CENTER FOR FOOD SAFETY

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Regulatory Analysis and Development, PPD, APHIS
Station 3A-03.8
4700 River Road, Unit 118
Riverdale, MD 20737- 1238

RE: Docket APHIS-2020-0021

Center for Food Safety (CFS) appreciates the opportunity to provide input on the notice of intent to prepare to prepare an Environmental Impact Statement (EIS) addressing the question of whether or not USDA's Animal and Plant Health inspection Service (APHIS) should grant a determination of nonregulated for Bayer's maize variety genetically engineered for resistance to dicamba, glufosinate, quizalofop and 2,4-dichlorophenoxyacetic acid (2,4-D), with tissue-specific glyphosate resistance, MON 87429.

For over a decade, CFS has engaged both USDA and EPA in regulatory decision-making with respect to numerous herbicide-resistant (HR) crops and their companion herbicides. This includes comments to APHIS on HR crops resistant to the herbicides at issue with MON 87429. Many points summarized here are addressed more fully in those comments, particularly those on APHIS's draft EIS's on dicamba-resistant [APHIS-2013-0043, dated 10/10/14] and 2,4-D resistant [APHIS-2013-0042, dated 3/11/14] crops. A quarter-century of experience with these crop systems has borne out much of the analysis we have provided and adverse impacts we predicted. Conversely, past APHIS assessments of HR crops have all too often relied excessively on registrant analysis and viewpoints that experience has shown were faulty.

In conducting this EIS, APHIS has promised to consider its past environmental assessment/EISs on similar HR crops as well as public comments on those assessments.[1] We hope this re-consideration will be critical in nature, acknowledging past mis-steps and applying lessons learned to this EIS on MON 87429.

MON 87429 must be assessed as a crop system

In preparing the EIS, APHIS should assess MON 87429 maize as a crop system comprising the herbicide-resistant crop itself and associated use patterns of the herbicides it is specifically engineered to withstand. Bayer/Monsanto market the Roundup Xtend Crop System, Corteva the Enlist weed control system. HR crop systems have characteristic use patterns – involving

[1] Federal Register, April 28, 2021, p. 22385.

the timing, frequency and rates of application – that differ sharply from other uses of the same herbicides and have different impacts. Failure to adequately account for these patterns and their impacts has been a major failing of both USDA and EPA regulation.

Impacts of the MON 87429 crop system on herbicide use

As APHIS states: "MON 87429 maize, if deregulated, could be cultivated to produce food, feed, fuel and industrial products…."[2] CFS agrees. Even if its use were limited to breeding, the resulting commercial maize hybrids incorporating this event could be widely grown for those purposes, making it necessary to fully consider the impacts resulting from full-scale commercial cultivation.

For all practical purposes, MON 87429 maize eliminates the severe biological constraints on use of the broad-spectrum herbicides glufosinate and glyphosate[3] and the grass herbicide quizalofop that pertain to other maize varieties. MON 87429 also substitutes resistance to 2,4-D and dicamba for the lower-level tolerance to these herbicides found in other maize varieties. APHIS should assess how MON 87429 hybrids offered to farmers would change the use patterns of these herbicides, relative to unmodified maize, in terms of amounts applied per acre and acre treatments, as well as annual usage based on expected adoption scenarios. We note that acre treatments is an important metric because it is insensitive to the very different application rates of various herbicides, and that USDA NASS data show a steep and consistent rise in herbicide acre treatments on maize since introduction and widespread adoption of various GE maize varieties incorporating resistance to these herbicides.

Herbicide-resistant weeds

Bayer/Monsanto present MON 87429 as a weed resistance management tool.[4] It is long past time to re-evaluate the notion that herbicide-resistant crops delay resistance to other herbicides, and acknowledge that, in fact, they have been major drivers of accelerating weed resistance to multiple herbicides. HR crops foster resistance via three system properties. The first two are weed science truisms: excessive reliance on and more frequent use of the companion herbicides. Payment of a premium for the HR trait constitutes an economic incentive for the grower to rely exclusively on the companion herbicide(s)[5] rather than

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[2] Federal Register, April 28, 2021, p. 22386.

