October 22, 2023

Ms. Jan Matuszko
Director
Environmental Fates and Effects Division
Office of Pesticide Programs
Environmental Protection Agency
1200 Pennsylvania Ave, NW
Washington, DC 20460-0001

Submitted via regulations.gov

RE: Memorandum to Open Docket for Comment "Draft Herbicide Strategy Framework to Reduce Exposure of Federally Listed Endangered and Threatened Species and Designated Critical Habitats from the Use of Conventional Agricultural Herbicides. Herbicide Strategy Framework Document"; Docket No. EPA-HQ-OPP-2023-0365

Dear Ms. Matuszko

Thank you for the opportunity to comment on the U.S. Environmental Protection Agency's (EPA) draft herbicide strategy framework to reduce exposure of federally listed threatened and endangered (T&E) species and their designated critical habitats from the use of conventional agricultural herbicides (EPA-HQ-OPP-2023-0365) (hereafter "herbicide strategy").

The Weed Science Society of America (**WSSA**), along with the Aquatic Plant Management Society (**APMS**), North Central Weed Science Society (**NCWSS**), Northeastern Weed Science Society (**NEWSS**), Southern Weed Science Society (**SWSS**) and Western Society of Weed Science (**WSWS**) (hereafter "**Weed Science Societies**") represent over 3000 weed scientists from around the world. Members include academic, governmental, and private industry research scientists, university extension professionals, educators, land managers, and crop consultants.

We applaud EPA for recognizing how critical this issue is for American agriculture. We need to strike a balance between protecting T&E species while minimizing impacts to growers and

pesticides that help feed and clothe the world. We also express our gratitude for extending the comment period by 30 days.

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Executive Summary

The Weed Science Societies appreciate the opportunity to comment on EPA's draft herbicide strategy. The EPA Office of Pesticide Programs (OPP) invested a great deal of work and thought into designing ways to protect threatened and endangered species and their habitats. The Weed Science Societies suggest nine additional ways to mitigate the impact of herbicides on listed species due to spray drift, which includes decreased buffers for ultra-coarse droplets, additional types of vegetation to intercept spray droplets and grower education. We also suggest six additional ways to mitigate herbicide runoff and erosion, which also includes grower education, more specific terminology for agricultural vs specialty crops as well as assigning more compensatory mitigation points for fields with subsurface drainage or cover crop practices. Most importantly, the Weed Science Societies want to stress that grower education will be the most effective way to implement EPA's Herbicide Strategy. We recommend a minimum of a 3-5 year phase-in period for the herbicide strategy ESA mitigation practices, which corresponds to the 3-5 year interval that pesticide applicators must be recertified.

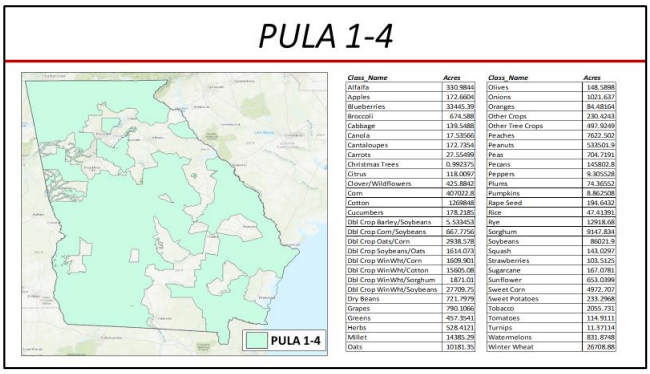
The Weed Science Societies present the results of a survey of weed scientists from across the country that looked at the 13 crop scenarios for pesticide runoff and erosion mitigation points that the EPA provided, plus 2 additional crop scenarios. Alarmingly, only 2 of the 15 crop production scenarios, or 13%, could obtain the nine runoff/erosion mitigation points considered necessary to maintain existing weed control practices. We provide additional information on

conservation specialists and programs in different states as well as a rationale for why EPA should create a database of the mitigation points needed by crop, pesticide use limitation area (PULA), and herbicide. We provide suggestions to enhance "Bulletins Live Two!" as well as a list of topics in dire need of research funding so we can best help protect T&E species and their critical habitat. Finally, we have provided a list of suggested education and training activities to successfully launch the ESA mitigation practices for pesticides.

Pesticide Use Limitation Areas (PULAs)

The first step in protecting listed species is understanding exactly where the species and their critical habitats are located. Whether restrictions being placed on pesticide use are included on the general product label or are specified on geographically specific bulletins, it is essential that up-to-date species ranges are identified. Utilizing accurate species range information when specifying mitigation measures for applicators ensures critical tools are not inaccurately restricted in areas where listed species aren't actually located.

<u>The proposed PULA approach outlined in the Herbicide Strategy ignores scientific accuracy for the sake of simplicity and efficiency</u>. When following the procedure detailed in the draft Herbicide Strategy framework, the impact to Georgia agriculture was calculated and the data suggested the same benefit to the endangered species could be achieved with herbicide restrictions on only 0.4% of the acreage that would otherwise be restricted using the PULA approach. The results clearly demonstrate this broad-brush approach impacts most of Georgia agriculture and is not supportive in cooperating to develop methods that protect agriculture or listed species and their habitats. It is likely that similar results would be observed in other states and with alternative species.



Class_Name	Acres
Alfalfa	330.9844
Apples	172.6604
Blueberries	33445.39
Broccoli	674.588
Cabbage	139.5488
Canola	17.53566
Cantaloupes	172.7354
Carrots	27.55499
Chrismas Trees	0.992375
Citrus	118.0097
Clover/Wildflowers	425.8842
Corn	407022.8
Cotton	1269848
Cucumbers	178.2185
Dbl Crop Barley/Soybeans	5.538453
Dbl Crop Corn/Soybeans	667.7756
Dbl Crop Oats/Corn	2938.578
Dbl Crop Soybeans/Oats	1614.073
Dbl Crop WinWht/Corn	1609.901
Dbl Crop WinWht/Cotton	15605.08
Dbl Crop WinWht/Sorghum	1871.01
Dbl Crop WinWht/Soybeans	27.709.75
Dry Beans	721.7979
Grapes	790.1066
Greens	457.3541
Herbs	528.4121
Millet	14385.29
Oats	10181.35

Class_Name	Acres
Olives	148.5898
Onions	1021.637
Oranges	84.48164
Other Crops	230.4243
Other Tree Crops	497.9249
Peaches	7622.502
Peanuts	533501.9
Peas	704.7191
Pecans	145802.8
Peppers	9.305528
Plums	74.36552
Pumpkins	8.862508
Rape Seed	194.6432
Rice	47.41391
Rye	12918.68
Sorghum	9147.834
Soybeans	86021.9
Squash	143.0297
Strawberries	103.5125
Sugarcane	167.0781
Sunflower	653.0399
Sweet Corn	4972.707
Sweet Potatoes	233.2968
Tobacco	2055.731
Tomatoes	114.9111
Turnips	11.37114
Watermelons	831.8748
Winter Wheat	26708.88

The PULA concept that the EPA is proposing is defined in the Herbicide Strategy framework as follows:

"To efficiently and effectively implement geographically specific mitigations for the Strategy, EPA is not proposing to develop single species PULAs and bulletins, but rather to produce four bulletins, each of which represents multiple species that have common taxonomy and habitats and thus need the same mitigations." (*Pg. 11- Draft Herbicide Strategy Framework)*

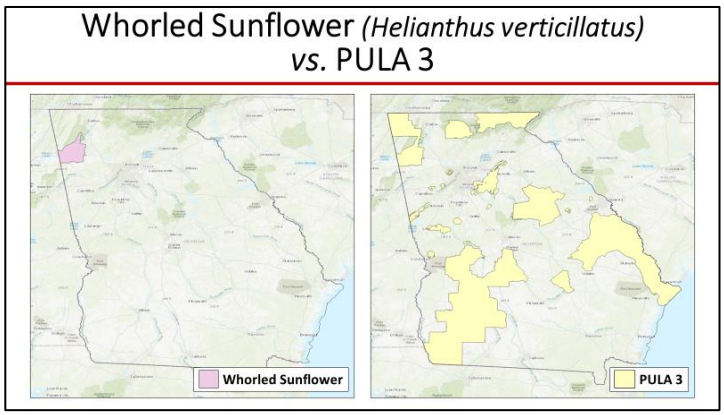
The approach of assuming plants within similar taxonomy classes (monocot, dicot) and habitats (terrestrial, aquatic, wetland) respond to a given herbicide in a similar fashion has been scientifically proven false many times, and sufficient evidence is available throughout the literature. To highlight this point, examples are included below:

- First, the herbicide Basagran (bentazon) effectively controls the plant coffee senna (*caesalpinia family, Caesalpiniaceae, Senna occidentalis)* but does not control sicklepod (*caesalpinia family, Caesalpiniaceae, Senna obtusifolia)*. These two plants have similar

taxonomy (dicot) with the exact same habitat (terrestrial). Furthermore, these two species belong to the same taxonomic rank of *family* and *genus*, while still responding completely different to the herbicide.

- Second, Staple (pyrithiobac) herbicide effectively controls pitted morningglory (morningglory family, *Convolvulaceae, Ipomoea hederacea*) but does not control tall morningglory (morningglory family, *Convolvulaceae, Ipomoea purpurea*). Similar to the example presented above, these species share similar taxonomic characteristics and habitats.
- Many additional examples exist in the literature, such as nutsedge species response to metolachlor or bentazon, and the response of *Amaranthus* species to many different herbicides.

