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Chapter Authors: Petra Moser, Paul W. Rhode

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8

Did Plant Patents Create the American Rose?

Petra Moser and Paul W. Rhode

In 1930, the US Congress established the first intellectual property rights (IPRs) for living organisms. With the Plant Patent Act (PPA) it created patent rights to prevent the replication of genetic materials through roots and cuttings (rather than seeds). Breeders of such "asexually-propagated" plants, including fruit trees and roses, argued that they needed IPRs to recover large development costs. By creating IPRs, the US government hoped to encourage domestic innovation and the development of a domestic plant breeding industry.

This chapter uses historical data on patents and registrations of new plant varieties to examine the effects of the Plant Patent Act on biological innovation. Evidence on a later Act, the Plant Variety Protection Act (PVPA) of 1970, is mixed. The PVPA complemented the PPA by extending IPRs to plants that reproduce "sexually" through seeds, such as wheat, soybeans, or cotton. Survey results suggest that it encouraged research expenditures and "stimulated the development of new varieties of wheat and soybeans" (Butler and Marion 1985; Perrin, Kunnings, and Ihnen 1983). Most of these increases in research investments, however, came from the public sector, and there is little evidence that crops, and specifically wheat, performed

Petra Moser is assistant professor of economics at Stanford University and a faculty research fellow of the National Bureau of Economic Research. Paul W. Rhode is professor of economics at the University of Michigan and a research associate of the National Bureau of Economic Research.

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better after 1970 (Alston and Venner 2002).[1] For cotton, on the other hand, changes in acreage and in the variety of cotton crops suggest a positive effect of IPRs (Naseem, Oehmke, and Schimmelpfennig 2005).

The small number of patents for crop plants, such as fruit trees and vines, suggest that the effects of the PPA on commercial agriculture were limited: "The great hopes for agriculture have not been realized" (Daus 1967, 394). For the rose industry, however, observers noted that "the Plant Patent Act cannot be deemed unsuccessful" (Daus 1967, 389).

Nearly half of 3,010 plant patents granted between 1931 and 1970 were for roses. Large commercial nurseries, which began to operate extensive mass hybridization programs in the 1940s and 1950s, account for most of the plant patents, suggesting that the creation of IPRs may have helped to encourage the creation of a domestic US rose industry (e.g., Harkness 1985). Industry experts, however, cautioned that [p]atented roses have not lived up to expectations" (Swecker 1944, 120). A potential explanation for the discrepancy between the large number of rose patents and the disappointment about the PPA is that breeders may have used plant patents strategically to protect themselves from litigation (e.g., Kile 1934), so that increases in patenting do not reflect increases in innovation. To separate changes in strategic patenting from changes in innovation, we collect data on registrations of new rose varieties as an alternative measure of innovation.

Registration data show that US breeders created *fewer* new varieties after 1930 compared with before. European breeders continued to create most roses after 1930, and only one American breeder was among the ten breeders with the largest number of registrations. The data also show that only a small share of newly-developed roses—less than one in five—were patented.

Notably, some of the most prominent American roses were based on European roses that US nurseries had begun to license and propagate during World War II. At a time when plant patents strengthened incentives to invest in R&D, US nurseries also benefited from demand shocks as a result of World War II when European supplies were cut off and US breeders began to grow and improve roses that had been developed abroad.

8.1 The Plant Patent Act of 1930

Although Congress had discussed IPRs for plants as early as 1885, it took food shortages during World War I and demands from the farm bloc states

1. Instead of arguing that IPRs failed to encourage innovation, Alston and Venner (2002) conclude that an exemption of the PVPA, which allows farmers to copy seeds for their own use, weakened breeders' ability to appropriate the returns of R&D. Another factor is that IPRs may have limited effects on crops that can be protected through secrecy (e.g., Moser, forthcoming). Secrecy is particularly effective to protect innovations in hybrid seeds whose desirable characteristics cannot be replicated by replanting the improved seeds. Analyses of certificate data indicate that breeders of hybrid corn were reluctant to use IPRs (Janis and Kesan 2002; Dhar and Foltz 2007).

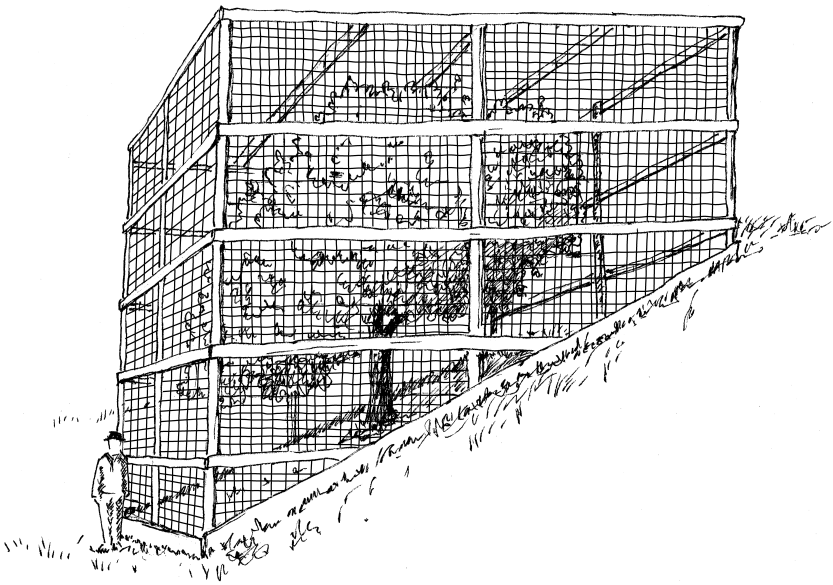

Fig. 8.1 A cage that Stark Brothers built around its *Golden Delicious* apple
Notes: The cage was built around the Stark Brother's *Golden Delicious* tree to prevent competitors from stealing shoots of the tree; it was equipped with an alarm. Drawing based on Rossman (1930, 395).

