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March 11, 2014

Biotechnology Regulatory Services
Animal and Plant Health Inspection Service (APHIS)
Station 3A-03.8
4700 River Road Unit 118
Riverdale, MD 20737-1238

Re: Draft Environmental Impact Statement - Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D-Resistant Corn and Soybean Varieties. Docket Number: APHIS-2013-0042-0050

Dear Sir/Madam,

We are writing to comment on the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) draft Environmental Impact Statement (DEIS) for the deregulation of 2,4-D resistant corn and soybeans (DAS-40278-9 corn, DAS-68416-4 soybean and DAS-44406-6 soybean). The agency's proposal to deregulate and allow into the environment a threatening genetic material will lead to damaging effects on crops, native plant species, and the environmental biodiversity required for plant health; propagate noxious weeds; and cause direct and indirect adverse impacts on human health and the environment.

The hazards and damage that deregulation of 2,4 D resistant corn and soybeans will wreak on plants and the environment cannot be evaluated in a regulatory, legal, and scientific vacuum. In upholding its statutory obligations to evaluate whether the sound science permits deregulation of 2,4 D resistant corn and soybeans and thus does not pose risk of damage to plants or invasion of noxious weeds, APHIS must look to the full spectrum of sound science and potential impacts concerning not only the plants themselves, but also the associated use and effects of 2,4 D herbicide, from which it is inseparable.

2,4-D resistant corn and soybean, and its accompanying use of 2,4-D (a new choline salt of 2,4-D - Enlist™) are being marketed to combat the surge in glyphosate-resistant weeds brought on by a previous generation of GE crops (Roundup Ready) and the accompanying increase in herbicide (glyphosate) use.

These new 2,4-D resistant crops, with the accompanying increased 2,4-D use, do not provide the solution to burgeoning weed resistance and threaten to introduce more damage to plants through encouraging yet another strain of noxious weeds. It is counter–intuitive and futile to treat the impacts of

GE use with more GE crops and increased herbicide use. Additionally, because the increase in 2,4-D use as well as the accompanying increase in weeds resistant to 2,4-D, would be inevitable and cannot be divorced from the use of 2,4-D resistant crops, APHIS should not make a final decision on this deregulation action before the registration review by the U.S. Environmental Protection Agency (EPA) is completed.

EPA's review requires consideration of both unreasonable human health effects and environmental effects, which should inform APHIS's decision. As the agency is aware, many environmental, farmworker and consumer groups are concerned about the inevitable increase in 2,4-D use that this deregulation decision would bring. According to APHIS, 2,4-D use on the deregulated crops is estimated to effect an increase of 1.75 -3 times current use.[1] This means that potential adverse impacts and contamination from this highly toxic herbicide will also increase, along with the demonstrated plant-damaging effects. APHIS believes that 2,4-D has a history of "safe and effective use." However, the scientific literature has shown that 2,4-D is far from being a "safe" chemical. Over the decades of its use, 2,4-D has been linked to an increased risk of birth defects, reduced sperm counts, increased risk of non-Hodgkin lymphoma, Parkinson's disease, and hormone disruption, as well as other health problems.

Similarly, 2,4-D drift is a major concern, especially those who live adjacent to and near agricultural areas. 2,4-D is known to drift into homes, where it can stay in the indoor environment for up to a year,[2] further exposing these communities to 2,4-D. While APHIS believes the new formulation (Enlist™) has a reduced tendency to drift, the risk from drift that will occur under a best case and worst case scenario cannot go ignored.

As we have done in previous comments to the agency, we urge APHIS to use its full statutory authority and reject the petition to deregulate 2,4-D resistant corn and soybeans by citing the plant-damaging and noxious-weed propagating risks that have not been fully evaluated by the petitioner when considered alongside the accompanying use of 2,4 D herbicide. We urge APHIS to consider both the environmental effects and human health effects this dangerous combination will pose and to deny petitioner's request for deregulation.

