CENTER FOR
FOOD SAFETY

May 16, 2022

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Agricultural Marketing Service, USDA, Room 2055–S, STOP 0201
1400 Independence Avenue SW
Washington, DC 20250–0201.

RE: Docket No. AMS-AMS-22-0025: Competition and the Intellectual Property System: Seeds and Other Agricultural Inputs

Center for Food Safety appreciates the opportunity to comment on competition and the intellectual property system as it relates to seeds and other agricultural inputs. Center for Food Safety (CFS) is a public interest, nonprofit organization with 970,000 members and supporters, and offices in Washington, D.C., San Francisco, California, and Portland, Oregon. CFS's mission is to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture. Through groundbreaking legal, scientific, and grassroots action, CFS protects and promotes the public's right to safe food and the environment.

Qualifications

CFS has extensive expertise in the areas of intellectual property protection of plants and seed industry concentration and how they affect the nation's farmers. Our 2005 report, *Monsanto vs. U.S. Farmers*, is the first comprehensive assessment of Monsanto's litigation against US farmers for alleged patent infringement involving genetically engineered (GE) seed.[1] The report provides both legal analysis and, based on interviews with dozens of affected farmers, insights into the company's investigation and litigation practices. The report was updated and expanded in 2013 to cover similar actions against farmers by other seed-pesticide firms.[2]

Our 2007 report on Monsanto's then proposed acquisition of the Delta and Pine Land Company, the world's largest cotton seed firm, was submitted to the Bush Administration's Department of Justice as it reviewed the proposed merger.[3] The report is a data-driven analysis of concentration in the cotton seed industry and the anticompetitive effects the proposed merger would likely have, many of which have come to pass. CFS worked with the American

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[1] CFS (2005). "Monsanto vs. U.S. Farmers," Center for Food Safety, 2005. https://www.centerforfoodsafety.org/files/cfsmonsantovsfarmerreport11305.pdf. See also

[2] CFS (2013). Seed Giants vs. U.S. Farmers, Center for Food Safety, 2013. https://www.centerforfoodsafety.org/reports/1770/seed-giants-vs-us-farmers.

[3] Freese, B. (2007). "Cotton Concentration Report: An Assessment of Monsanto's Proposed Acquisition of Delta and Pine Land," International Center for Technology Assessment/Center for Food Safety, February 2007. https://www.centerforfoodsafety.org/files/cfs-cta_monsanto-dpl_merger_report_public_release_-_final__2_.pdf.

Antitrust Institute on this issue, and the report was cited by 13 state attorneys general in Tunney Act objections to the proposed settlement.

In addition, CFS attorneys have submitted amicus briefs in several cases involving Monsanto's patent infringement lawsuits against farmers, including one in support of a petition for a writ of certiorari that invoked the doctrine of patent exhaustion.[4] In 2012, CFS science policy analyst Bill Freese accompanied attorneys representing Indiana farmer Vernon Hugh Bowman to a meeting with the Dept. of Justice officials as the Solicitor General was weighing whether or not to recommend the Supreme Court grant *a certiorari* in a case involving alleged patent infringement with respect to soybean seeds. CFS followed up this meeting with a letter to then Solicitor General Donald Verrilli, Jr., expanding on our reasons for supporting a Supreme Court hearing of the case (Attachment 1). CFS also submitted comments earlier this year to the the Federal Trade Commission and Department of Justice regarding mergers in the seed, pesticide and biotechnology sectors and their consequences (Attachment 2). Attachment 3 addresses the hazards of a new herbicide-resistant corn variety, and is illustrative of the misdirection of crop development attributable to concentration of the seed industry and its consolidation with the pesticide sector.

Question 1: *Please describe concerns related to market concentration and market power in the agricultural input industries, including effects on …. research and innovation ….*

CFS agrees with the conclusions of a USDA Economic Research Service report, which found that:

> "Those companies that survived seed industry consolidation appear to be sponsoring less research relative to the size of their individual markets than when more companies were involved. … Also, fewer companies developing crops and marketing seeds may translate into fewer varieties offered."[5]

This conclusion is based on declining numbers of genetically engineered crop field trials conducted by private firms as a function of seed sales, both by crop, during the late 1990s when considerable consolidation of the seed and pesticide industries took place. As we discuss in response to Question 2, this decline in research intensity is accompanied by a sharp narrowing of R&D into particular applications accompanied by neglect of other more useful traits.

Question 2: *Are seed companies offering an adequate variety of types of seeds and traits?*

No, pesticide-seed companies have produced a very limited array of new traits for a quite limited range of crops. Virtually 100% of genetically engineered (GE) crop acreage is

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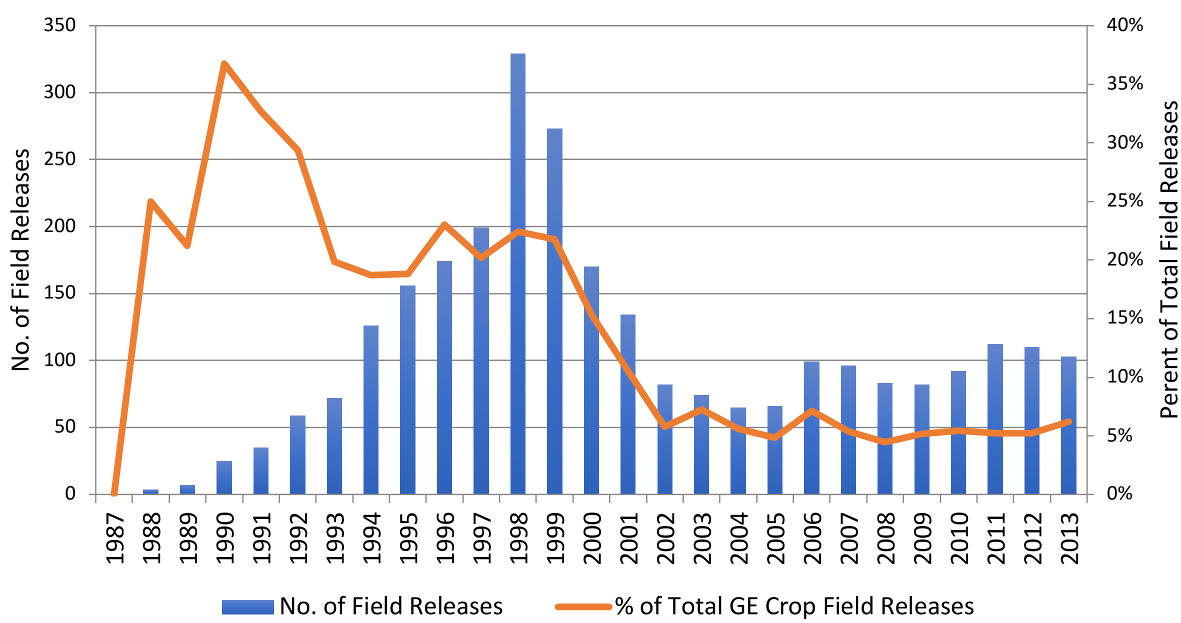
[4] Br. for Ctr. for Food Safety et al. as Amici Curiae Supporting Pet. For Cert., McFarling v. Monsanto Co., 552 U.S. 1096 (2008) (No. 07-241), 2008 U.S. LEXIS 73.

[5] Fernandez-Cornejo, J. and Schimmelpfennig, D. (2004). "Have Seed Industry Changes Affected Research Effort?" USDA Economic Research Service, AmberWaves, February 2004, p. 19. https://ageconsearch.umn.edu/record/131780/?ln=en.

comprised of corn, soybeans, cotton, canola, sugar beet and alfalfa varieties that are resistant to one or more herbicides, with resistance to select insect pests also incorporated into corn and cotton varieties.

Commercial pesticide-seed companies have largely failed to deliver crop varieties with more useful traits – particularly those that are increasingly needed to meet the many challenges of climate change, such as drought tolerance, improved nitrogen use efficiency, and disease resistance. For instance, private sector research effort to develop disease-resistant crops plummeted during the period of pesticide-seed industry consolidation, from the late 1990s on (Figure 1). It may well be that the once vigorous efforts to develop disease-resistance traits flagged once the seed firms working on such traits were acquired by the pesticide industry, which saw a conflict with their interests in marketing more fungicide products (most plant diseases are caused by fungi). In any case, it is undisputed that foliar fungicide use on the nation's most widely planted crops, corn and soybeans – which until recently was essentially unknown – has skyrocketed over the past two decades (Figure 2). (Fungicides are also ubiquitous as seed treatments in many crops.) Much of this increase is due to unethical marketing of supposed "plant health" benefits of fungicide use absent any disease issues, and exaggerating the threats posed by new diseases. Nonetheless, such marketing efforts to expand fungicide use would be undercut if the pesticide-seed companies selling fungicides were concurrently marketing crops with GE disease-resistance traits.

Figure 1: Field Releases of Disease-Resistant Genetically Engineered Crops: 1987 to 2013



Source: Data formerly available at Information Systems for Biotechnology, http://www.isb.vt.edu/phenotype-by-years.aspx. The chart displays "location" data for field trials involving experimental GE crops engineered for virus-resistance, fungal resistance or bacterial resistance. Each location represents a single state where a particular GE disease-resistant crop is field-tested. Bars represent sum total of all approved disease-resistant GE crop field release locations each year; line represents GE disease-resistant field release locations as percentage of all GE crop field release locations.

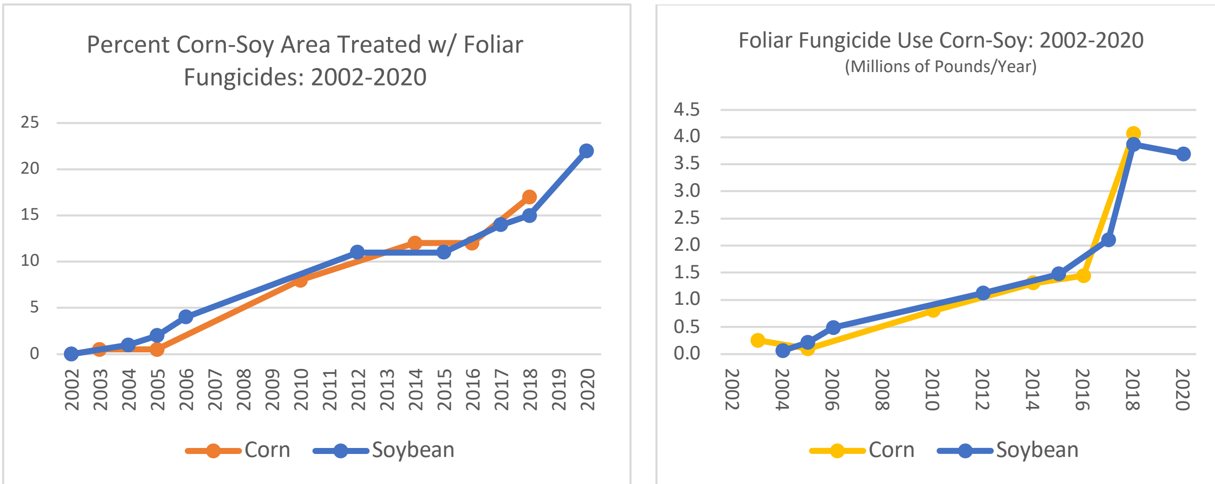


Figure 2: Sharp Rise in Fungicide Use on Corn and Soybeans Since 2002. Based on USDA Quick Stats figures for "Fungicides," downloaded 4/11/22. Excludes fungicidal seed treatments.

The question as to whether crop varietal offerings are adequate to farmers needs should not be limited to "new and improved varieties." Farmers have diverse needs which change from season to season, and sometimes less is more. Farmer access to elite conventional crop varieties without GE traits, for instance, is vital for at least two reasons: first, as less expensive options when farmers have no interest in the GE trait; or find its added value to be less, for their particular farming circumstances, than the trait premium being charged; and second, as critical elements of a pesticide resistance management strategy. [Cite to letter] Yet pesticide-seed companies have largely phased out conventional seeds. [Cotton statistics].

The same point can be made with respect to lesser-traited seeds. Monsanto (acquired by Bayer in 2018) pursued a biotech trait penetration strategy whereby its seed offerings were heavily weighted to varieties with the maximum possible number of GE traits. This once meant "triple-stack" corn with the glyphosate resistance trait forced on farmers who were mainly interested in one or both of two insect resistance traits, for above and belowground pests (Figure 3). Subsequently, Monsanto sought to move farmers to SmartStax corn, with still more traits. This strategy of forcing unwanted traits on farmers was pursued to maximize profits, since seed prices rise with the number of GE traits they contain. See Attachment 1 for further discussion.

Figure 3: Area in U.S. Planted to Monsanto GM Corn with Bt Trait(s) Alone vs. Varieties with Roundup Ready Trait: 1996-2008

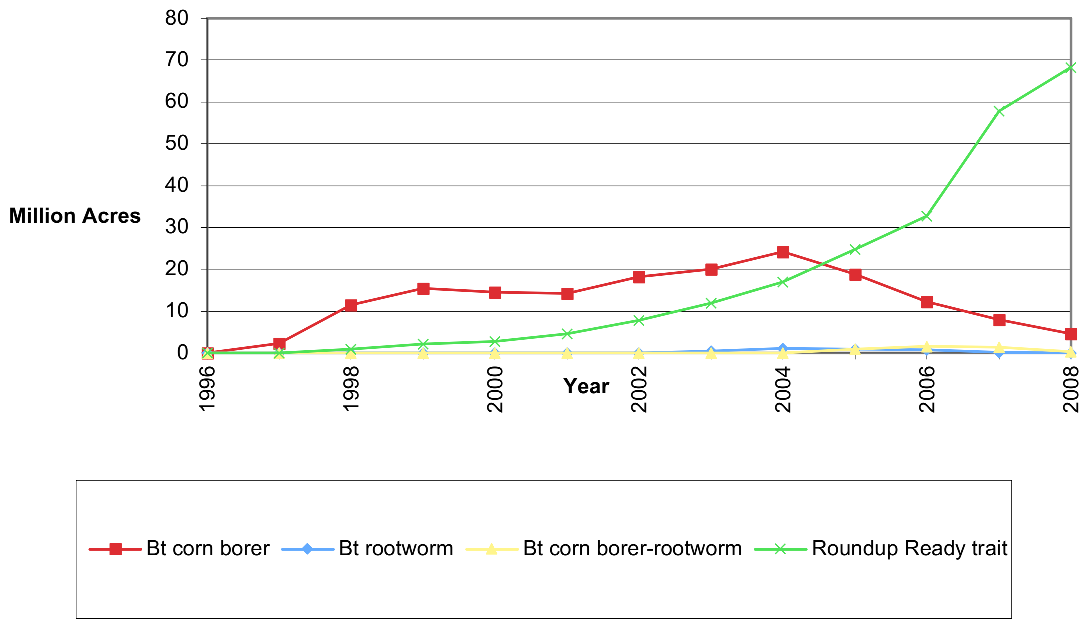


Figure 3. Source: Monsanto Biotechnology Trait Acreage: Fiscal Years 1996-2009, Updated October 7, 2009. Available upon request. Note that the "Roundup Ready trait" curve comprises all varieties that contain a glyphosate-resistance trait, mostly in combination with both Bt traits.