Although the proposed Herbicide Strategy framework has grouped species into four PULAs for purposes of identifying specific mitigation areas, it still appears that the most sensitive herbicide – plant species relationship in the group is ultimately driving the implementation of mitigation measures for all the species in the PULA across the agriculture landscape. As an example of this concept in Georgia, if the Whorled Sunflower (*Helianthus verticillatus)* is sensitive to 2,4-D and triggers mitigation measures, rather than just require mitigations for the locations that contain the one plant species, mitigations will be required for all species in the PULA group. This is clearly an unacceptable approach that is scientifically flawed.



The most scientifically sound and practical method to protect sensitive species, while minimizing the devastating impacts to agriculture is to define PULAs based on the specific interactions between individual species and herbicide sensitivity. Yes, this approach will place much more strain on regulatory agencies and will require greater collaboration with academic scientists to generate much needed data. But the question must be asked, is it more acceptable to be efficient at the expense of placing regulations lacking scientific merit on agriculture, or to work closely with scientists to address the topic accurately for the protection of all entities. The Weed Societies are committed to assisting regulatory agencies with this process.

Generating Accurate Maps for Listed Species Habitats and Farm Fields: If pesticide restrictions are to be put in place based on the geographic location of species ranges, the overlap mapping process of listed species and pesticide use sites must be precise. Again, we respect the work begun recently by FWS to further refine species range maps, however currently the process of using outdated range maps, maps based on habitat that may have historically occurred, or

unrefined range maps based on geopolitical boundaries is flawed and unacceptable. Utilizing conservative ranges when the exact locations of listed species are not defined could potentially increase the "overlap" of pesticide use and species habitat. Furthermore, inaccurate range maps lead to increased pesticide use restrictions, which ultimately impacts more farmland than necessary and consequently the livelihoods of more families.

Included below is a general summary of how Georgia's Endangered Species Pilot Program, a team of diverse partners, is working successfully to identify exactly where two listed species are located in Georgia and understand their proximity to our agricultural fields. The complete summary report from this project, over 50 pages, is complete and has been shared by the University of Georgia with the EPA and the Services.

Endangered Species restrictions were added to the Enlist Duo herbicide label in 2022, removing its use from corn, cotton, and soybeans in 11 Georgia counties. The decision was based on the concept of proactively protecting the frosted and flatwood salamanders from the potential impacts of pesticide exposure, two species which have historical presence in the counties. Combined over a five-year period for each impacted county (following methods outlined in "Revised Method for National Level Listed Species BE of Conventional Pesticides" for determining potential overlap; U.S. EPA, 2020), this restriction ultimately prohibited use of the herbicide on 951,557 acres of cotton, corn, and soybean (USDA NASS 2017-2021). Working with regional species experts, the habitat of the two flatwoods salamanders was defined, data sources were evaluated, and a mapping process was developed to identify the habitats suitable for the survival of these species in each impacted area. The process accounts for both historical habitats that still exist, while also identifying habitats that were either missed in the past or have recently emerged. When developing new range maps for these two species in Georgia, the possible interaction of Enlist Duo pesticide uses, and potential salamander locations were 3,526 acres; 99.63% less than the acres originally prohibited from receiving treatment.

Furthermore, understanding where our agricultural fields are located within spatial datasets, and how these fields "overlap" with listed species ranges in the analysis process is equally important. Therefore, in order to protect both listed species and our family farms, identifying the exact locations of listed species, habitats, and agriculture fields potentially treated with a pesticide allows for a scientific determination of the locations of sensitive sites where protections may be needed and would benefit the target species.

Occurring concurrently, another objective of the Georgia project was to determine the ability of the USDA Cropland Data Layer to accurately identify agricultural fields, for the purpose of representing pesticide use sites and determining potential overlap of these sites with listed species habitat. Results were concerning, as the mapping process identified a large number of spurious pixels in the cropland data layer that were falsely representing production fields or pesticide use sites. In fact, in one example, the represented farm fields in the data layer that overlap with historical listed salamander locations were actually in a housing development established for more than 30 years. It is critical that spurious pixels and other erroneous use sites

are removed from the spatial data used to determine overlap, as they not only misrepresent quantity of pesticide use, but also present a pesticide use site that could interact with species ranges, therefore falsely increasing overlap in the analysis. Additional mapping procedures are currently being developed by the Georgia team, with the continued effort of ensuring exact locations of the listed species and agricultural fields are identified, so protective management plans can be implemented exactly where they are needed on these sensitive sites. An additional concern is that the EPA has merged approximately 300 crops (USDA, 2014) into 11 usage data layers (UDL). By merging multiple crops into one UDL the potential location of an individual crop is lost in the assessment. While making the assessment easier for the EPA, this combination of layers loses individual crop specific characteristics (e.g., use rates, number of applications, season when crop is grown, etc.) that should be considered when considering the risk to threatened and endangered species.

Impact of PULA on Herbicide Resistance Management

If growers use reduced herbicide rates to meet the mitigation requirements, they will increase the potential to select for resistant weeds. Work by Busi et. al (2012) demonstrated that using reduced rates of herbicides rapidly lead to herbicide resistance evolution in *Lolium rigidum* field populations. Reducing herbicide application rates is contrary to recommendations from extension weed scientists across the United States, PRN 2017-1 2017-2, and will serve to exacerbate the already significant management challenges of herbicide-resistant weeds. Resistance to soil-residual herbicides is manifested as reduced length of residual weed control. Reducing herbicide application rates to satisfy mitigation point requirements will further shorten residual weed control, thereby placing additional emphasis on foliar herbicide applications to reduce crop yield loss. The increasing frequency of enhanced metabolism-based resistance mechanisms in *Amaranthus* species has significantly limited the utility of many foliar-applied herbicides previously effective for control.

Potential Economic Impact of PULA on Land and Rent Prices and Gross Revenues

If land is found to be in a PULA, the value of the property and the rent that can be charged for that land will be greatly reduced. Research from Georgia examined the consequences of prohibiting Enlist Duo use throughout 11 Georgia counties for tolerant cotton, corn, and soybean. These 11 counties produce over 374,000 acres of cotton, 104,500 acres of corn, and 13,900 acres of soybean (Univ. of Georgia, 2021). This label restriction impacted over 492,000 acres. While an extreme example, it demonstrates that many acres could be impacted in a single state. Growers will prefer to select land that does not have the agronomic constraints/mitigation requirements inherent in these PULA areas. This will have negative effects on the economic vitality of rural communities, many of which are already struggling.

The Herbicide Strategy framework is said to follow a FIFRA/ESA regulatory process so the economic impact should have been described. The economic impact could be enormous if we consider just a 10% yield loss as a result of regulations prohibiting the use of current weed management tools. Two examples are presented, lettuce and corn/soybeans, from Table 1 the Summary of Crop Scenarios. Using lettuce as an example the 2022 crop value was $12.8 billion

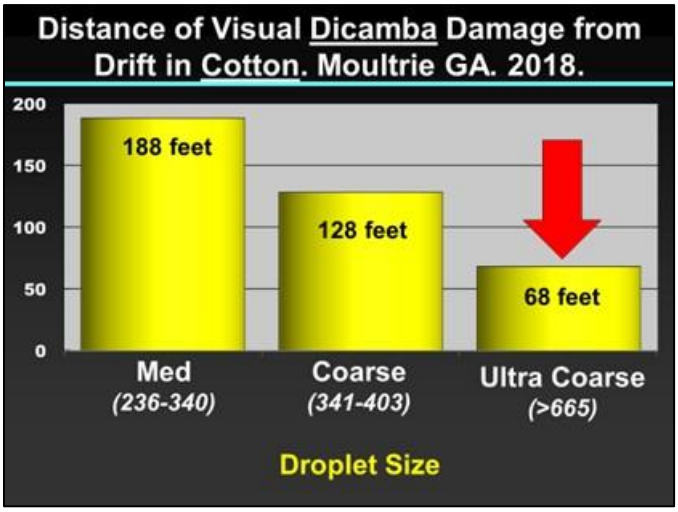
(USDA, 2023). If uncontrollable weeds directly reduce production a mere 10% or cause contamination in which Hazard Analysis Critical Control Point (HACCP) or vegetable distributors standards are not met then a loss of $128 million dollars would occur. If Illinois corn had a 10% yield loss because weeds were not controlled then that loss would equal $147 million dollars for corn and $ 97 million dollars for soybean (USDA, 2022). These three examples alone account for over $370 million dollars which should be considered a major economic impact under FIFRA.

Spray (Particle) Drift Additional Mitigation Suggestions

Chemigation applications may only need a minimum buffer. The Herbicide Strategy framework does not describe spray drift mitigation for chemigation. The WSSA agrees with this premise because the droplet size of 1690 to 3008 microns (Spray Drift Task Force, 1997) for chemigation/sprinkler systems is very large compared to <145 to >500 microns for pesticide sprayers, based on ASABE ratings. The data from the Spray Drift Task Force shows minimum or no drift with this size droplet. Chemigation systems with end guns may still be of concern because they may be incorrectly adjusted and apply pesticides outside the field area. The WSSA suggests that the EPA specifically state that there are no buffer requirements for chemigation applications.