Responsibilities Under the Law

The *Plant Protection Act of 2000* sets out that GE organisms must not pose a plant pest or noxious weed risk.[3] APHIS is mandated[4] to regulate these organisms when there is the potential for "unacceptable" risk. APHIS' mission to "protect and promote U.S. agricultural health"[5] is one that must provide "leadership in ensuring the health and care of plants and animals. . .improves agricultural productivity and competitiveness, and contributes to the national economy and the public health."[6] However, this

[1] APHIS. 2013. Draft Environmental Impact Statement. Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D Resistant Corn and Soybean Varieties. Biotechnology Regulatory Services. U.S. Department of Agriculture. Riverdale, MD. pp133.
[2] Nishioka MG, Burkholder HM, Brinkman MC, Gordon SM. 1996. Measuring lawn transport of lawn applied herbicide acids from turf to home: Correlation of dislodgeable 2,4-D turf residues with carpets dust and carpet surface residues. *Environmental Sci and Tech*. 30:3313-3320.
[3] Plant Protection Act of 2000 (PPA), 7 U.S.C. § 7702.
[4] PPA, 7 U.S.C. §§ 7701(7), 7711, 7712.
[5] APHIS. About APHIS. Available at http://www.aphis.usda.gov/wps/portal/banner/aboutaphis
[6] USDA. USDA agencies and Offices overview: http://www.usda.gov/wps/portal/usda/usdahome?navid=AGENCIES_OFFICES

proposal on GE crops calls into question the agency's compliance with the statute and commitment to its mission. We view this inadequate analysis of the full-spectrum of environmental impacts as an accommodation of special interests myopic exercise of its legal responsibilities.

According to section 7712(a) of the PPA, APHIS must prohibit and/or restrict any plant or plant product that may introduce or disseminate a plant pest or noxious weed within the U.S.[7] A "noxious weed" is defined as any "plant or plant product that can directly or indirectly injure or cause damage to crops….or other interest of agriculture…. the public health, or the environment."[8] Resistant weeds, like those resistant to glyphosate (Roundup), have ballooned in recent years, due particularly to the expansion of Roundup-ready crops, including soybeans and corn. Increased selection pressure from widespread use and reliance on glyphosate, and the simultaneous reductions in the use of sustainable weed management practices have resulted in glyphosate-resistant weeds.[9] The introduction of 2,4-D resistance is predictable by this mechanism. These resistant weeds present an ever-growing economic concern to farmers, since a widespread distribution of hard-to-control weeds has the potential to cause significant agricultural economic losses underestimated in the APHIS analysis.

Indeed, under the required National Environmental Policy Act (NEPA) review, APHIS acknowledges the following unavoidable environmental impacts:

> Herbicides represent a tool that allows for the economical production of corn and soybean. As long as herbicides are used to produce corn and soybean, weeds will develop resistance to the herbicides used. *Under all four [NEPA] Alternatives, the selection of herbicide-resistant weeds is an unavoidable impact.* Growers may mitigate the rate at which weeds develop resistance by adopting best management practices as described in Section 5.3.2.[10]

Despite this blatant acknowledgment of the inevitable propagation of 2,4-D-resistant weeds, APHIS goes on to say that it "does not have the authority to regulate grower management practices nor does APHIS have the authority to regulate herbicide use."[11]

We beg to differ. The impact of GE crops like DAS-40278-9 corn, DAS-68416-4 soybean and DAS-44406-6 soybean in the environment poses an "unacceptable" noxious weed propagating risk, in violation of the PPA and NEPA.[12] Resistant weeds must be interpreted as "noxious weeds" that are directly and

[7] PPA, 7 U.S.C. § 7712(a).
[8] PPA, 7 U.S.C. § 7702(10).
[9] APHIS. 2012. Dow AgroSciences Petition (09-349-01p) for Determination of Nonregulated Status of Event DAS-68416-4. US Department of Agriculture.
[10] APHIS. 2013. Draft Environmental Impact Statement. Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D Resistant Corn and Soybean Varieties. Biotechnology Regulatory Services. U.S. Department of Agriculture. Riverdale, MD, at 148.
[11] *Id.*
[12] NEPA, 42 U.S.C. § 4332,

> The Congress authorizes and directs that, to the fullest extent possible:
> (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter, and
>
> (2) all agencies of the Federal Government shall—

indirectly causing undue burden to U.S. agricultural interests in terms of additional costs, economic burden to farmers, especially organic farming systems, and impact to overall agricultural productivity, as well as contaminating the environment. APHIS therefore can and must use its authority to restrict further spread of these resistant, "noxious weeds" to prevent further impact on U.S. agricultural systems. Introducing into the environment GE material, the very agent which is reliant on herbicides that promote the spread of resistant weeds violates section 7712(a) of the PPA and poses "unacceptable" risk to plant health and an unreasonable risk to the environment.

Dergulation of these crops only serves to undermine U.S. agricultural interests in the long-term. In addition, the continued allowance of GE technology and chemical-intensive practices raises a severe economic threat to non-GE plant systems, such as crops certified under the USDA organic standards.

