

Agricultural Biotechnology, Patent Law, and Equity

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Introduction

Biotechnology is a rapidly growing industry that continues to experience innovation after innovation to the point that laws and regulations struggle to keep up. Current regulatory frameworks tend to be outdated and do not cover the breadth that biotechnology now does, leaving gaps that may pose safety and equity concerns (Louwaars & De Jonge, 2021). As the reach of biotechnology is ever-expanding, this review paper will focus specifically on agricultural biotechnology, exploring issues surrounding intellectual property (IP) rights for genetically modified (GM) crops and equity for farmers. It is important to protect the patented crops and IP of private companies in order to maintain incentives for innovation; however, this protection has also posed myriad issues for the farmers that grow these crops (Louwaars & De Jonge, 2021; Lim, 2022; Jiang et al., 2025; Pandey, 2025; Hsu & Imamura, 2025). These issues range from limited access to new technologies to unwanted hybridization from neighboring fields growing GM crops (Louwaars & De Jonge, 2021; Lim, 2022; Jiang et al., 2025; Pandey, 2025; Hsu & Imamura, 2025). Issues go beyond monetary limitations and setbacks, however, as traditional agricultural practices, indigenous knowledge, and the cultures surrounding them are beginning to be overshadowed and replaced by the work of private seed companies (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025; Hsu & Imamura, 2025).

This review will begin by covering the history of seed distribution and how it evolved from being an integrated part of farming communities via seed sharing to being a role primarily dominated by private companies (Louwaars & De Jonge, 2021; Lim, 2022). From here, the patenting and IP protection of GM seeds by private companies will be discussed, with a primary focus on the relevant legal framework in the U.S. and the EU. This review will conclude with a discussion of the equity issues faced by farmers and policy changes proposed in a sample of

scholarly literature. With this, the main goal of this paper is to analyze the imbalance between incentivizing agricultural biotechnology innovation and protecting farmers' rights and traditions.

History of Seed Companies and Farming Systems

As described in detail by Louwaars and De Jonge (2021), early farmers would typically retain seed from their own harvests for replanting in the next season, with some exceptions for sharing with neighboring farms when a crop variety was faring better than others. Additionally, among the many niches that different farmers took on in their communities, some specialized in quality seeds (Louwaars & De Jonge, 2021). Although these seed-providing farmers typically did not rely on this craft for a living, some did eventually develop into larger seed companies (Louwaars & De Jonge, 2021). Farmers also had much greater public support from universities and government agencies such as the USDA and were regularly supplied with free seed (Louwaars & De Jonge, 2021; Lim, 2022). Despite this great foundation of a strong community and ample public support, it had its drawbacks. Not all seeds were easy to come by, with some crops requiring over a year to set seed—a timeframe that many farmers could not afford. This is where more specialized seed providers would fill in the gaps for crops that were trickier to obtain seed from (Louwaars & De Jonge, 2021). Once these seed providers became established, the government stopped freely distributing seeds to farmers, and a shift to privatized seed distribution occurred (Louwaars & De Jonge, 2021; Lim, 2022). Research by public universities began to skyrocket as the Bayh-Dole Act of 1980 established patenting rights for their government-funded research (Lim, 2022). This, however, caused the last public distributors of seeds to fade away as these universities began to opt for collaboration with agricultural biotechnology companies and relinquish rights in exchange for greater investment into research and development (Lim, 2022).

Legal Frameworks Regarding Agricultural Biotechnology IP

With patents and IP comes a great need for protection from infringement. In the U.S., there is the Plant Patent Act of 1930 and the Plant Variety Protection Act of 1970, which initially allowed the patenting of plants and their propagating tissues (Lim, 2022). Then there was the court decision for *Diamond v. Chakrabarty* in 1980, which declared that GM organisms were patentable within the U.S., including GM crops and seeds (Jiang et al., 2025). With the wave of patented GM seeds that began sale on the market, there also began to be conflict between companies and farmers, sparking some key court cases and precedents. *Bowman v. Monsanto Co.* in 2013 led to a court decision that declared that farmers would be infringing on patent rights and violating the license agreement for using GM seeds by saving and replanting seeds from patented crops (Lim, 2022). Although patent rights may be exhausted after the sale of the physical seed, they are not exhausted with respect to the traits inserted by agricultural biotechnology companies. Furthermore, in 2017, *Impression Products, Inc. v. Lexmark International Inc.* brought about a court decision that expanded patent exhaustion to international sales as well (Lim, 2022). Despite the *Lexmark* decision holding that companies cannot continue to restrict the use of patented goods after sale and granting some level of autonomy to farmers, this does not apply to the reproduction of genetic traits through farmers' saving and replanting of GM seeds (Lim, 2022).