Reduced Buffers for Ultra-Coarse Droplets – Ground Application. The WSSA suggests that ultra-coarse droplets be included in the mitigation list with reduced buffer distances. The proposed *Herbicide Strategy* offers the ability of a pesticide applicator to reduce the required spray buffer distance in some scenarios by increasing the application droplet size from fine to coarse, this decision is supported by science. The agency has also allowed an additional reduction in buffers for aerial applicators when further increasing the droplet size from coarse to an ultra-coarse size, however, this same option is not offered to those making ground applications. In fact, no buffer reductions have been included for ground applications when the droplet size is increased from coarse to ultra-coarse.

Currently, auxin tolerant crop systems have been widely adopted in many states. Many herbicides in addition to the auxin chemistry are being applied with ground sprayers using nozzles that produce ultra-coarse droplets, which significantly reduces the potential for spray drift (adjacent figure).



A survey of Georgia Extension Agents across 34 major agricultural producing counties was conducted to determine the percent of herbicide applications made with ultra-coarse droplets in cotton, corn, soybeans, and peanuts during 2023. With a range of 30 to 100% and an average of 62%, the

number of acres treated with ultra-coarse droplets accounted for 911,459.8 acres in just 34 counties. Thus, one can conclude that well over half of the herbicides applied in row crop production in Georgia were made using ultra-coarse droplets with reduced offsite movement.

Control droplet size using adjuvants. The WSSA recommends that if an adjuvant will be used to produce a specific droplet size that the product be tested and certified using the Application Enhancement Certification Program developed by the Council of Producers and Distributors of Agrotechnology (CPDA). This certification program was developed to verify and test these products and can provide additional confirmation of an adjuvant's performance.

Education – In the Herbicide Strategy framework, currently no credit is provided for education or communication in regard to pesticide stewardship. Education will be critical to explaining and implementing the number of changes that the Herbicide Strategy indicates will take place in weed management and agricultural practices in the U.S. Appendix B provides suggestions on the training materials that will need to be provided to pesticide users and regulators. When the Enlist™ Weed Control and XtendiMax® with VaporGrip® Technology were introduced for weed control the users were required to take training before using the products. The WSSA thinks training will be equally important for educating users on the new spray drift and runoff/erosion mitigation practices.

Georgia agriculture has taken a strong stance on education through developing its flagship pesticide stewardship program, *Using Pesticides Wisely*, in 2015. Based on the latest research, this program provides growers and other pesticide applicators with information on understanding the factors that contribute to on-target pesticide applications. In Georgia, extension agents have been involved with all trainings around the state and have even routinely conducted the annual training within their respective counties, providing another opportunity to connect on a personal level with the growers served on a daily basis. To date, 17,130 individuals have attended the training, leading to a greater than 80% reduction in the number of pesticide drift complaints made to the Cooperative Extension Service. Education should be included as an option to reduce buffer distances, such as providing information to the applicator on the use of hooded sprayers or windbreaks to reduce potential spray drift in the field.

The WSSA suggests that the EPA organize an information gathering session with SFIREG, American Association of Pesticide Safety Educators (AAPSE), Association of American Pest Control Officials (AAPCO), State Lead Agencies (SLAs), Pesticide Safety Education Programs (PSEPs), Extension, retailors, registrants, users, and others to find out what is needed.

3 - 5 Year Phase-in Period for ESA Mitigations. Implementing ESA for hundreds of pesticides will dramatically transform farming, the agricultural landscape, and the people involved across the nation. This is a tremendously large undertaking that will impact hundreds of crops (USDA, 2014), millions of acres, and trillions of dollars. This process should take a phased in approach. The EPA has historically dealt with large pesticide issues such as the Worker Protection Standards which had a 5-year grace period, and the 8-year phase-out of soil fumigation with methyl bromide under the treaty for the Montreal Protocol on Substances that Deplete the Ozone Layer, plus 9 additional years when users could apply for a critical use exemption. The Weed

Science Societies believe that the ESA changes should be phased in over 3-5 years after all of the training materials have been made available. This interval was selected because pesticide applicators must be recertified every 3-5 years, generally through education courses, to maintain their license. The phase-in will allow the EPA, registrants, and Extension time to create, from scratch, all of the educational and training materials that will be needed (Appendix B), and allow time for consultants, growers, registrants, regulators, retailors, and researchers to receive that training, including those without internet access.

After growers understand what the restrictions and regulations mean to their operation, they will need time to implement these changes. Learning how to grow and terminate cover crops without negatively impacting the next crop can require years of individual testing. Many of the mitigations such as field terraces, windbreaks, vegetated waterway will all require time and money and in the case of rented land (only 23% of farms in Illinois are owned by the farmer) will take the owner agreeing to the changes and then finding the money to pay for these changes. Developing new weed management programs potentially using different herbicides and application methods can also take years.

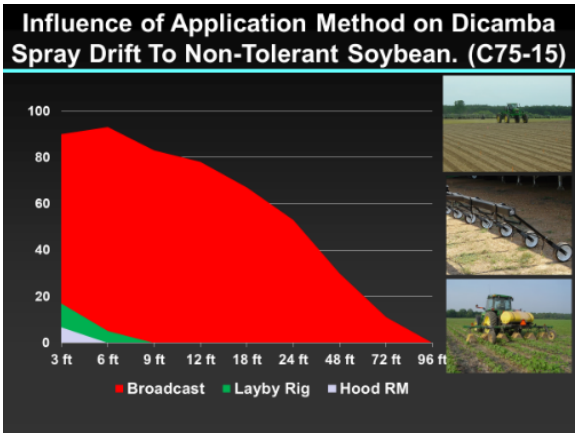
Reduce the number of applications per crop. On page 19 the Herbicide Strategy framework mentions rate reductions to minimize spray drift deposition. The WSSA suggests that reducing the number of applications per crop be considered along with rate reductions similar to the credits provided for reducing applications of Enlist One and Enlist Duo. Each application poses a potential risk to the environment. By reducing the number of applications per crop the user should get credit for that risk reduction similar to the rate reduction credit.

Vegetation to intercept particle drift. The EPA has deemed windbreaks are barriers, usually consisting of trees and shrubs, that can be used to reduce and redirect wind 50% when the height of the windbreak is equal to or higher than the release point of a pesticide. This is a scientifically sound option to offer pesticide applicators; however, there are two additional items to consider.

First the terminology used to define a windbreak should be more flexible than the current approach of suggesting trees and shrubs. An option may consist of "*living plant material the full length of the treated crop with leaves visible over the entire length, with no noticeable gap".* Viera et al. (2018) demonstrated that planting 8 corn rows around a soybean field (0.91, 1.22, and 1.98 m height where the nozzle height was 0.86 m above ground) effectively reduced downwind particle drift from the field. In this study the 0.91 m tall corn was the most effective height to reduce drift. In this study the corn rows resulted in drift reductions with fine spray droplets of 99% at corn height of 0.91 meters within the first 2 meters of the corn planting. With ultra coarse droplets and 0.91 m tall corn there was a 99% drift reduction within 1.49 m inside the corn buffer.

Second, the literature referenced within the "*Draft Technical Support for Runoff, Erosion, and Spray Drift Mitigation Practices*" provides support for including two categories within this mitigation practice, which would increase flexibility for growers: 1) For downwind windbreaks twice as high as the boom, buffer could be reduced 75%; 2) For downwind breaks equal to the height of the boom, buffer reduction equals 50% as currently defined.

Layby Directed Sprayers and Hooded Row Middle Sprayers to Reduce Drift. Research in Georgia with directed layby sprayers and hooded row sprayers demonstrates that they eliminate pesticide drift more effectively than any other field practice; however, these options, unlike regular hooded sprayers, are not mentioned in the Herbicide Strategy framework. These two application methods are successfully utilized for pesticide applications in agronomic crops to ensure drift to high-value vegetable and fruit crops does not occur; therefore, this is an excellent option to apply pesticides near sensitive sites. The use of directed layby sprayers and hooded row middle sprayers should be included as options to reduce the spray drift buffer distance

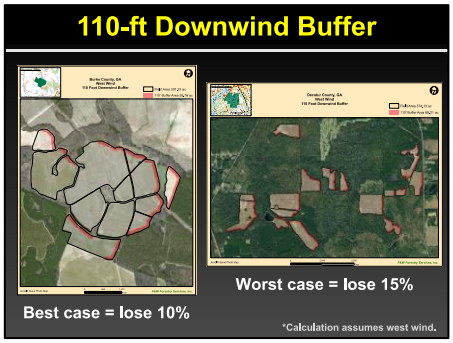


Buffer Impacts

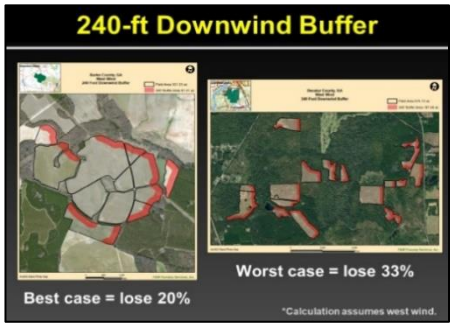
Buffers can substantially reduce available farmland. In-field buffers are simply not sustainable at the farm level, and information was collected in Georgia to illustrate this point. The Herbicide Strategy framework describes a buffer requirement and in many cases those buffers will need to be within the field in order to avoid the listed species or their critical habitat.