[3] Monsanto's petition makes it clear that MON 87429 "will be combined, through traditional breeding methods, with other deregulated events that confer full-plant glyphosate tolerance" (p. 5). Therefore, APHIS should assess glyphosate use associated with "full-plant" glyphosate resistance of maize hybrids incorporating MON 87429, and not just its more limited use in the context of maize breeding.

[4] Petition, p. 5.

[5] Orloff, SB et al (2009). "Avoiding weed shifts and weed resistance in Roundup Ready alfalfa systems," Publication 8362, University of California, February 2009.

implement diversified weed control practices, as does the much-vaunted "simplicity" of such over-reliance. The crop's resistance facilitates multiple applications in one season. A third – post-emergence use – has been shown to be an independent factor promoting resistance in modeling conducted by Paul Neve (with respect to glyphosate-resistant weeds).[6] This might be explained by the fact that POST applications to HR crops are often made when weeds are larger and less likely to be controlled (than smaller weeds) at typical application rates, such that even low-level tolerance is selected, and over time with continual use amplified to resistance.

Glyphosate-resistant weeds were practically unknown prior to the introduction of the glyphosate-resistant crop system, but now infest at least 120 million acres in the U.S. alone.[7]

Dicamba-resistance, also rare prior to introduction of dicamba-resistant soybeans and cotton, had already emerged in Palmer amaranth in just the third season of Xtend crop cultivation in Tennessee,[8] even faster than glyphosate-resistant weeds, which began to emerge only after four years of Roundup Ready crops. Indeed, weed scientists fear a repeat of the glyphosate-resistant debacle with dicamba used with the Xtend crop system. Moreover, two populations of glufosinate-resistant Palmer amaranth, and a third with lower-level resistance to both glufosinate and dicamba, were recently identified in Arkansas.[9]

The introduction of MON 87429 would also dramatically increase year-on-year selection pressure for dicamba resistance in weeds, assuming as seems likely that many current growers of Xtend soybeans and cotton would also adopt MON 87429, and spray dicamba year-in, year-out in their corn/soybean rotations. We remind APHIS that this is precisely the scenario that played out with glyphosate-resistant crops. While glyphosate-resistant weeds did emerge to some extent when Roundup Ready soybeans were rotated with corn not resistant to glyphosate, the epidemic of glyphosate-resistant weeds began in earnest only with increased adoption of Roundup Ready corn around 2005.

Multiple herbicide-resistant crop systems are no answer, because resistance traits accumulate in weeds over time, and for instance spraying dicamba and glyphosate on dual-resistant crops means glyphosate-resistant weeds experience only one effective mode of action – driving additional resistance to dicamba.[10]

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[6] Neve, P. (2008). "Simulation modeling to understand the evolution and management of glyphosate resistance in weeds," Pest Management Science 64: 392-401.

[7] Pucci J. The war against weeds evolves in 2018. CropLife, March 20, 2018.

[8] Steckel L. Dicamba-resistant Palmer amaranth in Tennessee: stewardship even more important. University of Tennessee News Blog, 7/27/20. https://aaes.uada.edu/news/pigweed/.

[9] McGeeney R. As options dwindle, new resistance emerges in pigweed. Arkansas Agricultural Experiment Station, Feb. 18, 2021. https://aaes.uada.edu/news/pigweed/.

[10] Mortensen DA, Egan JF, Maxwell BD, Ryan MR, Smith RG (2012). "Navigating a Critical Juncture for Sustainable Weed Management," Bioscience 62(1): 75-84.

The very fact that Bayer/Monsanto seek deregulation of MON 87429 resistant to five herbicides speaks to this very phenomenon of accumulating resistance. With continuation of current unsustainable weed control practices implemented with HR crops, the company correctly anticipates increasingly resistant weeds that will evade control with post-emergence use of two or three herbicides on currently deployed dual- or triple-resistant crop systems. MON 87429 represents the latest step in the transgenic treadmill – the race between engineered resistance in crops and artificial selection of resistance to the HR crop companion herbicides in weeds.[11]