These are the major laws and court cases that define the legal framework for the protection of patents and IP from reproduction by farmers in the U.S. Essentially, farmers are not allowed to replant seeds collected from protected GM crops, regardless of whether the farmer cultivated the crop or not. If the seeds contain traits inserted by an agricultural biotechnology company, it would be seen as illegally reproducing the patented product by replanting, and companies can

pursue legal action against farmers (Louwaars & De Jonge, 2021; Lim, 2022; Jiang et al., 2025; Pandey, 2025; Hsu & Imamura, 2025). There are also similar legal frameworks in place in the EU that prevent the replanting of patented seeds (Jiang et al., 2025). Patent holders' rights are codified and protected by the European Patent Convention (EPC) as well as similarly restrictive licenses attached to patented seeds (Jiang, 2025). Community Plant Variety Rights (CPVR) grant a level of autonomy to farmers by protecting their privilege to replant crops; however, this does not apply when crops are patented (Jiang, 2025). Additionally, under CPVR exists a breeder's exemption, which allows for the use of patented and protected crop materials in breeding efforts without the authorization of the patent holder or owner. However, this does not apply to farmers as their use is considered commercial and for-profit (Jiang et al., 2025).

Impact on Farmers

As mentioned previously, farming systems were originally community-based and supported by public sources (Louwaars & De Jonge, 2021; Lim, 2022). With the privatization of seed distribution, it has become more common for farmers to purchase their seeds rather than save and replant them. However, as these private companies have grown, so has their control over the seed industry, and farmers have begun to have fewer choices when it comes to purchasing seeds (Louwaars & De Jonge, 2021; Lim, 2022). After the court ruling in *Monsanto v. Bowman*, the long-established farmer's right to replant seeds has become null for patented seeds, leading to farmers facing legal action for practices that had once been second nature (Lim, 2022). Both consolidation of the seed industry and extensive patent protection contributed to a sharp increase in prices, with some staple GM crops seeing particularly steep price increases (Hsu & Imamura, 2025). Farmers have little power to negotiate prices and are forced to pay these prices annually if

they want to have seed for the next planting season (Lim, 2022; Pandey, 2025; Hsu & Imamura, 2025).

Farmers still have the option to use non-patented varieties of seed and can continue small-scale plant breeding; however, these methods typically cannot keep up with GM crops when it comes to adapting to climate change and needs for greater crop yields (Louwaars & De Jonge, 2021).

With the lack of local plant breeding and seed sharing, which are key aspects of traditional farming systems, there are beginning to be concerns over biodiversity (Louwaars & De Jonge, 2021; Pandey, 2025; Hsu & Imamura, 2025). The mass-produced patented GM seeds tend to be uniform and not adapted to local climates, decreasing the amount of natural genetic outcrossing possible (Louwaars & De Jonge, 2021). Traditional farming systems were built over generations of combined knowledge specific to their region and community needs (Lim, 2022). This knowledge is now being abandoned in favor of using new GM crops that cannot outcross without risk of legal action (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025; Hsu & Imamura, 2025).

When it comes to navigating legal frameworks surrounding GM seeds, farmers are disadvantaged as they can be unaware of the implications of purchasing patented seeds. Some farmers may lack legal literacy and fail to fully understand the limitations imposed by acquiring a license to plant patented seeds (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025; Hsu & Imamura, 2025). Because of this, farmers may enter contractual agreements that prohibit replanting saved seeds without realizing, exposing them to the risk of lawsuits (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025; Hsu & Imamura, 2025). Intent to reproduce patented seeds is not necessary for agricultural biotechnology companies to pursue legal action—the accidental planting of their seeds without authorization can be similarly prosecuted (Louwaars &

De Jonge, 2021; Lim, 2022; Pandey, 2025). As Lim (2022) describes, contamination of fields by GM crops can occur via sharing farm equipment and even airborne pollen—known as drift. When implicated by these events, farmers are required to prove they did not intentionally reproduce patented seeds, often leading to a battery of genetic tests to ensure their fields do not contain GM crops (Lim, 2022; Jiang et al., 2025). This only adds financial burden to farmers who may not even want to cultivate GM crops to begin with.

