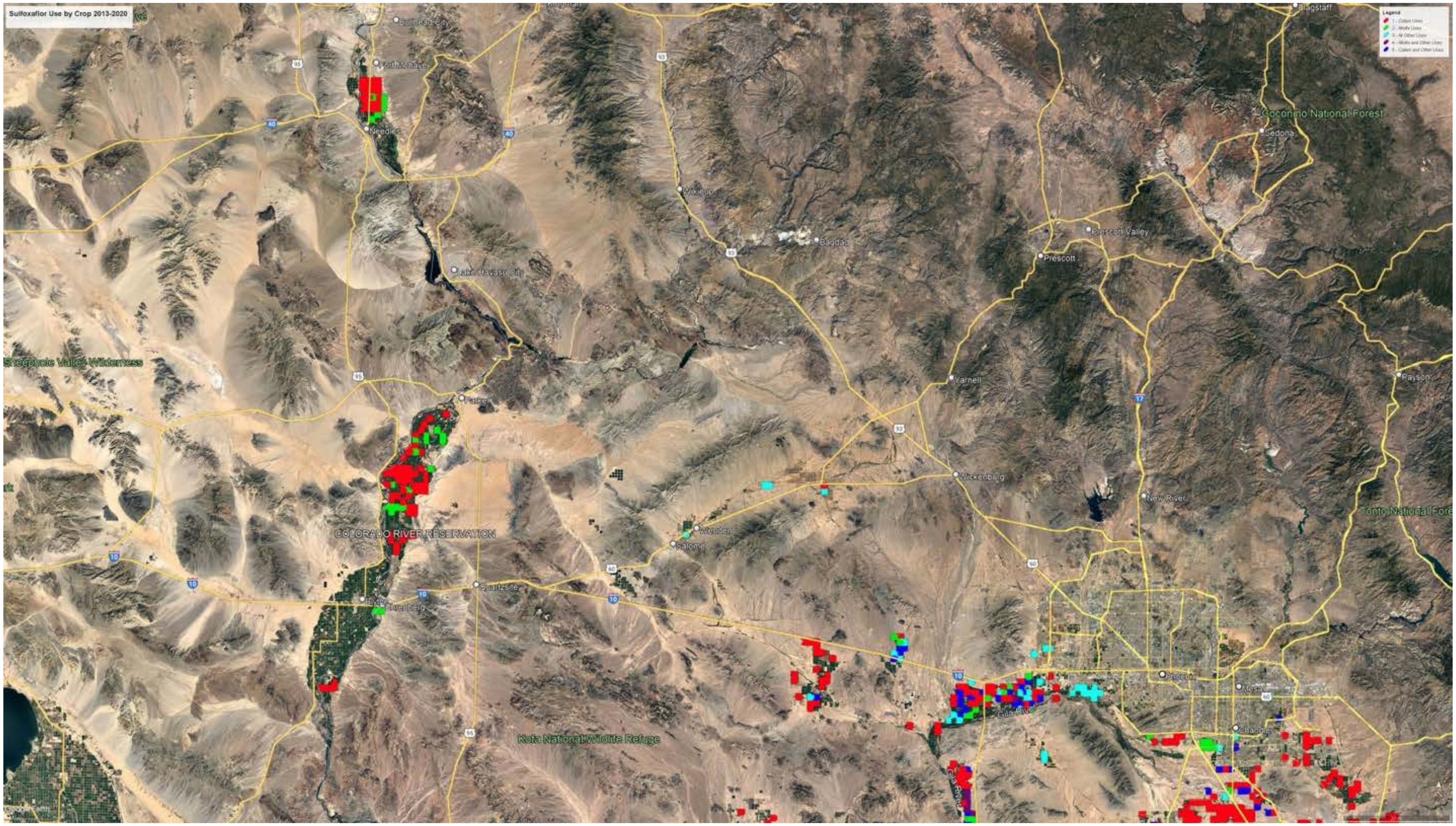
Map 1: State of Arizona
Map 2: Yuma region
Map 3: Western and north central Arizona
Map 4: Central Arizona
Map 5: South central and eastern Arizona
Map 6: Close up of western Yuma County
Map 7: Close up of La Paz County



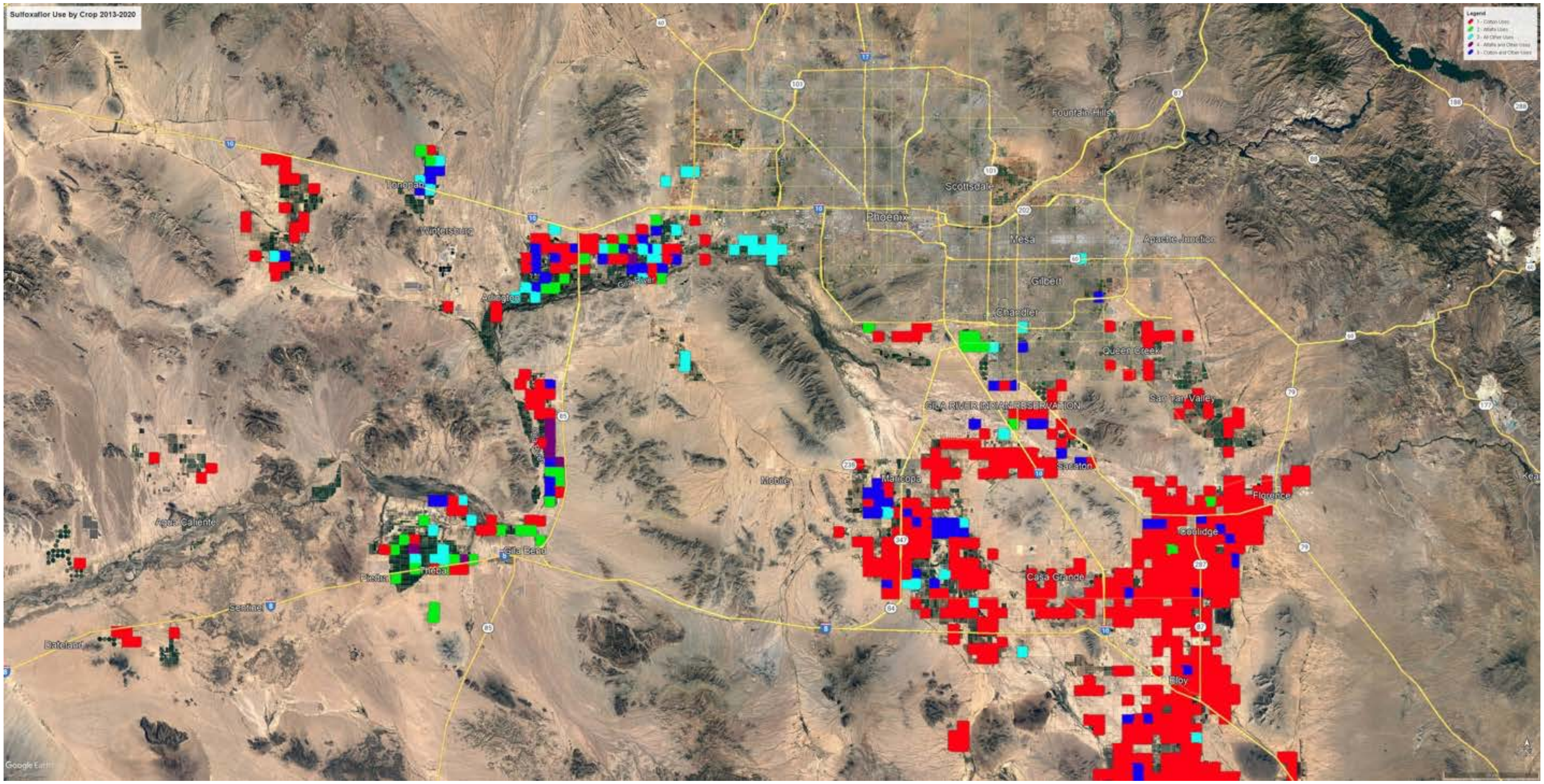