Cross-resistance between dicamba, 2,4-D and other synthetic auxin herbicides

APHIS should also assess the evidence for cross-resistance to dicamba, 2,4-D and other auxin herbicides in weeds. A waterhemp population resistant to 2,4-D also showed reduced sensitivity to dicamba,[12] while dicamba-resistant Palmer amaranth in Tennessee has reduced sensitivity to 2,4-D.[13] In view of the common mechanism of action of 2,4-D and dicamba, these findings strongly suggest full-fledged cross-resistance will emerge in weeds treated with either dicamba and phenoxy herbicides. Use of either or both on MON 87429 may well promote resistance to both, and potentially other auxin herbicides. Because auxin-resistant weeds that develop in MON 87429 could spread to other fields via seed dispersal, or the trait transferred to sexually compatible weeds via gene flow, MON 87429 cultivation may compromise the utility of both major herbicides in the crops of non-adopting farmers.

Metabolic resistance

Weed scientists report ever more examples of weeds that are resistant to multiple herbicides via metabolic mechanisms, also called enhanced metabolism, one form of nontarget site resistance.[14] Metabolic resistance is conferred by native plant detoxification mechanisms, such as cytochrome P450 or glutathione S-transferase (GST) enzymes, that evolve under herbicidal selection pressure to detoxify herbicides. Unlike target site-based cross-resistance, which is common within certain classes of herbicides, metabolic resistance can confer resistance, unpredictably, to quite dissimilar weed-killers. For instance, a hairy fleabane

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[11] Binimelis R et al. (2009). "Transgenic treadmill": Responses to the emergence and spread of glyphosate-resistant johnsongrass in Argentina. Geofourm 40(4): 623-633.

[12] Bernards ML et al. (2012). A waterhemp (*Amaranthus tuberculatus*) population resistant to 2,4-D. Weed Science 60: 379-384.

[13] Steckel L. Dicamba-resistant Palmer amaranth in Tennessee: stewardship even more important, July 27, 2020. https://news.utcrops.com/2020/07/dicamba-resistant-palmer-amaranth-in-tennessee-stewardship-even-more-important/.

[14] Hartzler B. Metabolism-based resistance – Why the concern? Iowa State University, 3/9/19. https://crops.extension.iastate.edu/blog/bob-hartzler/metabolism-based-resistance-why-concern.

biotype has been identified in California that has non-target site resistance to glyphosate, paraquat, dicot, and 2,4-D.[15] Another recent example is a population of the feared Palmer amaranth that withstands six herbicides, with tests suggesting "predominance of metabolic resistance" coupled with EPSPS gene amplification conferring resistance to glyphosate.[16] The authors note that "such accumulation of resistance traits in a single Palmer amaranth population poses serious questions on the effectiveness of stacked resistance traits in crops, such as 2,4- D + glyphosate + glufosinate or dicamba + glyphosate resistance in corn and beans." Still another recent report documented enhanced metabolism as the mechanism in Palmer amaranth resistant to both glyphosate and dicamba in Tennessee.[17]

The most common recommendation for managing weed resistance is application of multiple herbicides with differing modes of action, either sequentially or in mixtures. This tactic is increasingly ineffective on weeds with target site resistance to multiple herbicides, and could well foster metabolic resistance to diverse herbicides. MON 87429's resistance to five herbicides will facilitate resistance-promoting post-emergence applications of many different herbicide combinations, and thus has an increased potential to foster metabolic resistance to them.

This is particularly true when MON 87429 is used in hybrid seed corn production. Inbreds grown to produce hybrid maize seed tend to be less competitive with weeds, and seed corn has a far higher value than field corn. Both factors conduce to more intensive use of herbicides in weed control, with correspondingly increased selection pressure from multiple herbicides and resistance the likely outcome. For example, some multiple herbicide-resistant waterhemp biotypes first evolved in seed maize production fields.[18] Such weeds will then likely spread to fields of field corn and other crops.