A similar situation obtains with respect to pesticidal seed treatments, which often come "bundled" with the seed as the default option. Growers are often unaware of the identity or purpose of the multiple pesticides coated onto seeds, and thus cannot judge whether they offer any benefit in his/her particular farming circumstances. Commercial seed treatment products combine multiple pesticides – normally at least one insecticide and several fungicides – and farmers are presented with a take-it-all or leave-it-all choice, with no option for tailoring the seed treatments to his/her situation. And in many cases "take-it-all" will be the only available option, or the only one of which farmers are aware, since most varieties of e.g. corn come with these treatments as the default option. As with traits, pesticidal seed treatments become another price point to justify still higher seed prices.

Possible solutions are discussed in response to Question 22 below.

Question 4: *Please share your views on whether, and if so how, the existing IP system—including plant patents, utility patents, and plant variety protection certificates—appropriately balances the need to incentivize innovation with the goal of ensuring public access to new and improved products at reasonable cost.*

Utility patent protection of plant varieties increased the profit potential in an historically low-profit industry, and thereby drove concentration in the seed sector and its takeover by major pesticide firms.[6] As discussed in the responses to Questions 1 and 2, this concentration in turn reduced research and innovation, and led to a narrowing of seed innovations comprising primarily herbicide-resistance traits.

Question 6: *Does the existing IP system, as relating to seeds …. effectively meet the statutory goal of rewarding invention through protection from competition for a fixed term? Does it fairly and effectively promote competition and innovation, or does it inappropriately suppress competition and innovation?*

In combination with technology use agreements, utility patents have been wielded by pesticide-seed companies to pursue and sue farmers for the traditional practice of seed-saving, perversely interpreted as patent infringement (discussed further in response to Question 9). Annulling the traditional right to save and replant non-hybrid seed with utility patents has had two innovation-suppressing effects. First, because farmer seed-saving represents a cost-saving alternative to the purchase of commercial seed each year,[7] seed firms needed to develop new crop varieties with properties that farmers regard as valuable enough to justify the large cost differential vis-à-vis saved seed.[8] Patent-based seed-saving prohibitions destroy that innovation incentive, and together with extreme concentration in the seed sector make seed companies less responsive to the diverse needs of their farmer-customers. Second, farmers can no longer conduct their own improvement with patented seeds, for example phenotypic selection, shutting down this important source of innovation – in this case, innovation tailor-made to improve crop performance under the local and farm-specific conditions of an individual grower.[9]

Question 8: *Please share your views on whether and how the different forms of IP protection for new plant varieties appropriately promote access to germplasm for the development of new varieties.*

As discussed further in response to Question 9, farmers and public sector plant breeders are prohibited from saving and replanting the seeds of a crop protected by utility patent, according to deeply misinformed U.S. Patent Office and court decisions. This of course shuts

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[6] Fernandez-Cornejo (2004), "The Seed Industry in U.S. Agriculture," USDA Economic Research Service, Agriculture Information Bulletin 786, pp. 25-28. While the 1970 Plant Variety Protection Act initiated the wave of mergers and acquisitions, it accelerated rapidly in the 1980s, spurred by development of biotechnology and the ability to obtain the stronger and more flexible protection afforded by utility patents on genes and plant parts as well as whole plant varieties.

[7] Hubbard K (2009), Out of Hand: Farmers Face the Consequences of a Consolidated Seed Industry, Farmer to Farmer Campaign on Genetic Engineering, December 2009, Figure 11, p. 39. http://www.farmertofarmercampaign.com/Out%20of%20Hand.FullReport.pdf

[8] For non-hybrid crops like cotton, wheat and soybeans that breed true and hence can be saved and replanted, "a seed company must offer improved varieties each year to attract repeat customers." https://web.archive.org/web/20060908001242/http://cls.casa.colostate.edu/transgeniccrops/saveseeds.html.

[9] Hubbard K (2009), op. cit., p. 40: "Many farmers still prefer to selectively harvest seed or traits and performance," for instance David Shupe of Illinois.

down all farmer/public access to huge swaths of elite germplasm protected by utility patent, and hence all possibility of farmers or others utilizing it for further improvements. Even the time-honored practice of phenotypic selection is prohibited as a form of patent infringement.

In contrast, the Plant Variety Protection Act (PVPA) of 1970 prevents commercial seed firms from appropriating the fruits of each other's breeding work, while at the same time containing exemptions for farmers and public sector breeders to utilize protected germplasm for further crop improvement.

Congress passed the PVPA as an alternative intellectual property regime specific to plants, because after much deliberation it determined that "the patent system [was not] the proper vehicle for the protection of [plants]."[10] The momentous decision to allow patenting of plants [and other life forms] was not made by the people's body, but by Patent Office bureaucrats and judges who evinced little knowledge or understanding of agriculture.

Question 9: *Do you believe farmers, breeders and small and medium sized enterprises face challenges from other companies asserting their IP rights against them?*

While not the first plants to which utility patent protection was applied, it can be said that the movement from PVPA to utility patent protection was spearheaded by genetically engineered (GE) crops. Patent claims generally apply to the genetic modification (e.g. the introduced transgene), the method by which it is accomplished, and/or the trait thereby generated. However, additional claims often seek to extend IP rights to the plant's cells and the plants themselves, by virtue of the fact that they embody the transgene or genetic modification. Incredibly, such claims are granted, even though the introduced or altered DNA confers only a single property (e.g. herbicide resistance), and is just one among the many thousands of native genes that are responsible for all of the other many properties of the GE variety.[11] These non-GE properties include yield potential, time to maturity, seed size, various seed qualities (e.g. nutritional enhancements), disease resistance, drought tolerance, and adaptations to particular soils and climates, among many others. These non-GE properties, in turn, were not invented by any individual or firm, but rather represent the collective achievement of millenia of plant breeding activity by farmers and public sector breeders, aided only in very recent times by private sector actors (see Attachment 1, pp. 2-4).

It is on this biologically ignorant basis that utility patents have been improperly interpreted to claim rights to the progeny of patent-protected plants (second-generation seed) – that is, merely because the seed contains a facsimile of the patented gene (which represents the only inventive activity), and despite the fact that the plant's reproductive capacity (which "duplicated" the patented gene along with thousands of native genes) owes nothing to the transgene or its method of introduction.

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[10] See Hubbard K (2022). Now is the time to sow fairness back into our farm fields," The Hill, June 14, 2022. https://thehill.com/opinion/energy-environment/3522893-now-is-the-time-to-sow-fairness-back-into-our-farm-fields/.

[11] For instance, the soybean genome is estimated to contain over 46,000 protein-coding genes. Schmutz, J et al (2010). "Genome sequence of the palaeopolyploid soybean," Nature 463: 178-183.

This perverse interpretation – contrary to biology and common sense – has been used as the basis for lawsuits against farmers who practice the traditional right to save and replant seeds from their harvest. As of January 2013, Monsanto alone had filed 144 lawsuits based on purported violations of its Technology Use Agreement and its patents on GE seed technology. These cases involved 410 farmers and 56 small businesses or farm companies, in at least 27 different states. Sums awarded to Monsanto in 72 recorded judgments totaled over $23 million. Based on materials formerly provided by Monsanto on its website, CFS estimates that Monsanto instituted between 2,391 and 4,531 "seed piracy" cases against farmers that result in out-of-court settlements in which farmers paid the company from $85 to $160 million.[12]

The misapplication of utility patents to plants has also nearly destroyed important sectors of the seed cleaning industry. Seed cleaners remove dirt, weed seed and chaff from saved seed for farmers, which enables re-planting to proceed without introducing unwanted weeds to the field. As recently as 1982, 45% of soybean acreage, 50% of cotton acreage, and 90% of wheat acres were planted with saved seed.[13] By 1997, those figures had dropped to just 25% for soybeans and cotton and 63% for wheat.[14] Seed-saving rates for soybeans and cotton are even lower today, due mainly to the prevalence of patented GE varieties[15] and Monsanto's aggressive litigation against farmers.

Steve Hixon, a seed cleaner from Illinois, reports that 14 seed cleaners within 50 miles of his Claremont, Illinois operation have gone out of business since the mid-1990s.[16] While Monsanto's litigation against farmers is chiefly responsible for this outcome, the company has also directly sued seed cleaners for "aiding and abetting" seed-saving farmers.[17] Lawsuits against farmers and seed cleaners have virtually eliminated the seed-saving option in soybeans and cotton – true-breeding, non-hybrid, largely GE crops for which utility patents are the predominate IP system.

Besides suppressing innovation (see response to Question 6), this development has also contributed substantially to the astronomical rise in GE seed prices referred to by USDA in the Federal Register notice. By offering a cost-cutting alternative to commercial seed: "[t]he ability of farmers to plant last year's soybeans to produce the next year's crop has kept a lid on soybean seed prices, at least until the GE era."[18]

For a debunking of talking points from the pesticide-seed industry on the supposed harms to their interests from farmer seed-saving, and the necessity of squelching it, see Attachment 1, pp. 7-8, 13-17.

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[12] CFS (2013), op. cit., p. 30. For the Monsanto materials upon which this estimate is based, see: https://www.centerforfoodsafety.org/files/monsanto-v-us-farmer-2012-update-final_98931.pdf.

[13] Fernandez-Cornejo (2004), op. cit., p. 26.

[14] Ibid, pp. 36-37.

[15] For instance, Roundup Ready soybeans with replant restrictions comprised 54% of all soybean acres by the year 2000, 81% in 2003, and 91-94% since 2007. See: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx.

[16] Personal communication.

[17] CFS (2013), Seed Giants, op. cit., p. 29.

[18] Benbrook, C. (2009a). "The Magnitude and Impacts of the Biotech and Organic Price Premium," The Organic Center, December 2009. http://www.organic-center.org/reportfiles/Seeds_Final_11-30-09.pdf.

Question 12: *To what extent do requirements or inducements to buy a main product (e.g., seed) with a second product (e.g. pest management chemical), bundle, stacked trait, or* service impact the farmer or other agricultural input competitors? *For instance, does such a practice lock a farmer into or out of certain product choices?* Please offer specific recommendations for reforms.

Herbicide-resistant GE crops are marketed to farmers as "systems" comprising the GE seed and the companion herbicide(s): for instance, the Roundup Ready Xtend Crop System19 and the Enlist Weed Control System.[20] Whether the seed-herbicide package is explicitly bundled or not, the great majority of farmers rely exclusively for weed control on the herbicide(s) to which the GE crop is resistant. One reason for this is that the high price of the GE seed – much of it attributable to technology fees for the herbicide-resistance trait(s) – constitute an inducement to farmers to fully exploit that trait and "recoup their investment" by "rely[ing] solely on repeated glyphosate applications alone as a weed control program" (in the case of glyphosate-resistant, Roundup Ready crops, here alfalfa).[21]

The result of exclusive reliance on glyphosate for weed control in Roundup Ready crops has been an epidemic of glyphosate-resistant weeds that infest at least 120 million acres of cropland in the fields of nearly three-quarters (73%) of surveyed farmers.[22] USDA found that glyphosate-resistant weeds reduced farmers' total returns by $67.29 per acre of planted corn, and estimated a $22.53 per acre loss for soybean farmers who reported declining effectiveness of glyphosate on weeds,[23] which amounts to a collective annual loss of $5.4 billion (assuming half the 120 million acres of glyphosate-resistant weed-infested fields are corn, and half soybeans).

We are now in the process of seeing the same phenomenon play out with crops resistant to dicamba and 2,4-D inducing exclusive reliance on these herbicides, and rapid evolution of still more intractable weeds resistant to multiple herbicides. Increasingly resistant weeds will redouble the impact of glyphosate-resistant weeds noted above, and make weed control still more expensive for farmers – both in the form of pricey HR seeds with additional resistance traits, and the perceived need to spray additional companion herbicides.

Question 14: *Please comment on implications, negative or positive, of mergers in the seed industry and in industries that sell other agricultural inputs.*

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[19] https://www.roundupreadyxtend.com/Pages/default.aspx.
[20] https://www.enlist.com/en.
[21] Orloff, SB et al (2009). "Avoiding Weed Shifts and Weed Resistance in Roundup Ready Alfalfa Systems," Publication 8362, University of California, February 2009.
[22] Pucci J (2018). The war against weeds evolves in 2018, Croplife, March 20, 2018. https://www.croplife.com/crop-inputs/the-war-against-weeds-evolves-in-2018/.
[23] Livingston M et al. (2015). The Economics of Glyphosate Resistance Management in Corn and Soybean Productiond, USDA Economic Research Service Report No. 184, April 2015.

We encourage USDA to explicitly acknowledge and address the fact that seed industry concentration is at the same time consolidation of two formerly distinct industries or sectors: pesticides and seeds. Most germplasm resources, at least in major field crops like corn, soybeans and cotton, have been acquired by pesticide companies. One cannot understand the market power of or anticompetitive effects in the "seed industry" without fully appreciating the profound consequences of this historic merger. Thus, we encourage USDA to call a spade a spade, and refer, as appropriate, to the "pesticide-seed industry," or a similar designation that makes explicit the merger of these formerly distinct sectors.

Since the 1980s, pesticide firms have obtained massive stocks of germplasm via acquisitions of hundreds of major and minor, formerly independent, seed companies. These pesticide firms have also acquired numerous biotechnology start-ups to augment in-house research and development in the techniques of genetic engineering. The latest wave of concentration has seen the six leading seed-pesticide-biotechnology behemoths merge into three still larger entities. Bayer acquired Monsanto, Dow and DuPont merged and spun off their agricultural sectors to form Corteva; and ChemChina acquired Swiss giant Syngenta. A fourth firm, German BASF, is largely a pesticide supplier but has acquired some germplasm.

