Seed Privatization and the Path Toward Equitable Exchange

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The land-grant university system is being built on behalf of the people, who have invested in these public universities their hopes, their support, and their confidence.
— President Abraham Lincoln upon signing the Morrill Act, July 2, 1862

The crops that we grow are the basis of our civilization. If anything belongs in the public domain, it is the crops we grow for food.
— Todd Leake, North Dakota grain grower, public testimony at a Department of Justice workshop in Ankeny, Iowa, March 12, 2010

If we will not endure a king as a political power, we should not endure a king over the production, transportation, and sale of any of the necessaries of life.
— Sen. John Sherman, in proposing the Sherman Antitrust Act of 1890

Overview

Once managed as a public resource, seed is now one of the most privatized agricultural inputs today. Laws, policies, and practices governing intellectual property (IP) on plant genetics have fostered dramatic marketplace and cultural changes in a few short decades. The commercial seed marketplace has undergone tremendous structural changes, with ever more market power concentrating into the hands of fewer firms. IP rights have facilitated this extensive and rapid concentration. Beyond market domination at the retail sales level, farmers, plant breeders, and independent seed companies are dealing with the consequences of concentration at the more fundamental level of ownership, where IP owners determine whether germplasm is shared and how it is used. This paper provides a short history on what led to increased privatization in seed; the impacts of this privatization on breeders, farmers, and innovation; and recommendations for addressing root causes of the problem, including inappropriate IP tools, weak antitrust oversight, and the Bayh-Dole Act. This paper encourages much-needed policy change informed by a close examination of the trends identified herein, as well as new models for plant breeding and IP protection that decentralize ownership of seed.

A short history on the privatization of seed

A core function of the U.S. Department of Agriculture (USDA) when it was formed in 1862 was the collection and distribution of germplasm. Concerted efforts to introduce new plants to the U.S. began centuries before. For much of the 19th century, before USDA was established, the Patent Office fervently carried out these activities, mailing millions of seed packages to farmers across the nation.

By the end of the 19th century, a third of USDA's budget was allocated for germplasm collection and distribution. The department encouraged farmers to trial any crop that seemed economically important to U.S. agriculture, and continued the practice of distributing seed free of charge. And, thanks to the Morrill Act, states now had a place in the plant sciences through the newly established land grant university system. Land grants largely focused on collecting germplasm and conducting research in areas that were not profitable to burgeoning private ventures. Together, USDA and our land grant universities aimed to expand agriculture for the sake of prosperity and security – to further research, education, and innovation, and make advancements accessible to all.

USDA freely distributed seed to farmers not so much as a commodity but as an essential natural resource best managed in the hands of the people. The department understood that the nation's growing crop diversity was a product of farmers serving as the nation's first plant breeders. Their labor and land – and the knowledge base they built through experimenting, screening, and selecting – effectively adapted exotic plants to regional agricultural environments.

Land grant universities' regional breeding programs gained momentum, providing new plant varieties to farmers. These public programs advanced U.S. agriculture by increasing yields and developing a strong base of scientific knowledge. Private companies emerged and expanded, and soon organized to confront their most formidable competitor: the government. In 1924, after years of lobbying, the seed trade convinced Congress to shut down USDA's free seed distribution. Over the decades that followed, the number of seed companies grew.

The political climate was such that lawmakers were facing heightened pressure throughout the 20th century to create policies that protected investments in research and development. IP rights had been discussed for decades, and the first law to provide breeders some protection passed in the form of the Plant Patent Act of 1930. Importantly, the law only applied to asexual reproduction, such as grafting and cuttings, and excluded sexually reproducing plants as patentable subject matter.

In fact, Congress long argued that sexually reproducing plants should not be awarded utility patents under the U.S. Patent Act – "patents for invention" – for fear of curtailing innovation, threatening the free exchange of genetic resources, and increasing market concentration. A 1966 congressional committee report states that while its members "acknowledge the valuable contribution of plant and seed breeders, it does not consider the patent system the proper vehicle for the protection of such subject matter" (Report of the President's Commission, 1966).