Responsibility of the U.S. Environmental Protection Agency (EPA)

APHIS mentions several times in its DEIS that the potential for adverse impact to the environment from the expected increased use of 2,4-D (direct and indirect impacts) are under the jurisdiction of EPA and the *Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)*.[13] APHIS assumes that herbicide applications would conform to EPA registered uses for corn and soybean, and that possible drift will be mitigated by registration requirements established by EPA. While EPA does indeed have jurisdiction over herbicide applications and APHIS does not, it is inappropriate for APHIS to make a final determination on an action that would impact herbicide use under the purview of EPA without EPA first finalizing its authority over said herbicide use.

Currently, 2,4-D and its various forms, including the new choline salt, are undergoing registration review by EPA. According to EPA, this registration review, which will review human and ecological toxicological data, is not expected to be completed before 2017.[14] Consequently, since APHIS acknowledges that cumulative impact (of 2,4-D corn and soybean) results from the "combined action of USDA on the subject of petitions and of the EPA's action to register 2,4-D for use on Enlist™ corn and soybean,"[15] APHIS must therefore await EPA's registration review of 2,4-D before APHIS can move on a decision that will inevitably impact decisions made by EPA.

While EPA review findings should be integrated into APHIS's evaluation of whether to deregulate 2,4 D resistant crops, APHIS must itself assess the impact of herbicide use on agricultural health, including impacts on non-GE conventional and organic production, the effect of resistant weeds on the long-term economics of agriculture, and the range of alternative management strategies available that may offer better protection from the onset of resistance and environmental degradation. Thus, while APHIS has a duty to consider the full spectrum of sound science in making its determination, including EPA's review,

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment.

[13] Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), 7 U.S.C. §§ 136-136Y.

[14] USEPA. 2012. 2,4-D Preliminary Work Plan. Reregistration Review: Initial Docket Case No. 73. Office of Pesticide Programs. Washington DC.

[15] APHIS. 2013. Draft Environmental Impact Statement. Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D Resistant Corn and Soybean Varieties. Biotechnology Regulatory Services. US Department of Agriculture. Riverdale, MD.

EPA's duty to perform a pesticide registration review cannot be used as a substitute to help APHIS satisfy its statutory duty.

A. Cumulative Impacts

A. 1. Increased Selection of 2,4-D Resistant Weeds

The proliferation of glyphosate-resistant weeds presents an ever-growing economic concern to farmers, since a widespread distribution of hard-to-control weeds has the potential to cause significant economic losses. Scientists studying the phenomenon agree that it is of economic concern, and have advised against the dependence on herbicides, and advocate for the use of crop rotations and the rotation to non-GE crops.[16] It is almost inevitable that the introduction of 2,4-D tolerant crops would result in 2,4-D resistant weeds. APHIS recognizes that the adoption of 2,4-D corn and soybean can have a "potentially significant environmental impact," on the proliferation of resistant weeds, due to changes in farming practices, i.e., increased reliance on 2,4-D for weed control. The DEIS states, "If 2,4-D resistant weeds were to be selected as a result of these combined actions, growers who rely on 2,4-D for effective control and inexpensive weed control are likely to experience increased socioeconomic impacts from more costly and restrictive weed control alternatives."[17] To mitigate the onset of weed resistance and reduce selection pressure, APHIS (and DOW AgroSciences) recommends that farmers utilize herbicides with varying modes of action, and other chemical-intensive management practices such as using broad-spectrum herbicides, applying according to label rates, and avoiding application of similar herbicides in the same growing season. However, despite these and other best management practices, the agency concedes that given the prevalence of glyphosate-resistant weeds, it is "very likely" that 2,4-D resistant weeds will occur. Even though Dow AgroSciences has provided information that supports its belief that the onset of 2,4-D resistance in the U.S. is almost non-existent, APHIS is aware that weed resistance to 2,4-D has already been identified in other countries,[18] and therefore this phenomenon is also expected with 2,4-D in the U.S. Thus far, 28 species across 16 plant families have already evolved resistance to the synthetic auxin herbicides, the mode of action to which 2,4-D belongs, with 16 known to be resistant specifically to 2,4-D.[19]

Additionally, many of these genetically diverse weed species under chemical-intensive selection have already demonstrated the ability to evolve resistance to a several herbicide modes of action (multiple-resistant weeds). Experts have predicted that with the introduction of herbicide-tolerant genes, plants carrying multiple resistances will become common after commercial GE release.[20] According to data