Georgia economic impacts of buffers. One example is the case of Georgia agricultural fields and the economic impact of buffers on those fields. If one considers the total 2021 Georgia cotton, peanut, and corn acreage and their associated economic values, the loss of treatable land was shocking; proving that without the ability to apply our most effective pesticides in these areas, profitable crops *cannot* be produced. A best- and worst-case scenario was mapped for three different buffer distances within the crop field, which is a realistic approach for Georgia farmers:

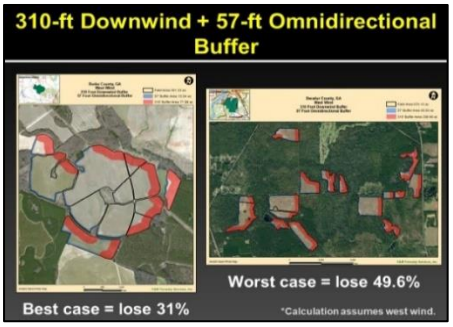
1. When a downwind buffer of 110-ft. is implemented, pesticides could not be applied to 10-15% of the cropland. This cropland (10-15%) where pest management would be challenged for cotton, peanuts, and corn equates to yield losses of $150 million, $117 million, and $14 million, respectively (Univ. of Ga, 2021).



2. A downwind buffer of 240-ft. restricts pesticide applications to 20-33% of the cropland. This cropland (20-33%) where pest management would be challenged for cotton, peanuts, and corn equates to yield losses of $331 million, $256 million, and $30 million, respectively.



3. A 310-ft downwind buffer plus 57-ft. omnidirectional buffer restricts pesticide applications to 31-49.6% of the cropland. This cropland (31-49.6%) where pest management would be challenged for cotton, peanuts, and corn equates to yield losses of $502 million, $388 million, and $91 million, respectively.



4. If all of the appropriate herbicides for that crop and pest(s) have a buffer requirement and the impacted area is too small to grow another crop then the grower may need to take that portion of the field out of production. In that case the economic impacts would be even greater.

Runoff/Erosion Additional Mitigation Suggestions

Education. The second area within Herbicide Strategy framework where education should play an important role is serving as a maximum credit (3 points) for mitigating off-target runoff/erosion. Data are available from the University of Georgia to support this request and is clear on the impact from education; no other single mitigation measure will have more influence on pesticide stewardship if implemented appropriately. Education of applicators and pesticide users has influenced/reduced pesticide movement more than any other mitigation approach in Georgia. A large amount of data from the Georgia "Using Pesticides Wisely" program has been shared with EPA. Appendix B has a list of suggested education and training topics.

Develop Terminology Specific to Specialty Crops. The terminology that describes conservation/mitigation practices is appropriate for field crops, but does not transfer as readily to specialty crops. This makes sense since the majority of research has been conducted in field crops. However, this makes it difficult to translate into mitigation points for other crops such as perennial orchards or vineyards. Appendix B in this document suggests listening sessions where specialty crop groups could be asked to provide lists of conservation practices and terminology unique to their situations. This would make it easier to pick the correct herbicide to fit the mitigation points and to adjust the mitigation points to the unique agronomic practices.

Using New York apples as an example, grass aisles between tree rows are a common practice but the scenario (Scenario 10: Apple orchard in Washington sloped land, sandy soils, drip irrigation) lists contour farming with strips for 3 points. A point value for grass aisles would be helpful. Herbicides are generally sprayed in a strip between the trees. Tractors are driven in the area between trees, not in the treated areas. Therefore, less compaction and greater infiltration occur in the treated areas. This be addressed by a clear description of the practice and an appropriate number of mitigation points.

Cover Crops Are More Effective Than Listed. The Herbicide Strategy framework indicated that cover crops would receive one mitigation point. However, work by many authors suggest cover crops can reduce sediment loss by 50 - 69% not the 10% estimated by the EPA. Work by

Carver et al. (2022) in Kansas indicated a 69% reduction in sediment loss when a cover crop was added to the system. Work by Nelson et al. (2023) in Kansas indicated a 50% reduction in sediment loss when a cover crop was added to the system. Potter et al. (2011) showed a 98% reduction in fomesafen runoff using cover crops and irrigation incorporation.

Cover crops can improve weed control as well as sediment loss. A meta-analysis of cover crop usage has found that cover crop biomass is the single most effective way to provide weed suppression (Osipitan et al. 2019). Additionally, grass cover crops provide better weed suppression than broadleaf cover crops (Osipitan et al. 2019). Conservation tillage paired with cover crops was found to be comparable to mechanical and chemical weed control (Osipitan et al. 2018). To measure cover crop effectiveness most studies measure.

- Weed biomass at cover crop termination
- Weed biomass up to 7 weeks after planting of the main crop
- Weed density at termination of cover crop
- Weed density up to 7 weeks after planting of the main crop
- Percentage weed control up to 7 WAP
- Yield of the main crop

All studies acknowledge the cover crop species ability to suppress weeds is influenced by the presence of their residue, phytoallelopathy, biomass productivity, surface cover, and agronomic management strategies adopted (Osipitan et al. 2019).

Pittman et al. (2020) does a great job explain the relationship between cover crop biomass and weed suppression of specific species. *Amaranthus retroflexus, Ipomoea lacunosa*, and *Digitaria sanguinalis* can be suppressed by 50% for 6 weeks after termination with 5,280 kg ha^{-1} biomass, 5,680 kg ha^{-1}, and 5,570 kg ha^{-1}, respectively (Pittman et al 2020). These levels of cover crop biomass were achievable in this study with cereal rye alone and then combinations of crimson clover + cereal rye, hairy vetch +cereal rye, forage radish + cereal rye, crimson clover + forage radish + cereal rye, and hairy vetch + forage radish + cereal rye (Pittman et al 2020).

Field has Subsurface Drainage Installed. The Herbicide Strategy, page 50, says "Runoff from the entire field would need to be controlled and directed into a pond or saturation zone." For drainage systems that are not directed into a pond or saturation zone, the EPA should consider **three erosion/runoff mitigation points for subsurface drainage.** Research dating back to at least the 1980's (Skaggs et al., 1982) demonstrates substantial reductions in runoff and erosion when subsurface drainage systems are installed. In addition, EPA should consider **three additional erosion/runoff mitigation points** when the field with subsurface drainage installed drains into vegetated ditches, a bioreactor or other filtration systems, or has a water control structure (e.g., gate at the discharge point) at the end of the system**.**

Reduce the Number of Applications Per Crop. In the runoff/erosion section of the proposed Herbicide Strategy framework, a pesticide applicator that reduces the rate below the maximum use rate is given mitigation credit. The EPA should consider the same approach with the number of applications made to a crop because each application poses a potential risk to the environment.

When the number of applications made during the season is less than the number allowed on the label, then mitigation credit should be provided. For example, if the label of herbicide X allows four applications to be made during the season in a given crop and a grower makes only two of those applications then the potential environmental load is reduced by 50% and credit should be provided to the pesticide applicator. Additionally, this credit would serve to assist Extension in promoting sound herbicide resistance management strategies.

Provide Examples of Reduced Tillage Systems (Flex Fallow Tillage). There are numerous reduced tillage systems in the U.S. and a list of examples would help people understand this mitigation measure. For example, flex fallow systems are used in the low rainfall zone of eastern Washington to maintain residue on fields as long as possible while controlling weeds, usually into late May. A tillage implement, usually a rod weeder with a horizontal counter rotating rod, is then used to break capillary connections above and below the tillage depth to ensure evenness of moisture at planting, which usually occurs in late August. The flex fallow system is a compromise between no-till fallow, which results in poor stand establishment due to uneven soil moisture depths in August, and conventional fallow, which is very tillage intensive for a longer period of time. The benefit of a flex fallow system is that the resulting wheat stand, which stabilizes the soil against wind erosion, is more uniform and reliable.

WSSA Survey Results of Crop Scenarios of Runoff/Erosion Mitigation Points

The EPA (2023b) provided 13 crop scenarios demonstrating how pesticide applicators could potentially achieve mitigation measures across cropping systems and the country. The WSSA Endangered Species Committee sent an individual survey to fourteen different weed scientists in states identified by the EPA in their examples to obtain input on the number of mitigation points their growers would be able to achieve based on local production practices. An extra survey was also sent to an Illinois weed scientist working in corn and soybean to serve as a second location for the EPA's Indiana scenario. And a survey was also sent to a Kansas weed scientist to describe sorghum production in western Kansas. Surveys focused on adoptable and non-adoptable mitigation measures as proposed by the EPA as well as identifying additional mitigation practices and local organizations that foster conservation practices.

The Herbicide Strategy framework indicated that some herbicides would require 9 mitigation points to be used in some areas. Table 1 (Crop Scenario's: Summary of WSSA Survey of Potential Mitigation Points) shows the results of that survey. Of the 15 surveys received only Georgia cotton and Washington apples would receive 9 points (12% of sites). However, in Georgia we estimate that less than 1% of the fields would get 9 mitigation points. Seven crop/state combinations would get 6 to 8 points (41%). Eight crop/state combinations would get 1 to 5 points (43%). The survey results indicate that only 12% of the crop and state combinations will be able to use herbicides with 9 mitigation points. This indicates that the majority of crops by state combinations, 88%, listed in the scenarios will have fewer herbicides to control weeds in their crops. Since only 1% of Georgia cotton is estimated to get 9 points that means that none of the large agronomic crops would have 9 mitigation points for herbicides. This is of concern

because a commonly used herbicide for broad spectrum control and resistance management such as s-metolachlor requires 9 mitigation points in many crops. These results suggest economic losses, greater herbicide resistance, and an approach to threaten the sustainability of family farms.