Herbicide drift fosters resistance

Repeated exposure of weeds to herbicide drift can select for those with increased tolerance, and over seasons this could be an important mechanism for evolution of resistance. A recent wind-tunnel study found that drift-level doses of glyphosate, 2,4-D and dicamba did

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[15] Moretti ML et al. (2021). Cross-resistance to diquat in glyphosate/paraquat-resistant hairy fleabane (*Conyza bonariensis*) and horseweed (*Conyza canadensis*) and confirmation of 2,4-D resistance in *Conyza bonariensis*. Weed Technology, https://doi.org/10.1017/wet.2021.11.
[16] Shyam C. et al (2021). Predominance of metabolic resistance in six-way-resistant Palmer amaranth (*Amaranthus palmeri*) population. Frontiers in Plant Science 11: 614618.
[17] http://www.weedscience.com/Pages/Case.aspx?ResistID=19221.
[18] McMullan PM and Green JM (2011). Identification of a tall waterhemp (*Amaranthus tuberculatus*) biotype resistant to HPPD-inhibiting herbicides, atrazine and thifensulfuron in Iowa. Weed Technology 25: 514-518.

indeed select for Palmer amaranth and waterhemp biotypes with reduced sensitivity to these herbicides over just two generations.[19]

These three herbicides have been the ones most frequently implicated in drift damage episodes for many years, even before the introduction of dicamba-resistant soybeans and cotton.[20] Dicamba drift of course has become rampant since Xtend(flex) crops were introduced in 2017. Cultivation of MON 87429 maize hybrids would dramatically increase drift exposure of weeds to these three herbicides as well as quizalofop and glufosinate – still another spur to increasingly resistant weeds that plague farmers.

APHIS should carefully consider the potential for MON 87429 to accelerate the evolution of multiple herbicide resistance in weeds as discussed above. Particular attention should be paid to the resistance-promoting features of HR crops generally, the hybrid maize seed production setting, cross-resistance among auxin herbicides, metabolic versus target-site resistance and resistance-promoting drift. APHIS should also assess the spread of resistance via seed dispersal and pollen-based gene flow to other fields. Past and anticipated future costs of herbicide-resistant weeds should also be assessed, particularly to those farmers who choose not to adopt MON 87429 maize hybrids.

Reliance on herbicide-resistant weed management practices has failed

The usual response to concerns about accelerating weed resistance to herbicides is to recommend implementation of herbicide-resistant weed management practices, chiefly, use of diverse herbicides with multiple modes of action. These recommendations have demonstrably failed to stem HR weeds, and if anything have accelerated their emergence. We urge APHIS to conduct a real-world assessment of the (in-)efficacy of past HR weed management practices, and consider alternatives, for instance "herbicide-frequency reduction targets."[21] Fees on sales of HR crop seed and/or companion herbicides could both discourage excessive herbicide use, and fund university extension outreach on adopting integrated weed management strategies that de-emphasize reliance on herbicides. Finally, greater incentives could be provided for implementation of cover-cropping, which can both suppress weeds and reduce nutrient loading of streams.[22]

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[19] Vieria BC et al. (2020). Herbicide drift exposure leads to reduced herbicide sensitivity in *Amaranthus* spp. Scientific Reports 10: 2146.

[20] AAPCO (1999 & 2005). "1999/2005 Pesticide Drift Enforcement Survey," Association of American Pesticide Control Officials, at https://www.centerforfoodsafety.org/files/aapco-2005_29712.pdf. Survey periods 1996-1998 and 2002-2004, respectively.

[21] Harker KN, John T. O'Donovan, Robert E. Blackshaw, Hugh J. Beckie, C. Mallory-Smith, and Bruce D. Maxwell (2012). Our View. Weed Science, 60(2): 143-144.

[22] Mortensen et al. (2012), op. cit.

MON 87429 maize volunteers resistant to quizalofop, glufosinate, glyphosate, dicamba and 2,4-D as weeds

Maize volunteers sprouting from seeds that escape harvest have long been considered problematic weeds, and this is exacerbated by herbicide-resistance traits, which narrow the range of control options.[23] APHIS should assess the increased weediness of MON 87429 volunteers. The assessment should include increased costs of control, increased use of herbicides, increased weed resistance risks from a narrowing of herbicidal control options and increased reliance on those (few) herbicides still effective, as well as greater use of tillage.

Interplay between HR traits and Bt resistant pests

MON 87249 hybrids will likely be offered mainly in varieties stacked with Bt traits. Research described in past CFS comments to APHIS on 2,4-D-resistant corn and soybeans show that HR corn volunteers produce lower levels of Bt toxin and thereby promote Bt resistance in corn rootworm; the more HR traits in the corn volunteers, the less likely they will be managed adequately, and hence the more likely they will contribute to Bt resistance.