to "place agriculture on a basis of economic equality with industry" to create sufficient pressure for legislative action (Kloppenburg 2004, 132; US House 1906, 6–7; Olmstead and Rhode 2000). Breeders of roses and fruit trees, such as Paul Stark of Stark Brothers Nursery, were the driving force behind the PPA (Fowler 2000, 628–35; Kevles 2008, 210–12, Terry 1966, 30–34). In the absence of IPRs, Stark Brothers had taken desperate measures to protect agricultural innovations. In the mid-1910s it built a large cage, armed with a burglar alarm, to prevent competitors from stealing cuttings of the first *Golden Delicious* apple tree (fig. 8.1; Rossman 1930, 394–95; Terry 1966, 48). Another large nursery, Jackson and Perkins, advised Congress in May 1930 that the plant patent legislation was "of very great importance to the agricultural and horticultural interests of the United States" and would provide "wonderful stimulus" (*Congressional Record,* 71st Cong., 2nd Sess. May 12, 1930, 8751).[2] Thomas A. Edison (1847–1931) supported the Act in congressional debates:

> Nothing that Congress could do to help farming would be of greater value and permanence than to give the plant breeder the same status as

2. In the 1950s and 1960s roses accounted for 15 to 20 percent of US nursery sales, which includes other ornamental plants and fruit trees.

> the mechanical and chemical inventors now have through the patent law. (US House 1930, 2–3)

Edison had been a close friend of Luther Burbank (1849–1926) an American breeder who had developed more than new 800 plant varieties (Smith 2009, 308–309). Edison observed that at present "there are but few plant breeders" and that patents would "give us many Burbanks."[3] When Fiorello ("Little Flower") LaGuardia remarked that "Luther Burbank did very well without protection" (*Congressional Record,* 71st Cong., 2nd Sess. May 5, 1930, 8391), supporters of the Act presented a letter from Burbank to Paul Stark:

> A man can patent a mousetrap or copyright a nasty song, but if he gives to the world a new fruit that will add millions to the value of earth's annual harvest he will be fortunate if he is rewarded by so much as having his name connected with the result. (US House 1930, 11)

The Plant Patent Act passed in the House on May 13, and President Herbert Hoover signed it into law on May 23 (Allyn 1944, 13, Appendix A). In its final report, Congress emphasized the importance of intellectual property rights in the absence of alternative mechanisms:

> To-day the plant breeder has no adequate financial incentive to enter upon his work. A new variety once it has left the hands of the breeder may be reproduced in unlimited quantity by all. The originator's only hope of financial reimbursement is through high prices for the comparatively few reproductions that he may dispose of during the first two or three years. After that time, depending upon the speed with which the plant may be asexually reproduced, the breeder loses all control of his discovery. (US House 1930, 10–11)

By creating intellectual property rights the government hoped to attract private investments in R&D and support the creation of a commercially viable domestic plant breeding industry.

> To-day plant breeding and research is dependent, in large part, upon Government funds to Government experiment stations, or the limited endeavors of the amateur breeder. It is hoped that the bill will afford a sound basis for investing capital in plant breeding and consequently plant development through private funds. (US House 1930, 10)

3. Edison had entered the field of experimental plant breeding when he was trying to increase the rubber content of goldenrod, a golden yellow American flower. Edison's experiments produced a 12-foot tall plant that yielded as much as 12 percent of especially resilient and long-lasting rubber, which Edison used to build tires for his own Model T. Although Edison had turned his research over to the US government in 1930, goldenrod rubber never went beyond the experimental stage (Rossman 1930, 394–95).

8.1.1 IPRs under the Plant Patent Act of 1930

To protect the property rights of private investors, the PPA granted seventeen years of exclusive rights for new varieties of asexually propagated plants—plants that reproduce by roots, shoots, or buds. Sexually propagated plants were excluded after plant scientists of the American Society of Horticultural Sciences argued that the characteristics of new varieties would not be genetically stable. Paul Stark of Stark Brothers Nursery recalled that "it was clearly evident that no Plant Patent bill could be passed that included sexually propagated plants" (US Senate 1968, 863).[4] The Act also excluded edible tubers—such as potatoes—possibly to prevent private firms from holding monopoly rights over vital US food supplies (Allyn 1944, 34).[5]

Compared with other types of patents, plant patents are narrower in scope (Daus 1967, 392). Similar to drug patents that cover a single molecule, plant patents cover only the asexual reproduction of an individual plant grown in cultivation; they do not cover the seeds of the new plant, or other plants with the same characteristics. Grant rates, measured as patent grants over publications, are higher for plant patents than for other types of IPRs. Thus, 92 percent of applications between 1961 and 1965 were accepted by the United States Patent and Trademark Office (USPTO) (576 grants over 628 applications), compared with 59 percent for utility patents and 55 percent for design patents (Daus 1967, 392). Plants did not have to be "useful" to be patentable (Allyn 1944, 13–14).

In principle, asexually-propagated plants have to be new, distinct, and not found in the wild to be patentable; in practice, however, sports—random bud variations that can be found in a nursery, a garden, or in the wild—were frequently patented.[6] The *Briarcliff* rose, for example, which was not patented, yielded seven sports that were patented; *Talisman* yielded fourteen sports that were patented.[7] Two sports of Talisman, *Souvenir* (PP [plant patent] 25) and *Mrs. Franklin D. Roosevelt* (PP 80) produced six sports, and every one of them was patented. A sport of *Briarcliff* called *Better Times* (PP23)

4. Although the American Seed Trade Association wanted IPRs, Stark convinced them that the time was not ripe: "It seemed to be the wise thing to get established the principle that Congress recognized the rights of the plant breeder and originators. Then, in the light of experience, effort could be made to get protection also for seed propagated plants which would be much easier after this fundamental principle was established" (Fowler 1994, 82–84 citing the American Seed Trade Association, 1930 Proceedings, 66). Stark's lobbying efforts cost the American Association of Nurserymen about $12,000 in 1930 ($130,000 in 2009 purchasing power; White 1975, 132).

5. Another argument against patents for tubers was that infringements are difficult to prove for tubers, so patent rights would be difficult to enforce (US Senate 1968, 863).

6. Even though the USPTO was officially in charge of determining whether a plant was "new and distinct," the PPA allowed it to seek advice from the US Department of Agriculture (USDA).