Possible Next Steps

All referenced scholarly sources repeated the same sentiment: there needs to be a balance between incentivizing innovation in agricultural biotechnology and equity for farmers in this new landscape. There is agreement on the importance of promoting further innovation by maintaining IP protections and enforcing patent law as this is necessary for agricultural biotechnology companies to recoup their investments and fund new projects. Additionally, these sources recognize the need to treat farmers with equity so they can maintain autonomy and their traditional farming systems without falling victim to unexpected and unfair legal action (Louwaars & De Jonge, 2021; Lim, 2022; Jiang et al., 2025; Pandey, 2025; Hsu & Imamura, 2025).

Louwaars and De Jonge (2021) primarily advocate for diversity and inclusion through measures such as Integrated Seed Sector Development (ISSD). This would ensure that farmers and their knowledge are included in discussions about policy development, allowing for greater diversity and inclusion in future decisions (Louwaars & De Jonge, 2021). Lim (2022) also suggests policy reforms to lessen the legal and monetary burdens imposed on farmers. This includes shifting the burden of mitigating contamination of patented seeds to the agricultural biotechnology companies and allowing farmers who become subject to contamination to sue (Lim, 2022). He

also suggests maintaining the policy on patent exhaustion for international sales as well as better implementation of antitrust law to prevent companies from monopolizing patents (Lim, 2022).

Pandey (2025) emphasizes the adoption of new technology with a focus on sustainability, suggesting that farmers, agricultural biotechnology companies, and policymakers collaborate so that policy becomes more effective and inclusive. Hsu and Imamura (2025) do not provide detailed suggestions for policy reform and instead primarily advocate for greater education for farmers and small-scale breeders on IP and patent laws. This would enable farmers to better protect themselves against unwanted licensing agreements and breeders to better protect their IP. Finally, Jiang et al. (2025) suggest the implementation of patent clearing platforms and other publicly accessible systems to promote transparency. These systems would simplify farmer and breeder navigation of crops with stacked patented traits on top of other balancing efforts, such as the use of compulsory licensing to promote access to patented plants (Jiang et al., 2025). Though their writing is focused on patent and regulatory issues in the EU, they are parallel to issues being faced in the U.S. and should be taken into consideration.

Conclusion

Over the years, agricultural systems have evolved from being rooted in close-knit communities to being divided between farmers and large agricultural biotechnology companies (Louwaars & De Jonge, 2021; Lim, 2022). With the rise of agricultural biotechnology came genetically modified crops and a desire to protect them as intellectual property. Implementing patent rights on GM crops allowed companies to receive a return on their investment that they could reinvest into future research. However, this directly conflicted with the traditional agricultural practice of saving seeds from one season's harvest to use in the next planting (Louwaars & De Jonge, 2021; Lim, 2022; Jiang et al., 2025; Pandey, 2025; Hsu & Imamura, 2025). By saving seeds from

patented crops, farmers found themselves facing legal action and lawsuits from large agricultural biotechnology companies—whether they propagated the seeds intentionally or accidentally (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025). In order to prevent farmers from being unfairly burdened by monopolistic patents and aggressive enforcement of IP rights, and to maintain incentives for innovation by agricultural biotechnology companies, a balance must be found in policy. Scholarly sources all recognize this idea and provide myriad suggestions for how to achieve this balance. Solutions range from providing better education for farmers on legal topics to incorporating inclusive frameworks such as ISSD to ensure the equal recognition of traditional farming systems and emerging innovative systems (Louwaars & De Jonge, 2021; Lim, 2022; Pandey, 2025). It will be key to conduct further investigation into the international impacts of these patent laws and explore broader pathways to ensure farmers across the globe are treated with equity.

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