The integration of these sectors has led to channelization of the research agendas of the conglomerates into narrow pathways that maximize synergies between their seed and pesticide products, and thereby led American agriculture into an ever more pesticide-intensive and less sustainable agricultural future. It is thus no accident that very nearly 100% of genetically engineered crop acreage in the U.S. comprises crops with one or more herbicide-resistance traits, which dramatically increase use and sales of the companion herbicides.[24]

Besides the costs of resistant weeds (response to Question 12), herbicide-resistant crop systems are inherently anti-competitive, in that they force farmers to buy these crops, where available, in self-defense, or suffer the drift-damaging consequences. To understand this, consider that prior to the introduction of herbicide-resistant crops in the mid-1990s, most herbicide applications were made at or before planting time, to avoid injuring the crop. The herbicide-resistance trait facilitates "over-the-top" applications to the growing crop weeks to months later in the season than had hitherto been possible, leading to substantial herbicide drift damage to other crops from hundreds of yards to miles away from the sprayed field. This in turn induces neighbors to buy herbicide-resistant versions of the crop to protect themselves from often costly drift damage, a phenomenon called "defensive adoption," even when they otherwise have no interest in the herbicide-resistance trait.

In reversing EPA's approval of dicamba herbicide, used in conjunction with Monsanto's dicamba-resistant soybeans and cotton, the Ninth Circuit Court of Appeals discussed two anti-competitive effects of dicamba drift, which affected millions of acres of soybeans, fruits and vegetables: defensive adoption, as described above, and the loss of customers on the part of small seed firms that refused to offer these hazardous seeds or their companion herbicides.[25]

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[24] For instance, EPA found that agricultural herbicide use in the U.S. rose by an astounding 34% - 420 to 564 million lbs/year - from just 2005 to 2012. See EPA (2017). Pesticides Industry Sales and Usage: 2008-2012 Market Estimates, EPA, Table 3.2.

[25] Decision available at: https://www.centerforfoodsafety.org/files/125--dicamba-opinion_35970.pdf.

Nor is the issue limited to this particular seed-herbicide combination. The glyphosate-resistant, Roundup Ready crop system had similar, if less publicized or extensive, impacts. As veteran Arkansas weed scientist Ford Baldwin reported over a decade ago, many farmers purchased Roundup Ready corn merely to protect themselves from glyphosate drifting over to their fields from applications made to Roundup Ready soybeans and cotton. Baldwin makes the further point that glyphosate drift also damages rice, for which there is no glyphosate-resistant variety available.[26] Nor is the problem limited to Arkansas. According to Iowa State University Extension: "Extensive damage" to corn from glyphosate drifting over from Roundup Ready soybean fields was only mitigated when farmers purchased Roundup Ready corn, defensively.[27]

The prevalence of herbicide-resistant weeds and their large costs to farmers and agriculture, the massive toll taken by herbicide drift, and the anticompetitive "defensive adoption" of seeds with herbicide-resistant traits, are all consequences of herbicide-resistant crop systems introduced by pesticide-seed-biotechnology conglomerates over the past quarter-century. And there is no end in sight to the escalating, destructive and anticompetitive impacts they will have. Bayer-Monsanto recently petitioned USDA to approve a corn variety resistant to five different herbicides (see Attachment 3).

Climate change exacerbates more extreme weather events. This includes drought conditions in California, which have become so severe that both surface and groundwater resources are being rapidly depleted by fruit, vegetable and nut production. The State of California is just beginning to enforce limits on groundwater use that will make present levels of vegetable and fruit production in the state impossible to sustain. There is thus an urgent need to ramp up fruit and vegetable production in other states in compensation.[28] However, massive drift damage attributable to herbicide-resistant crop systems is making the Midwest, Midsouth and Plains state – the Heartland of America, with some of the world's richest soils – progressively more inhospitable to cultivation of anything but herbicide-resistant or -tolerant field crops. It is difficult to imagine the necessary transition to even somewhat more crop diversity if current trends continue.

A second pathway strongly favored by vertical integration of these sectors is coating seeds with insecticides and fungicides. The integrated firms, particularly Bayer/Monsanto and ChemChina/Syngenta, are leaders in both seed sales and the development and deployment of these so-called "seed treatments" on their own seed and those of other firms. Virtually 100% of U.S. corn seed, the majority of soybean seed, and the seeds of many additional crops are routinely coated with neonicotinoid insecticides that are known to harm pollinators,[29] as well as multiple fungicides that both synergize the toxicity of insecticides, and often have their own harmful environmental effects. Farmers have little or no choice of "bare" seed, and often have little knowledge of the

[26] Baldwin, F.L. (2010). "Herbicide drift damaging rice," Delta Farm Press, June 7, 2010. http://deltafarmpress.com/rice/herbicide-drift-damaging-rice-0607/. See also: Baldwin F.L. (2008). Many drift problems in Arkansas rice fields. Delta Farm Press, June 6, 2008. https://www.farmprogress.com/many-drift-problems-arkansas-rice-fields.

[27] Iowa State University. Not all drift is created equal. December 29, 2016. https://crops.extension.iastate.edu/blog/bob-hartzler/not-all-drift-created-equal.

[28] Philpott, T. (2020). *Perilous Bounty*. Bloomsbury Publishing, New York, NY, 2020.

[29] Thomas J. Wood and Dave Goulson (2017). The environmental risks of neonicotinioid pesticides: a review of the evidence post 2013, Environ Sci Pollut Res 24: 17285-17325.

pesticidal coatings or their purpose;[30] and indeed, agronomists have found they often serve no useful pesticidal purpose at all,[31] but rather superfluously pollute the environment. But like herbicide-resistance traits, seed coatings serve as price points for the firms in their marketing to farmers. And seed costs have risen dramatically with the advent of genetic engineering and seed treatments.[32]

It is impossible to say which directions crop development might have taken, if antitrust officials had been alert and blocked the consolidation of the seed and pesticide industries. Seed firms free to follow the demands of the farmer customers, with no financial interest in boosting herbicide sales, would certainly have been far less interested in herbicide-resistance crop development than today's consolidated firms. Likewise, pesticide firms with no germplasm resources of their own would have had been unable to make seed treatments nearly universal on major field and many minor crops. While neither technology development would have been blocked or prohibited, they would have been more selectively introduced, in response to farmer demand, rather than imposed by conglomerates which combined far too much control over both resources.

Question 17: *Do you believe farmers, breeders and other stakeholders have appropriate access to information, education, and support services around seeds and other agricultural inputs,*

No, USDA and land-grant universities could and should be doing much more on this count. There is a shocking degradation in the capacities of government to provide essential, fundamental data that could better inform farmers and other stakeholders with regard to seeds, pesticides and other inputs.

We urge USDA to reinstate the Cotton Varieties Planted reports, which for over a quarter-century has provided valuable data on the types of cotton varieties planted throughout America. This information is critical to assess trends in insect resistance (e.g. to Bt traits) and herbicide resistance and use.

USDA should also reinstate the National Agricultural Statistics Service's Crop and Seed Price Index (discontinued after 2015), since seed prices are obviously of great importance in assessments of competition and concentration in the agricultural inputs industries.

Given the growing prominence of pesticides in agricultural innovation, as discussed in these comments, the federal government needs to do a far better job of data collection. USDA Agricultural Chemical Surveys should be better funded for more frequent surveys of a broader array of crops. An extremely important data gap is pesticides coated onto seeds. No government agency – neither EPA, USDA, nor USGS – provides even elementary data – what percentage of particular crops seeds (by planted acreage) are treated with which pesticide(s), annual amounts, etc. Finally, the reliance on private data collection firms like Kynetec must end. It is ridiculous for the government to pay firms to collect data of broad public interest, as on pesticide use practices, but

[30] Claudia Hitaj et al. (2020). Sowing uncertainty: what we do and don't know about the planting of pesticide-treated seed, Bioscience 70(5): 390-403.

[31] Spyridon Mourtzinis et al. (2019). Neonicotinoid seed treatments of soybean provide negligible benefits to US farmers. Scientific Reports 9: 11207.

[32] Charles Benbrook (2009). The Magnitude and Impacts of the Biotech and Organic Seed Price Premium. The Organic Center, Dec. 2009. https://kohalacenter.org/archive/publicseedinitiative/images/seedpricepremium.pdf.

then either itself be denied access to the proprietary survey methodology behind the data, or be forced to limit data disclosure to the public. We would note that U.S. Geological Survey (USGS) relies on Kynetec, and the firm ended all reporting of seed treatment uses of pesticides after 2015; and USGS recently announced a dramatic cutback in the number of pesticides it will be reporting, based on Kynetec data. Far better for government agencies to have these essential data collection capabilities in-house.

Question 22: *Please comment on the strengths, weaknesses, effectiveness, and gaps in current USDA policies and programs to facilitate access to affordable seeds and other agricultural inputs for farmers, plant breeders, ranchers, and other stakeholders.*

USDA needs to increase its commitment to breeding programs at land-grant universities, which provide valuable new crop traits and varieties at affordable costs to farmers. This is becoming all the more vital as private seed-sellers raise prices to astronomical levels, and stack them to the hilt with packages of take-it-or-leave it traits that many farmers do not need or want. In particular, USDA should support development of crop varieties with valuable traits like disease resistance and drought tolerance that are not being provided, for the most part, by pesticide-seed conglomerates. USDA also needs to take action to defend these breeding programs from debilitating injury via herbicide drift.[33]

Questions 23 and 24: *How could IP systems and antitrust enforcement address concerns highlighted?*

With regard to IP systems for plant varieties, market failure results in paucity of seed varieties. Public sector breeding by USDA itself and via funding of land-grant universities needs more support. Conventional breeding methods have proven more effective than genetic engineering for drought-tolerance and increased nitrogen use efficiency,[34] and deserve far more support from agencies like USDA.

Otherwise, please see Chapter Four: Policy Options, of our 2013 report Seed Giants, appended with these comments.

Antitrust action is urgently needed to breaking up the seed and pesticide sectors, which would sharply decrease the incentives driving U.S. agriculture on its current pathway of astronomically rising seed prices, a narrowing of socially and agronomically useful innovation as well as seed options for farmers, and intensifying pesticide use and its adverse effects. For example, seed companies without pesticide portfolios would be less motivated to tie their offerings to pesticides, either through herbicide-resistance traits or seed coatings, and would more readily respond to farmer demands for conventional or untreated seeds. Each sector would better meet the full range of farmers' diverse needs as they negotiate an increasingly precarious world of climate destabilization, and the rising demands of consumers for sustainably produced foods.

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

[34] Gilbert N (2014). Cross-bred crops get fit faster: Genetic engineering lags behind conventional breeding in efforts to create drought-resistant maize. Nature 513: 292 (Sept. 18, 2014).

There is much more that could be said on this topic. CFS would happy to discuss any of the issues raised in these comments, and provide fuller documentation of the points made. We have uploaded to the docket the Ninth Circuit Court of Appeal's opinion discussed above.

Sincerely,

Bill Freese, Science Director
Center for Food Safety

Attachment 1

August 17, 2012

Donald B. Verrilli, Jr.
Office of the Solicitor General
950 Pennsylvania Ave., NW
Washington, DC 20530-0001

Re: *Bowman v. Monsanto Co.,* U.S. Supreme Court Case No. 11-796

Dear Mr. Verrilli:

I am the science policy analyst at Center for Food Safety (CFS), a Washington, DC-based non-profit organization that supports sustainable agriculture and critically assesses new agricultural technologies, such as genetic engineering. I write today to urge your office to support the petition for certiorari of farmer Vernon Hugh Bowman against Monsanto in the above-referenced case.

CFS's concerns include food and environmental safety as well as the social, economic and agronomic implications of new farm and food technologies. CFS educates the public through reports and fact sheets, provides the over 200,000 members of our True Food Network with opportunities to make their voices heard, engages regulatory agencies through submission of expert scientific and legal comments on proposed rule-making, and takes legal action, as needed, in pursuit of our goals.

CFS has extensive expertise in the areas of intellectual property protection of plants and seed industry concentration. Our 2005 report, *Monsanto vs. U.S. Farmers*, is the first and to our knowledge only comprehensive assessment of Monsanto's litigation against US farmers for alleged patent infringement involving genetically engineered (GE) seed.[35] The report provides both legal analysis and, based on interviews with dozens of affected farmers, insights into the company's investigation and litigation practices.

Our 2007 report on Monsanto's then proposed acquisition of the Delta and Pine Land Company, the world's largest cotton seed firm, was submitted to the Bush Administration's

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[35] CFS (2005a). "Monsanto vs. U.S. Farmers," Center for Food Safety, 2005. This report and the 2010 update are included in supplementary materials accompanying this letter.

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Department of Justice as it reviewed the proposed merger.[36] The report is a data-driven analysis of concentration in the cotton seed industry and the anticompetitive effects the proposed merger would likely have, many of which have come to pass. CFS worked with the American Antitrust Institute on this issue, and the report was cited by 13 state attorneys general in Tunney Act objections to the proposed settlement.

In addition, CFS attorneys have submitted amicus briefs in several cases involving Monsanto's patent infringement lawsuits against farmers, including one in support of a petition for a writ of certiorari that invoked the doctrine of patent exhaustion.[37]

The issue of patent exhaustion in the context of genetically engineered seeds is an important one that merits Supreme Court review. CFS supports Vernon Hugh Bowman's cert petition from our firm commitment to a ***diverse and affordable seed supply*** for American farmers. The prevailing intellectual property (IP) regime, coupled with seed industry concentration, has dampened innovation, narrowed seed options, and dramatically increased seeds costs, trends that do not serve the best interests of American farmers. Additional consequences include restrictions on independent scientific research on crop properties and performance as well as and environmental and agronomic harms stemming from a dearth of conventional crop varieties.

Below, we first provide brief background sections on the history of plant breeding and intellectual property regimes for plants in the U.S. The following two sections address some of the adverse consequences of the current IP regime and how considered application of patent exhaustion to seeds might ameliorate them. The final section addresses the argument that strict IP regimes are needed to incentivize the development of new crops to feed a growing world.

THUMBNAIL HISTORY OF PLANT BREEDING

Humans have been improving plants since the dawn of agriculture. The elite varieties of agricultural crops grown today are the culmination of this long history of plant breeding. Farmers, public sector breeders, and private seed firms have all made important contributions.

Farmer-Breeders

Farmers have contributed most to this steady genetic improvement of crops through the simple but effective process of mass or phenotypic selection, in which seeds from the healthiest and most productive plants are saved and replanted the following season.