7. *Talisman* was the offspring of *Ophelia,* introduced in 1912, which was prone to mutation and produced more than 20 sports (McFarland 1947, 191–92).

yielded thirteen sports; the USPTO patented all of them. At least one of these sports (PP452) yielded yet another generation of patented roses (Allyn 1944, 31, 50; and Fowler 1994, 86–88).

In 1954 the USPTO ruled that "mere fortuitous finds" such as mutant seedlings were not patentable, but Congress quickly amended the law to include "chance seedlings producing distinct new plants, whether found in cultivated or uncultivated states" (White 1975, 133, 256–57; Alston et al. 2010, 212).

In principle, the PPA also excluded plants that had been introduced or sold to the public more than two years before the patent application; in practice, however, most of the plants patented by 1934 were developed before 1930.[8] In 1944, the patent attorney Robert Starr Allyn observed that "many of the patents thus far issued appear to be invalid" and at least 61 of 610 plant patents granted by 1943 had been developed before 1930 (Allyn 1944, 57). Most notably, nursery stock was exempt from the rule of prior use.

Patent examiners were especially lenient in granting patents for nursery stock that Luther Burbank had developed with financing from Stark Brothers and that was owned by Stark Nurseries after his death (Allyn 1944, 54). In 1933 alone, the USPTO granted nine patents to Burbank's estate, including two for roses (PP65 and 66, *Burbank's Apple Blossom* and *Burbank's Golden Sunset*), four for plums, two for peaches (PP12, 13, 14, 15, 16, and 18), and one for a new variety of cherry (PP41). As late as 1937 and 1938, the USPTO granted PP235 for *Burbank's Golden Comet* (in 1937) and PP266, PP267, and PP269 for *Burbank's Copper Climber, Burbank's Snow White Climber,* and *Burbank's Dawn Glow* (in 1938). None of these posthumously patented roses became commercially important (Terry 1966).

8.2 Most Early Plant Patents Were Roses

On August 31, 1931, the Patent Office granted the first plant patent (PP1) to Henry F. Bosenberg, a New Jersey gardener (figure 8.2) for *New Dawn,* a continuously blooming bud variant of a disease-free and vigorous climbing rose that he selected and propagated (*Journal of Heredity,* 1931, 313–19).[9] Four additional patents were granted in 1931: two for roses, one for a dewberry, and one for a new variety of carnation.[10]

8. Allyn 1944, 55. The principle of excluding plants that had been introduced before the Act was affirmed in *Cole Nursery Co. v. Youdath Perennial Garden* (1936) over a potential infringement of PP110, the Horvath Barberry plant. Judge Paul Jones invalidated PP110 because the Horvath plant had been produced in the winter of 1923–1924. By 1943, the exclusion period had been reduced to one year.

9. *New Dawn* was nearly identical to a climbing rose that Van Fleet had discovered in his work at the USDA, but this older rose bloomed once a year (a dominant trait caused by a single gene) while *Bosenberg's New Dawn* bloomed continuously throughout the year (following the recessive trait, Kile 1934, 59–61).

10. Throughout the 1930s the average lag between application and grant was 321 days (calculated from data in "Die amerikanischen Pflanzenpatente," *Wirtschaftlicher Teil,* 1931–1939).

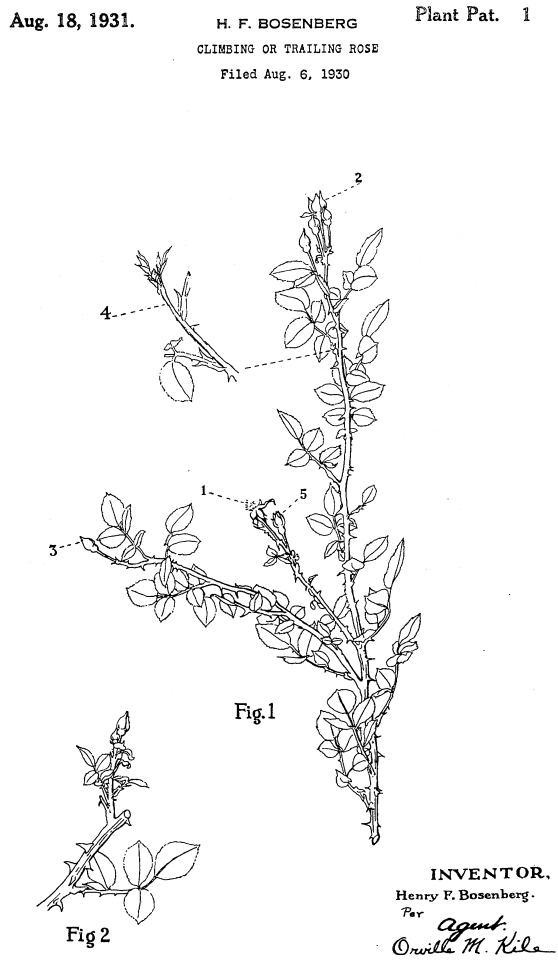

Fig. 8.2 Plant patent USPTO PP1

Notes: The first plant patent was granted to Henry F. Bosenberg on August 18, 1931, for a climbing or trailing rose that he observed in the wild. Bosenberg's rose, which became known as *New Dawn,* was a sport—a random bud variation—of another rose that Walter Van Fleet had developed before 1922. Image from the United States Patent Office (www.uspto.gov).

Between August 1931 and April 1, 2009, a total of 19,973 plant patents were granted in the United States. From 1931 to 1940 the number of plant patents per year increased from five to nearly ninety (figure 8.3); with the

More generally, the lag between a patent application and a patent grant varies with the complexity of the patent and the workload of the examiners (Popp, Juhl, and Johnson 2004). For utility patents in the chemical industry in the 1930s, the lag between patent grants and patent applications was between two and three years (Moser and Voena, forthcoming); for utility patents of sewing machines in the 1870s, the lag was 140 days (Lampe and Moser 2010).