But the seed trade and plant breeders were eventually successful in convincing Congress that more protection was warranted. This came in the form of a "patent-like" protection under the Plant Variety Protection Act (PVPA) of 1970. The law represented a compromise: Breeders had the exclusive right to propagate and market varieties for 20 years, but the law provided important exemptions. First, other plant breeders can use varieties protected by a PVP certificate for research, including plant breeding. Second, farmers can save seed from protected varieties to replant on their own farm. (Prior to 1994, this exemption also allowed farmers to sell saved seed.)

Although PVP protections are still widely used today, Congress' concerns regarding IP and plants have been realized, but not because of the PVPA. In 1980, the U.S. Supreme Court upheld the first patent on a living organism in *Diamond v. Chakrabarty*. The PTO had originally refused to award this patent, which involved a GE bacterium, before Chakrabarty appealed. In 1985, in *Ex parte Hibberd*, the Board of Patent Appeals and Interferences effectively extended the *Chakrabarty* decision by allowing a broad utility patent on plant matter (*Hibberd*, 1985). A 2001 Supreme Court decision later affirmed in *J.E.M. Ag Supply vs. Pioneer Hi-Bred International* that the scope of the Patent Act was not limited by the Plant Patent Act or the PVPA. Although utility patents awarded for seed and plants increased after the earlier 1980 and 1985 decisions, this Supreme Court ruling eliminated remaining uncertainties around utility patents on plants, opening the floodgates to further privatize our plant genetic heritage.

Patents and licensing agreements

Owners of utility patents have far-reaching control over access and use of their protected products. A single patent can cover a plant, seed, tissue cultures, future generations, crosses with other varieties, and the methods used to produce it. While the PVPA has exemptions for researchers and farmers, utility patents can be legally enforced to forbid access to protected material for purposes of research, including plant breeding and on-farm seed saving. Patents therefore remove valuable genetic material from the diverse pool of resources breeders rely on for improving agricultural crops. When access to breeders is provided, it often hinges on restrictive licensing agreements.

Patents are also commonly enforced to remove a farmer's right to save and replant seed, the very practice that helped establish much of the tremendous diversity of domesticated crops and varieties we have today. By being forced to repurchase seed each year, farmers not only shoulder higher annual input expenses, they lose the ability to adapt seed to regional climates, soils, and disease pressures.

Today, in many an industry, be it agriculture or software, the scope of licenses that communicate patent rights (or simply serve to transfer material

and dictate the terms even in absence of a patent) has expanded beyond their traditional use. Many licenses now transfer IP without transferring many presumed rights of the user, upsetting the balance that public policy aims to achieve between IP owner rights and the public interest (Winston, 2006).

In agriculture, the ability of IP owners to restrict seed saving epitomizes this shift away from the public interest. With the proliferation of patenting and licensing, farmers began seeing licensing agreements on their seed bags ("bag tag" contracts) that communicate patent rights to growers. The aggressive enforcement of bag tags is most notable with agricultural biotechnology products – genetically engineered (GE) seed – though bag tags are increasingly found on non-GE seed bags and even vegetable seed packets.

Many growers of GE crops – specifically, soybeans and cotton – suffered a rude awakening beginning in the late 1990s when the Monsanto Company began spending millions of dollars on private investigators to go after farmers who were allegedly infringing its patents by saving seed. By 2005, the company had carried out thousands of investigations and filed approximately 100 lawsuits against its customers (Center for Food Safety, 2005). Many more farmers who were under investigation paid expensive settlements and signed gag orders to avoid legal action. Once Monsanto started down this path of using strong-arm tactics, rivals followed. DuPont started investigating seed saving among its farming customers in 2013 (Kaskey, 2012).

The expansion of IP rights facilitated increased concentration of financial and genetic resources. The enormous profits from licensing patented products led to dozens of acquisitions and mergers in a short timeframe. As a result, farmers and businesses now operate within a highly consolidated seed marketplace.