Table 1. **Weed Scientists Survey of Potential Mitigation Points by Crop Scenario**

Crop Scenarios	OPP Mitigation Total Points	Mitigation Total Points* from Weed Scientists
#1. Non-irrigated corn and soybeans on sloped land, non-sandy soil in Iowa	11	6
#2. Non-irrigated corn and soybeans on flat land, non-sandy soil in Indiana	7	5 to 7
#2b. Same questions as Indiana for Illinois		3 to 7
# 3. Non-irrigated, low rainfall grain sorghum or wheat in the Western US	5	4 Flat Land 3 – 5 Sloped Land
# 3b. Same question as #3 for sorghum in Western Kansas		3 to 4
#4. Furrow irrigated cotton on laser leveled fields in Mississippi Delta Crop	4	4
# 5. Non-irrigated High Plains Texas cotton	4	4
# 6. Irrigated Georgia cotton	9	3 to 9
# 7. Non-irrigated, field grown vegetables in Delaware	4 - 6	4 - 6
#8 (OPP #9). Irrigated leafy vegetables in California	6 - 8	5 – 7
#9. Irrigated, field grown vegetables in Florida	6 – 8	3 to 5
#10. Apple orchard in Washington sloped land, sandy soils, drip irrigation	9	9
# 11. Apple orchard in New York sloped land, heavy soils, drip irrigation	7	3 – 4 apple 3 – 4 vineyard
#12. Bare ground almond in California	5 - 7	5 – 7
#13. You-pick blueberry operation in Maryland	10	8
Average Number of Mitigation Points	Average = 7 Range = 4 - 11	Average = 5.1 Range = 3 – 9 Only GA cotton & WA orchards get 9 points 8 sites get 1 to 5 pts 7 sites get 6 to 8 points

**Mitigation Total Points are based on input from weed scientists in each state.*

The WSSA received scenario information from more than one state for scenario #1 (corn and soybeans) and #3 (sorghum and wheat) and received apple orchard and vineyard information for New York. The researcher that provided the information is listed with each scenario description. In some cases we did not receive additional information so not all sections have an entry.

Survey: Are these conservation practices used?

#1. Non-irrigated corn and soybeans on sloped land, non-sandy soil in Iowa.
Bob Hartzler, Iowa State University

6 points – residue tillage mgt., contour farming, terracing, grassed waterways, and multiple categories. In areas with sloping fields some sort of conservation tillage is practiced. Short growing season complicates adoption of cover crops, plus impact on crop yields. I suspect more terraces have been taken out than installed due to increases in equipment size. Grasses waterways are fairly common, but probably less than 50% of fields. Vegetative filter strips are not real common. Most fields would have some sort of residue management along with some other practice.

#2. Non-irrigated corn and soybeans on flat land, non-sandy soil in Indiana
Bill Johnson, Purdue University

5 to 7 points - <2% slope (most fields have more than 2% slope and would not get these points), cover crop (on 10 to 15% of acres), residue tillage mgt., adjacent to field vegetative filter strip, multiple categories. Less than 2% slope and filter strips would not be a very high percentage in Indiana. Cover crops are used on 10-15% of the acres at most, and it might go down next year if commodity prices stay low.

#2 b. Non-irrigated corn and soybeans on flat land, non-sandy soil in Illinois
Aaron Hager, University of Illinois

3 to 7 points – Majority of fields would only get 3 points. <2% slope (53% of acres), cover crop (4-5%), residue tillage mgt. (70%), adjacent to field vegetative filter strip (estimate 20 to 25%), multiple categories. 53% of Illinois acres have 0–2% slope, 76% have 5% or less slope. These data were compiled by NRCS personnel located in Champaign, Illinois. The 2017 census of ag indicated Illinois had 0.7 million acres of cover crop. With 23 million acres of harvested cropland, this represents a practice used on 3% of Illinois acres. We estimate this has increased since 2017, perhaps now between 4 – 5% of Illinois acres. The 2017 census also lists Illinois with 9.5 million acres "reduced" till; 6.5 million acres of no-till; the rest (6.7 million) "intensive" tillage. On 23 million acres, that's 42% reduced, 29% non-till, and 30% intensive tillage. We are unsure how to determine the percent of Illinois farmland adjacent to a vegetative filter strip; our estimate is 20 – 25%. Some mitigation practices likely are used in concert (reduced tillage or no-tillage combined with cover crop, for example).

Cover crops can reduce available soil moisture in dry springs when crops are being planted and delayed termination can adversely impact the cash crop. This occurred across much of Illinois in 2023 and could reduce cover crop acres in 2024. "Bad years" with cover crops (such as 2023) tend to "stick" in growers' minds for several years. Nevertheless, with continued financial assistance for establishment, we anticipate the number of cover crop acres will remain stable or increase slightly.

The following data, Table 2, were generated by agricultural economists at the University of Illinois. As illustrated in the following graphic, less than 25% of Illinois farmland is owned by the person who farms the land (Zwilling, 2022). It is unlikely farmers will invest capital to modify/alter farmland they might not be farming the following growing season. Additionally, land modification is not possible if permission is not granted by the landowner. This greatly limits the ability of farmers to implement many of the runoff mitigation practices being proposed by EPA.

Table 2 Percentage of Land Owned, Crop Shared and Cash Rented for Illinois Farms

	2017	2018	2019	2020	2021
Northern Illinois Pure Grain Farms					
% owned	20	19	20	18	19
% crop shared	21	21	19	19	17
% cash rented	59	60	61	63	64
Central Illinois Pure Grain Farms (High SPR)					
% owned	15	15	14	15	14
% crop shared	44	42	42	40	40
% cash rented	41	43	44	45	46
Southern Illinois Pure Grain Farms					
% owned	23	24	22	22	22
% crop shared	37	36	36	36	33
% cash rented	40	40	42	42	44
State of Illinois (All Farms)					
% owned	24	23	23	23	23
% crop shared	33	33	32	30	30
% cash rented	43	44	45	46	47

Source: Illinois FBFM Association and the University of Illinois

farmdocDAILY

#3. Non-irrigated, low rainfall grain sorghum or wheat in Washington (Western US).
Ian Burke, Washington State University

Flat Land 4 points – residue tillage mgt, <2% slope (~20% of land), western agriculture). Sloped Land - 3 to 5 points: residue tillage management, contour farming is rare, western agriculture. Terracing or contour farming is not practical on the slopes of the Palouse. Individual fields are usually trafficked on the contour. Most fields are tiled to increase access in the early spring, and there is minimal land adjacent to fields that would be used for retention ponds or other similar mitigation measures. We also do not practice incorporation – single pass planting and fertilizer systems are very common and range in levels of disturbance. If more than one pass is made, the first pass is usually a light tillage and fertilizer application, or a preplant burndown herbicide treatment. These inputs often occur 1-3 weeks in advance of planting and would not be suitable for incorporation of pesticides.

#3. Non-irrigated, low rainfall grain sorghum or wheat in Western Kansas (Western US).
Sarah Lancaster, Kansas State University

3 points: Residue tillage management (2) and western agriculture (1). Only a few fields would have a vegetated ditch (1).

#4. Furrow irrigated cotton on laser leveled fields in Mississippi Delta Crop.
Jason Bond, Mississippi State University
4 points: <2% slope, irrigation management, adjacent vegetated ditch, multiple categories. Vegetated ditch would most often be natural vegetation and not vegetation that was managed as a component of the drainage system. However, I would offer that most ditches would qualify as "vegetated.

 # 5. Non-irrigated High Plains Texas cotton
Peter Dotray, Texas Tech and Texas A&M University
4 points: <2% slope, residue management, western agriculture, cover crop (10%)
Less than 2% slope will work for many producers on the High Plains but certainly not all and maybe not all land for some producers. But we are very flat on top of the Caprock. Even following intensive rainfall surface water does not move far. Just to the closest low area (Playa Lake). Some pointed out that water movement does not travel more than 1 mile.

Residue management is an interesting term and can mean lots of things. There may be no residue to manage, but they are trying. Continuous cotton does not leave much residue. Some rotation crops would help but this option would mainly be sorghum. When cotton is lost due to environmental conditions (wind, hail, drought), this may be planted to late season sorghum. There is definitely an increase in residue the following year.

 # 6. Irrigated Georgia cotton
Stanley Culpepper, University of Georgia
3 to 9 points: Very few would get 9 points (estimate >1%). 2% slope (50 – 60%), cover crop (30 to 40%), sandy loam soil (70 to 80%), irrigation management (45 to 50%), residue tillage mgt (60 to 70%), adjacent vegetated filter strip (not common 10 to 20%), & multiple categories (at least 95%). The intersection of these mitigation practices is less than 1% (% slope * % cover crop * % sandy loam soil * % irrigation mgt. * % residue tillage * % adjacent vegetated filter strips= > 1%).