[16] Culpepper, A. S. 2006. Glyphosate-Induced Weed Shifts. *Weed Technology*, 20(2), 277–281.
[17] APHIS. 2013. Draft Environmental Impact Statement. Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D Resistant Corn and Soybean Varieties. Biotechnology Regulatory Services. US Department of Agriculture. Riverdale, MD.
[18] APHIS. 2011. Plant Pest Risk Assessment for DAS-40278-9 Corn. U.S. Department of Agriculture.
[19] Egan JF, Maxwell BD, Mortensen DA, et al. 2011. 2,4-Dichlorophenoxyacetic acid (2,4-D)-resistant crops and the potential for evolution of 2,4-D-resistant weeds. Proc Natl Acad Sci. 108(11): E37.
[20] Eastham, K., and Sweet, J. 2002 Genetically modified organisms (GMOs): The significance of gene flow through pollen transfer. Assessing the Impact of GM Plants (AIGM) programme for the European Science Foundation and the European Environment Agency Environmental issue report.

published by Purdue University Extension, resistant weeds species have several negative effects on a farm, including increased labor, increased costs, and increased risk of crop injury. [21]

This is contrary to industry promises of an overall increase in agricultural productivity with a decrease in chemical use for GE crops. One published report, which utilized data from USDA, shows that GE crops have been responsible for an increase of 404 million pounds of herbicide use in the U.S. over the first 16 years of commercial use of GE crops (1996-2011).[22] Another survey of farmers' herbicide use patterns found that herbicide use continues to increase, with many farmers making one to three post-applications per year.[23] Given that resistant weeds are the direct result of herbicide overuse, the problem will not be resolved simply by adding new herbicide-resistance traits into our crops. APHIS's decision to deregulate 2,4-D resistant corn and soybeans would only serve to further compound the growing weed resistance problems which goes against the agency's mission to "protect American agriculture."

A.2. Impact on Non-GE and Organic Agriculture

In APHIS' DEIS, the agency presents a case that protecting organic and non-GE farms from GE contamination is a burden to be borne by the organic/non-GE farmer. APHIS lays out several best management practices which it assumes farmers "are already using, or have the ability to use" to minimize contamination, including; delayed planting, and physical barriers and buffer zones. Not only does APHIS place the burden of minimizing GE contamination on the non-GE farmer, but these farmers also have no clear redress for contamination. For instance, corn, a wind pollinated crop, has the potential to have its genetic material (pollen) transfer across neighboring plants and crops. Evidence suggests that GE corn plants can cross-pollinate non-GE corn plants up to and beyond a distance of 200 meters.[24] In order to limit gene flow between plant species, several best management practice methods like those mentioned above are employed. However, the scientific literature demonstrates that these efforts are not effective, as do the recent known incidents of genetic contamination.

In 2013, the U.S. Supreme Court issued a decision in a landmark federal lawsuit, *Organic Seed Growers and Trade Association et al v. Monsanto,* limiting the ability of farmers to protect themselves from genetic drift. The case, brought by a coalition of organic farmers and concerned groups, challenged Monsanto's patents on GE seed, and attempted to shield farmers from being sued for patent infringement by Monsanto should they become contaminated by drift of the company's GE seed, a legal strategy Monsanto has been pursuing for years. While the case evoked a public commitment from Monsanto that it would not sue farmers faced with contamination of crops containing "trace amounts" of the company's patented genes, organic and non-GE farmers are still seriously concerned their farms

[21] Boerboom, C and Owen, M. Facts About Glyphosate Resistant Weeds. The Glyphosate, Weeds, and Crops Series. Purdue Extension.
[22] Benbrook, C. 2012. Impacts of genetically engineered crops on pesticide use in the U.S. -- the first sixteen years. *Environmental Sciences Europe*, 24:24 doi:10.1186/2190-4715-24-24.
[23] Givens, W. A., Shaw, D. R., Johnson, W. G., Weller, S. C., Young, B. G., Wilson, R. G., Owen, M. D. K., & Jordan, D. 2009. A Grower Survey of Herbicide Use Patterns in Glyphosate-Resistant Cropping Systems. *Weed Technology*, 23(1), 156-161.
[24] Eastham, K., and Sweet, J. (2002) Genetically modified organisms (GMOs): The significance of gene flow through pollen transfer. Assessing the Impact of GM Plants (AIGM) programme for the European Science Foundation and the European Environment Agency Environmental issue report.

and livelihoods will be impacted by GE contamination. APHIS should not assume organic/non-GE farmers are able to protect themselves from contamination or address economic consequences in the market.