Concentration and its consequences

Rapid consolidation in the seed industry should have raised eyebrows at the U.S. Department of Justice but instead went unchecked. For example, the dominant firm, the Monsanto Company, achieved its No. 1 position in the seed industry in less than a decade by capturing the markets for corn, soybeans, cotton, and vegetables.

Concentration in the seed industry is well documented. Dr. Phil Howard of Michigan State University has followed agribusiness concentration through articles and information graphics, including trends in the global seed industry.[1] Howard's most recent research reveals that, while corn, soybeans, and cotton are highly impacted by consolidation, the trend is growing in other crops, including vegetables, and that consolidation continues at a rapid rate. The top eight firms acquired more than 70 companies in the last five years alone (between 2008 and 2013). The Independent Professional Seed Association estimates the U.S. has lost more than 200 companies in the last two decades alone (Wilde, 2009).

Economists have established that an industry loses its competitive character when the concentration ratio of the top four firms reaches 40 percent or higher. In seed, we've clearly exceeded that benchmark. Three firms (Monsanto, DuPont, and Syngenta) collectively control more than half of the global seed market, up from a 22% share in 1996. By crop type it's even more telling, where four major biotechnology and chemical firms command 86% of the retail market for corn. The top two firms (Monsanto and DuPont) account for 66% of this market and 62% of the soybean retail market (Matson et al., 2012).

This level of concentration in corn and soybeans has meant less choice for farmers and skyrocketing prices, regardless of whether farmers choose to grow GE or conventional (non-GE) seed.[2] Demand for non-GE soybeans surged in 2009 as prices of GE seed increased dramatically and the problem of herbicide-tolerant weeds worsened. Finding suitable alternatives proved difficult, if not impossible in some regions.[3]

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[1] See Dr. Howard's seed industry information graphics at

[2] These trends are detailed in *Out of Hand: Farmers Face the Consequences of a Consolidated Seed Industry* (Hubbard, 2009).

[3] In 2009, some university extension reported a doubling in conventional soybean sales, and shortages were reported across the South. University extension estimated that if Mississippi soybean growers planted all the public and private conventional seed available, the amount would add up to no more than 3 percent of the state's

Patents are expensive, so it's no surprise that the top two industry leaders that have profited tremendously from IP rights on seed are also the top two owners of utility patents on plant varieties. Between 2004 and 2008, Monsanto and DuPont accounted for 60% of these applications (Pardey et al., 2013).

Yet, contrary to the claims of these firms and other IP owners, patents and restrictive licensing has not spurred innovation in crop improvement. In fact, the opposite appears true. For example, in plant biotechnology, USDA documented that as the corn, soybean, and cotton markets became more concentrated "private research intensity dropped or slowed" relative to what would have occurred without consolidation (Fernandez-Cornejo and Schimmelpfennig, 2004). That's why leading economists, including Dr. Neil Harl of Iowa State University, warn that firms become complacent and less likely to innovate when they can produce less and obtain a higher price for their input (Harl, 2000). Market protection in the form of antitrust oversight is needed to prevent undue concentration of economic power and to encourage innovation.

DOJ and USDA abdicate their role in confronting seed concentration

In 2010, the U.S. departments of Justice and Agriculture began to take a hard look at anticompetitive conduct in the seed industry. The agencies hosted five workshops across the country that year to discuss competition and regulatory issues. These workshops were historic. Never before had the two departments joined forces in an effort to examine antitrust issues in agriculture. And yet, despite well-attended public workshops (approximately 1,700 people attended the Colorado workshop) and more than 18,000 written comments, the agencies failed to take action in response to the compelling evidence provided.

The public comments represented a range of agricultural industries – from poultry to hogs to cattle – yet seed remained a prominent subject of public comments delivered at each workshop. Comments called on USDA to protect genetic diversity in seed, to keep germplasm public and accessible to our public land grant universities, and to address the abuse of patents as they are being applied to seed.

Even the assistant attorney general for the DOJ's Antitrust Division, Christine Varney, who has since left the DOJ, highlighted the problem of patents in her opening remarks: "You know, patents have in the past been used to maintain or extend monopolies, and that's illegal, and you can be sure, Secretary, that we are going to be looking very closely at any attempt to maintain or extend a monopoly through an abuse of patent laws" (DOJ and USDA, 2010).