We have the ability to use each of these at some level, it will just vary by field (not by farmer but by field) causing extreme complexity. I am not sure there is more than a small handful of fields that would get the 9 points from these options, terraces will help a few growers as well but still very few fields get the 9 points from these specific options. Being creative with pesticide rates within each application will be critical if we are to be able to reach 9 points over large acres.

 # 7. Non-irrigated, field grown vegetables in Delaware
Mark Van Gessel, University of Delaware
4 to 6 points: <2% slope, adjacent to field vegetative filter strip, multiple categories and some soil incorporation (2 more points). Most fields in DE have a vegetative filter strip. This filter strip is often adjacent to a grass/vegetative drainage ditch.

#8 (OPP #9). Irrigated leafy vegetables in California

Richard Smith, University of California Extension

Points 5 to 7: <2% slope, irrigation mgt, water retention systems, and some soil incorporation based on labels (2 more points), Information was only received for CA.

#9. Irrigated, field grown vegetables in Florida

Jason Ferrell, University of Florida

3 to 5 points: <2% slope, irrigation mgt, multiple categories, and very little soil incorporation (2 more points). Majority of veg fields are laser leveled. This would cover 80-85% of total fields. Majority of fields are highly organic (muck) or sand. Little sandy loam. Vast majority use drip tape to make most of water. Little use of filter strips since most fields are <2% slope. Also, sandy soils result in little runoff or soil erosion during rain events. Very little soil incorporation. Row middles are not incorp and most beds are covered with plastic

#10. Apple orchard in Washington sloped land, sandy soils, drip irrigation

Rui Liu, Washington State University

9 points: sandy loam soil, western agriculture, irrigation mgt, adjacent to field vegetative filter strip, contour farming with strips, and multiple categories.

 # 11. Apple orchard in New York sloped land, heavy soils, drip irrigation

Lynn Sosnoskie, Cornell University

Apple or vineyard: 3 to 4 points: Irrigation mgt (some orchard and vineyard fields have drip emitters), adjacent to field vegetative filter strip, multiple categories, and contour farming (not common for 1 point).

#12. Bare ground almond in California

Brad Hanson, University of California - Davis

5 to 7 points: <2% slope, irrigation mgt., water retention system, western agriculture. Soil incorporated herbicides are uncommon because they destroy tree roots (for 2 points). Not all almonds are grown east of US 395 so would not be eligible for western agriculture point.

Most of the CA almond acreage is on nearly flat field sites in the Central Valley. 100% of CA almond orchards are irrigated, mostly with precision equipment such as drip or micro sprinklers. Virtually no irrigation runoff occurs in almond. Most almond orchards are level-flat and many also have retention ditches to further reduce runoff of winter rain water. ~99% of US almonds are produced in the Central Valley of CA which has a Mediterranean climate with dry summers and winter rains ranging from ~8 inches in the south to perhaps 24 inches in the northern part of the region.

The vast majority of the almond acreage is on very flat sites so there is virtually no runoff of irrigation water and relatively little offsite movement of rain water in most years. There are some almonds produced in the foothill regions around the edges of the Valley; these can have some topography and would be potential opportunities for some of the runoff mitigation tactics.

#13. You-pick blueberry operation in Maryland

Kurt Vollmer, University of Maryland

8 points: <2% slope, inter-row vegetated strips, mulching, and multiple categories.

Mulching and grass strips between rows are standard. Farmers don't need adjacent vegetative buffer strips on flat ground. especially if they interfere with the public getting to the plantings. They already have filter strips between the rows.

Survey: Additional Conservation Practices That Should be Considered.

#1. Non-irrigated corn and soybeans on sloped land, non-sandy soil in Iowa.
Bob Hartzler, Iowa State University

I think the practices promoted for Iowa's Nutrient Reduction Strategy would be effective at reducing off target movement of herbicides.

#2. Non-irrigated corn and soybeans on flat land, non-sandy soil in Indiana
Bill Johnson, Purdue University

Yes, post application timing should be considered. Use of other herbicides which can reduce reliance on products of concern should also be considered.

#2b. Non-irrigated corn and soybeans on flat land, non-sandy soil in Illinois
Aaron Hager, University of Illinois

Plant a narrow crop row spacing so soil surface could be protected from erosion earlier in the growing season. Early crop planting so soil surface could be protected from erosion earlier in the growing season. Winter wheat (most common type grown in Illinois) acres could be considered as "cover crop" acres; these acres are planted late fall, wheat emerges and overwinters, and resumes growth the following spring. Following harvest, the soil remains covered with crop residue even if double-crop soybean are planted into the wheat residue (assuming no tillage occurs prior to soybean planting).

 # 3. Non-irrigated, low rainfall grain sorghum or wheat in the Western US.
Ian Burke, Washington State University

Flex fallow, reduced tillage, systems are used in the low rainfall zone of eastern Washington to maintain residue on fields as long as possible.

#4. Furrow irrigated cotton on laser leveled fields in Mississippi Delta Crop
Jason Bond, Mississippi State University

Overhead irrigation is popular in some areas. Also, in furrow-irrigated systems, computerized hole selection has been widely adopted to reduce volume of irrigation water and runoff by extension.

 # 5. Non-irrigated High Plains Texas cotton
Peter Dotray, Texas Tech University and Texas A&M University

Contour strips in some areas of High Plains, more south than north. Some terrace farming but not a lot. About 10% of dryland cotton is planted to cover crops. Success is dependent on rainfall. What about bed architecture and direction. This plays a part in water movement.

 # 6. Irrigated Georgia cotton
Stanley Culpeper, University of Georgia

Education: It has influenced pesticide movement more than any other mitigation approach in GA. We have a large amount of data that we have been sharing with EPA. The other suggestion is the number of point categories within practices, for example there is plenty of data for three cover crop categories as influenced by the level and stability of cover that should allow 1, 2, or 3 points.

 # 7. Non-irrigated, field grown vegetables in Delaware
Mark Van Gessel, University of Delaware

For the vegetated filter strip could the grower plant an annual planting such as a crop around the edge to serve the same purpose?

#8 (OPP #9). Irrigated leafy vegetables in California
Richard Smith, University of California Extension

Herbicides are frequently banded over the seedline or on bed top. This reduces the overall amount applied per acre. Information only received for CA.

#9. Irrigated, field grown vegetables in Florida
Jason Ferrell, University of Florida

1. Plastic covered beds. Except for sweet corn and potatoes, 85% of veg crops are under plastic. The plastic prevents runoff and leaching from any herbicide applied under the plastic.
2. Use of drip tape irrigation. Allows multiple bursts of irrigation daily to supply water to crop needs without over-irrigation and leaching. Can there be a mitigation for use of drip tape and an additional mitigation for multiple burst irrigation strategy over single irrigation event strategies?
3. Vegetated row-middles, using rye in middles, mowing often, to reduce need for herbicide application.
4. Cover crops. Planting into terminated cover-crop to reduce weed pressure and herbicide needs. This practice needs additional research to make sure the cover crop does not puncture the plastic.

 # 11. Apple orchard in New York sloped land, heavy soils, drip irrigation
Lynn Sosnoskie, Cornell University

Another conservation practice to consider is mulching. Mulches, plant residues or other suitable materials can be added to reduce erosion from water or wind, reduce evapotranspiration, and reduce concentrated flow erosion (NRCS Practice Code 484). Organic mulch materials can be cereal straw, grass hay, wood chips, bark, or shavings.

#12. Bare ground almond in California
Brad Hanson, University of California - Davis

Almond herbicide programs typically have some programs applied in “strips” centered on the tree row (usually 25-50% of the full orchard area) and the “middles are managed less intensively. Most acres get at least one “full orchard floor treatment” in the summer to control weeds on the orchard floor to facilitate harvest operations (nuts are shaken from the tree and swept up from the ground). This is not an erosion/runoff mitigation; it is for harvest efficiency.

Survey: Are growers currently enrolled in a state/federal runoff/erosion control program?

Not all surveys addressed this question.

#1. Non-irrigated corn and soybeans on sloped land, non-sandy soil in Iowa.
Bob Hartzler, Iowa State University
Many growers are enrolled in Iowa's Nutrient Reduction Strategy.

 # 6. Irrigated Georgia cotton
Stanley Culpeper, University of Georgia
Conservation tillage programs through NRCS are common for the conservation tillage producers.

 # 7. Non-irrigated, field grown vegetables in Delaware
Mark Van Gessel, University of Delaware
All of our DE growers have nutrient management planner that is written by someone who has a state issued license specific for writing these plans. Almost all of these plan writers are also Certified Crop Advisors (CCA), but it's not a requirement to be CCA certified. Individual growers can take training for nutrient management certification.

#8 (OPP #9). Irrigated leafy vegetables in California
Richard Smith, University of California Extension
Growers apply for EQUIP Grants through the NRCS. I am not sure what percent of growers participate in these programs but it is done here. There are certain areas with more risk of runoff and growers employ practices (retention basins, cover crops, irrigation management, filter strips, etc.) to reduce runoff.

#9. Irrigated, field grown vegetables in Florida
Jason Ferrell, University of Florida
Erosion/runoff is not a common problem due to our topography. However, essentially 100% of growers are enrolled in Florida BMP program to manage water and nutrient leaching. Florida Water Management Districts provide assistance and funding for water conservation practices. Many growers are going away from overhead irrigation due to these programs and replace it with subsurface drip irrigation. The same strategies that reduce nutrient leaching/runoff should be useful to prevent off-site movement of herbicides.