Additionally, APHIS states that, "No cumulative impacts are expected on organic growers because these growers do not use herbicides such as 2,4-D for weed control." This is somewhat misleading as cumulative impacts from 2,4-D drift and the economic costs of genetic drift are also experienced by organic/non-GE farmers. Additionally, non-organic, non-GE farmers also experience the economic costs of controlling resistant weeds. While the agency believes that this new formulation of 2,4-D (Enlist™) is 50 times less volatile than other 2,4-D formulations, without the completed EPA assessment, it is inappropriate for APHIS to underestimate the impact of 2,4-D drift.

A.3. 2,4-D Drift and Environmental Degradation

2,4-D is one of the most widely used herbicides for the control of broadleaf weeds for commercial agriculture and residential landscapes in the U.S. An increase in the application of 2,4-D in the environment would increase environmental harm. According to EPA, under most environmental conditions, various forms of 2,4-D will degrade rapidly to form 2,4-D acid. While 2,4-D acid degrades fairly quickly in soils, it is relatively persistent in anaerobic aquatic environments (half-life ranges from 41 to 333 days).[25] This will have implications for fragile wetland areas, especially those under conservation. According to Donald et al., concentrations of herbicides in water from wetlands where herbicides are not used are as high as those from locations where herbicides are used.[26] Non-target plants in these areas and others are also at risk. 2,4-D is toxic to aquatic plants and is more toxic to vascular plants than to non-vascular plants.

2,4-D drift has long been a known problem to off-site locations, endangered species and non-target crops. Many forms of 2,4-D volatilize above 85°F[27] and 2,4-D drift has been known to damage tomatoes, grapes and other plants. Herbicide concentrations 100 times below the recommended label rate have been reported to cause injury to grapes. Drift can injure plants half a mile or more from the application site.[28] In addition to non-target plants, 2,4-D can impact species listed under the jurisdiction of the Endangered Species Act (ESA). In 2011, the National Marine Fisheries Service (NMFS) identified 2,4-D as likely to jeopardize all listed salmonids, based on current registration and label directions.[29]

APHIS relies on EPA label use restrictions for 2,4-D to mitigate the potential (non-target) risks from exposure. However, label directions have been shown to have no effect on decreasing spray drift. In

[25] USEPA. 2005. 2,4-D RED Facts. Available at http://www.epa.gov/oppsrrd1/REDs/factsheets/24d_fs.htm
[26] Donald DB, Gurprasad NP, Quinnett-Abbott L, Cash K. 2001. Diffuse geographic distribution of herbicides in northern prairie wetlands. Environ Toxicol Chem. 20(2):273-9.
[27] Hales, R. 2010. Herbicide Injury a Problem on Plants. Colorado State University Cooperative Extension.
[28] Ball, D.A, Parker, R, et al. 2004. Preventing Herbicide Drift and Injury to Grapes. Oregon State University Extension Service
[29] NMFS. 2011. Endangered Species Act Section 7 Consultation Biological Opinion: 2,4-D, Triclopyr BEE, Diuron, Linuron, Captan, and Chlorothalonil. National Marine Fisheries Service

fact, EPA has acknowledged this and is currently attempting to review and revise pesticide labeling guidance.[30]

2,4-D's contamination with dioxins has long been a part of 2,4-D's history. While recent manufacturing advancements have reduced dioxin levels in 2,4-D, the threat of dioxin contamination is still very much a consequence of 2,4-D use. The science is very clear that dioxins are a carcinogenic class of chemicals that have left a toxic legacy for human health and environmental protection across the U.S due to their persistence and toxicity. The issue of 2,4-D contaminants, such as dioxins that are present in formulations, has been ignored and is probably much more serious in terms of degradation issues than the "active ingredient." Dioxins have notoriously long half-lives, are bioaccumulative, and present broadly significant health risks developmentally and postnatally, including increased risk of heart disease and diabetes.[31] APHIS has not sufficiently taken into account the possibility of increased dioxin contamination to fields using 2,4-D and the threat to environmental health.

New 2,4-D formulation- Choline salt

Most noteworthy, Dow AgroSciences states that the new 2,4-D formulation (choline salt), which is to be exclusively used with the new 2,4-D resistant corn and soybeans, is anticipated to have lower volatility (50 times lower) and thus decreased drift compared to other forms of 2,4-D.[32] However, the technical information supporting this has not been made available for public and peer review. Moreover, the surfactants and non-ionic solvents added to commercial mixtures can substantially alter volatility and these, at present, are undefined. Therefore, we believe APHIS must delay its final determination on these new GE crops and their companion 2,4-D formulation until EPA has published and held for public comment its risk assessment for this new 2,4-D form. According to EPA's schedule, the registration review of 2,4-D and its related salts is not expected until 2017.[33]

As mentioned before, APHIS' reliance on EPA for an assessment that has not been completed and falls short of its more expansive assessment requirements under statutes outside of EPA's jurisdiction is unlawful.