Fourteen state attorneys general also contributed to the conversation:

> In a concentrated industry, law enforcers must carefully analyze whether any holder of intellectual property is acting within the scope of its patent in imposing any restrictions on the use of the claimed invention…The complexity of the seed industry requires a thorough understanding of the industry, current antitrust jurisprudence, and intellectual property laws. State Attorneys General, the DOJ and USDA should explore the concerns which have been raised and consider whether

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soybean acreage (and just 0.5 percent if only the public cultivars available were planted). Not only has choice in conventional seed diminished, single and even double trait corn is more difficult to locate. Farmers report, for example, that it is increasingly hard to find Bt corn without the Roundup Ready trait. This means farmers who prefer these options can only access the newest genetics by paying for unnecessary traits. To drive farmers toward stacked traits, Monsanto implemented dramatic price increases for single and double stack options while reducing single and conventional options in its own brands and subsidiary companies. Some of these companies eliminated conventional options altogether, so when a new high-yielding cultivar is introduced, it is only available with stacked GE traits. Each trait adds a royalty (or "technology fee") to the price of that bag of seed. Some farmers are paying three times what they paid for ten years ago for a bag of GE seed corn. In soybeans, the royalty for the Roundup Ready trait added $4.50 per bag when introduced. Farmers paid a $17.50 royalty for the same trait in 2009 (Hubbard, 2009).

there are bases for changes in policy and existing laws.[4]

Three years earlier, in 2007, at least two state attorneys general initiated investigations into Monsanto's business practices. A federal investigation followed in 2009.

The federal investigation seemed to focus solely on competition among biotech trait developers – squabbles between the largest industry players, including complaints made by DuPont and Syngenta against Monsanto over biotech trait licensing agreements.[5] According to public documents and media reports, the state investigations may have been broader, focusing not only on whether licensing agreements were unlawful but if Monsanto had used its dominance to illegally maintain a monopoly.

Still, the root causes of the lack of competition seemed to largely go ignored, including investigations into an "abuse of patent laws," as Ms. Varney stated.[6] The agencies should have broadened their investigation on a number of levels, including taking a hard look at the interface of IP laws and antitrust laws – a balance that, at least in seed, is clearly tipped toward the protection of patent rights at the expense of competition.

But any hope that state and federal agencies would expand their investigations was short-lived. Two years later, the DOJ issued a report outlining some complaints heard at the workshops (DOJ, 2012). But the agency's response ended there. The agency also closed its antitrust investigation into Monsanto because of "marketplace developments that occurred during the pendency of the investigation" (Khan, 2013). The developments included a new licensing deal between Monsanto and DuPont. State antitrust investigations also closed that year. Therefore, both state and federal regulators have failed the public in fully investigating how concentration, patent rights, and licensing practices facilitate unfair market advantage in the seed trade, inhibit innovation for the public good, impinge farmers' freedom to operate, and increase social costs and risks.

Patenting and licensing at our public universities

The practices of patenting and licensing have been more visible in the private seed trade, and therefore the consequences as well (i.e., market concentration, legal disputes, higher seed prices, and seed saving restrictions, to name a few). How patenting and licensing have impacted public plant breeding and other seed research at our land grant universities, on the other hand, is less understood and demands a serious examination.

Academic research in general has become more privatized over the past quarter century. More industry funding is directly supporting university research (Mowery et al., 2001). And, as explained below, universities increasingly use patents and licensing to disseminate research as opposed to placing it in the public domain. Bhaven N. Sampat (2006) has documented this shift. Universities were historically reluctant to patent and license their inventions for fear they might be seen as compromising their commitment to "open science" and their institutional mission to broadly disseminate knowledge. Throughout much of the 20th century, many universities avoided patenting altogether, while others took a hands-off approach by leaving patenting decisions and management up to the inventor and outside entities.