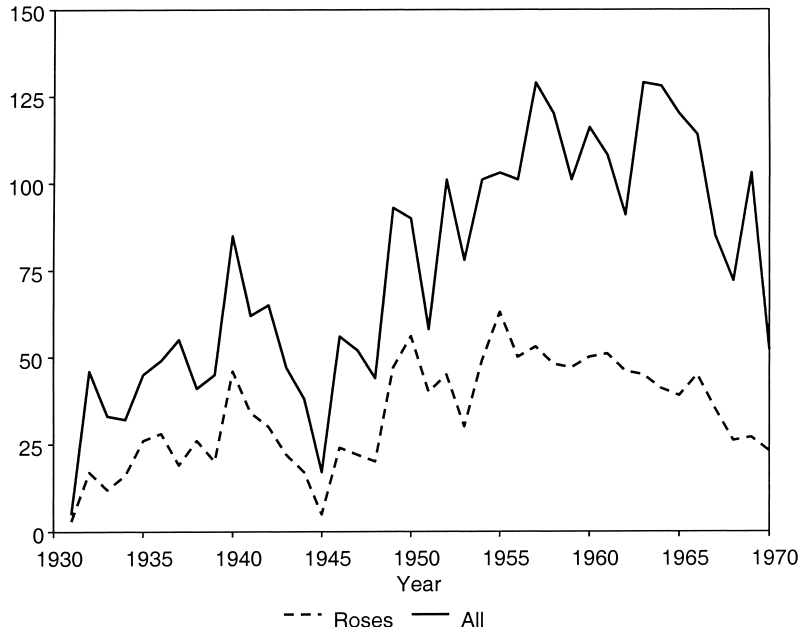

Fig. 8.3 Plant patents per year, 1931–1970
Notes: Plant patents from the USPTO *Patent Statistic Reports* (available at www.uspto.gov).

advent of World War II, patents per year fell to fewer than twenty in 1945; after the war, plant patents recovered to 120 in 1957. By 1970, the annual number of plant patents declined to fifty-two.

Nearly 45 percent of all patent grants between 1931 and 1970 were for roses. The share of rose patents was highest in the 1930s and 1940s; 295 of 592 plant patents between 1930 and December 8, 1941, were for roses (figure 8.3). During the war, rose patents declined, reaching a low of four patents in 1945. After the war rose patents recovered, reaching nearly 70 patents in 1955. After 1955, the number of rose patents per year began to decline gradually, while the number of other plant patents stayed roughly constant.

Information on the names of patentees ("originators") from the patent documents reveals that all of the top ten patentees were connected with major companies (table 8.1). Eugene S. Boerner (no. 1) was the single originator on 170 patents between 1940 and 1970; he worked for Jackson and Perkins (J&P) for his entire career from 1920 to 1973 and assigned most of his patents to J&P. Herbert C. Swim (no. 2), whom his colleagues called "the best hybridizer of them all," (McGredy and Jennett 1971, 65) appears as an originator on 115 patents, and as a sole originator on 76 patents. Swim

Table 8.1 **Breeders with the largest number of US plant patents, 1931–1970**

Breeder	Years of professional activity (years of patenting)	Nursery/common assignee	Patents		
			All	Single-authored	Weighted
Eugene S. Boerner (1893–1966)	1943–1973 (1940–1970)	Jackson & Perkins	170	170	170
Herbert C. Swim	1941–1982 (1940–1983)	Armstrong, Conard-Pyle, Weeks	115	76	95.5
Roy L. Byrum	1930–1974 (1935–1974)	Hill	54	53	53.5
Josephine D. Brownell	1940s and 1950s (1932–1955)	Brownell Nurseries	50	49	49.5
Ralph S. Moore (1907–2009)	1927–2008 (1948–2008)	Sequoia Nursery	49	49	49
Francis Meilland (1912–1958)	1912–1958 (1912–1958)	Conard-Pyle	42	42	42
Walter E. Lammerts (1904–1996)	1940–1974 (1943–1972)	Armstrong, Germains, De Vor	37	37	37
Dennison H. Morey (d. 2000)	1957–1980 (1958–1967)	Jackson & Perkins	29	29	29
Frederick H. Howard (ca. 1874–1948)	1916–1956 (1932–1949)	Howard & Smith	26	26	26
Marie Louise Meilland	1958–1994 (1958–1990)	Conard-Pyle	23	23	23

Notes: Breeders' names are collected from the full text of patent documents at www.uspto.gov. Years of professional activity are measured by the years when a breeder registered new roses according to a directory of roses at www.helpmefind.com.

changed his employer several times, which may have lowered his productivity as a breeder. "Now to leave a company . . . is a disaster for a hybridist, because the breeding stock, the roses he selected and grown to provide pollen and seed, does not belong to him and he has to leave it behind and start again" (McGredy and Jennett 1971, 65). Roy L. Byrum (no. 3) was an associate of the Joseph H. Hill Company of Richmond, Indiana. Josephine D. Brownell (no. 4) of Little Crompton, Rhode Island, one of the earliest and most prolific female patentees of plants, was married to the owner of Brownell Nursery. Brownell created two tea roses (PP347 and 458) that were continuously blooming, winter-hardy, and resistant to wilt and black rust (Stanley 1993, 37). Ralph Moore (no. 5), known as the father of miniature roses, was a co-owner of Sequoia Nursery in California; Francis and Marie-Louise Meilland (nos. 5 and 10) owned the leading French firm, which often partnered with Conard-Pyle.

8.2.1 Large Nurseries Drive the Increase in Patenting

Prolific patentees, such as Gene Boerner and Herbert Swim, assigned most of their patents to large nursery firms. For the late nineteenth century, such assignments, which typically transfer patent rights from the inventor to a firm that markets the invention, have been interpreted as a sign of improvements in markets for patented inventions (e.g., Lamoreaux and Sokoloff 1999). In the twentieth century, however, US laws effectively forced employees to assign inventions to their firm (Fisk 1998, 2001), so that assignments are a more accurate measure of the share of inventions that occurs within firms.

Assignment data indicate that commercial breeders account for a disproportionate share of rose patents. Between 1931 and 1970, 77 percent of all rose patents were assigned at issue, compared with 58 percent of other plant patents.[11] For example, Bosenberg assigned the rights to PP1 for *New Dawn* to Louis Schubert, who began to market the rose through the Somerset Rose Nursery. Similarly, Robert L. Catron assigned the rights to PP23 for *Better Times* to his employer, the Joseph H. Hill Company, which developed *Better Times* to become "the backbone of the U.S. cut rose industry until the late 1940s" (Hasek 1980, 84).