B. Risks to Human Health

B.1. 2,4-D is Hazardous to Human Health

2,4-D is neurotoxic, mutagenic and genotoxic, and poses serious risks to human health. In sub-chronic laboratory studies, rats exposed to 2,4-D experienced decreases in red cell mass, decreases in ovary and testes weights, and increases in liver, kidney, and thyroid weight.[34] A study found that 2,4-D is indeed

[30] USEPA. 2009. Pesticide Spray and Dust Drift. Available at http://www.epa.gov/pesticides/factsheets/spraydrift.htm
[31] NIEHS. 2011. Environmental Health Topics: Dioxins. National Institutes of Health. Research Triangle Park, NC. Available at http://www.niehs.nih.gov/health/topics/agents/dioxins/index.cfm.
[32] APHIS. 2013. Draft Environmental Impact Statement. Dow AgroSciences Petitions (09-233-01p, 09-349-01p, and 11-234-01p) for Determinations of Nonregulated Status for 2,4-D Resistant Corn and Soybean Varieties. Biotechnology Regulatory Services. US Department of Agriculture. Riverdale, MD.Challenges Shared with Scientific Community. FR docket ID: APHIS-2010-0103-1205
[33] USEPA. 2012. 2,4-D Preliminary Work Plan. Reregistration Review: Initial Docket Case No. 73. Office of Pesticide Programs. Washington DC.
[34] Charles, J.M., Cunny, H.C., Wilson, R.D., and Bus, J.S. 1996. Comparative Subchronic Studies on 2,4-Dichlorophenoxyacetic Acid, Amine, and Ester in Rats. *Fundamental and Applied Toxicology* 33, 161-165.

cytotoxic and induces apoptosis via direct effect on mitochondrial membranes.[35] Changes to maternal behavior in rats, along with increased catecholamine levels and a drastic decrease in indolamine levels have also been observed.[36] 2,4-D is also an endocrine disruptor and is known to interfere with the thyroid hormone. According to EPA, current data "demonstrate effects on the thyroid and gonads following exposure to 2,4-D, [and] there is concern regarding its endocrine disruption potential."[37] EPA researchers found that persons with urinary 2,4-D presence have low levels of thyroid hormone. Their results also indicate that exposure to 2,4-D was associated with changes in biomarkers that have been linked to risk factors for acute myocardial infarction and type-2 diabetes.[38] One study of agricultural workers found an increased risk of gastric cancer among those who worked in areas where 2,4-D was applied.[39] Others found that those exposed to 2,4-D had poor semen quality.[40,41] Higher rates of birth defects were also observed in farmers with long-time exposure to 2,4-D. [42]

Laboratory studies have observed the hormone effects of 2,4-D exposure, including estrogenic activity in rainbow trout[43] exposed to 2,4-D, decreases in the thyroid gland transport and production functions, and impairment of hormone iodination in the thyroid glands of laboratory rats.[44] A study investigating developmental toxicity in mice of a common commercial formulation of herbicide containing a mixture of 2,4-D noted a decrease in litter size associated with a decrease in the number of implantation sites, at very low and low environmentally relevant doses.[45] Other studies have found that 2,4-D promotes the proliferation of androgen-sensitive cells by acting synergistically with its main metabolite, 2,4-dichlorophenol (DCP), also known for its endocrine disrupting effects. [46,47] This heightened androgen-sensitive cell population may be linked to the recent escalation of polycystic ovary syndrome in reproductively aged women[48] that results in reproductive impairment due to inability to ovulate and carry young to term. Occupational exposure to 2,4-D is also associated with an increased risk of