Map 1: Distribution of all sulfoxaflor use by crop, 2013 to 2020, in Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



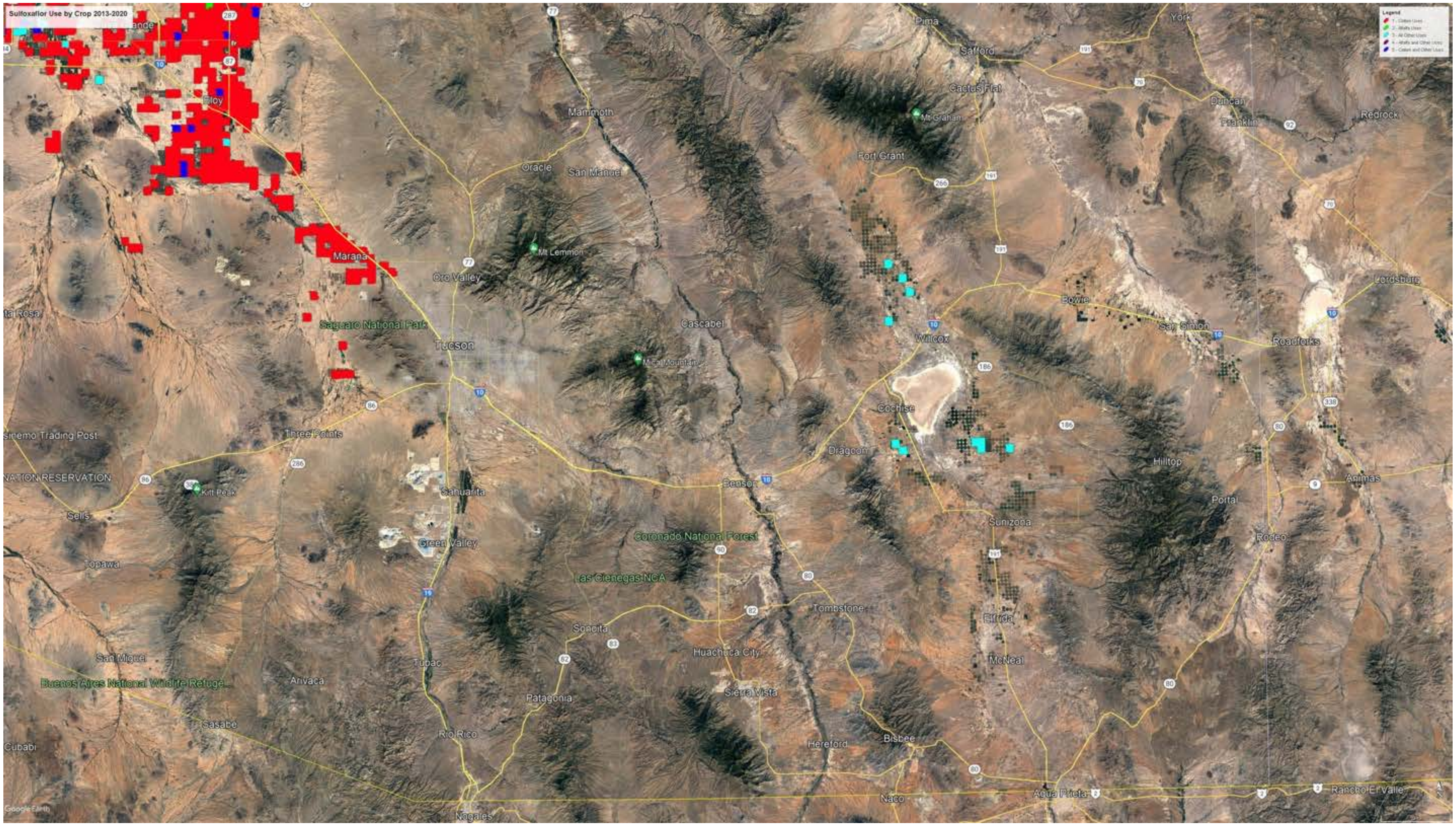
Map 2: Distribution of all sulfoxaflor use by crop, 2013 to 2020, in the Yuma region of Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



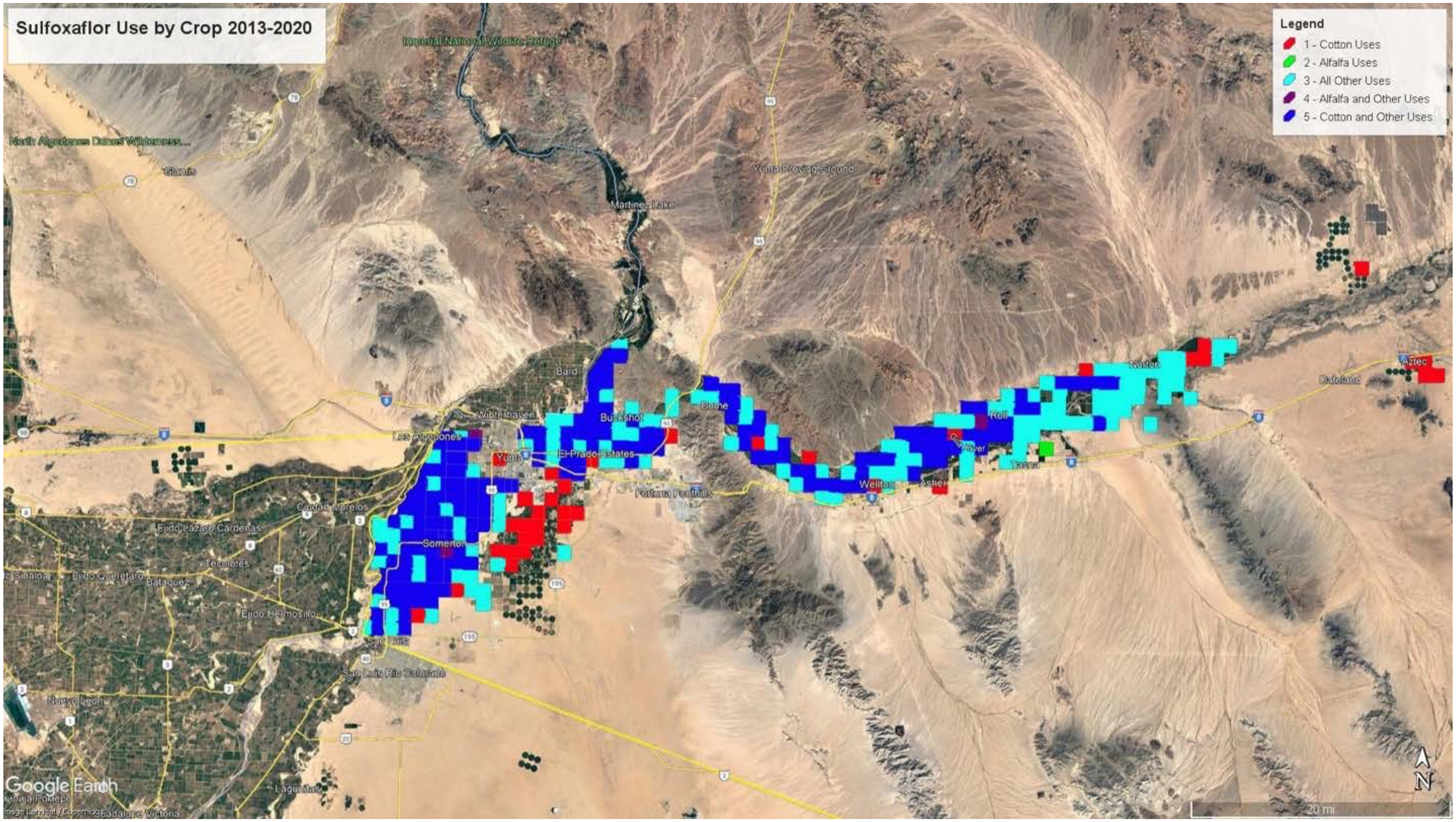