Assignment data also suggest that the increase in patenting until the mid-1950s was driven by commercial breeders. Between 1931 and 1943, the share of assigned rose patents increased from 33 to 82 percent (compared with 40 percent of other plant patents in 1943). Between 1943 and 1962, the share of assigned rose patents remained above 80 percent for most years. After

11. In comparison, assignment rates in a sample of Connecticut patents increase from only 1 in 454 patents between 1837 and 1851 to 1 in 3 patents by 1876 (Moser, forthcoming). Of 1,341 roses patented between 1931 and 1970, 1,033 were assigned at issue; 714 were assigned across state lines.

1962, the share of assigned rose patents dropped to 56 percent, while the share of other plant patents assigned at issue continued to increase.

8.3 A Brief History of Commercial Rose Breeding

The importance of patents for commercial rose breeding may be due to two characteristics that rose breeding shares with pharmaceuticals: in both industries, the costs of developing new products are high relative to the costs of imitation, and only a small number of new products become commercially successful.

The origins of commercial rose breeding date back to early nineteenth century when European merchants brought back Chinese "tea roses" from Asia. European breeders began to cross winter-hardy European roses, which produced clustered short-bloomed pink or red flowers, with Chinese tea roses, which produced stems with one large bloom in white, pink, red, and even the rare yellow for several months (Stewart 2007, 128). By the 1840s, French breeders succeeded in creating roses that bloomed repeatedly through the summer and fall (Zlesak 2007, 271–72). In 1867, Jean-Baptiste Guillot of Lyon, France, introduced *La France,* the first modern "hybrid tea rose"—a plant with a tall stature and only one large bloom per stem (Harkness 1985, 11–20; Zlesak 2007, 697). Breeders relied on pollination by wind or insects, and many new varieties originated from self-pollinating roses.

Scientific methods of rose breeding began in Stapleford, England, in 1868, when the cattle farmer Henry Bennett took pollen from one rose to fertilize the carpel (the seed-bearing receptive surface) of another rose. Bennett set up a scientific breeding station in a heated green house. Similar to Stark Brothers, Bennett relied on secrecy to protect his work: "self-interest compels me for the present to keep secret" this "entirely new mode of culture" (Harkness 1985, 24–25). Borrowing a term from cattle breeding, Bennett promoted his roses as "pedigree" hybrids of the *tea rose* (Harkness 1985, 27). In 1884 he sold the red *William Francis Bennett* for the equivalent of $109,000.[12]

Using Bennett's methods, twentieth century breeders created *polyantha,* short plants with large sprays of small blooms, *floribunda,* medium stature plants with large clusters of medium-sized blooms, and *grandiflora,* tall plants with small clusters of medium to large-sized blooms (Harkness 1985; Zlesak 2007, 699). Today, tea roses are the mainstay of the cut flower business, while roses of all types (*hybrid teas, polyantha, floribunda, grandiflora,* climbers, and miniature roses) are marketed as garden roses.

12. In 2009 purchasing power, using the GDP deflator, www.measuringworth.com.

8.3.1 Hobbyists and Public Sector Breeders Created High-Quality Roses before 1930

Prior to 1930, hobbyists and public sector researchers created a large number of new varieties in the United States. Walter Van Fleet (1857–1922), for example, improved *Rosa Rugosa* and other wild roses to create hardy climbing roses that could withstand the climate of the American Northeast. Van Fleet had left his medical practice in the late 1900s to work as a hybridizer for the US Department of Agriculture (USDA). In 1919 the Massachusetts Horticultural Society honored him with the George Robert White Medal of Honor "for advance in the hybridization of garden plants, especially of the rose"; the name "'Van Fleet' is synonymous with meritorious climbing roses of American origin" (*Journal of Heredity,* vol. XI, 1920, 95–96, also *New York Times,* January 28, 1922).

Van Fleet roses such as *Rugosa Magnifica, American Pillar, Beauty of Rosemawr,* and *Silver Moon* continue to be considered "the best in the world" (Griffin Lewis 1931, 135). *Rugosa Magnifica,* for example, is rated 9.0 out of 10 by members of the American Rose Society, placing it in the top percentile. Van Fleet's rose *Silver Moon* is rated 7.8 (in the upper range "of a very good to solid rose," compared with an average of 6).[13] Bosenberg's *New Dawn* was based on a sport of a Van Fleet rose; it is rated 8.5 ("a very good to excellent rose, recommended without hesitation," American Rose Society 1999, 3).

Van Fleet and other public sector hybridizers helped to spread scientific knowledge about rose breeding among hobbyists. Van Fleet published his "Rose Breeding Notes" in the *American Rose Annual* between 1916 and 1922. George C. Thomas, of the Society in Southern California, argued that any serious rose gardener should try to hybridize roses: "No other form of rose-culture is so intriguing as breeding new varieties. It involves but little expenses, and no more than reasonable effort . . . Anyone who has the smallest of greenhouses is foolish not to hybridize roses inside" (Thomas 1931, 33–38).

Hobbyist rose breeders shared their advances freely "over the fence" (Ross 1994). In fact, one of the main goals of the American Rose Society (ARS) was to encourage the diffusion of new roses. In the 1920s, for example, ARS began to encourage the diffusion of Van Fleet's "superb creations" (McFarland 1920, 30–31; Pyle 1921, 32–34).

Commercial nurseries continued to overlook infringements by hobbyists (Swecker 1944, 122).[14] Today, enthusiasts for "old" roses (developed

13. Ratings between 8.8 and 9.2 are granted to the top 1 percent of all roses, with "major positive features and essentially no negatives." Rankings are available at Rose Files: http://rosefile.com/Tables/xVanFleet.html.

14. The PPA includes no fair use provision, which, in the case of utility patents, allows for noncommercial applications.

before the introduction of *La France* in 1867) are especially passionate about diffusing knowledge of newly-recovered varieties. For example, Carl Cato of the Heritage Rose Society

> [B]elieves sincerely in the fellowship that this organization espouses. He's a skilled propagator, and has helped return a number of roses to the nursery trade, but when I met him he was very definite about the fact that had never sold a rose; he had given them all away.[15]

In addition to the desire to disseminate knowledge, the costs of patenting may have discouraged hobbyists from patenting. Patent fees for plant patents were around $200 in the 1930s (equivalent to $2,150 in 2009 purchasing power, using the GDP deflator), including filing and grant fees of $30 each (equivalent to $322 in 2009 purchasing power, *New York Times,* April 19, 1936; January 10, 1938). Plant patents were, however, cheaper than utility patents, with application fees around $500 a year (in 2009 dollars) in 1930 (US House Report No. 96-1307, 96th Cong., 2d Sess. (1980); Fisher 1954; Watson 1953).