[35] Oakes, D.J., and Pollak, J.K. 2000 The in vitro evaluation of the toxicities of three related herbicide formulations containing ester derivatives of 2,4,5-T and 2,4-D using sub-mitochondrial particles. *Toxicology* 151, 1-9.
[36] Stürtz, N., Deis, R.P., Jahn, G.A., Duffard, R., and Evangelista de Duffard, A.M. 2008. Effect of 2,4-dichlorophenoxyacetic acid on rat maternal behavior. *Toxicology* 247, 73-79.
[37] U.S. EPA. 2005. Reregistration Eligibility Decision for 2,4-*D*. Office of Prevention Pesticides and Toxic Substances. Washington DC.
[38] Schreinemachers DM. 2010. Perturbation of lipids and glucose metabolism associated with previous 2,4-D exposure: a cross-sectional study of NHANES III data, 1988-1994. Environ Health. 9:11.
[39] Mills PK and Yang RC. 2007. Agricultural exposures and gastric cancer risk in Hispanic farm workers in California. Environ Res. 104(2):282-9.
[40] Swan SH, Kruse RL, Liu F, Barr DB, et al. 2003. Semen quality in relation to biomarkers of pesticide exposure. Environ Health Perspect. 111(12):1478-84.
[41] Lerda, D., and Rizzi, R. 1991. Study of Reproductive Function in Persons Occupationally Exposed to 2,4-Dichlorophenoxyacetic Acid (2,4-D). *Mutation Research* 262, 47-50.
[42] Garry, V.F., Schreinemachers, D., Harkins, M.E., and Griffith, J. 1996. Pesticide Appliers, Biocides, and Birth Defects in Rural Minnesota. *Environmental Health Perspectives* 104, 394-399.
[43] Xie, L.T., Thrippleton, K., Irwin, M.A., Siemering, G.S., Mekebri, A., Crane, D., Berry, K., and Schlenk, D. 2005. Evaluation of estrogenic activities of aquatic herbicides and surfactants using an rainbow trout vitellogenin assay. *Toxicol. Sci*. 87, 391-398.
[44] Malysheva, L.N., and Zhavoronkov, A.A. 1997. Morphological and histochemical changes in the thyroid gland after a single exposure to 2,4-DA herbicide. *Bull. Exp. Biol. Med.* 124, 1223-1224.
[45] Cavieres, M,F, Jaeger, J and Porter, W. 2002. Developmental toxicity of a commercial herbicide mixture in mice: I. Effects on embryo implantation and litter size. *Environ Health Perspect*. 110(11): 1081–1085.
[46] Kim, H.-J., Park, Y.I., and Dong, M.S. 2005. Effects of 2,4-D and DCP on the DHT-Induced Androgenic Action in Human Prostate Cancer Cells. *Toxicological Sciences*. 88(1), 52–59 pp. 52-59.
[47] McKinlay, R., Plant, J.A., Bell, J.N.B., and Voulvoulis, N. 2008. Endocrine disrupting pesticides: Implications for risk assessment. Environment International 34, 168-183.
[48] Mason, H, Colao, A, et al. 2008. Polycystic ovary syndrome (PCOS) trilogy: a translational and clinical review. Clinical Endocrinology, 69(6): 831–844

Parkinson's disease. 2,4-D has effects on dopaminergic neurons in experimental settings and is associated with more than a 3-fold increased risk of disease.[49]

B.2. Occupational Exposures to 2,4-D Use Go Underestimated

APHIS states, "APHIS has not identified any direct or indirect effects on worker safety that would result from choosing the Preferred Alternative Hazards to workers occurring through the various management practices that are used to grow corn and soy." However, the scientific literature confirms that farmers, farmworkers and their families face extraordinary and disproportionate risks from pesticides, making the expansion of pesticide use an issue of environmental justice. Application and pesticide drift result in dermal, inhalation, and oral exposures that are typically underestimated. According to a study by Arcury et al.,[50] workers experience repeated exposures to the same pesticides evidenced by multiple pesticides routinely detected in their bodies. This study of 196 farmworkers found that 86 percent of them contained 2,4-D in their urine. Others have also reported 2,4-D detections in a majority of samples including those of pregnant workers.[51,52] A 2004 study detected agricultural pesticides in the homes near to agricultural fields.[53]

Researchers from the National Cancer Institute and the National Institutes of Health found that increasing acreage of corn and soybean fields within 750 meters of homes is associated with significantly elevated odds of detecting agricultural herbicides. 95 percent of the homes sampled here contain 2,4-D.[54] 2,4-D has also been detected in the semen of farmworkers in Canada, which could be toxic to sperm cells and can be transported to the woman and developing embryo/fetus.[55] Phenoxyacetic acid herbicides, specifically 2,4-D, is associated with non-Hodgkin lymphoma (NHL) and a high incidence of NHL has been reported among farmers and other occupational groups working with 2,4-D. According to the National Cancer Institute, frequent use of 2,4-D, has been associated with 2- to 8-fold increases of NHL in studies conducted in Sweden, Kansas, Nebraska, Canada, and elsewhere.[56] Farmers using 2,4-D are associated with an increased risk of NHL in 131 lymphohematopoietic cancers (LHC) in a case-control study embedded in a cohort of 139,000 members of United Farm Workers of America (UFW) diagnosed in California between 1988 and 2001.[57] Despite industry attempts to downplay these findings and claim that 2,4-D has low toxicity, farmworkers continue to bear the brunt of these exposures and chronic health effects. APHIS has not adequately looked at the increased occupational risks posed by 2,4-D. The