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[4] These comments were signed by the attorneys general of Montana, Iowa, Maine, Maryland, Mississippi, New Hampshire, New Mexico, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Vermont, and West Virginia. They were submitted to the DOJ and USDA on March 11, 2010, the day before the first competition workshop in Ankeny, Iowa.

[5] In 2009, Monsanto filed a lawsuit against DuPont claiming the company violated their licensing agreement when it tried to develop a new product that stacked its own technology with Monsanto's Roundup Ready trait. In 2012, a jury in the U.S. District Court in St. Louis ordered DuPont to pay Monsanto $1 billion in damages for violating the licensing agreement. The following year, DuPont said it would pay Monsanto $1.75 billion in a new licensing deal that threw out the jury award.

[6] Christine Varney was expected to be more aggressive on antitrust law enforcement. In some of her first remarks as the department's antitrust chief, she denounced the department's guidelines for the enforcement of Section 2 of the Sherman Act, saying she had withdrawn the guidelines because they "effectively straightjacketed antitrust enforcers and courts from redressing monopolistic abuses, thereby allowing all but the most bold and predatory conduct to go unpunished and undeterred" (Varney, 2009).

The 1970s saw a marked growth in university patenting. Sampat (2006) argues that this is likely because of the increase in "use-oriented" basic research in fields like molecular biology, as well as a decline in federal funding for university research. Several universities were already entering into "institutional patent agreements" that allowed them to retain the right to agency-funded patents. Patent policies differed by federal agency, something that frustrated universities, which increased pressure on Congress to create uniform patent policy across all federal agencies.

Uniform policy came in the form of the Bayh-Dole Act of 1980. Universities and businesses could now obtain the rights to any patents resulting from grants or contracts funded by any federal agency. Not only did Bayh-Dole make it easier for universities to patent and license their research, it largely eliminated the reluctance to do so.

Prior to Bayh-Dole, universities' fears that patenting and licensing practices would be frowned upon by the broader public likely provided a check on their ambition to widely patent academic research, especially for profit, and especially in cases where other channels of dissemination were sufficient (Sampat, 2006). Today, a practice that used to give universities pause is now proudly embraced and celebrated.

Although universities were patenting research before Bayh-Dole, the number of universities involved in patenting and licensing more than quadrupled between 1980 and 1990 (Sampat, 2006). The number of patents awarded to universities also climbed following its passage, from fewer than 300 a year to more than 3,000 (Sampat, 2010). Universities now earn almost $2 billion annually from licensing (Sampat, 2010).

These figures are now widely used to boast the success of Bayh-Dole, to claim the law was necessary for improving technology transfer of publicly funded research. But numbers demonstrating increased patenting and licensing of university research (and income generated) don't necessarily mean more outputs are being transferred, that the public good is being served, or that profits are coming back to research and development programs. In fact, evidence has emerged that challenge these supposed benefits, at least in the broad context of academic research. There remains a major gap in literature on how Bayh-Dole has impacted plant breeding and seed research specifically. Still, the following findings are instructive.

First, Bayh-Dole was passed on little, and some argue faulty, evidence that patenting and licensing were necessary for improving the commercialization and development activities at universities.[7] These activities, and their potential impacts, weren't well understood when Bayh-Dole was passed in 1980 and they are still not well understood today. Therefore, the claims that Bayh-Dole was necessary to enhance technology transfer – to improve commercialization and innovation – are unfounded (Sampat, 2006; Mowery et al., 2001). More importantly, the value of public research and the potential risks of passing Bayh-Dole were neglected during the bill's hearings (Sampat, 2006).

Second, the arguments for Bayh-Dole dismiss other forms of research dissemination, including: consulting, publishing, public conferences, teaching, and hiring students. In fact, surveys show that most industries rank patents and licensing near the bottom of the list when asked how they learn from university research (Cohen et al., 2002). Publications, conferences, consulting, and informal exchanges ranked highest – channels that keep research in the public domain, benefiting future academic research as much as industry (Sampat, 2010).