8.3.2 Commercial Rose Breeding Involves High Development Costs

In contrast to hobbyists, commercial breeders had lobbied for patents and began to use them swiftly to discourage competitors from propagating new varieties (McGredy and Jennett 1971, 14, 26–27, 60–86). Infringement suits typically involved commercial growers. For example, *Cole Nursery Co. v. Youdath Perennial Garden* (1936), *Kim Bros. v. Hagler* (1958), *Pan-American Plant Co. v. Matsui* (1977), and *Imazio Nursery, Inc. v. Dania Greenhouses* (1995) were disputes among nurseries.

When lobbying for patents, commercial breeders had cited exorbitant development costs. Developing a new rose took up to twelve years, and less than 1 in 1,000 seedlings proved commercially successful (Robb 1964, 389; Stewart 2007, 131). Current methods of commercial rose breeding apply Bennett's process: breeders extract pollen from one flower to fertilize another and create a hybrid seed (de Vries and Dubous 1996, 241); after that, they propagate seedlings by budding or cuttings to create thousands of plants. Breeders, then, select plants with desirable characteristics, such as an intense color or smell, or a specific shape, and propagate them to create the next generation of roses.

This process favors large commercial nurseries that can grow many seedlings at a time.[16] Boerner, for example, created more than 250,000 crosses per year in the 1940s and 1950s as the chief breeder for J&P (Harkness 1979, 117; Harkness 1985, 74; Beales 1998, 677). By 1945, "all the large rose producers

15. Christopher (1989, 33; also see 36, 66, 84, 18, 203, and 211).

16. Selecting new plants from random bud variations would be less costly but sports with desirable properties are rare and must be noticed, selected, and systematically propagated to become commercially viable (Terry 1966, 1).

have their own research departments with a staff of scientifically trained personnel" (Sinnock 1945, 96).[17]

Large producers, such as J&P, Conard-Pyle, Stark Brothers, DeVor, Weeks, and Hill continue to dominate the domestic rose breeding industry today. Internationally, Tantau (Germany), Meilland (France), Harkness (Britain), Wilhelm Kordes Söhne (Germany), Austin (Britain), Poulsen (Denmark), Dickson (Britain), Guillot (France), and McGredy (New Zealand) are the leading firms.

8.3.3 Copying New Varieties Is Cheap

In contrast to the costly development process, replication is quick and easy. Bennett had already noted in the 1880s that the outcome of his scientific methods of breeding would be vulnerable to imitation and relied on secrecy to protect his inventions. If discovered, new roses could quickly be replicated by repeated grafting; a plant would produce 10 grafts by January, which could be used to make 100 by March, and these could be used to make 1,000 by May (Harkness 1985, 25). As a result, the price of new roses fell quickly: this was equivalent to more than a 90 percent decrease in the first year. Once discovered, "a new variety would be placed upon the market and within a year or so it would be listed in nearly all nursery catalogs" (Sinnock 1945, 95).

> The only way a grower could make a profit on a new rose before 1930 was to build up, as secretly as possible, all the stock his capital permitted, then throw it all on the market at the top prices people would pay. In a year or so, competitors would be building up their own stocks grown from the no-longer-secret variety, now widely distributed. (Kneen 1948, 363)

For example, the US firm Conard & Jones invested two years to develop *Rosa Hugonis* (aka *Father Hugo Rose*) for the American market, but lost out to other nurserymen, who had quietly propagated *Rosa Hugonis* and were able to capitalize on Conard's advertising efforts, while offering their own roses at a lower price (Moon 1920, 49–51).[18]

17. Within these research departments, star breeders play an important role. For example, Armstrong Nursery was unable to develop the nursery stock of Herbert Swim after he left (Zlesak 2007, 712; McGredy and Jennett 1971, 65–66). The rose breeding industry is also geographically concentrated, allowing firms to access a larger pool of qualified labor. In 1966 Armstrong Nurseries moved to Wasco, California, a city of 21,000 in the southern San Joaquin Valley; J&P moved its operations to Wasco when it merged with Armstrong in 1968. Over the next two decades, DeVor, Weeks, and other nurseries followed to take advantage of the 280-day growing season, sandy soil, inexpensive land, and a growing pool of workers skilled in budding roses. Today, more than half of all domestically produced roses originate from Wasco and the surrounding area (Clark 1993, 22). In the 1970s, the cut flower (as opposed to garden plants) business began to be dominated by Colombia, Ecuador, and other tropical countries with long growing seasons, cheap labor, and little regulation (Järvesoo 1983, 323–24). In 2006, domestic firms made up less than 10 percent of the value and less than 5 percent of the volume of US sales (USDA, *Floriculture and Nursery Crops Yearbook 2007,* table C-15).

18. *Rosa Hugonis* was originally bred in England in 1899, so that, had it been patented in the United States, Conard would have had to purchase the rights to it from its original breeders.

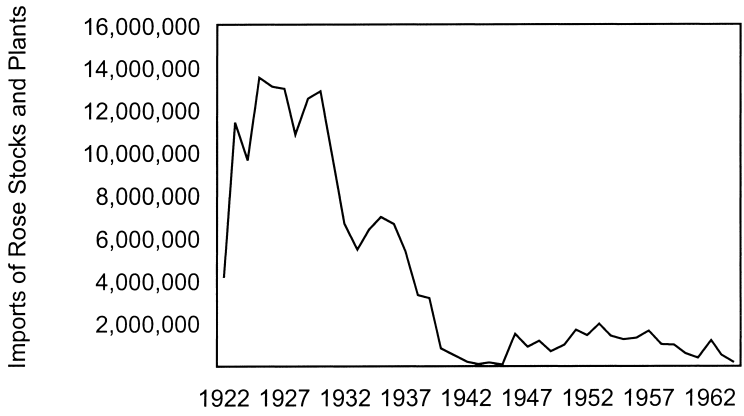

Fig. 8.4 Rose imports into the United States

Notes: Data on rose plants imported per year from US Department of Commerce, *Foreign Commerce and Navigation of the US,* various years, US Bureau of the Census, *Foreign Trade Reports* No. 110.