[49] Tanner CM, Ross GW, Jewell SA, et al. 2009. Occupation and risk of parkinsonism: a multicenter case-control study. Arch Neurol. 66(9):1106-13.
[50] Arcury, T, Grzywacz, J, Talton, J, et al. 2010. Repeated Pesticide Exposure among North Carolina Migrant and Seasonal Farmworkers. *Am J Ind Med*. 53(8): 802–813.
[51] Arcury, T, Grzywacz, J, et al. 2009. Seasonal Variation in the Measurement of Urinary Pesticide Metabolites among Latino Farmworkers in Eastern North Carolina. Int J Occup Environ Health.15(4): 339–350.
[52] Cooper, S, Burau, K, Sweeney, A, et al. 2001. Prenatal exposure to pesticides: A feasibility study among migrant and seasonal farmworkers. Am. J. Ind. Med. 40:578–585
[53] Quandt SA, Arcury TA, Rao, P, et al. 2004. Agricultural and residential pesticides in wipe samples from farmworker family residences in North Carolina and Virginia. Environ Health Perspect. 112(3): 382–387.
[54] Ward MH, Lubin J, Giglierano J, et al. 2006. Proximity to crops and residential exposure to agricultural herbicides in Iowa. Environ Health Perspect. 114(6):893-7.
[55] Arbuckle TE, Schrader SM, et al. 1999. 2,4-Dichlorophenoxyacetic acid residues in semen of Ontario farmers. Reprod Toxicol. 13(6):421-9.
[56] Zahm SH and Blair A. 1992. Pesticides and non-Hodgkin's lymphoma. Cancer Res. 52(19 Suppl):5485s-5488s.
[57] Mills PK, Yang R, Riordan D. 2005. Lymphohematopoietic cancers in the United Farm Workers of America (UFW), 1988-2001. Cancer Causes Control. 16(7):823-30.

agency therefore cannot make a determination for DAS-40278-9 corn until occupational health is specially considered.

Conclusion

APHIS has a responsibility under the law to prohibit and/or restrict any plant or plant product that poses a risk to the environment. APHIS, in its DEIS has not met its statutory duty to fully review the impacts of GE 2,4-D resistant corn and its associated dependency on increased 2,4-D use, and therefore, must not approve the petition for the deregulation of 2,4-D resistant corn and soybeans (DAS-40278-9 corn, DAS-68416-4 soybean and DAS-44406-6 soybean). To allow new GE material into the environment with the backdrop of documented problems created by other herbicide-tolerant GE crops is taking U.S. agriculture in a wrong and hazardous direction. GE gene flow in the environment and increased herbicide dependency has been left unchecked for many years, resulting in an increasing population of resistant weeds and insects that are becoming more difficult and costly to control.

2,4-D and its resistant crops are not the solution for glyphosate resistant weeds created by other herbicide-tolerant GE crops deregulated by APHIS. Had a proper environmental assessment been conducted on previous GE decisions, the economic and environmental threat of resistant noxious weeds may not be an issue. It is time for the agency to focus on other sustainable, integrated methods for long-term weed management, which allow our nation's farmers to get off the toxic treadmill. 2,4-D is highly toxic to human health, especially to farmers and farmworkers, and poses a direct threat to non-target plants and non-GE and organic crops. These impacts, as was seen with Roundup-Ready crops, continue to be underestimated by the agency. Similarly, APHIS must not finalize its decision before a comprehensive human and ecological review of 2,4-D registered uses is completed by EPA, since APHIS is citing as support EPA's registration of a new formulation of a product whose review will not be completed until 2017.

We urge the agency not to escalate the American agricultural economy's broad reliance on 2,4-D, because other pesticidal technologies – glyphosate- have failed. Now is the time to concede that GE technologies have not lived up to their promises and encourage our nation's farmers to return to more sustainable methods of farming, without the deregulation of 2,4-D resistant corn and soybeans.

Respectfully,

Beyond Pesticides