And, third, some universities have strayed from the purpose of Bayh-Dole, where the transfer of technology for the public good may not be driving patenting and licensing decisions as much as their desire to generate income. Another survey of 62 research universities shows that licensing income is the most important criterion by which technology transfer offices measure their success (Thursby and Thursby, 2001). Notably, generating income from patenting and licensing was not an established purpose of Bayh-Dole at the time of its passage.

[7] Sampat (2006) argues that Bayh-Dole not only passed based on little evidence, but inaccurate evidence, where data presented in hearings primarily involved research by private firms and not universities.

Although universities can demonstrate increased income on account of patenting and licensing, this income doesn't necessarily provide a funding stream for more academic research. The Brookings Institution concluded that, in any given year, the revenue funneled into university budgets from patents and licensing deals is not enough to cover the cost of running most technology transfer offices (Valdivia, 2013). Other studies similarly show that earning licensing income from academic research is often not lucrative (Sobolski et al., 2005).

As mentioned, a comprehensive analysis is lacking on how patenting and licensing impacts university plant breeding and other seed research specifically. However, examples of problematic practices have emerged. For example, the same licenses that restrict farmers from saving seed also restrict independent research. In 2009, 26 corn-insect specialists submitted anonymous comments to the Environmental Protection Agency (EPA) about licenses enforced by biotechnology firms, stating, "as a result of restricted access, no truly independent research can be legally conducted on many critical questions regarding the technology" (Editors, 2009). Specifically, scientists said the licenses were keeping them from researching the effectiveness and environmental impact of GE crops. Instead, university scientists have to seek permission, which is sometimes denied or comes with strings attached, such as whether the findings can be published.[8]

The anonymity of these scientists showcases the fear that powerful IP rights create. This includes fear of enforcement and fear of losing industry support for university research. Industry funding of public research may not be something to criticize on its own, especially in light of dwindling public funds. But it's clear that industry funding and licensing agreements can come with strings attached that dictate the terms and direction of research. Crop research in general has narrowed, prioritizing commodities where the most profit can be made, leaving minor crops and smaller markets underserved. There is also a fear of the unknown, where university researchers say they can't easily know whether germplasm they're using is patented. Especially problematic is the increased trend in broad patents that include traits that also occur in nature and are selected for through classical breeding methods, such as "red" lettuce and "brilliant white" cauliflower (Hamilton, 2014).

The broader shift in U.S. policy toward stronger rights for IP owners has contributed as much, if not more, to increased patenting and licensing at universities as Bayh-Dole (Mowery et al., 2001). Court decisions that greatly expanded the definition of patentable subject matter were game changers, as discussed above with the cases of *Chakrabarty, Ex parte Hibberd,* and *J.E.M. Ag Supply*. Given these changes, the extent to which living organisms – from new plant varieties to the identification of useful genetic traits – are patented and licensed by research universities demands careful analysis. This is especially prudent (and urgent) given the mission of our land grant universities and the importance of plant breeding to our nation's food supply, agricultural economy, and germplasm conservation systems.

Utility patents on living organisms have only been challenged in a few cases. In 2013, the Supreme Court ruled on two relevant cases: (1) the patentability of human genes, and (2) the patent exhaustion doctrine as it relates to saving patented seed.

In the first case, at issue were breast cancer genes identified and sequenced by Myriad Genetics, a molecular diagnostic company. In *Association for Molecular Pathology v. Myriad Genetics* (2013), the Supreme Court unanimously held that "a naturally occurring DNA segment is a product of nature and not patent eligible merely because it has been isolated," invalidating Myriad's gene patents. (The decision reiterated, however, that the Court still views utility patents on plant varieties appropriate.)

Whether the Myriad ruling leaves a door open to further challenge how patents are applied to seed remains to be seen. Justice Elena Kagan's comments suggest it does. "Our holding today is limited – addressing the situation before us, rather than every one involving a self-replicating product," she wrote. "We recognize that such

[8] This appears to be common practice across industries, where one survey of industry executives shows that 27 percent of their university licenses include clauses that allow deletion of information from papers before they are submitted (Thursby, 2003).

inventions are becoming ever more prevalent, complex and diverse."