8.4 Did Plant Patents Create a Domestic Breeding Industry?

If high development costs and easy imitation discouraged nurseries from developing new varieties, the creation of IPRs may have encouraged innovation and facilitated the development of a domestic plant breeding industry.

> Prior to 1930, the US was not competitive in the field of plant breeding and especially of rose breeding. Most of the new roses came from second, third, and fourth generation hybridizers of Europe. Today . . . more than half the finest plant breeders and especially those breeding new varieties of roses are at work here in the US (Hart 1965, 93)

Import data, however, indicate that the US dependency on European nursery stock began to weaken prior to the Act. The number of rose plants imported into the United States declined from 12,916,461 in 1930 to 10,025,162 in 1931 and 6,715,588 in 1932 (figure 8.4). This decline was too early and too large to be due to three roses that were patented in 1931. A more plausible explanation is that the Great Depression reduced the demand for roses.[19]

19. The Smoot-Hawley Tariffs Act of June 1930, intended to protect the domestic agricultural industry (Irwin 1998; Eichengreen 1988), did not raise tariffs on roses. Rose plants, budded, grafted, or grown on their own roots were charged an import tariff of 4 cents per plant in 1913, 1922, and 1930 ("Comparison of Tariff Acts of 1913, 1922 and 1930, with Index" House, Committee on Ways and Means, Congress Session 71-3 (1930), document date 1931, 80). Tariff rates remained constant throughout the 1930s and were reduced for a select group of countries (Belgium, Netherlands, and Luxemburg) in 1948 and for the remaining countries in the 1960s (Corder and Parisi, 1959, 103–104).

8.4.1 World War II Cuts Off European Imports

When demand recovered, World War II disrupted the production of roses in Europe (Harkness 1985, 51–52, 93, 104, 141). The English rose breeder Walter Easlea II (1859–1945) deplored

> Not within living memory has there been such a shortage of rose plants for sale in Great Britain as there is in this season of 1944–45. This is mainly due to government restrictions on land that can be used for growing rose plants. Some growers who formerly produced 500,000 plants for sale have budded only 20,000 for the past two seasons. (*American Rose Annual* 1945, 46)

Unable to export grown plants, European nurseries began to export nursery stock to US firms. Meilland, for example, sent nursery stock for the *Peace* rose to be propagated by Pyle; the stock left France on the last plane before the German occupation in 1940 (Meilland 1984, 4; McGredy and Jennett 1971, 13).

American breeders made good use of the opportunity to propagate European plants and expand their own business: "WW-II left it open for the American rose industry to take off, and take off it did, with Gene Boerner and J&P as major contributors" (Cunningham 2005).

8.4.2 Gene Boerner's Mass Hybridization Program

Born to German-immigrant parents in Wisconsin in 1893, Gene Boerner joined J&P in 1920. Known as "Papa Floribunda," Boerner hybridized more than 60 *floribunda* roses, including 11 All American Rose Selections (AARS) winners (*American Rose Annual* 1945, 225; Beales 1998, 677). Boerner also acted as a "hybridizing father" to the New Zealander Sam McGredy (Harkness 1985, 77) and the younger members of the German family firm Wilhelm Kordes Söhne referred to him as "Uncle Gene."

As the chief breeder of J&P, Boerner led the company's mass hybridization program in Newark, New York, in the 1940s and 1950s. Sam McGredy argued that the existence of patent protection encouraged the creation of mass hybridization in the United States:

> The Americans were the first to have plant patents and that fact encouraged the rise of mass hybridization techniques in the States, of the techniques of the modern rose-breeding business. (McGredy and Jennett 1971, 51)

Many of J&P's most successful products, however, were based on European roses, and especially Kordes roses, which J&P began to propagate after the onset of the war. In 1939, J&P licensed Kordes' *World's Fair,* which won one of the first four AARS awards in 1940 and became a great commercial success in the United States. Its popularity allowed the J&P to capture a

large market share and eliminate the middlemen by becoming a major mail order retail company.[20]

In 1942, J&P introduced *Pinocchio,* which Kordes had developed in 1940 and named after the Disney movie of the same year (Cunningham 2005). Boerner used *Pinocchio* to create *Masquerade,* of which Harkness (1985, 75–76) says: "no rose of that kind had ever been seen. The nearest to it was an old China rose, *Mutabalis,* a shrub which proceeded from buds of saffron to magenta in its old age." *Fashion,* one of the first coral-colored American roses, was Boerner's second triumph derived from *Pinocchio* (Harkness 1985, 75–76). Boerner also used *Pinocchio* to create *Lavender Pinocchio* (PP947), which continues to be prominent today. He used *Crimson Glory,* developed by Wilhelm Kordes in 1935, to create *Diamond Jubilee* (introduced in 1947).[21]

During World War I, the ability to access foreign-owned patents and produce foreign-owned inventions had encouraged domestic invention in organic chemicals (Moser and Voena, forthcoming). World War II may have had a similar effect on US roses. Under the Trading with the Enemy Act (TWEA), domestic producers were not required to pay license fees for roses that German or French firms like Kordes, Tantau, and Meilland had patented in the United States (US Office of the Alien Property Custodian 1946, 202). Boerner kept royalties for Kordes in escrow and repaid Kordes after the war to help rebuild their firm (Cunningham 2005), but it is unlikely that he could fully compensate the Kordes firm for the profits that it lost as a result of US competition.

Boerner's *floribunda* were also based on European roses; he created them by refining the small-flowered *polyantha* rose that the Danish nursery Poulsen had developed in the 1920s (McGredy and Jennett 1971, 60–61; Harkness 1985, 92). Thus, Boerner's case suggests that access to European roses was at least as important as patents to the development of US plant breeding.