Map 3: Distribution of all sulfoxaflor use by crop, 2013 to 2020, in western and north central Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



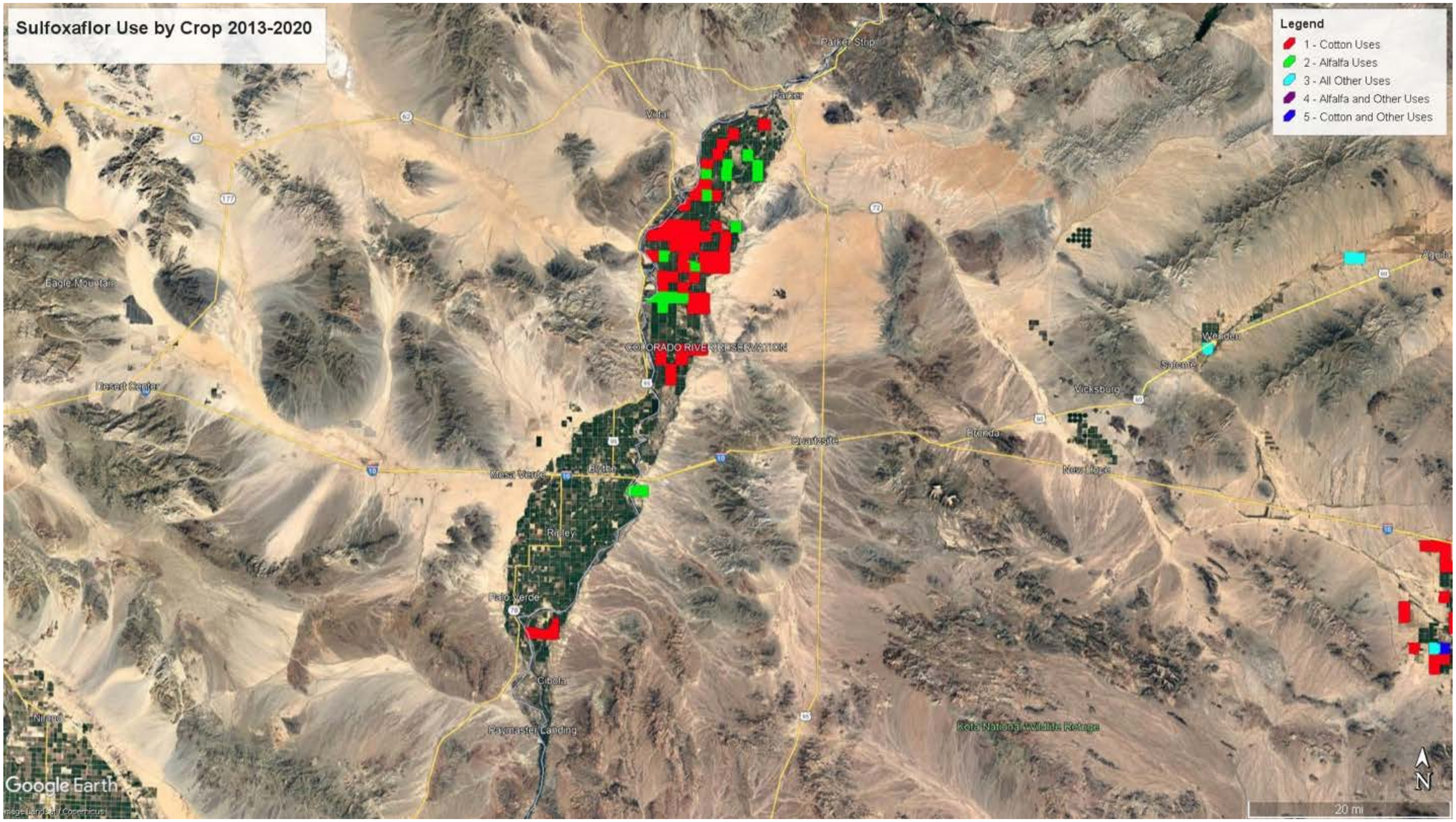
Map 4: Distribution of all sulfoxaflor use by crop, 2013 to 2020, in central Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



Map 5: Distribution of all sulfoxaflor use by crop, 2013 to 2020, in south central and eastern Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



Map 6: Distribution of all sulfoxaflor use by crop, 2013 to 2020; close up of western Yuma County, Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.



Map 7: Distribution of all sulfoxaflor use by crop, 2013 to 2020; close-up of La Paz county, Arizona. Red = cotton uses; green = alfalfa; light blue = all other crops; purple = alfalfa plus other crops; dark blue = cotton and other crops, including alfalfa. Resolution is by section, each about 1 square mile or 640 acres.