 # 11. Apple orchard in New York sloped land, heavy soils, drip irrigation
Lynn Sosnoskie, Cornell University
For vineyards, there aren't many consultants, but many growers have a soil conservation plan with local Soil and Water Conservation districts.

Additional Information on Conservation Specialists or State Programs

The WSSA suggests that when reviewing the suitability of a conservation program to receive mitigation points or an exemption that the impacts on that field as well as adjacent areas be considered. For example, developing a conservation plan to keep herbicides on a field is important. But equally important could be a plan to protect adjacent wetlands

(https://h2.ohio.gov/) where the plan is designed a bit differently but will contribute to habitat restoration. It would be helpful to provide a decision tree to the individuals designing conservation programs on how to assess points when local regulations do not allow the use of some of the mitigation measures proposed by the EPA.

- **Certified Crop Advisors (CCA)** - Certified crop advisors (after passing challenging written examinations), must acquire 40 continuing education credits over a two-year period (CCA 2015), with five hours being required in each area. In terms of relevant conservation expertise, all CCA's must be certified in the competency areas of nutrient management and soil and water management.
- **National Association of Independent Crop Advisors (NAICC)** - Has a certification programs to train their members as conservation experts.
- **California Healthy Soils Program -** California Healthy Soils Program - Provides financial assistance to California farmers, growers, and ranchers (up to $100,000 for a 3 year project) for implementation of one or more HSP agricultural management practices to improve soil health, including compost & mulch application, cover cropping, no-till methods, conservation planting, and more. https://solanacenter.org/healthy-soils-program/#:~:text=California%20Department%20of%20Food%20and,%2C%20cover%20cropping%2C%20no%2Dtill?
- **Delaware -** All vegetable fields and agricultural production on over 11 acres must have a nutrient management plan designed by a licensed expert. The same strategies that reduce nutrient leaching/runoff should be useful to prevent off-site movement of pesticides.
- **Florida BMP program -** Essentially 100% of growers are enrolled in Florida Best Management Program (BMP) to manage water and nutrient leaching. Florida Water Management Districts provide assistance and funding for water conservation practices. Many growers are going away from overhead irrigation due to these programs and replacing it with subsurface drip irrigation. The same strategies that reduce nutrient leaching/runoff should be useful to prevent off-site movement of herbicides. https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Best-Management-Practices
- **Kansas Conservation Programs -** Watershed Restoration and Protection Strategy (WRAPS) uses Soil and Water Assessment Tool (SWAT) to examine rainfall, soil cover, soil type and numerous other easily observable items to estimate runoff and concentration of pollutants in the runoff. **https://kswraps.org/**
- **Maryland Conservation Programs -** Maryland Department of Agriculture has cost sharing plans for cover crops and nutrient management plans. This program is designed to reduce nutrient runoff but the practices would also reduce pesticide runoff/erosion. https://mda.maryland.gov/resource_conservation/Pages/financial_assistance.aspx
- **Michigan Agriculture Environmental Assurance Program –** Michigan Department of Agriculture certifies farms that have made a commitment and efforts to protect their land and public water. They verify cropping systems based on their water use, soil conservation, and nutrient management practices that decrease erosion and runoff and

assist farmers to comply with state and federal law. Farmers must keep detailed records of pesticide applications to continue the certification. Farmers also have the option to have their whole farmstead evaluated, with a focus on chemical, fuel, and pesticide storage. Over 6,316 farms are certified in Michigan. https://www.michigan.gov/mdard/environment/maeap .

- **H2Ohio** - H2Ohio focuses on encouraging agricultural best management practices and restoring and enhancing wetlands to reduce nutrients that contribute to harmful algal blooms. Since the launch of the program in 2019, ODNR has implemented more than 140 natural-infrastructure projects involving nearly 15,000 acres of ecosystem restoration. These H2Ohio projects emphasize the ecosystem services that wetlands provide - to slow and store flood water and absorb or remove surface-water nutrients, sediment, and pollutants that negatively affect downstream water bodies. Wetlands are also prized ecosystems because they provide a host of other benefits including critical habitat for migratory birds, threatened or endangered wildlife species, and recreational opportunities for hunters, anglers, birders, and wildlife enthusiasts. https://h2.ohio.gov/

Provide a Database of Herbicide Runoff/Erosion Mitigation Points

The Herbicide Strategy framework contains tables listing the number of runoff/erosion mitigation points for 12 different herbicides (e.g., Table 8-6. General Label: Runoff/erosion Points for Terrestrial Areas [page 69]). In order for a grower, crop consultant, or herbicide user to develop a season long pest control program that information needs to be available in a searchable and sortable database. The database will help protect threatened and endangered species and their habitat by making it easier to select the herbicide with the fewest mitigation points, it will make it easier for users follow instructions, and would only involve ~ 20 herbicides per year (~300 herbicide active ingredients / 15 year reregistration period

The Runoff/Erosion Mitigation Points (REMP) database should allow the user to select a crop/site for a type of pesticide (e.g., herbicide) PULA category, state, or county and see the mitigation rating for all of the herbicides registered on that crop. The Weed Science Societies assume the database will be a work in progress because it would add new herbicides as they are registered or go through the reregistration process.

Some crops like corn and soybean have over 40 registered herbicide active ingredients and because it is multiplied by 4 different PULA conditions, it would be very time consuming and nearly impossible to look up each one individually. And most users and crop consultants have multiple fields with different mitigation points in each. For example, if the average farm size in Iowa is 350 acres and the average corn or soybean field is 33 acres then the average farmer has 10 fields of corn and/or soybean to review. If each field has a different number of REMP ranging from 4 to 6 points, then the user or crop consultant would have to refer to over 40 individual corn and soybean herbicide labels to find the required REMP. There is a very real chance of making a mistake after looking at all those labels. Any educational or training materials that the EPA can provide to help speed up this process will help improve the compliance with the ESA.

The database needs to be designed so that all individual crops are listed, not categories like vegetable or ground fruit "VGN" or "other grains". A specific herbicide could have very different mitigation numbers on different crops because of the different use rates and number of applications on crops within this category (e.g., broccoli versus lettuce versus strawberry) and the same could be true between "other grains" (e.g., barley versus sorghum versus teff). The database should be exportable to a comma separate value (csv) or Excel file format so that the user can sort the data in other ways. A user or crop consultant might want to sort the information very differently than an extension agent or state lead agency.

A second method to get this information about REMP to users and consultants is for the EPA and the registrants to jointly develop a free app that would allow growers to pinpoint their fields and select a given herbicide, and then have the tool provide the specific mitigations required. Since internet access can be a problem, the Weed Science Societies could work with governments and registrants to develop a funding program so that tablets loaded with this information could be distributed to every rural ag retailer and USDA Service Center where access is a problem.

Bulletins Live Two!

Additional Information is Needed

It is very difficult to find every herbicide for which mitigation for a listed species or the critical habitat is required in a given state or county. A crop consultant, user or Extension employee must search through the list herbicide by herbicide to find the list of herbicides with mitigations for their state. This would allow consultants, growers, and extension personnel to develop a season long weed control program that considers the impacts on endangered and threatened species and their habitat. This information needs to be available in a searchable and sortable database, similar to the Runoff/Erosion Mitigation Points (REMP) database described previously. The database should be searchable and sortable by county or state to provide a list of herbicides with mitigations in that area and should be exportable to a csv or Excel file format. The Weed Science Societies assume the database will be a work in progress because it would add new herbicides as they are registered or go through the reregistration process.

It will be difficult to develop Bulletins Live 2! as an inclusive website and still be user friendly. EPA should consider how the end user will interact with this website and develop it in a manner that puts the most critical information front and center and all the background information on separate webpages.

Suggestions When Internet Access Is Not Available

The Herbicide Strategy stated on page 46 "As EPA undertakes particular FIFRA actions (*e.g.*, registration review actions), EPA expects to find that a reference to BLT on pesticide product labeling is necessary for most conventional pesticide products with outdoor uses." Use of this webpage requires access to the internet to check for restrictions on how a pesticide may be used in an individual county. As stated, before the USDA (2021) and Appendix A, has shown that many farmers in the U.S. do not own or use a computer and do not have internet access. In New Mexico only 36% of farmers own or use a computer and only 50% have internet access. We

discussed this with an individual from the New Mexico Department of Agriculture and one from the New Mexico State University and they suggested other ways that pesticide users could get information on endangered species restrictions in their county. Use of Bulletins Live Two! to disseminate information may not always be appropriate because many growers do not have access to the internet.

Recommendation. If users do not have internet access, other ways to distribute the information could include:

- Registrant representative(s) along with labels
- Retailors
- Extension programs, BLM, or Soil and Water Districts
- Informational, one-page handouts for distribution at extension programs
- Pesticide license CEU presentations
- Tribal Nations generally have federal pesticide applicators license, in New Mexico this is administered through Region 9. They would only have a state license if they use restricted use pesticides. No clear information on their attendance at extension training but the Apache and Zuni have extension presence. NMSU Science Center at Farmington, NM (https://farmingtonsc.nmsu.edu/) provides educational programing directed towards the needs of the Navajo agricultural community particularly NAPI (Navajo Agricultural Products Industry; https://napi.navajopride.com/).
- The Amish and Mennonites are common in some states and would not use a computer or access the internet. We could not find clear information on their attendance at extension training.