The second case, *Bowman v. Monsanto,* reflected that complexity. In this case the Supreme Court ruled that "patent exhaustion does not permit a farmer to reproduce patented seed through planting and harvesting without the patent holder's permission" (*Bowman v. Monsanto*, 2013). Beyond trying to save money, this farmer was challenging the relatively new paradigm of allowing utility patents on living organisms.[9] In 2011, the Organic Seed Growers and Trade Association sued Monsanto challenging some of its patents on GE seed. The court sided with Monsanto by dismissing the case.

Where do we go from here?

We must step up our response to the abuse of patents and licensing, and simultaneously work to decentralize our nation's plant breeding, seed production, and distribution systems. Because of the complexity of IP issues, especially as they pertain to seed, the role of numerous decision makers and stakeholders must be considered in the policy pathway moving forward. This pathway must clearly articulate which forms of IP protections are appropriate, especially those governing public research. Specifically, as a community, we should consider the following ideas and recommendations.

Utility patents on plant genetics must be confronted

The law needs to change. Utility patents are the wrong tool for protecting new cultivars and other germplasm. Their application, especially coupled with restrictive licensing agreements, is unethical, resulting in grave economic and social consequences. Utility patents should not be awarded for seed and plants, and for any living organism for that matter. Though not a silver bullet to the multifarious challenges discussed in this paper, confronting the abuse of patents and licensing agreements is paramount to building broad support for the models of plant breeding and IP we must foster. This education, research, and organizing must include our public universities.

Furthermore, we should consider creating tools that assist plant breeders in accessing information about existing patents, including new patents that may impact their work as well as patents that are ending and freeing up material. Many breeders relay that they often don't know if and when they may be infringing a patent, and it's difficult to find out. This reality creates undue fears in our public plant breeding community, and serves as another barrier to innovation. We should also create a system that allows breeders to report examples of patents that are especially egregious and should be challenged in court, such as patents on naturally occurring traits.

The DOJ and USDA must further investigate seed concentration

Chemical and biotechnology firms have merged with or acquired a significant number of competitors, and though some have drawn antitrust scrutiny, no meaningful action has been taken to further investigate the impacts of this level of consolidation. Independent seed companies say the licensing agreements they sign with larger firms unreasonably restrain competition. University breeders say these agreements keep them from conducting important research on protected products. The public must be protected from predatory practices that ultimately hinder innovation and independent research.

The balance of power is currently tipped toward IP owner rights and away from the public interest. This imbalance must be seriously considered as part of a new investigation that includes a hard look at the interface of IP laws and antitrust laws. For starters, restrictions on research and germplasm exchange must be removed from licensing agreements, since independent research relies on access to protected products for purposes of innovation and information sharing.

For all proposed and pending acquisitions and mergers that could result in further concentration of the seed industry, the DOJ and USDA should establish a public process that assesses how the

[9] Rep. Marcy Kaptur, of Ohio, introduced legislation in 2004 and 2013 to establish a registration and fee system that would allow farmers to legally save patented seed. "Companies deserve a fair return, not an exorbitant return," Kaptur said (Ferguson, 2013).

merger will impact the structure of agriculture. This assessment should be made public with ample opportunity for public comment prior to any governmental action on the merger.

Finally, antitrust law must be enforced when there is evidence of anticompetitive conduct. If the DOJ determines that anticompetitive conduct exists as a result of concentration in the seed industry or an abuse of patent and licensing rights, it should use all remedies at its disposal through the Sherman Antitrust Act and Clayton Antitrust Act to eliminate these practices. Breeders deserve to operate freely, without fear of infringing patent rights or conducting research that could reflect poorly on industry. And farmers deserve an open and fair marketplace that encourages innovation and provides a variety of seed options at competitive prices.

The impacts of Bayh-Dole on public plant breeding programs must be examined

The Bayh-Dole Act must be evaluated in the context of publicly funded plant breeding and other seed research. These findings should inform changes to the law, as well as changes to IP policies at universities and federal agencies administering research grants.