MON 87429 and drift damage

Deregulation of MON 87429 would entail potentially widespread post-emergence use of up to five herbicides on maize, and corresponding drift damage to crops and wild plants across much of the country. Most concerning is the impact of post-emergence use of dicamba on tens of millions of maize acres. Dicamba use on Xtend soybeans and cotton has caused entirely unprecedented drift damage to millions of acres of crops, with, as APHIS states, "significant economic impact on neighboring crop and orchard fields because of unintended drift and volatilization of the herbicide."

According to a USDA survey reported by EPA, soybeans on up to 15.66 million acres of soybeans grown by 256,000 farmers in 2018 were injured by dicamba drift.[24] There are many reports of yield loss from this drift, which is particularly severe in those frequent instances of multiple drift episodes. Jason Norsworthy reported dicamba-damaged soybean fields that would yield at best 5 bushels per acre in Arkansas.[25] Two-hundred Minnesota soybean growers

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[23] Jhala AJ et al (2021). Interference and management of herbicide-resistant crop volunteers. Weed Science 69: 257-273.

[24] US EPA. Dicamba Use on Genetically Modified Dicamba-Tolerant (DT) Cotton and Soybean: Incidents and Impacts to Users and Non-Users from Proposed Registrations (PC# 100094, 128931), October 26, 2020, Table 8, p. 31.

[25] Report of the 2017 State of Arkansas Dicamba Task Force Meetings, Winthrop Rockefeller Institute, p. 142. https://www.centerforfoodsafety.org/files/arkansas-dicamba-task-force-report--9-21-17_39181.pdf.

collectively suffered an estimated $7 million in yield losses.[26] South Dakota vegetable grower John Seward has seen the crops of his small Community Supported Agriculture (CSA) farm devastated year after year by dicamba drift, with estimated losses of more than $11,000 in unharvested crops, destroyed seed and lost fall and winter CSA shares.[27] Bill Bader, proprietor of Bader Farms in southeast Missouri, the largest peach producer in the mid-South, experienced devastating injury to thousands of peach trees, and won compensation of $15 million for his losses in litigation against dicamba registrants Bayer/Monsanto and BASF. Arkansas beekeeper Richard Coy reported a 50% drop in honey production in areas in which wild flowering plants were devastated by dicamba drift, and in consequence was forced to move his hives to Mississippi.[28] Beekeepers across the country have reported similar issues.[29] These are just a few of many examples that could be cited.

Most broadleaf crops are extremely sensitive to dicamba injury. One recent study found up to 5% yield reduction in V3 soybeans exposed to doses of just 0.28 and 0.56 g a.e. dicamba per hectare.[30] Similar studies show a wide range of sensitivity, influenced by cultivar, growth stage, weather conditions, physiological condition of the plant, and other factors. Conservative endpoints of injury sufficient to cause yield loss should be used in any APHIS assessment of this issue.

APHIS should estimate dicamba drift damage from past use of the dicamba-resistant crop system since its introduction in soybeans and cotton in 2017 to inform its assessment of damages to be anticipated should MON 87429 be deregulated, based on anticipated adoption scenarios. In conducting such an assessment, APHIS should be wary of reliance on average annual yields for e.g. soybeans, whether at the national, state or even county level. This is because weather conditions have the greatest impact on yield, and good growing conditions that contribute to high yields will mask dicamba-induced yield losses suffered by individual

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[26] Steil M. Minnesota farmers' harvest hit hard by drifting weed killer. Minnesota Public Radio News, November 13, 2017. https://www.mprnews.org/story/2017/11/13/minn-farmers-harvest-hit-hard-by-drifting-weed-killer.

[27] E. Unglesbee, When drift hits home: dicamba moves beyond bean fields and into the public eye. DTN The Progressive Farmer, July 20, 2018. https://www.dtnpf.com/agriculture/web/ag/crops/article/2018/07/20/dicamba-moves-beyond-bean-fields-eye.

[28] Steed S. Arkansas honey seller faults dicamba in closing, January 5, 2019. https://www.arkansasonline.com/news/2019/jan/05/honey-seller-faults-dicamba-in-closing-/?page=1#story-comments.