America's early leaders understood that strengthening agriculture was absolutely essential to the nation's economic development. Farmers played a crucial role in this process, aided,

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[36] Freese, B. (2007). "Cotton Concentration Report: An Assessment of Monsanto's Proposed Acquisition of Delta and Pine Land," International Center for Technology Assessment/Center for Food Safety, February 2007. This report is included in supplementary materials accompanying this letter.

[37] Br. for Ctr. for Food Safety et al. as Amici Curiae Supporting Pet. For Cert., McFarling v. Monsanto Co., 552 U.S. 1096 (2008) (No. 07-241), 2008 U.S. LEXIS 73.

interestingly enough, by the U.S. Patent Office.[38] Commissioner of Patents Henry Ellsworth regarded the provision of novel plant varieties to be as much the business of the Patent Office as encouraging mechanical inventions. Beginning in 1839, Ellsworth obtained congressional funding to coordinate the collection of new crop varieties from around the world and their wide distribution to American farmers. Farmers tested these new seeds, conducted extensive breeding with them, and thereby laid the genetic foundations for American agriculture. Among the more famous farmer-bred varieties are Red Fyfe wheat, Grimm alfalfa and Rough Purple Chili potato. The U.S. Department of Agriculture (USDA), founded in 1862, continued this program of germplasm distribution and farmer-led breeding into the early 20th century. Some farmers continue to practice phenotypic selection today.[39]

Public Sector

The USDA, land-grant universities, state experiment stations and other publicly-funded institutions conducted more systematic testing and breeding of new crop varieties in the 20th century. Publicly funded scientists revolutionized breeding with backcrossing, a process whereby a valuable trait (e.g. disease resistance) of an otherwise unsuitable variety is introduced into an elite line. Public sector scientists also developed the process of hybridization, including the first high-yielding hybrid corn varieties.[40] Most major new crop varieties developed throughout the 20th century owe their origin to publicly funded agricultural research and breeding. In 1980, for instance, the share of overall U.S. crop acreage planted with public sector seed was 70% for soybeans, and 72-85% for various types of wheat.[41] The substantial yield increases in corn, cotton and soybeans since 1930 (Appendix 1) further demonstrate the "unambiguous hegemony of public science in the field of plant breeding"[42] in the 20th century.

Private Sector

Until recently, the private sector's chief role in the seed industry was to multiply and sell regionally-adapted varieties developed in the public domain. This was done primarily by numerous, often family-owned seed firms scattered across the country.[43] Only in those few field crops that had been successfully hybridized (corn, sorghum, and sunflower) did the private sector play a more active breeding role.[44] Besides increased yield, the attraction of hybrid seed to private firms was that it does not breed true and so must be purchased anew each year, offering more profit potential than true-breeding crops like wheat and soybeans. Pioneer and

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[38] For the following discussion, see: Kloppenburg, JR (2004). *First the Seed: The Political Economy of Plant Biotechnology*, 2nd edition, University of Wisconsin Press, pp. 55ff.

[39] Hubbard, K. (2009). "Out of Hand: Farmers Face the Consequences of a Consolidated Seed Industry," National Family Farm Coalition, December 2009, p. 41. http://farmertofarmercampaign.com/Out%20of%20Hand.FullReport.pdf.

[40] Kloppenburg (2004), op. cit., pp. 78, 97ff.

[41] Fernandez-Cornejo, J (2004). "The Seed Industry in U.S. Agriculture," USDA Economic Research Service, Agriculture Information Bulletin 786, Tables 17 & 21 on pp. 36 & 40. http://www.ers.usda.gov/publications/aib-agricultural-information-bulletin/aib786.aspx.

[42] Kloppenburg (2004), op. cit., p. 82.

[43] Fernandez-Cornejo (2004), op. cit., p. 25.

[44] Ibid, p. 25-26. There has also been some success in hybridizing vegetables, such as onion, tomatoes, broccoli, cabbage, melons and spinach.

other corn seed firms adopted hybridization techniques developed by public sector breeders and became dominant in hybrid corn beginning in the 1930s.[45]

INTELLECTUAL PROPERTY REGIMES FOR PLANTS

Private breeders began pressing for a plant patent system as long ago as 1885.[46] In 1930, Congress responded with the Plant Patent Act of 1930 (PPA), which established a patent system for non-sexually reproducing plants (e.g. fruit and nut trees, ornamentals, and other plants reproduced via budding, cutting and grafting rather than cross-pollination).[47] However, Congress excluded the great majority of plants, which are sexually-reproducing, from the PPA's purview due to a reluctance to grant monopoly control over staple food crops, as well as opposition from farmers and USDA. For the same reason, tuber-propagated plants such as potatoes were denied PPA coverage.[48]

In 1970, Congress passed the Plant Variety Protection Act (PVPA), which empowered USDA to grant Certificates of Protection for novel, sexually reproducing plant varieties.[49] The Certificates conferred exclusive marketing rights to the breeder for an 18-year term. While the ostensible purpose of the PVPA was to stimulate production of improved plant varieties, many in the seed industry viewed it more as a marketing tool – a means to brand new plant varieties without significant improvements, and thereby charge higher prices.[50] In any case, the PVPA balanced the interests of seed firms, farmers and public sector plant breeders. On the one hand, it prevented a seed firm from illicitly multiplying and selling a variety developed by a corporate competitor. At the same time, it provided critical exemptions to farmers and breeders. Farmers could save and replant PVPA-protected seed, while plant breeders could utilize protected varieties in further breeding work to develop still better plants. A 1994 amendment to the PVPA prohibited farmers from selling PVPA-protected seed to other farmers, which the original PVPA had allowed.[51]

Until 1985, the U.S. Patent and Trademark Office rejected applications for utility patents on non-hybrid plant varieties on the grounds of preemption by the PPA and PVPA.[52] That is, plants protectable under existing laws could not also be granted general patent protection. The Board of Patent Appeals reversed this policy in the 1985 *Ex parte Hibberd* case, in which a patent was granted for a corn variety selected from tissue culture. Henceforth, plants and plant parts became eligible for utility patent protection, setting the stage for prohibition of farmer seed-saving and breeding with IP-protected varieties as forms of patent infringement. Today, utility

[45] Ibid, pp. 25, 30.
[46] Kloppenburg (2004), op. cit., p. 132.
[47] Ibid, pp. 132-133.
[48] Ibid, pp. 132-133.
[49] Fernandez-Cornejo (2004), op. cit., pp. 20-21.
[50] Kloppenburg (2004), op. cit., pp. 142-146; prior to this, the seed industry had successfully fought off efforts by USDA to mandate review and registration of new plant varieties, a system that would have demanded a clear showing that a new variety incorporated some concrete improvement (e.g. higher yield or disease resistance) rather than mere novelty, which suffices for PVPA protection (Ibid, p. 137).
[51] Fernandez-Cornejo (2004), op. cit., pp. 20-21.
[52] See Kloppenburg (2004), op. cit, pp. 263ff for the following discussion.

patents have largely superseded PVPA Certificates of Protection as the preferred vehicle for IP rights to new plant varieties, particular those developed with use of genetic engineering.

Utility patents on GE plants are based on "gene" and "method" claims covering both the introduced transgene(s) and the means of introducing the transgene into the plant via genetic engineering. Further claims normally extend IP rights to the plant cells and plants that embody the transgene, even though the introduced transgene confers only a single property (e.g. herbicide-resistance), and is just one among the many thousands of native genes that are responsible for all of the other many properties of the GE variety.[53] These non-biotech properties include yield potential, time to maturity, seed size, various seed qualities (e.g. nutritional enhancements), disease resistance, drought tolerance, and adaptations to particular soils and climates, among many others.

No commercial GE crop has been engineered for increased yield potential. In fact, GE soybeans have been found to suffer from a "yield drag" relative to conventional lines,[54] and a recent detailed assessment of GE crop performance confirms that conventional breeding, not biotechnology, is the engine of continuing yield increases in modern corn and soybean varieties.[55] These findings are further corroborated by USDA yield data for the major GE crops – corn, soybeans and cotton – displayed in Appendix 1.[56]

CONSEQUENCES OF UTILITY PATENT PROTECTION FOR PLANTS

The ability to obtain utility patents on plants has been a major factor in: consolidation of the seed industry; rising seed prices; a decline in seed-saving; reduced innovation; a narrowing of seed choices for farmers; and restrictions on independent scientific research.

Seed Industry Concentration

By increasing the profit potential in an historically low-profit industry, the advent of utility patent protection for plants helped trigger a wave of mergers and acquisitions in the 1980s that continues to the present day.[57] Large agrichemical firms such as Monsanto, DuPont, Syngenta and Bayer acquired scores of seed companies, including many of the largest firms with the

[53] For instance, the soybean genome is estimated to contain over 46,000 protein-coding genes. Schmutz, J et al (2010). "Genome sequence of the palaeopolyploid soybean," Nature 463: 178-183.
[54] Elmore et al (2001). "Glyphosate-Resistant Soybean Cultivar Yields Compared with Sister Lines," Agron J 93: 408-412.
[55] Gurian-Sherman, D. (2009). "Failure to Yield: Evaluating the Performance of Genetically Engineered Crops," Union of Concerned Scientists, March 2009.
http://www.ucsusa.org/food_and_agriculture/science_and_impacts/science/failure-to-yield.html
[56] The chief attraction of the major class of GE crops, Monsanto's Roundup Ready varieties, is the convenience and labor-saving entailed by Roundup-only weed control (see Duffy, M (2001). "Who benefits from biotechnology?" presented at the American Seed Trade Association, December 5-7, 2001.
http://www2.econ.iastate.edu/faculty/duffy/Pages/biotechpaper.pdf), though this benefit is being quickly eroded by the extremely rapid emergence of Roundup-resistant weeds (see below).
[57] Fernandez-Cornejo (2004), op. cit., pp. 25-28. While the 1970 PVPA initiated the wave of mergers and acquisitions, it accelerated rapidly in the 1980s, spurred by development of biotechnology and the ability to obtain the stronger and more flexible protection afforded by utility patents on genes and plant parts as well as whole plant varieties.

highest-quality germplasm (e.g. DeKalb, Holden's Foundation Seeds, Pioneer).[58] The four above-named companies accounted for 49% of the world's proprietary seed sales in 2007 (Appendix 2). Monsanto has been particularly active in this area (Appendix 3), and is now the world's largest seed firm, accounting for 23% of proprietary seed sales in the world. However, Monsanto's predominance in biotech "traits" is much higher, roughly 86% of overall U.S. biotech trait acres.[59] In 2009, the Independent Professional Seed Association estimated that the number of independent seed companies has declined to just 100, from 300 independent and consolidated firms in 1996.[60] With this concentration has come increasing market power to raise prices and slash offerings of more affordable seed. Consolidation has also erected increasingly high barriers to entry. Because elite germplasm comprises a resource base developed through millennia of plant breeding, no would-be entrant can replicate it, whatever skills or ingenuity he or she may possess. Entry is only possible through acquisition of germplasm from current industry players.

Increased Seed Prices

Seed prices have risen dramatically in those crops in which patented GE varieties have become predominant, such as corn, soybeans and cotton. Companies normally charge a "technology fee" premium for each GE "trait" introduced into a seed line. Monsanto's Roundup Ready trait fee has risen precipitously, from just $4.50 per bag of soybean seed in 1996 to an estimated $17.50 by 2008.[61] USDA data displayed in Appendix 4 show that the average cost of soybean seed to plant one acre increased modestly, by 60%, over the two decades prior to the 1996 introduction of Roundup Ready soybeans (1975-1995): from $8.32 to $13.32. In the 16 years since (1995-2011), per acre seed costs have risen by a dramatic 325%, from $13.32 to $56.58. Similar trends are evident for corn and cotton seeds.

Crop Seed Cost ($/planted acre)	1975	1995	2011	1975-1995 (% increase)	1995-2011 (% increase)

[58] Ibid, Figures A-1 to A-4, pp. 32-35. Note that portions of the Advanta Group (Figure A-4) have since been acquired by Monsanto, Syngenta and Limagrain.

[59] Based on comparison of USDA figures for overall GE crop acreage (% of total crop that is GE x total crop acreage) and Monsanto trait acreage data for 2009, the latest data we have found for Monsanto. Overall GE crop acreage in 2009 (corn, soybeans, cotton, canola, sugar beets, alfalfa) was 153.9 million acres; GE crops with Monsanto traits were planted on 151.4 million acres, although 21.4 million of those acres comprised crops with a non-Monsanto trait as well. 151.4/(153.9+21.4) = 86.3%. Monsanto data from Monsanto (2010), "Supplemental Toolkit for Investors," Monsanto, February 2010, pp. 5-6. http://www.monsanto.com/investors/documents/supplemental_toolkit.pdf., supplemented with author's estimates of GE canola, sugar beet and alfalfa acreage. USDA data on GE share of total major crop acreage from: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx. Total crops acres from USDA at: http://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=CROPS. The disparity in Monsanto's share of overall seed and trait sales is explained by its broad licensing of its GE traits (especially Roundup Ready) to other seed firms for incorporation in their varieties.

[60] Wilde, M (2009). "Independent seed companies a dying breed," WF Courier, 5/31/2009. http://wcfcourier.com/business/local/article_7cef1ffc-b0bb-56a8-8d83-faf894bf76ad.html.

[61] Hubbard (2009), op. cit., Figure 6, p. 22; for an assessment of GE trait fees in cotton, see Freese, B (2007), op. cit., Section 2.2, Figure 5, Appendix 3.

Soybeans	$8.32	$13.32	$56.58	60%	325%
Corn	$9.30	$23.98	$86.16	158%	259%
Cotton	$5.88	$15.67	$96.48	166%	516%
Figures from USDA Economic Research Service: Commodity Costs and Returns: U.S. and Regional Cost and Return Data. Datasets accessible at: http://www.ers.usda.gov/Data/CostsAndReturns/testpick.htm. See Appendix 4 for graph of complete datasets.					