Offset/Habitat Establishment

Many questions have been raised regarding the establishment of plant vegetation for a food source or habitat. Habitat offsets are considered a reasonable and prudent alternative under the ESA. Offsets have typically been used to mitigate the impacts of transportation or housing projects by establishing alternative habitat that's beneficial to T&E species. Could a grower "offset" or establish critical habitat for a T&E species elsewhere on their farm such as on Conservation Reserve Enhancement Program areas or in the unfarmed areas around the outside of irrigation pivots to mitigate the impacts of pesticides on T&E species in their farm fields? While not described in the Herbicide Strategy this will be an issue going forward. It would be helpful if the EPA or the Services could develop a readily accessible document to explain the legal requirements and obligations of establishing offsets or habitats.

Research Funding is Needed for ESA Implementation

The following list of topics is designed to give government and private organizations guidance on areas where research funding is direly needed to ensure proper ESA mitigation measures.

The EPA should provide clear guidance on how to conduct and evaluate research on alternative mitigation measures. Most weed scientists find it very difficult to know how to conduct this type of research and do not understand how it will be evaluated by the EPA. A short document to describe the process, the relevant guideline studies, and how the studies will be evaluated would be incredibly valuable to weed scientists looking to provide helpful information.

Basic herbicide degradation, effects and fate research. There is very little funding for this type of research in government or university laboratories. Very few students have been trained in this area in the last 20 years. This expertise is being lost and is of critical importance to elucidate how and where herbicides reside in the environment.

Communication and Educational materials on ESA. The ESA is just beginning to have an impact on pest control and agricultural practices in the U.S. In most cases the pesticide users, regulators, registrants, and researchers do not realize the changes that are about to occur. Funding is needed to develop communication and education materials (Appendix B) to explain to these groups how and why agriculture is being impacted.

Phytotoxic effects of herbicides on endangered plant species. There are no research programs and no government or university funding to look at the phytotoxicity effects of threatened and endangered plant species. Currently, ten crop plants are used to estimate phytotoxicity to the over 900 listed plant species. This research would be conducted on closely related plant species to help give regulators more relevant information on the sensitivity of these plant species.

Funding to update maps on threatened and endangered species and their critical habitat. Research should be funded to update these maps. Many listed species do not have updated maps of where the species are located. To be protective of these species' government agencies over-estimate the areas where these species are found. This leads to needless impacts on farmland in the U.S. This is described in more detail in the section on Generating Accurate Maps for Listed Species Habitats and Farm Fields.

Crop Density or modified row spacing of crops to reduce runoff/erosion. Research should be funded to determine if different crop densities, narrow row spacing, or earlier crop planting will protect the soil from erosion during earlier portions of the growing season.

Adjuvants for preemergence herbicides to reduce runoff. Research should be funded to evaluate adjuvants to reduce leaching or runoff of preemergence herbicides. Some research has been conducted with adjuvants to reduce leaching of herbicides in coarse-textured soils and/or irrigated fields, but the results have not been conclusive (Calhoun et al. 2022). This area of research could be enhanced if the EPA were to indicate to manufacturers that it would consider this as an area for future research.

Conclusion

Herbicides are critical tools of agriculture and are essential to the production of food and fiber to meet the demands of a growing population. Any decision that impacts the ability of a grower to meet those needs, and one that limits weed management options must be considered very seriously. The members of the Weed Science Societies believe that science is the building block of all sustainable integrated weed management programs, and that science should be the basis for regulatory decisions. Scientifically implementing EPA's Herbicide Strategy for T&E species will require more research and education. These processes will take time. For that reason, we strongly urge EPA to provide at least 3-5 years to phase-in the proposed herbicide strategy. The Weed Science Societies willingness to cooperate in this process is strong, and so is our commitment to providing data to support these critical regulatory decisions to protect T&E species. Please do not hesitate to reach out to any of our members.

Sincerely,

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P.s. If our members can be of assistance in any way, please contact:

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Appendix A. Farm Internet Access

Farm Internet Access – States and United States: 2019 and 2021 (USDA, 2021)

State	Farms			
	With internet access		Internet access by paying a cell phone company or internet service provider	Internet access without paying a cell phone company or internet service provider
	2019	2021	2021	2021
	(percent)	(percent)	(percent)	(percent)
Alabama	74	83	100	(Z)
Arizona 1	63	63	100	(Z)
Arkansas.	76	76	96	4
California.	85	90	99	1
Colorado.	84	84	96	4
Florida	83	83	93	7
Georgia.	86	94	99	1
Idaho	92	95	99	1
Illinois.	79	90	97	3
Indiana.	79	79	99	1
Iowa.	75	82	96	4
Kansas.	82	91	97	3
Kentucky	75	80	100	(Z)
Louisiana	77	85	96	4
Maryland 2.	77	80	99	1
Michigan.	81	84	99	1
Minnesota.	82	83	99	1
Mississippi.	69	76	100	(Z)
Missouri.	70	79	100	(Z)
Montana.	83	88	97	3
Nebraska.	84	85	98	2
New Hampshire 3.	94	97	93	7
New Jersey	91	91	100	(Z)
New Mexico.	42	50	93	7
New York	81	81	92	8
North Carolina.	76	83	100	(Z)
North Dakota.	82	82	100	(Z)
Ohio.	63	64	99	1
Oklahoma.	75	80	99	1
Oregon.	83	91	97	3
Pennsylvania	64	64	99	1
South Carolina.	74	79	100	(Z)
South Dakota	82	90	100	(Z)
Tennessee.	65	80	99	1
Texas	75	83	99	1
Utah	92	96	93	7
Virginia	70	74	100	(Z)
Washington.	86	86	96	4
West Virginia	62	73	96	4
Wisconsin.	82	82	100	(Z)
Wyoming	88	89	99	1
United States 4.	75	82	98	2

(Z) Less than half of the unit shown.

1 Includes Arizona and Nevada.

2 Includes Delaware and Maryland.

3 Includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

4 Excludes Alaska and Hawaii.

Appendix B. Suggested Education and Training to Successfully Launch ESA.

When the EPA launched the Worker Protection Standards many training materials were made available to the state regulators and the public. The EPA has started to require pesticide registrations to consider the Endangered Species Act but there have been no equivalent training materials released to the state regulators or the public. The USDA webinars have been helpful but still short of the education that is needed. The Weed Science Societies suggest that the ESA mitigation be phased in over 3-5 years (the same interval as pesticide applicator training) after the training materials have been made available. The table lists education and training suggestions for consultants, state regulators, and users.

We received a comment from a pesticide operator that helps explain why the training is so important.

> *"There are quite a few cases where the operator might be fresh out of high school with limited to no farm background or maybe brand new to the occupation regardless of their age and might not comprehend what slope means, what exactly are they looking for when they see the term "cover crop," etc. For example, from my own experience, an operator might confuse a cover crop with a no-till field full of winter annual weeds. One way to alleviate the situation would be to put together a training seminar in the early spring for anyone involved in herbicide application."*

Action	Timeline
EPA Organize information gathering session to find out what is needed. • Include SLAs, Pesticide Safety Educators (PSEPs), extension, and others. • Conservation practices and terminology are different between crops and regions. Ask specialty crop groups to list conservation practices used with their crop.	Fall and Winter of First Year
Provide training materials on Endangered Species Act • Regional examples of listed species • Should include success stories	Fall and Winter of First Year
Provide training materials on Spray Drift and Conservation Practices • Goal of spray drift and conservation practices • Conservation practices - EPA definitions and difference between NRCS and EPA definitions • Conservation practices and point system • Drift buffer requirements • This training could be very extensive and take 4 to 8 hours depending on the audience.	Fall and Winter of First Year
Provide training materials on how to use Bulletins Live two! • How to look up mitigation practices • How to find field locations	Fall and Winter of First Year

Provide training on how to use Services websites to look up listed species in their state or county. • This will allow individuals to consider their location and additional ways they could be protected.	Fall and Winter of First Year
Training for conservation experts/certified experts. • Covering the spray drift and conservation practices and points.	Fall and Winter of First Year
Training for other groups: landowners, applicators, USDA NRCS, Conservation Districts, University Extension, SLAs, commodity groups, ag chemical dealers, and others	Fall and Winter of First Year
Training for other groups: landowners, applicators, USDA NRCS, Conservation Districts, University Extension, SLAs, commodity groups, ag chemical dealers, and others	Fall and Winter of First Year
	Second Year
Provide training on listed species mitigations for specific herbicide examples • How to understand the description and measure distances to critical habitat • How to design, install and get cost share for mitigation	Fall and Winter of Second Year
Provide training on herbicide Runoff/Erosion Mitigation Points (REMP) database which will list conservation points • How to look up individual herbicides • How to look up herbicide premixes • How to develop a season long weed control program by individual field and weeds.	Fall and Winter of Second Year
Provide training and suggested forms on ways to speed up determining the runoff/erosion points per field. • Suggestions on how to develop a season long weed control program where every field uses a different set of herbicides. • Results of WSSA Survey section demonstrates the average farm in Iowa has 10 fields to evaluate for mitigation points and develop individual herbicide plans.	Fall and Winter of Second Year
Offset/Habitat Establishment – Work with Fish and Wildlife Service • Who to contact for information on species, legal requirements, legal obligations (can the habitat ever be removed), seed source, etc.	Fall and Winter of Second Year