[29] Gross L. Bees face yet another lethal threat in dicamba, a drift-prone pesticide, January 23, 2019. https://revealnews.org/article/bees-face-yet-another-lethal-threat-in-dicamba-a-drift-prone-pesticide/.

[30] Marques MG et al. (2021). Dicamba injury on soybean assessed visually and with spectral vegetation index. AgriEngineering 3: 240-250.

growers. Likewise, high average yields over a region will have been still higher without the impact of dicamba injury.

Second, APHIS is encouraged to shun data and analyses on this score from dicamba registrants, who have shown themselves to be dishonest. For instance, APHIS's statement quoted above, that "significant economic impact on neighboring crop and orchard fields [occurred] because of ***unintended*** drift and volatilization of the herbicide" is incorrect. Dicamba drift damage was both anticipated and intended. Internal documents revealed during the Bader Farms litigation revealed that both registrants – Bayer/Monsanto and BASF – projected thousands of annual dicamba drift episodes in each of the first five years' of their system's use, and in fact exploited the threat of dicamba drift injury as a means to sell dicamba-resistant soybean seed "for protection from your neighbor." Both companies then denied culpability when the drift damage they projected did in fact occur. We urge APHIS to review the court filings and exhibits of the Bader lawsuit to gain a better appreciation of the duplicity of the dicamba registrants in all phases of the dicamba-resistant crop system rollout,[31] as well as an amicus brief submitted on behalf of Bader for the registrants' appeal of the case.[32] APHIS is also encouraged to consult the Ninth Circuit Court of Appeals' June 3, 2020 decision to vacate over-the-top dicamba formulations,[33] and associated briefs and court filings, which contain further valuable evidence.

Third, APHIS must also approach any putatively objective studies of dicamba, the Xtend crop system or MON 87429 produced by Bayer/Monsanto with the utmost skepticism. Studies they submitted to EPA that purported to show little or no dicamba volatility, and little or no drift damage from the crop system's use with the registered over-the-top dicamba formulations, proved to be worthless, contradicted by independent studies of dicamba's volatility and drift damage potential as well as real-world events. CFS urges APHIS to consider as well our comprehensive critique of Bayer/Monsanto's volatility-related dicamba studies, and EPA's assessment of the same, submitted with these comments.[34]

On this score, we remind APHIS that in your EIS on dicamba-resistant crops, you actually projected less dicamba drift injury if dicamba-resistant soybeans and cotton were deregulated, versus the No Action alternative. This defective assessment apparently resulted from uncritical reliance on registrants' "low-volatility" claims for their yet-to-be developed dicamba formulations.

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[31] Available at: https://usrtk.org/pesticides/dicamba-papers/.
[32] Available at: https://www.centerforfoodsafety.org/files/20-3665--nffc-et-al--bader-amicus-final-1_16111.pdf.
[33] Available at: https://www.centerforfoodsafety.org/files/125--dicamba-opinion_35970.pdf.
[34] Freese, B. The Dicamba Debacle: How regulators enabled historic herbicidal crop injury and failed American farmers. Center for Food Safety, May 2019.

APHIS should also critically assess the drift potential of the other four herbicides that would be utilized over-the-top with the MON 87429 crop system, particularly 2,4-D, given its long history of drift and volatility.

Damage to public sector breeding

Dicamba drift has caused extensive damage to soybeans at university breeding centers in Missouri, Arkansas, Nebraska and Kansas, resulting in loss of valuable experimental varieties being grown to develop valuable new traits like disease resistance and drought tolerance.[35] APHIS should assess the monetary losses already suffered by such breeding centers, as well as the delay in development or loss of valuable traits that would otherwise provide benefits to farmers. This assessment could then be used to estimate further such losses that would be incurred with dicamba drift associated with deregulation of MON 87429.

Drift damage to trees and residential plants

Herbicide drift has taken an incredible toll on trees throughout rural America: whether fruit trees in orchards, shade trees in towns and in residential settings, or trees in nature reserves. Unlike annual crops, trees suffer the cumulative effects of multiple drift episodes spanning not just a single season, but over many years. Millions of trees have been damaged by dicamba drift in particular,[36] as discussed in the CFS amicus brief in the Bader Farms case cited above, which provides additional references. APHIS should also consult the single study on tree sapling susceptibility to dicamba submitted to EPA and discussed in EPA's 2020 ecological assessment for the October 2020 re-registration of over-the-top dicamba formulations.