Agricultural economist Dr. Charles Benbrook has found that rapidly increasing GE seed prices claim an ever greater share not only of farmers' operating costs, but also of their gross crop income and net return per acre.[62] The latter measures suggest that the dramatically increased cost of GE seeds is offsetting any economic benefits they provide. Farmers and agronomists are greatly concerned by these seed price increases, especially in the context of rapidly rising costs for fertilizers and other inputs.[63] Companies often raise seed prices opportunistically, at times of high commodity prices, even if they haven't added value, because they know farmers can afford to spend more for the same seed and have few alternatives.[64] According to Dr. Benbrook: "If these GE seed price and income trends continue, the consequences for farmers will be of historic significance, as dollars once earned and retained by farmers are transferred to the seed industry."[65]

Decline in Seed-Saving

The rapid rise in seed prices has been accompanied by, and is partially attributable to, a precipitous decline in seed-saving. By offering a cost-cutting alternative to commercial seed: "[t]he ability of farmers to plant last year's soybeans to produce the next year's crop has kept a lid on soybean seed prices, at least until the GE era."[66] As recently as 1982, 45% of soybean acreage, 50% of cotton acreage, and 90% of wheat acres were planted with saved seed.[67] By 1997, those figures had dropped to just 25% for soybeans and cotton and 63% for wheat.[68] Seed-saving rates for soybeans and cotton are even lower today, due in part to the prevalence of patented GE varieties[69] and Monsanto's aggressive litigation against farmers (discussed below). Situations in which farmers choose to save and replant seed include when they are financially-strapped, for instance after a poor harvest; for lower-yield and hence lower-value double-crop soybeans;[70] and for those who wish to practice phenotypic selection.

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[62] Benbrook, C. (2009a). "The Magnitude and Impacts of the Biotech and Organic Price Premium," The Organic Center, December 2009. http://www.organic-center.org/reportfiles/Seeds_Final_11-30-09.pdf.

[29] For instance, fertilizer costs per acre of corn have nearly doubled from 2005 to 2011 ($69.35 to $132.83). "U.S. corn production costs and returns per planted acre, excluding Government payments, 2005-2011," USDA Economic Research Service, "Recent Costs and Returns: Corn," http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx/.

[64] Hubbard (2009), op. cit., p. 41.

[65] Benbrook (2009a), op. cit., p. 4.

[66] Ibid, p. 1.

[67] Fernandez-Cornejo (2004), op. cit., p. 26.

[68] Ibid, pp. 36-37.

[69] For instance, Roundup Ready soybeans with replant restrictions comprised 54% of all soybean acres by the year 2000, 81% in 2003, and 91-94% since 2007. See: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx.

[70] The economic motivation for saving seeds in this situation is further sharpened by the need for higher seeding rates. According to Illinois farmer David Shupe, seeding rates (number of seeds planted per acre) must be higher for double-crop soybeans following wheat because of "increased risk with this practice due to the later planting

Farmers who save soybean seed are advised to replant it just once to avoid genetic contamination or loss of seed vigor,[71] though three to five years is typical.[72] Farmers return to the commercial market for new seed for several reasons. Cross-pollination by other soybean varieties degrades the performance (e.g. disease-resistance, yield) of the saved variety over time; and new varieties may offer new or improved traits desired by farmers.[73]

Seed-saving requires the services of seed cleaners, who use specialized equipment to remove chaff and weed seed from harvested seed to prepare it for planting and prevent the seeding of weeds along with the crop. Only non-hybrid seed (e.g. soybeans, but not corn) can be replanted. The rise of patented seeds has precipitated a steep decline in seed-saving services available to farmers, especially in soybean-growing regions.[74]

Reduced Seed Options

USDA economists have found that seed industry consolidation has reduced research and likely resulted in fewer crop varieties on offer:

> "Those companies that survived seed industry consolidation appear to be sponsoring less research relative to the size of their individual markets than when more companies were involved. … Also, fewer companies developing crops and marketing seeds may translate into fewer varieties offered."[75]

One sign of this failing innovation is the paucity of GE crop types. Virtually 100% of biotech acreage in the U.S. is planted to crops with just one or two traits: herbicide- and/or insect-resistance.[76] Moreover, the great majority of herbicide-resistant (HR) crops are resistant to a single herbicide, glyphosate.[77] Neither is there any real diversity in the GE product pipeline,

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date." As quoted in Hubbard (2009), op. cit., pp. 26-27. Emerado, North Dakota farmer Todd Leake (personal communication) adds that higher seeding rates are used to compensate for a shorter season: "if the seeding is later, there is less time for the crops to mature … In order to compensate for the lower potential of each plant, a higher plant population rate per acre can help to compensate." Higher seeding rates, of course, mean higher seed costs.

[71] According to Pengyin Chen, director of University of Arkansas's soybean breeding program, as quoted in: Medders, H. (2009). "Soybean demand may rise in conventional state markets," University of Arkansas, Division of Agriculture, March 20, 2009.

[72] Personal communication, Steve Hixon, Claremont, Illinois seed cleaner.

[73] Personal communication, Todd Leake, Emerado, North Dakota farmer.

[74] Personal communication, Steve Hixon, Claremont, Illinois seed cleaner, who reports that 14 seed cleaners within 50 miles of his Claremont, Illinois operation have gone out of business since the mid-1990s.

[75] Fernandez-Cornejo, J. and Schimmelpfennig, D. (2004). "Have Seed Industry Changes Affected Research Effort?" USDA Economic Research Service, AmberWaves, February 2004, p. 19. http://ageconsearch.umn.edu/bitstream/129915/2/features_seedindustry.pdf.

[76] See http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx. There are two major types of insect-resistant corn, targeting the European corn borer and corn rootworm.

[77] In 2006, roughly 1 million acres of GE crops resistant to glufosinate were planted in the U.S., less than 1% of Roundup Ready crop acreage. See: Freese, B (2007), op. cit., pp. 33-34. Corn resistant to both glyphosate and glufosinate (SmartStax) was introduced in 2010, and is planted to some unknown acreage. The recently introduced glufosinate-resistant (LibertyLink) soybeans were reportedly planted on 1.3% of US soybean acreage

which is overwhelmingly dominated by HR crops resistant to one to three herbicides each.[78] The reason for the agrichemical-seed industry's strong proclivity for HR crops is clear: HR seeds and their associated herbicides are sold together as a profitable, packaged system, with herbicide revenues used to fund further HR crop development.[79]

Choices are further constrained by "biotech trait penetration" strategies, whereby agrichemical-seed firms heavily weight their product offerings to varieties that contain multiple traits, which are more expensive and profitable, and retire lines that have fewer or no traits.[80] A prime example is Monsanto's "triple-stack" corn (with the Roundup Ready (RR) trait and two insect-resistance traits); many corn farmers who have no need or desire for the RR trait nonetheless purchase "triple-stack" corn because of the dearth of elite varieties on offer that have either no traits or only insect-resistance traits.[81] Monsanto is already in the process of transitioning farmers from triple-stack to its eight-trait "SmartStax" corn,[82] the most expensive

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(978 million acres) in 2011. See: USDA APHIS (2012). "Dow AgroSciences Petition (09-349-01p) for Determination of Nonregulated Status of Event DAS-68416-4," Draft Environmental Assessment, USDA APHIS, p. 28.

[78] Fully 14 of 20 GE crops awaiting "deregulation" (commercial approval) by USDA are herbicide-resistant. See http://www.aphis.usda.gov/biotechnology/not_reg.html, last visited 8/8/12.

[79] Roundup sales of $2.8 billion accounted for roughly half of Monsanto's 2000 revenue (Barboza, D (2001). "A weed killer is a block to build on," New York Times, 8/2/01). Use of glyphosate (the active ingredient of Roundup) increased six- to seven-fold from 25-30 million lbs. in 1995 to 180-185 million lbs. in 2007, due to increasing use of Roundup Ready soybeans, corn, cotton, and canola over this period. See EPA (1997). Pesticide Industry Sales and Usage: 1994 and 1995 Market Estimates, EPA, August 1997, Table 8; and EPA (2011). "Pesticide Industry Sales and Usage: 2006 and 2007 Market Estimates," Environmental Protection Agency, Feb. 2011, Table 3.6. Now Dow AgroSciences and other firms have adopted the same model. For instance, Dow is poised to introduce corn and soybeans resistant to 2,4-D, part of the Agent Orange defoliant used in Vietnam, packaged with its proprietary version of 2,4-D, under the name: "Enlist Weed Control System." These crops are projected to increase annual agricultural use of 2,4-D from 27 million lbs. to well over 100 million lbs. See http://www.centerforfoodsafety.org/wp-content/uploads/2012/04/24-D-Organizational-SignOn-Letter-FINAL-13.pdf.

[80] For cotton seed, see Freese (2007), op. cit., Sections 2.4 & 2.5. CFS recently updated this analysis with 2011 figures. Between 2006, prior to Monsanto's acquisition of Delta and Pine Land (DPL), and 2011, the number of overall cotton varieties planted in the U.S. has declined from 203 to 114; conventional varieties from 36 to 12; and single GE trait varieties from 83 to 25, while stacked (multiple-trait) varieties held steady (84 to 77). The corresponding figures for DPL (2006) and post-acquisition for Monsanto (2011) are: total varieties (62 to 25); conventional (15 to 0); single-trait (19 to 3); and stacked (28 to 22). 2011 figures based on USDA AMS (2011). "Cotton Varieties Planted: 2011 Crop," USDA Agricultural Marketing Service, 9/2/11. http://www.ams.usda.gov/mnreports/cnavar.pdf.

[81] Hubbard (2009), op. cit., pp. 29-33. As recently as 2004, Monsanto met farmer demand for single-trait corn protected from corn borer attack by selling 21.5 million acres' worth of "U.S. *YieldGard* Corn Borer trait" seed; in 2009, sales of this single-trait seed had dropped to just 0.6 million acres' worth. Over the same period, sales of triple-stack seed (U.S. *YieldGard* Plus/*Roundup Ready*) increased from 0 to 31.2 million acres. See Monsanto (2010). "Supplemental Toolkit for Investors," Monsanto, February 2010, pp. 5-6. http://www.monsanto.com/investors/documents/supplemental_toolkit.pdf.

[82] "…Monsanto would like to move as many customers to triple stacks as possible. This can help make inventory and production management much more manageable and ***create a captive customer base*** for the 2010 launch of its SmartStax octo-stack product." (emphasis added). From: Goldman-Sachs (2008). "MON: Trait prices going up along with estimates and price target," Company Update, Goldman-Sachs, June 2, 2008 (no longer posted, available on request).

corn seed on the market,[83] which worries farmers who can't afford, don't need, or don't want the additional traits.[84]

Dearth of Conventional Seed Accelerates Evolution of Pest and Weed Resistance
Conventional (non-GE) lines – particularly elite varieties – are becoming particularly hard to find. ***A 2009 survey of Illinois farmers reveals that fully 40% do not have access to elite, conventional varieties of corn***.[85] Entomologists are extremely concerned by this market failure, because insect resistance to the insecticides in GE crops is a serious emerging issue in several Midwestern states, and greater use of conventional corn varieties is essential to reduce "selection pressure" and so impede further evolution of such resistant insect pests.[86] Hence, the dearth of high-quality conventional corn not only robs growers of lower cost seed options, but is also accelerating the evolution of Bt resistance in corn growers' most menacing insect pest (corn rootworm), promising substantial attendant costs in the form of highly toxic insecticide use and greater pest control expenditures.

There is also an urgent need for greater availability of conventional soybean seeds, and for much the same reason. The massive use of glyphosate (the active ingredient of Roundup) with Roundup Ready crops has triggered an epidemic of glyphosate-resistant weeds that in just a decade has become one of U.S. agriculture's most challenging problems.[87] Consequences of glyphosate-resistant weeds include increased herbicide use, increased use of soil-eroding tillage, a return to hand-weeding on hundreds of thousands of acres,[88] and greatly increased weed control costs.[89] Leading weed scientists warn that farmers are "running out of options" to control what is rapidly becoming an "unmanageable problem,"[90] and that with farmers' extraordinary dependence on RR crops, weeds resistant to glyphosate and multiple herbicides

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[83] Tomich, J (2010). "Monsanto growth falters as SmartStax yields, pricing raise questions," St. Louis Today, 10/6/10. http://www.stltoday.com/business/article_b0c5044b-c54d-5a84-a92a-042b3f7ef7da.html.
[84] "Somerville [Tennessee] farmer Harris Armour has nothing against bioengineered seed, but he has some reservations about SmartStax. 'I like to buy what I want,' he said. 'When they start stacking for things I don't need, it just makes the price of the seed go up.'" As quoted in: Roberts, J (2008). "Super seeds: Top biotech company re-engineers products to help global farmers," Memphis Commercial-Appeal, June 22, 2008. http://www.commercialappeal.com/news/2008/jun/22/super-seeds/.
[85] Gray, ME (2011). "Relevance of traditional integrated pest management (IPM) strategies for commercial corn producers in a transgenic agroecosystems: a bygone era?" Journal of Agricultural and Food Chemistry 59 (11): 5852–5858, Table 2, response to question: "Did You Have Access to Elite (High Yield Potential) Non-Bt Corn Germplasm in 2009?" "Bt" refers to Bacillus thuringiensis; one or more genes derived from Bt are engineered into Bt corn and Bt cotton to trigger production of insecticidal protein(s) in the tissues of these crops to protect them from attack by certain insect pests.
[86] Charles, D (2012). "Insect experts issue 'urgent' warning on using biotech seeds," The Salt, NPR's Food Blog, 3/9/12. http://www.npr.org/blogs/thesalt/2012/03/08/148227668/insect-experts-issue-urgent-warning-on-using-biotech-seeds.
[87] NRC (2010). "The Impact of Genetically Engineered Crops on Farm Sustainability in the United States," National Research Council, National Academy of Sciences, 2010 (prepublication copy), p. 2-21.
[88] Haire, B. (2010). "Pigweed threatens Georgia cotton industry," Southeast Farm Press, July 6, 2010. http://southeastfarmpress.com/pigweed-threatens-georgia-cotton-industry.
[89] Benbrook, C (2009b). "The Impact of Genetically Engineered Crops on Pesticide Use: The First Thirteen Years," The Organic Center, November 2009, Chapter 4. http://www.organic-center.org/science.pest.php?action=view&report_id=159.
[90] ScienceDaily (2011). "Waterhemp rears its ugly head...again," Jan. 26, 2011. http://www.sciencedaily.com/releases/2011/01/110126121738.htm.

pose a threat to global food production.[91] Glyphosate-resistant weeds are also driving the biotechnology industry's product pipeline, which consists largely of HR crops resistant to older, more toxic herbicides (e.g. 2,4-D, part of Agent Orange used in Vietnam) as one approach to control glyphosate-resistant weeds. However, this at best short-term fix will come at the cost of substantial increases in the use of such toxic herbicides, greatly increased crop injury from herbicide drift, the emergence of still more difficult-to-control weeds resistant to multiple herbicides,[92] and increased grower costs.