To what extent are university patents and licenses reducing access to germplasm and contributing to the "anti-commons" approach to plant genetic resource management? What criteria are technology transfer offices using to decide if and when to patent and license new cultivars and other germplasm? And at what cost to the public?

In the words of Bill Tracy of the University of Wisconsin, how do we encourage technology transfer programs that "have as their mission democratizing the seed sector rather than Balkanizing it?" There are likely opportunities to immediately address some of the constraints and frustrations that breeders have with their technology transfer offices, but it will take a deliberate effort. For starters, we should collect evidence of the problem as well as good, working examples, and then educate universities on best models and approaches to ensure shared value and future innovation, ensure royalties go to breeding programs, and ensure products remain in the public domain and serve the public good.

Finally, we should revisit the appropriate role of federal agencies in monitoring the patenting of public research, especially when broad dissemination is in the best interest of the public. Before Bayh-Dole, patenting and licensing policies varied between federal agencies given their differing missions and research and development programs. Plant breeding is a field of research that relies on the free exchange of germplasm and knowledge to succeed as a discipline and serve the public good. Therefore, agencies administering plant breeding grants should implement clauses in these contracts to ensure publicly funded research remains in the public domain.

Promote appropriate IP models for plant breeding

IP models that adhere to the principles of fairness, diversity, and shared benefits must be created and fervently promoted. Models will differ by breeding program and goals, and maybe by crop type. One example is the Open Source Seed Initiative (OSSI), described in Jack Kloppenburg's paper. Jack leads OSSI's effort to "preserve the right to use material for breeding and the right of farmers to save and replant seed by creating a 'protected commons' populated by farmers and plant breeders whose materials would be freely available and widely exchanged but would be protected from appropriation by those who would monopolize them."

Our team at Organic Seed Alliance (OSA) has been exploring appropriate IP models in partnership with OSSI and other seed professionals to determine how best to protect new cultivars developed through our participatory plant breeding program while recouping a return for our program and farmer and university partners. We believe it is possible to encourage innovation and receive fair returns on investments without giving away our genetic heritage and future. We are poised to release two new cultivars in 2015 under licensing agreements that adhere to the spirit of OSSI and serve as example language for other breeding programs.

In 2011, OSA published the following principles to guide actions that foster organic seed systems, including the development of IP models (Dillon and Hubbard, 2011):

- Seed is a limited natural resource that must be managed in a manner that enhances its long-term viability and integrity.
- The equitable exchange of plant genetics enhances innovation and curtails the negative impacts of concentrated ownership and power in decision making.
- The maintenance and improvement of genetic and biological diversity are essential for the success of sustainable food systems and greater global food supply.
- Farmers have inherent rights as agricultural stewards, including the ability to save, own, and sell seed, and are key partners in seed innovation.
- Public research should serve the public good and remain in the public domain.

With the help of a working group, we further identified key purposes of appropriate benefit-sharing IP models, which included the need to:

- Ensure open access to plant genetics to preserve and expand this invaluable resource.
- Improve availability, choice, and quality of cultivars, especially cultivars appropriate for organic systems.
- Support the viability of independent seed companies and individual plant breeders.
- Help overcome resource constraints and enable smaller entities to compete.
- Foster investments that further innovation in plant breeding, including fair compensation for plant breeding contributions.
- Meet the needs of participatory plant breeding projects.
- Encourage information sharing and coordination.
- Reverse problematic trends resulting from the patenting of plant genetics, including barriers to accessing genetics due to outright denial, cost, onerous licensing contracts, and fear of unintentional patent infringement.

We also concluded that appropriate IP models should have procedures to:

- Provide democratic management and an organized structure that encourages participation.
- Have a plan for dispute resolution.
- Acknowledge international context.
- Monitor progress and identify measurements of success.

A shared vision

Going back to the founding missions of our land grant universities and USDA, we need a significant shift in policy and mindset that recognizes seed as a public resource. Do we have to return to a time when most farmers saved seed and a third of USDA's budget went to the collection and distribution of seed? No, but we do need to recognize that seed demands careful management, and that it is best managed in the hands of many, not in the hands of few.

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