Defensive adoption

APHIS should make use of the analysis by the Economic Research Service demonstrating substantial "defensive adoption" of Xtend soybeans to avoid dicamba drift damage by farmers with no interest in applying dicamba over-the-top.[37] This should be accompanied by analysis of

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[35] Charles D. Rogue weedkiller vapors are threatening soybean science. National Public Radio, 7/19/19. https://www.npr.org/sections/thesalt/2019/07/19/742836972/rogue-weedkiller-vapors-are-threatening-soybean-science.

[36] Hettinger J. 'We've got it everywhere': dicamba damaging trees across Midwest and South. Midwest Center for Investigative Reporting, June 16, 2020. https://investigatemidwest.org/2020/06/16/weve-got-it-everywhere-dicamba-damaging-trees-across-midwest-and-south/.

[37] Wechsler SJ et al. The Use of Genetically Engineered Dicamba-Tolerant Soybean Seeds Has Increased Quickly, Benefiting Adopters but Damaging Crops in Some Fields, October 1, 2019. https://www.ers.usda.gov/amber-waves/2019/october/the-use-of-genetically-

the costs borne by defensive adopters in terms of the Xtend soybean's trait premium; the loss of the freedom to grow the soybean variety of one's choice; and the loss of premiums for non-GMO or organic soybeans for those compelled to switch. APHIS should also assess the adverse economic impacts defensive adoption has on seed firms which lose sales of non-dicamba-resistant seed; and on soybean growers who feel compelled to pay a premium for the dicamba-resistant trait they have no interest in using. Finally, APHIS should assess the extent to which growers who initially grow Xtend soybeans defensively then go on in later years to apply dicamba, and the impacts this expanded dicamba use would have on the evolution of dicamba-resistant weeds.

This assessment should then be used to inform an assessment of the corresponding impacts should MON 87429 maize hybrids be deregulated. Deregulation of MON 87429 would intensify and expand the dicamba drift debacle dramatically, potentially driving near-100% adoption of Xtend soybeans.

Socioeconomic impacts

In addition to the economic impacts discussed above, APHIS should assess the impact MON 87429 hybrids would have on farm size. USDA's Economic Research Service has found that herbicide-resistant seeds generally tend to increase farmland consolidation by decreasing labor needs for weed control.[38] Impacts on the structure of the increasingly consolidated seed-pesticide industry should also be assessed. APHIS should further assess the impacts on agricultural biodiversity of MON 87429 deregulation. The dwindling number of farmers who dare to diversify the agricultural landscape with broadleaf crops other than soybeans and cotton, or corn, find their livelihoods severely threatened by the ongoing dicamba debacle, which would only be exacerbated by deregulation of MON 87429. Finally, APHIS should assess the often intense strife and dissension caused by rampant dicamba drift in rural communities. These social costs of the dicamba crop system were highlighted in the Ninth Circuit Court of Appeals' decision as one grounds for vacating the dicamba registrations as violating FIFRA.

MON 87429 maize, tillage and soil erosion

Roundup Ready crops have not, as popularly imagined, reduced soil erosion or fostered increased use of conservation tillage. USDA data show that the major gains in reducing soil erosion came in the 1980s and early 1990s, in consequence of 1985 and 1990 Farm Bill provisions that tied subsidies to use of soil-conserving practices. In fact, soil erosion rates actually stagnated in the decade of Roundup Ready crop adoption. Instead, the glyphosate-

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engineered-dicamba-tolerant-soybean-seeds-has-increased-quickly-benefiting-adopters-but-damaging-crops-in-some-fields//

[38] MacDonald JM et al (2013). Farm size and the organization of U.S. crop farming. Economic Research Service, August 2013.

resistant weeds generated by RR crop systems have in some instances led to increased tillage for weed control and hence greater soil erosion. CFS has presented a detailed analysis to support these conclusions in past comments to APHIS regarding 2,4-D-resistant soybeans and other HR crops. This assessment finds support in a 2016 report of the National Research Council.[39]

There is no reason to assume that successor HR crop systems have reduced soil erosion, given the ongoing expansion of HR weeds with tillage as one control option, nor to expect MON 87429 would alter this trend.