Here, too, agronomists recommend greater use of conventional varieties to reduce the intense glyphosate selection pressure that fosters glyphosate-resistant weeds when RR crops are grown.[93] As with insect-resistant corn, however, the dearth of high-quality conventional varieties is an obstacle to addressing this serious issue. And it is clear that farmers are demanding more conventional soybeans, with demand exceeding supply in several states.[94] Among the reasons some farmers prefer conventional soybean seed are lower price, the excessive price of RR varieties, glyphosate-resistant weeds, and the ability to legally save and replant many conventional seeds.

Restrictions on Independent Scientific Research

Patent-based technology agreements that must be signed as a condition for purchasing GE seed have been used not only to outlaw farmer seed-saving, but also to stifle independent scientific research on GE crops.[95] According to 26 agronomists writing to the Environmental Protection Agency:

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[91] Powles, S.B. (2010). "Gene amplification delivers glyphosate-resistant weed evolution," Proceedings of the National Academy of Sciences 107: 955-56. http://www.pnas.org/content/107/3/955.full.

[92] Mortensen, DA et al (2012). "Navigating a critical juncture for sustainable weed management," BioScience 62(1): 75-84. http://www.iatp.org/files/Mortensen%20et%20al%20%202012%20%20Navigating.pdf.

[93] "The appearance of glyphosate-resistant rigid ryegrass should be a forewarning. The recently developed glyphosate-resistant crops will need to be used in rotation with conventional cultivars and in conjunction with non-chemical weed control and other herbicides if the selection of glyphosate-resistant weeds is to be avoided." From: Heap, I. (1997). "The occurrence of herbicide-resistant weeds worldwide," Pesticide Science 51: 235-43. While it is true that RR crop farmers could diversify weed management and slow resistance evolution by utilizing additional herbicides (for instance), the high cost of RR seed represents a strong economic incentive to avoid these additional costs and rely exclusively on inexpensive glyphosate. "The cost of RR alfalfa seed, including the technology fee, is generally twice or more than that of conventional alfalfa seed. Naturally, growers will want to recoup their investment as quickly as possible. Therefore, considerable economic incentive exists for the producer to rely solely on repeated glyphosate applications alone as a weed control program." From: Orloff, SB et al (2009). "Avoiding Weed Shifts and Weed Resistance in Roundup Ready Alfalfa Systems," Publication 8362, University of California, February 2009.

[94] Bennett, D. (2009). "More conventional soybean acres?" Delta Farm Press, Feb. 10, 2009, http://deltafarmpress.com/soybeans/conventional-acres-0210/; Bennett, D. (2009). "Conventional soybeans draw interest," Delta Farm Press, April 3, 2009, http://deltafarmpress.com/soybeans/conventional-soybeans-0403/; Roseboro, K. (2008). "Finding non-GMO soybean seed becoming more difficult: Fewer breeding programs for non-GMO soybeans are reducing supplies despite strong demand," The Organic and Non-GMO Report, July 2008. http://www.non-gmoreport.com/articles/jul08/non-gmo_soybean_seed.php;
Pollack, C. (2009). "Interest in Non-Genetically Modified Soybeans Growing," Ohio State University Extension, April 3, 2009, http://oardc.osu.edu/6229/Interest-in-Non-Genetically-Modified-Soybeans-Growing.htm.

[95] Pollack, A. (2009). "Crop scientists say biotechnology seed companies are thwarting research," New York Times, Feb. 20, 2009. http://www.nytimes.com/2009/02/20/business/20crop.html?_r=1&emc=eta1.

> "Technology/stewardship agreements required for the purchase of genetically modified seed explicitly prohibit research. These agreements inhibit public scientists from pursuing their mandated role on behalf of the public good unless the research is approved by industry. As a result of restricted access, no truly independent research can be legally conducted on many critical questions regarding the technology…"[96]

Companies suppress research in numerous ways. Scientists who are deemed too critical may be denied permission to conduct research at all.[97] In many cases, stringent and often unacceptable conditions are set.[98] For instance, Monsanto demanded the right to approve publication of scientific research on its Roundup Ready sugar beets by university researchers as a condition for allowing the research to proceed; the universities could not accept such strictures, and the research was abandoned. Pioneer forbade researchers to publish data on the near 100% mortality of lady beetles that had fed on an experimental variety of Pioneer GE corn. Dow threatened to sue an entomologist if he cited adverse data he had obtained from EPA concerning one of the company's GE corn varieties. Syngenta prohibits scientists from doing studies that compare its crops to those of its competitors.

University agricultural scientists have long provided farmers, the public and U.S. regulatory agencies with reliable independent data on the properties and performance of crops. This is a critical service for farmers inundated by biased marketing (mis-)information from firms anxious to sell them products. Independent science also provides vital input for U.S regulators, who otherwise depend almost exclusively on company-provided data in making regulatory decisions on GE crops. As one scientist notes, companies could "launder the data" they provide to regulators, and without the check of independent science, such laundered data would go completely unquestioned.[99]

If utility patents have been a major force leading to privatization of crop varieties themselves, patent-based technology agreements threaten to privatize – and thus remove from the public sphere – essential knowledge about the true properties and performance of those crops. In an area as crucial to society as the source of our food supply, CFS believes it is highly imprudent to cede so much power to private interests.

LIKELY CONSEQUENCES OF PATENT EXHAUSTION APPLIED TO SEEDS

CFS believes that considered application of the doctrine of patent exhaustion to plant varieties, such that farmers regain their traditional right to save seeds, and independent scientists their right to conduct unfettered research with them, would have numerous beneficial impacts for farmers and U.S. agriculture as a whole. These benefits could be achieved with minimal impact

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[96] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2008-0836-0043;oldLink=false, last visited 8/5/12.

[97] Dalton, R (2002). "Superweed study falters as seed firms deny access to transgene," Nature 419: 655, October 17, 2002. Available on request, summary at: http://www.merid.org/en/Content/News_Services/Food_Security_and_AgBiotech_News/Articles/2002/10/17/Superweed_Study_Falters_As_Seed_Firms_Deny_Access_To_Transgene.aspx.

[98] For the following discussion, see: Waltz, E. (2009). "Under Wraps," Nature Biotechnology, October 2009, pp. 880-882. http://www.emilywaltz.com/Biotech_crop_research_restrictions_Oct_2009.pdf.

[99] Pollack (2009), op. cit., quoting Cornell entomologist Elson J. Shields.

to seed industry revenue and R&D activity, and might restrain further excessive consolidation of the seed industry.

Seed-Saving, Seed Prices and Seed Industry Revenue

As explained above, the seed-saving option would give farmers hard-pressed by sharply rising seed and other input costs an economical alternative to the forced annual purchase of commercial seeds. However, it is very unlikely that seed-saving would increase dramatically, or inhibit seed company R&D activity. First, there would be no impact at all in corn, because nearly all corn grown in the U.S. is hybrid,[100] and farmers do not save and replant hybrid seeds due to a precipitous decline in yield and other measures of performance.[101] Similar considerations hold true for other crops where hybrid varieties are dominant: sorghum, sunflower, and some vegetables, such as tomatoes and spinach. It is worth noting that corn is by far the industry's most profitable seed, and represents, for instance, 58% of Monsanto's 2009 gross profits from its seed sector (over three-fold more than soybeans, which accounted for just 19%).[102]

But even with self-pollinating, true-breeding crops, such as cotton and soybeans, one would expect only a modest increase in seed-saving rates. In both crops, seed-saving was in decline even before massive adoption of varieties subject to patent- and contract-based seed-saving prohibitions. As noted above, acres planted to saved soybean and cotton seed declined from roughly 50% to 25% from 1982 to 1997, and are undoubtedly small fractions of those rates today. Many of today's farmers will not have the skills, time and/or inclination to save seed. Seed-saving would be further inhibited by the decline in seed-cleaning services that has accompanied the rise of patented seeds. Even those who do save seed typically return to the commercial market after 3-5 years. Thus, patent exhaustion would likely facilitate seed-saving of non-hybrid crops primarily in those limited circumstances where the economics are particularly compelling: for instance, soybean farmers strapped for cash after a poor harvest; or for those who wish to double-crop soybeans, where limited yield and hence profit potential makes a source of low-cost seed vital to the economic viability of this beneficial practice.

The seed-saving option implied by patent exhaustion would also exert a restraining influence on the rapidly climbing price of commercial seed (again, excluding corn and other hybrid-dominated crops). This influence would be modest, commensurate with the anticipated modest (re-)adoption of seed-saving. However, it could be a significant factor in restraining agrichemical-seed firms from pushing through particularly sharp price increases for non-hybrid seeds.

Monsanto's Investigation and Prosecution of Farmers

The legal right to save seeds would also provide farmers with some degree of relief from the aggressive investigation and litigation practices of industry-leader Monsanto. Monsanto maintains a staff of 75 and an annual budget of $10 million to investigate and sue farmers

[100] Fernandez-Cornejo (2004), op. cit., p. 25. By 1965, over 95% of U.S. corn acreage was planted to hybrid seeds, and the proportion is undoubtedly still higher today.

[101] See http://cls.casa.colostate.edu/transgeniccrops/saveseeds.html.

[102] Monsanto (2010), op. cit., p. 4. See pie chart entitled: "2009 Seeds and Genomics: Gross Profit."

suspected of seed-saving.[103] Nearly all cases involve Roundup Ready soybeans. The company hires private investigators, such as St. Louis-based McDowell & Associates, to investigate roughly 500 farmers each year. According to farmers, these investigators trespass on farmers' property to take photos or crop samples, issue threats, adopt disguises (e.g. pretend to be conducting surveys of seed and chemical purchases), and even engage in activity that closely resembles entrapment.[104] Farmers have been convicted of patent infringement even when they purchased seed without having been presented with, or signed, the technology use agreement that spells out the replant restriction.[105] In other cases, Monsanto has sued farmers based on contamination of the farmer's conventional crops (via cross-pollination or seed dispersal) with the company's patented variety; or detection of Roundup Ready "volunteers" (seeds left in the field after harvest, which sprout the following year) in an otherwise conventional field.[106] Neither situation involves intentional infringement of Monsanto's IP rights. In one case, a North Carolina farmer who grew both conventional and Roundup Ready soybeans but saved only the conventional beans spent thousands of dollars defending himself against Monsanto's accusations of patent infringement, before the company finally dropped the matter from lack of evidence.[107] In another case, Monsanto filed a federal lawsuit against a store-owner who had never farmed at all.[108] Monsanto also has a snitch line by which farmers can anonymously report a neighbor suspected of seed-saving.[109] One judge referred scathingly to Monsanto's "scorched earth policies" in pursuing farmers, noting that they have bred an atmosphere of distrust and suspicion in rural communities.[110]

CFS has tracked Monsanto's investigations and prosecution of U.S. farmers. As of January 2010,[111] public court records reveal 136 lawsuits involving 400 farmers and 53 farm businesses. Of those 70 lawsuits that ended with recorded damages, sums awarded to Monsanto totaled $23,345,821. These numbers, however, do not begin to tell the whole story. As one district court judge noted: "[t]he vast majority of cases filed by Monsanto against farmers have been settled before any extensive litigation took place."[112] Based on materials downloaded from Monsanto's website in 2006, CFS has arrived at a rough estimate of the scope of out-of-court settlements that are not captured in the figures cited above. Based on Monsanto's data, the

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[103] See CFS (2005a). "Monsanto vs. U.S. Farmers," Center for Food Safety, 2005, p. 23ff, and generally for the following discussion.
[104] In at least one case, Monsanto hired a man to approach its target farmer (Eugene Stratemeyer) with a request to purchase soybean seed for late-season planting, for the purpose of erosion control (it was too late in the season to produce a crop); after Stratemeyer sold this man the Roundup Ready soybean seed, Monsanto proceeded to sue him. Ibid, p. 27.
[105] At least six cases involved forged signatures, a common practice among seed dealers. Ibid, pp. 43-44.
[106] Ibid, pp. 38-41.
[107] Personal communication, farmer's name withheld at his request.
[108] Barlett, DL & Steele, JB (2008). "Monsanto's Harvest of Fear," Vanity Fair, May 2008. http://www.vanityfair.com/politics/features/2008/05/monsanto200805?printable=true&currentPage=all.
[109] See CFS (2010). "Monsanto vs. U.S. Farmers: 2010 Update," Appendix II.
[110] Stratemeyer v. Monsanto, No. 02-CV-505, slip op. at 3-4 (S.D. Ill. March 28, 2005).
[111] CFS (2010). "Monsanto vs. US Farmers: 2010 Update," Center for Food Safety, 2010.
[112] Monsanto Co. v. McFarling, 2005 WL 1490051, at *5 (E.D. Mo. 2005).

company has collected between $85.6 to $160.6 million dollars from farmers in 2,391 to 4,531 of what the company terms "seed piracy matters."[113]

Because such settlements are typically conditioned on a gag order prohibiting farmers from public disclosure of their cases, it is impossible to judge to what extent they have actually involved the replanting of 2nd-generation patented seeds. However, the foregoing discussion suggests that a perhaps sizeable minority of cases involve situations in which farmers had not (willfully) infringed Monsanto's patents. CFS has spoken with many farmers pursued by Monsanto, via a hotline set up with publication of our 2005 report. While some farmers have admitted to saving seed, those who have not replanted saved seeds are often just as likely to settle with the company. This willingness to accede to an unjust settlement arises from an understandably intense fear of facing this multinational giant in court, which can easily entail spending hundreds of thousands of dollars in attorneys' fees. Even when the farmer is in the right, and victory is likely, just a small chance of defeat is intolerable, for in some cases that defeat would entail the loss of his or her farm, patrimony, and the only life the farmer has ever known. It is difficult to convey the anguish of such farmers, who are goaded by a sense of justice and pride to fight, but cowed by the consequences for their families should they lose.

Patent Exhaustion Would Increase Innovation

The ability to save seeds would also encourage innovation, as agrichemical-seed firms would be incentivized to offer farmers compelling reasons – in the form of new seeds with valuable, much-desired new traits – to forego saving last year's seed and instead purchase new ones, though this incentive would apply only to non-hybrid crops.[114] As noted above, seed industry concentration and utility patents have exerted a dampening influence on innovation.

Implicit in the foregoing discussion is an appreciation of the great diversity of American farmers, who differ widely in income, farm size, crop mix, farming methods, soil quality, climate, etc. Equally important, the needs of the very same farmer can vary greatly from year to year, as influenced by the vagaries of weather, pest outbreaks, agricultural markets, and many other factors. With such great variability in farmers, farms and farming conditions comes an urgent need for diverse seed options, including the ability to save seeds, when and as appropriate.