Environmental impacts of MON 87429 maize hybrids

Herbicide use in corn – particularly as measured by acre treatments – has increased dramatically with the widespread adoption of past HR crop systems. Dicamba drift has caused widespread injury to trees and wild plants. As noted above, beekeepers have observed negative impacts to their operations due to dicamba suppression of flowering plants depriving their bees of nectar and pollen resources, and similar effects are likely to wild bees and other pollinators.

Monarch populations east and west of the Rocky Mountains have plummeted. The sharp decline in eastern population that migrates to Mexico is attributable in large part to near eradication of milkweed in farmers' fields due to intensive glyphosate use. Increased use of dicamba and 2,4-D, which are also damaging to milkweed, will only exacerbate these impacts. Greater applications of these herbicides and glufosinate with MON 87429 would further suppress flowering plants that monarch adults require for their migration via drift.

We refer APHIS to the environmental sections of our comments on HR crops resistant to glyphosate, dicamba, 2,4-D, glufosinate and quizalofop for further discussion of environmental impacts to be expected with intensified use of these herbicides on MON 87429 hybrids, including impacts on threatened and endangered species.

Health impacts of intensified herbicide use with MON 87429

Dicamba exposure has been linked to increased risk of several types of cancer in recent studies.[40] This is particularly concerning given the dramatically increased use of this herbicide and its ubiquitous presence in the atmosphere in regions where the herbicide has been heavily

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[39] National Academies of Sciences, Engineering, and Medicine. 2016. Genetically Engineered Crops: Experiences and Prospects. Washington, DC: The National Academies Press. doi: 10.17226/23395.

[40] Matich EK et al. (2021). Association between pesticide exposure and colorectal cancer risk and incidence: a systematic review. Ecotoxicology and Environmental Safety 219: 11237. Lerro CC et al. (2020). Dicamba use and cancer incidence in the Agricultural Health Study: an updated analysis. International Journal of Epidemiology, doi: 10.1093/ije/dyaa066.

used. Glyphosate-based herbicides have been found to be substantial causes of non-Hodgkin lymphoma (NHL) in many people who have a long history of using them, with dermal contact a major route of exposure. As described in past comments to APHIS, 2,4-D has also been implicated as a cause of NHL, and some formulations continue to be contaminated with dioxins, while glufosinate has been associated with adverse reproductive and developmental effects.

Intensified use of these herbicides with MON 87249 maize hybrids would exacerbate these adverse impacts to human health, and should be assessed by APHIS.

Antibiotic resistance

A spate of recent studies has demonstrated that co-exposure of bacteria to herbicides, including glyphosate, 2,4-D and dicamba, can alter and in some cases decrease their susceptibility to medically important antibiotics, and that the herbicides exhibited additive effects, potentially contributing to the ongoing antibiotic resistance crisis.[41]

Another study has shown that exposure of soil bacteria in various soil types to glyphosate, glufosinate and dicamba increases the abundance of antibiotic resistance genes (ARGs) and mobile genetic elements in soil microbiomes, and promotes the movement of ARGs between bacteria, “potentially contributing to the global antimicrobial resistance problem in agricultural environments.”[42]

APHIS should assess this potential threat in the context of increased intensity of herbicide use with MON 87429 maize hybrids.

Conclusion

CFS would be happy to provide additional resources as APHIS conducts its EIS, since these brief comments provide only a glimpse of the adverse impacts MON 87429 would likely have, if deregulated.

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[41] For one of several studies by this team: Kurenbach B et al. (2015). Sublethal Exposure to Commercial Formulations of the Herbicides Dicamba, 2,4-Dichlorophenoxyacetic Acid, and Glyphosate Cause Changes in Antibiotic Susceptibility in *Escherichia coli* and *Salmonella enterica* serovar Typhimurium. Mbio 6(2): e00009-15.

[42] Liao H et al. (2021). Herbicide selection promotes antibiotic resistance in soil microbiomes. Mol. Biol. Evol. 38(6): 2337-2350.