Patent Exhaustion Could Inhibit Further Seed Industry Concentration Without Crimping R&D Expenditures

Any modest check on the agrichemical-seed industry's increasing seed revenues that might be occasioned by patent exhaustion could also have the salutary effect of inhibiting further consolidation of the seed industry. To take Monsanto as an example, Appendix 3 shows that Monsanto has expended $10.2 billion to acquire 12 major seed firms and 15 of the regional

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[113] CFS (2010), op. cit., included in the supplementary materials, which contains reproductions of the Monsanto documents upon which these estimates are based.

[114] "For these [self-pollinating] crops [e.g. cotton and soybeans], a seed company must offer improved varieties each year to attract repeat customers." From http://cls.casa.colostate.edu/transgeniccrops/saveseeds.html. This statement of course does not apply to seeds with patent-based replant prohibitions.

seed companies represented by its American Seeds subsidiary.[115] In the five years from 2005 to 2009, Monsanto spent substantially more on acquisitions than on research and development. Monsanto claims it spent an average of $700 million per year on R&D from 2001 to 2010.[116] Other Monsanto data show aggregate expenditures of $4.814 billion for acquisitions from 2005-2009, for an average of $963 million per year.[117] Thus, over this period Monsanto spent over $250 million more each year to amass germplasm than it did for R&D related to seeds and chemicals. If soybean seed-saving had been legal during the period of this spending spree, Monsanto might have had somewhat less revenue for acquisitions, and thus not have purchased all of the seed firms it in fact did acquire.[118] Going forward, farmers' legal right to save Monsanto seeds might constrain seed revenue to some extent, and hence the company's ongoing acquisition activity. The result – broadened to all agrichemical-seed firms – would mean a somewhat less consolidated seed industry than would otherwise occur, and thus a relatively more competitive seed market. The negative effects of consolidation discussed above – decreased innovation, sharply increasing prices, and declining seed options – would likewise be ameliorated relative to continuation of the status quo.

It is important to note that germplasm acquisition is in no way integral to research and development in the field of agricultural biotechnology. Many small biotech firms with little or no germplasm resources have developed new biotech traits.[119] And in fact, even the world's largest owner of germplasm, Monsanto, earns a substantial proportion of its revenue by licensing its GE traits to other seed firms for incorporation into their varieties.[120]

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[115] This $10.2 billion figure represents the aggregate of Monsanto's acquisition costs for those firms for which CFS was able to find data (those entries in Appendix 3 with acquisition costs listed), and thus underestimates, perhaps considerably, the sums involved in Monsanto's extraordinary acquisition activity. Note that the total for Monsanto's acquisitions under its American Seeds subsidiary ($350 million) includes only those companies acquired from 2004-2006, and excludes the 7 or more acquired since. Appendix 3 was last updated in July 2009, and thus also excludes acquisitions since that date. For acquisitions by other agrichemical-seed firms, see Fernandez-Cornejo (2004), op. cit., Figures A-1 to A-4.

[116] Monsanto (2011). "Goldman Sachs Agricultural Biotech Forum 2011," Monsanto, 2/9/11, p. 14, http://www.monsanto.com/investors/Documents/2011/Goldman_Sachs_Presentation.pdf. Chart shows a cumulative $7 billion in R&D expenditures from 2001-2010, with gross profit of $22 billion, over three times R&D spending, over this period. Note that the R&D spending total includes not only seeds and genomics, but also the company's "chemicals" business (i.e. chiefly herbicides), so R&D expenditures on seeds is less than $700 million per year.

[117] Monsanto (2010), op. cit., p. 3. See line item entitled: "Cash Used for Acquisitions."

[118] This assumes, of course, that Monsanto would have prioritized R&D over acquisitions, which is an open question.

[119] For instance, North Carolina-based biotech startup Athenix Corporation developed a glyphosate-resistance trait that confers greater plant resistance to the herbicide than does Monsanto's Roundup Ready trait, allowing higher application rates, which in our view is a deeply misguided response to glyphosate-resistant weeds. See Service, RF (2007). "A growing threat down on the farm," Science 316: 1114-17, at 1116. Athenix was acquired by Bayer CropScience in 2009.

[120] Kaskey, J and Decker, S (2012). "Monsanto's $1 billion patent claim against DuPont to go to jury," Bloomberg, 8/1/12, http://www.bloomberg.com/news/2012-08-01/monsanto-s-1-billion-patent-claim-against-dupont-to-go-to-jury.html. As noted above, a rough measure of Monsanto's licensing activity is provided by the disparity between its proportion of the world's proprietary seed sales (23% in 2007) and the proportion of GE trait acres with Monsanto traits (roughly 86% in the U.S.).

PATENT EXHAUSTION AND NEW PLANT VARIETIES TO FEED A GROWING WORLD POPULATION

Much has been made of the supposed need for strict IP regimes to incentivize development of new plant varieties to feed a growing world population. In CFS's view, these arguments are naïve and fundamentally misconceived.[121]

There is a growing consensus among agricultural experts that hi-tech plant breeding has been vastly "oversold" as a means for developing nations to address their food needs. The UN and World Bank recently completed an exhaustive examination of world agriculture, the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD).[122] The IAASTD, which engaged some 400 agricultural scientists and development experts over a period of four years, concluded that GE crops have little potential to alleviate poverty and hunger.[123] These experts instead recommended a focus on agroecology, a sustainable approach to farming that emphasizes enrichment of the soil to produce more robust, productive and drought-tolerant plants; minimizing use of expensive and unaffordable inputs (e.g. synthetic fertilizers and pesticides); and exploitation of native plant and predatory insect populations to control problematic weeds and pests; among other innovative strategies. The success of sustainable, agroecological approaches has been demonstrated repeatedly. For instance, a 2001 review of over 200 sustainable agriculture projects in developing countries involving 4.42 million farmers found that average annual food production per household increased by 1.71 tonnes, an increase of 73%.[124] The "Brown Revolution" promoted by the Howard Buffett Foundation is further evidence of the growing appreciation of the overriding need to improve soil quality to increase agricultural productivity in developing nations.[125]

Those who promote utility patent rights as the key to incentivize development of new crop varieties to address world hunger have many difficult questions to answer. More than a quarter of a century has passed since *Ex parte Hibberd* opened the door to patents on most plants. A look at the facts shows that the GE crops developed under the aegis of this new IP regime have not made any meaningful contribution to reducing hunger.

First, genetically engineered crops have been developed overwhelmingly for use by large farmers in nations with highly mechanized, export-oriented agricultural sectors in North and South America. Just eight nations in the Americas – primarily the U.S., Canada, Brazil and

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[121] For the following discussion, see Freese, B (2009). "Why GM Crops Will Not Feed the World," GeneWatch, Vol. 22, Issue 1, Jan-Feb. 2009. http://www.councilforresponsiblegenetics.org/GeneWatch/GeneWatchBrowser.aspx?archive=yes&volumeId=22&issueNumber=1.

[122] Sullivan, D. (2008). "Groundbreaking report offers holistic remedies for famine relief and environmental protection in developing countries," The Rodale Institute, 4/18/08. http://www.rodaleinstitute.org/20080418/fp1.

[123] PANNA (2010). "Biotechnology and Sustainable Development: Findings from the UN-Led International Assessment of Agricultural Knowledge, Science and Technology for Development," Pesticide Action Network North America, August 2010. http://www.biosafety-info.net/file_dir/4542994024ca566872c339.pdf.

[124] Pretty, J & Hine, R. (2001). "Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence," University of Essex, February 2001, p. 15. http://www.essex.ac.uk/ces/occasionalpapers/SAFE%20FINAL%20-%20Pages1-22.pdf.

[125] AP (2011). "Buffett: New approach needed on hunger in Africa," Associated Press, 10/12/11. http://www.foxnews.com/us/2011/10/12/buffett-new-approach-needed-on-hunger-in-africa/

Argentina – accounted for 87% of GE crop acreage in 2011.[126] Brazil and Argentina, often portrayed as "developing countries," are home to some of the largest industrial soybean plantations in the world, and export the majority of their GE crops to rich nations. Second, just four industrial crops – soybeans, corn, cotton and canola – represented 99.6% of global GE crop acreage in 2011. Soybeans and corn are predominant, and are used primarily to feed animals or fuel cars (corn for ethanol, soybeans for biodiesel) in rich nations, not feed hungry people. What little effort has been made to develop GE crops of relevance to poor farmers has met with failure,[127] and even the most frequently touted "success story," GE (Bt) cotton in India, has recently been debunked.[128] Third, 85% of GE crop acreage worldwide is planted to crops engineered for resistance to herbicides,[129] a labor-saving weed control technology that has little relevance to poor farmers, most of whom cannot afford herbicides, much less in combination with high-priced GE seeds.

These hard facts make it clear why biotech promotion efforts have relied for over two decades on endless unfulfilled promises for the future. Yet somehow, attractive-sounding traits like enhanced nutrition and increased yield are never introduced. We are continually told that biotechnology is essential to feed a population of 9 billion by the year 2050, but never how the industry's product pipeline, dominated by herbicide-resistant crops,[130] will accomplish this daunting task; nor why the 400 million acres of GE crops being grown today have failed to put a dent in world hunger, which has increased from less than 800 million hungry people in the mid-1990s, when GE crops were first introduced, to over 900 million in 2010.[131]

Though of lesser importance than promoting agroecological approaches, plant breeding certainly has a role to play in addressing the food challenges of the present and future. But if solutions are to come from this sphere, they are unlikely to emerge from agrichemical-seed firms serving wealthy farmers with expensive, patented GE seeds. Instead, they will have to come from public sector breeding institutions, such as the Center for Improvement of Maize and Wheat and the International Rice Research Institute, which were largely responsible for the Green Revolution. Unfortunately, these institutions have suffered severe funding cutbacks, and often do not have sufficient funds even to distribute valuable new varieties they have already

[126] Statistics in this paragraph from ISAAA (2011). "Global Status of Commercialized Biotech/GM Crops: 2011." http://www.isaaa.org/resources/publications/briefs/43/executivesummary/default.asp.

[127] For one of many examples, see: Li Ching, L (2004). "Broken promises: GM sweet potato project turns sour," Synthesis/Regeneration 35, Fall 2004, http://www.greens.org/s-r/35/35-03.html

[128] Stone, GD (2012). "Bt cotton, remarkable success, and four ugly facts," Food, Farming and Biotechnology, a blog by anthropologist Glenn Davis Stone, who has conducted over a decade of research on adoption of Bt cotton in India. http://fieldquestions.com/2012/02/12/bt-cotton-remarkable-success-and-four-ugly-facts. Stone finds that yield gains often attributed to Bt cotton occurred primarily in years when it was very little grown, and that introduction of a new insecticidal seed treatment and increased irrigation are primarily responsible for cotton yield gains in India.

[129] ISAAA (2011), op. cit. Proportions of world biotech acreage (2011) by trait category are: 15% insect-resistant; 59% herbicide-resistant; 26% stacked with both traits. Thus, 85% of biotech crop acreage is herbicide-resistant. The few GE crops with other traits have been planted on too little acreage to register.

[130] In the U.S., where nearly all GE crops are first introduced, fully 14 of 20 GE crops awaiting "deregulation" (commercial approval) by USDA are herbicide-resistant. See http://www.aphis.usda.gov/biotechnology/not_reg.html, last visited 8/8/12.

[131] WHES (2012). "2012 World Hunger and Poverty Facts and Statistics," World Hunger Education Service, http://www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm.

developed.[132] Notably, Green Revolution crops were developed and distributed without "innovation-promoting" patent rights. The high cost of developing GE crops,[133] and the resultant high cost of seeds, makes them unsuitable to all but the minority of well-to-do developing country farmers who can afford them, and who have the other perquisites (e.g. resources for irrigation systems and herbicides) required for them to perform well.

Most scientists who promote biotechnology as the solution to world hunger are entirely ignorant of these facts. Many have fallen prey to misinformation generated by biotechnology industry front groups, such as ISAAA, which regularly produce deceitful reports touting all manner of illusory "benefits" from GE crops by using false assumptions, deceptive "simulations," and by hyping experimental crops that are never successfully commercialized.[134] Others are simply reacting to uninformed criticisms of the technology, which they find offensive as scientists. Still others are personally engaged in biotechnology research projects, and naively project their own laudable motives onto an industry that has quite different ones.

While there is some independent research that might eventually produce GE crops of value to developing country farmers, their development and introduction will require a strong commitment on the part of rich nations to fund public sector breeding institutions motivated more by the needs of poor farmers than profit.

CONCLUSION

As discussed above, considered application of the doctrine of patent exhaustion to new plant varieties could bring numerous benefits to U.S. farmers: more affordable seed, greater innovation, and more seed options. It would also likely act as a salutary, if modest, restraint on further consolidation of the seed industry, and could be fashioned to permit less fettered independent scientific research on crop properties and performance. These benefits could be achieved without significant impacts to seed industry R&D activity, and in fact would likely spur it. For all of these reasons, the Center for Food Safety strongly supports the petition of Vernon Hugh Bowman for grant of certiorari.

Please feel free to contact me should you have any questions or wish to discuss these matters further.

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[132] Bradsher, K & Martin, A (2008). "World's poor pay price as crop research is cut," New York Times, 5/18/08. http://www.nytimes.com/2008/05/18/business/worldbusiness/18focus.html?pagewanted=all

[133] Up to $100 million for a single GE crop, according to industry estimates. As cited in: Waltz (2009), op. cit. Though seldom discussed, the technology's high failure rate is largely responsible for the high costs of development.

[134] For studies debunking such reports, see Benbrook (2009b), op. cit., Chapter 6; Stone (2012), op. cit.; FoEI (2008). "Who Benefits from GM Crops: The Rise in Pesticide Use," Friends of the Earth International, January 2008, http://www.foei.org/en/resources/publications/pdfs/2008/gmcrops2008full.pdf/view; Bocking, S. (2002). "Genetic Illusions," Alternatives Journal 28(4), Fall 2002; CFS (2005b). "Genetic Engineering Front Group Exposed," Center for Food Safety, February 2005, http://www.centerforfoodsafety.org/pubs/NCFAP%20debunked%20-%20Final%20Feb%202005.pdf. CFS recently critiqued the widely-accepted misconception that Roundup Ready crops are responsible for increased use of conservation tillage (e.g. no-till) farming methods. See http://www.centerforfoodsafety.org/wp-content/uploads/2012/04/CFS-Science-Comments-II_24-D-corn.pdf, pp. 2-9.

Sincerely,

Bill Freese
bfreese@icta.org
814-237-2767

[Appendices omitted]

Attachment 2

April 21, 2022

Lina Khan, Chairwoman
Federal Trade Commission
600 Pennsylvania Ave., NW
Washington, DC 20580

Jonathan Kanter, Ass't Attorney General for Antitrust
U.S. Department of Justice
950 Pennsylvania Ave., NW
Washington, DC 20530

RE: Request for Information on Merger Enforcement; FTC-2022-0003

Center for Food Safety appreciates the opportunity to comment on the need for improved guidelines for enforcement of mergers. Center for Food Safety (CFS) is a public interest, nonprofit organization with 970,000 members and supporters, and offices in Washington, D.C., San Francisco, California, and Portland, Oregon. CFS's mission is to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture. Through groundbreaking legal, scientific, and grassroots action, CFS protects and promotes the public's right to safe food and the environment.

In these comments, we describe an egregious instance of anti-competitive conduct in the seed-pesticide industry that has caused substantial harms to farmers and small seed companies, and which threatens to create, in the words of the Ninth Circuit Court of Appeals, a "monopoly or near-monopoly" in the market for seeds of America's second-most widely planted crop, soybeans.[135] We then briefly describe how vertical integration of the seed, pesticide and biotechnology trait sectors fosters such egregious conduct, and more generally advances an ever more pesticide-intensive agriculture that harms the interests of both farmers and consumers.

<u>The Dicamba Debacle</u>

The near-monopoly in soybean seeds was created by the Monsanto Company's 2017 introduction of the dicamba-resistant crop system: soybeans and cotton genetically engineered to survive over-the-top application of drift-prone dicamba herbicide, and a dicamba formulation for use on them.

The dicamba system created an agricultural nightmare. Sprayed in large quantities over-the-top of resistant crops in the summertime heat, dicamba vaporized and drifted long distances to cause enormous damage across the landscape. Soybeans not engineered for resistance to dicamba are particularly sensitive to it, and thus were particularly hard hit, with nearly four million acres reported damaged in the system's first year of use.[136] Pesticide expert Andrew Thostenson of North

[135] Nat'l Family Farm Coalition et al. v. EPA, 960 F.3d 1120 (9th Cir. 2020). Center for Food Safety was co-plaintiff and counsel in this lawsuit, discussed further below.
[136] Kevin Bradley, A final report on dicamba-injured soybean acres, University of Missouri Integrated Pest & Crop Management, October 30, 2017.
https://ipm.missouri.edu/cropPest/2017/10/final_report_dicamba_injured_soybean/.

Dakota State University said it was unlike anything that "has ever happened in the history of pesticide use in this country."[137]

Soybean farmers desperate to avoid damage in future years shifted *en masse* to Monsanto's seeds. University of Tennessee's Larry Steckel reported: "Many growers have told me they simply gave up trying to grow [non-dicamba-resistant] soybeans because they had repeatedly seen dicamba injury in past years – often multiple times in the same year."[138] North Dakota State University agricultural economist David Ripplinger similarly stated that "almost all" [the farmers he spoke to] are "going to grow dicamba soybeans this year [2018] because they don't want to be exposed to the risk."[139] Thus, it is no surprise that dicamba-resistant crop plantings more than doubled from 2017 to 2019, when they comprised roughly two-thirds of both crops, covering 60 million acres.[140] Based on a 2018 survey of soybean farmers by USDA, from one-third to one-half of the dicamba-resistant soybeans in major soybean states were likely planted for self-protection, since not treated with dicamba.[141]

Center for Food Safety and other groups sued the U.S. Environmental Protection Agency (EPA) for illegally registering the three dicamba formulations for use on resistant crops, alleging in part that EPA had not assessed costs, such as those resulting from dicamba drift damage. The Ninth Circuit ruled in our favor and revoked the three dicamba registrations in June of 2020, though under the Trump Administration EPA re-registered dicamba in October 2020.[142] The same plaintiffs challenged this re-registration. The case is currently pending, and meanwhile dicamba drift has continued to cause devastating damage in 2021, year five of this debacle.

Among the grounds for the Court's revocation was that EPA had failed, as required by the Federal Insecticide, Fungicide and Rodenticide Act, to assess the costs of the registrations, including "the economic cost imposed by the coercion" of farmers to convert to dicamba-resistant crops, "and the resulting anti-competitive effect of that coercion." Aside from higher seed costs for farmers, the Court explained that Monsanto's dicamba system put small independent seed firms at a competitive disadvantage, quoting the principals of Rob-See-Co of Nebraska, and Merschman

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[137] Robin Booker, Dicamba volatility causes anxiety as new season nears, The Western Producer (May 3, 2018), https://www.producer.com/crops/dicamba-volatility-causes-anxiety-as- new-season-nears/.
[138] NFFC, 960 F.3d at 1143.
[139] Id. at 1142-43. In fact, internal memos released in the context of class-action lawsuits against Monsanto reveal that the company anticipated, years before release, that its dicamba system would cause thousands of dicamba drift episodes, and planned to exploit the drift threat as a means to sell farmers its seed. See: Johnathan Hettinger, 'Buy it or else': Inside Monsanto and BASF's moves to force dicamba on farmers, Midwest Center for Investigative Reporting, Dec. 4, 2020, https://investigatemidwest.org/2020/12/04/buy-it-or-else-inside-monsanto-and-basfs-moves-to-force-dicamba-on-farmers/.
[140] At the same time, USDA estimated that up to 15.7 million acres of soybeans, 18% of the soy planted that year, were damaged by dicamba drift. See: US EPA, Dicamba use on genetically modified dicamba-tolerant (DT) cotton and soybean: incidents and impacts to users and non-users from proposed registrations, Table 8, Docket: EPA-HQ-OPP-2020-0492-0003, October 26, 2020.
[141] Seth J. Wechsler et al. (2019). The use of genetically engineered dicamba-tolerant soybean seeds has increased quickly, benefiting adopters but damaging crops in some fields. USDA Economic Research Service Amber Waves, October 1, 2019, https://www.ers.usda.gov/amber-waves/2019/october/the-use-of-genetically-engineered-dicamba-tolerant-soybean-seeds-has-increased-quickly-benefiting-adopters-but-damaging-crops-in-some-fields/.
[142] See footnote 1.

Seeds of Iowa, both of whom saw long-term customers abandon them to instead purchase dicamba-resistant seeds, to forestall drift injury, from a Monsanto subsidiary or licensee.[143]

Most insidious is the devastating effect dicamba drift has had on public sector soybean science. University soybean breeding programs in Missouri, Arkansas, Kansas and Nebraska have all seen experimental varieties in their outdoor plots damaged by dicamba drift, destroying valuable research that could help all farmers. As University of Missouri's Pengyin Chen, a professor of soybean breeding and genetics, put it: "If you kill the public research programs, who is going to study disease resistance, or stress tolerance? Those efforts are going to be gone."[144] Chen also worries that dicamba drift will further marginalize affordable, non-commercial, soybean varieties that university breeding programs such as his offer directly to farmers, since they do not incorporate dicamba resistance.

Vertical Integration of Seeds, Pesticides and Biotechnology Traits

The dicamba debacle described above would likely never have occurred absent vertical integration of the germplasm/seed, pesticide and biotechnology trait sectors. Going forward, similar episodes are far more likely as long as these three sectors remain consolidated.

Since the 1980s, pesticide firms have obtained massive stocks of germplasm via acquisitions of hundreds of major and minor, formerly independent, seed companies. These pesticide firms have also acquired numerous biotechnology start-ups to augment in-house research and development in the techniques of genetic engineering. The latest wave of concentration has seen the six leading seed-pesticide-biotechnology behemoths merge into three still larger entities. Bayer acquired Monsanto, Dow and DuPont merged and spun off their agricultural sectors to form Corteva; and ChemChina acquired Swiss giant Syngenta. A fourth firm, German BASF, is largely a pesticide supplier but has acquired some germplasm.

The integration of these sectors has led to channelization of the research agendas of the conglomerates into narrow pathways that maximize synergies between their seed and pesticide products, and thereby lead American agriculture into an ever more toxic, pesticide-dependent future. It is thus no accident that very nearly 100% of genetically engineered crop acreage in the U.S. comprises crops with one or more herbicide-resistance traits, which dramatically increases use and sales of the companion herbicides. A recent example is Corteva's Enlist crop system, comprising corn, soybean and cotton varieties resistant to 2,4-D, another volatile herbicide of the same class as dicamba. Despite far less crop area devoted to this system as of yet, it is already beginning to generate outsize drift damage, much as dicamba has. The future R&D priorities of the integrated companies is more of the same: crops engineered for resistance to, and hence dramatically increased use and sales of, multiple herbicides.[145]

A second pathway strongly favored by vertical integration of these sectors is coating seeds with insecticides and fungicides. The integrated firms, particularly Bayer/Monsanto and

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[143] NFFC, 960 F.3d.

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

[145] Bayer recently petitioned USDA to approve a corn variety resistant to five different herbicides, and resistance traits have been identified for most major classes of herbicide, awaiting only incorporation into seed via genetic engineering.

ChemChina/Syngenta, are leaders in both seed sales and the development and deployment of these so-called "seed treatments." Virtually 100% of U.S. corn seed, the majority of soybean seed, and the seeds of many additional crops are routinely coated with neonicotinoid insecticides that are known to harm pollinators,[146] as well as multiple fungicides that both synergize the toxicity of insecticides, and often have their own harmful environmental effects. Farmers have little or no choice of "bare" seed, and often have little knowledge of the pesticidal coatings or their purpose;[147] and indeed, agronomists have found they often serve no useful pesticidal purpose at all,[148] but rather superfluously pollute the environment. But like herbicide-resistance traits, seed coatings serve as price points for the firms in their marketing to farmers. And seed costs have risen dramatically with the advent of genetic engineering and seed treatments.[149]

Breaking Up the "Inputs" Industry

Breaking up the seed, pesticide and agricultural biotechnology sectors would sharply decrease the incentives driving U.S. agriculture on its current pathway of intensifying pesticide use. For example, seed companies without biotechnology and pesticide portfolios would be less motivated to tie their offerings to pesticides, either through herbicide-resistance traits or seed coatings, and would more readily respond to farmer demands for conventional or untreated seeds. Each sector would better meet the full range of farmers' diverse needs as they negotiate an increasingly precarious world of climate destabilization, and the rising demands of consumers for sustainably produced foods.

There is much more that could be said on this topic. CFS would happy to discuss any of the issues raised in these comments, and provide fuller documentation of the points made. We have uploaded to the docket the Ninth Circuit Court of Appeal's opinion discussed above.

Regards,
Bill Freese, Science Director
Center for Food Safety

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[146] Thomas J. Wood and Dave Goulson (2017). The environmental risks of neonicotinioid pesticides: a review of the evidence post 2013, Environ Sci Pollut Res 24: 17285-17325.
[147] Claudia Hitaj et al. (2020). Sowing uncertainty: what we do and don't know about the planting of pesticide-treated seed, Bioscience 70(5): 390-403.
[148] Spyridon Mourtzinis et al. (2019). Neonicotinoid seed treatments of soybean provide negligible benefits to US farmers. Scientific Reports 9: 11207.
[149] Charles Benbrook (2009). The Magnitude and Impacts of the Biotech and Organic Seed Price Premium. The Organic Center, Dec. 2009. https://kohalacenter.org/archive/publicseedinitiative/images/seedpricepremium.pdf.

Attachment 3

May 28, 2021

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.[150] 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

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

the Enlist weed control system. HR crop systems have characteristic use patterns – involving 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…."[151] 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[152] 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.[153] 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

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

[152] 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.

[153] Petition, p. 5.

incentive for the grower to rely exclusively on the companion herbicide(s)[154] rather than 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).[155] 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.[156]

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,[157] 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.[158]

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-

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

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

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

[157] 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/.

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

resistant crops means glyphosate-resistant weeds experience only one effective mode of action – driving additional resistance to dicamba.[159]

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.[160]

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,[161] while dicamba-resistant Palmer amaranth in Tennessee has reduced sensitivity to 2,4-D.[162] 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.[163] Metabolic resistance is conferred by native plant detoxification mechanisms,

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

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

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

162 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/.

163 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.

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 biotype has been identified in California that has non-target site resistance to glyphosate, paraquat, dicot, and 2,4-D.[164] 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.[165] 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.[166]

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.[167] Such weeds will then likely spread to fields of field corn and other crops.

Herbicide drift fosters resistance

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[164] 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.
[165] Shyam C. et al (2021). Predominance of metabolic resistance in six-way-resistant Palmer amaranth (*Amaranthus palmeri*) population. Frontiers in Plant Science 11: 614618.
[166] http://www.weedscience.com/Pages/Case.aspx?ResistID=19221.
[167] 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.

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 indeed select for Palmer amaranth and waterhemp biotypes with reduced sensitivity to these herbicides over just two generations.[168]

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.[169] 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."[170] 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

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[168] Vieria BC et al. (2020). Herbicide drift exposure leads to reduced herbicide sensitivity in *Amaranthus* spp. Scientific Reports 10: 2146.
[169] 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.
[170] 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.

provided for implementation of cover-cropping, which can both suppress weeds and reduce nutrient loading of streams.[171]

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.[172] 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.[173] 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

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

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

[173] 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.

would yield at best 5 bushels per acre in Arkansas.[174] Two-hundred Minnesota soybean growers collectively suffered an estimated $7 million in yield losses.[175] 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.[176] 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.[177] Beekeepers across the country have reported similar issues.[178] 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.[179] 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

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[174] 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.

[175] 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.

[176] 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.

[177] 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.

[178] 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/.

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

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 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,[180] as well as an amicus brief submitted on behalf of Bader for the registrants' appeal of the case.[181] APHIS is also encouraged to consult the Ninth Circuit Court of Appeals' June 3, 2020 decision to vacate over-the-top dicamba formulations,[182] 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.[183]

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

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

reliance on registrants' "low-volatility" claims for their yet-to-be developed dicamba formulations.

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.[184] 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,[185] 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.[186] This should be accompanied by analysis

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[184] 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.
[185] 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/.
[186] Wechsler SJ et al. The Use of Genetically Engineered Dicamba-Tolerant Soybean Seeds

of 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.[187] 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

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

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

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-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.[188]

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.[189] This is particularly concerning given the dramatically increased use of this herbicide

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

[189] 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

and its ubiquitous presence in the atmosphere in regions where the herbicide has been heavily 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.[190]

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."[191]

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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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.

[190] 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.

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