8.5 Registrations of New Roses

Why did rose patents increase so quickly after the creation of IPRs? Contemporaries observed that nurseries that marketed new varieties without patents risked "having someone turn up a little later with a patent" threatening to sue for infringement (Kile 1934, 61–62). The "Plant Patent Act

20. http://www.jacksonandperkins.com/gardening/GP/gatepage/history, accessed December 28, 2010.

21. Data from www.helpmefind.com. No systematic price data are available for this period, but proponents of IPRs argue that the introduction of plant patents lowered the prices that nurseries charged to consumers. Kneen (1948, 363), for example, observed that the thornless *Festival* rose, which was introduced in 1940, sold for "much less than fancy new roses brought in pre-patent days" and that "[t]oday buyers no longer have to pay $5 or $10 for a new rose, $10 for a new iris or gladiolus bulb, $20 for a fancy dahlia."

makes it almost a necessity to take out patents on all valuable new varieties"; growers would soon learn "the necessity of handling only such new plants as have been patented" (Kile 1934, 61–62). Large nurseries, which drove the increase in rose patents, were more likely to be sued and may have used patents strategically to protect themselves from litigation.

To separate increases in strategic patents from changes in innovation, we create an alternative measure of innovation. This measure is based on the number of new varieties that were registered with the ARS between 1916 and 1970.[22] Unlike patenting, registering a new plant does not create property rights that could be enforced in court (Loscher 1986, 59–62), so that registrations cannot be used strategically in the same way as patents. Breeders register the name of new varieties for the simple purpose of naming the plant and for the prestige that it brings to them and the namesake of a rose.

Registration data include unique names for US and foreign roses.[23] An entry in the *American Rose Annual* of 1926 (188), for example, includes the name of the rose, the name of its originator, and the date of the registration:

Sarah Van Fleet, H. Rug, by the American Rose Society, June 29, 1925.[24]

Matching rose patents with registrations makes it possible to estimate the share of newly-created roses that were patented. One difficulty with this process is that plant patents typically do not list the name of a rose. To address this problem, we first appended common names to patent records, using a publication of the American Association of Nurserymen (*Plant Patents with Common Names*).[25] Ninety-six percent of all plant patents between 1931 and

22. The ARS was originally established in 1892, sixteen years after the Royal National Rose Society in Britain was formed in 1876. Although European horticulturalists had begun to discuss the establishment of an international rose register in the 1910s, World War I disrupted their efforts. The ARS, however, pushed ahead and became an early leader in rose registration. It was a "welcome candidate" in 1955 to become the International Cultivar Registration Authority (or ICRA) for the Genus, Rosa L. (Vrugtman 1986, 225–28), assuming global responsibility to register new roses. Rose societies in Australia, France, Germany, India, Italy, Japan, the Netherlands, New Zealand, South Africa, Switzerland, and the United Kingdom serve as "regional representatives." The ARS is one of seventy ICRAs currently operating under the International Code of Nomenclature for Cultivated Plants (ICNCP), charged with registering names for different groups of plants. Systems of biological registration date back to Aristotle's classification of animals and the Inquiry in Plants by his student, Theophrastus. The Swedish botanist Carl Linnaeus (1707–1778) extended these lists to create the modern taxonomy of plants.

23. Commercial breeders typically employ different trade names in different countries. For example, the French rose *Madame Ferdinand Jamin* was marketed as *American Beauty* in the United States. To create unique identifiers, rose breeders developed a parallel system of code names, which consist of a three-letter prefix that designates the breeder followed by letters or numbers that denote the specific variety. The competing systems led to disputes in the early 1980s, which ARS resolved by adjusting its classification system (Gioia 1986, 265–71).

24. In 1930, J. Horace McFarland, the *Annual*'s long-time editor, combined this information with material on foreign roses into the first edition of *Modern Roses.* We use the 12th edition of *Modern Roses* (Young, Schorr, and Baer 2007).

25. The American Association of Nurserymen was formed in 1876 and is now called the American Nursery and Landscape Association. It has administered the National Association

1970 can be matched with common names. We then use the variety's name, its originator, and the originator's location to match patents with registrations. For example, we match

> "Polar Bear," registered in 1934 by "Nicolas" with PP132, "Polar Bear" by the originator "Jean H. Nicolas" granted in 1935.

Ninety percent of patents, 1,241 between 1931 and 1970, can be matched with at least one registration. Some patents are matched with more than one registration because alternative spellings or abbreviations are recorded to create a complete record of names. For example, *Irene of Denmark* is also registered as *Irene von Dänemark* and *Doctor F. Debat* is also registered as *Dr. F. Debat*. Duplicates of this type account for 17 percent of registrations, but there is no evidence of systematic variation. To be conservative, we repeat all tests with and without duplicates.

8.5.1 Less Than One-Fifth of New Varieties Are Patented

Registration data indicate that only a minority of new varieties was patented. Including duplicates, only 18 percent of new varieties between 1931 and 1970 were patented (1,341 of 7,436, figure 8.5). Excluding duplicates, only 16 percent of new roses were patented. Low patenting rates are consistent with results in other data sets that capture innovations with and without patents. For example, roughly 20 percent of machinery innovations exhibited at the Crystal Palace World Fair of 1851 were patented. Similar to breeders of fruit and roses, nineteenth-century inventors of machinery could not depend on secrecy to protect their innovations because new machines (unlike dyes or other types of chemical innovations) could be easily copied (Moser, forthcoming).

The share of patented varieties increased as breeders learned to use the patent system and became concerned about litigation. In 1932, 11 percent of new varieties were patented; by 1954, 26 percent of new varieties were patented (figure 8.5, excluding duplicates). Patenting rates spike briefly to 31 and 33 percent in 1942 and 1952, possibly due to changes in the speed of examination. In the mid-1950s, patenting rates began to decline; by the late 1960s, only 14 percent of new varieties were patented.[26]

Changes in the number of new varieties per year closely track the conditions of the European rose breeding industry. From 1900 to 1920, registrations per year stayed relatively constant around 100, with a significant dip during World War I (figure 8.6). From the 1920s to the late 1930s, rose registrations increased to above 200 per year, with a dip during the early years of the Great Depression, when demand for roses decreased in the United

of Plant Patent Owners (NAPPO), which was organized in 1939 to address the "gross misunderstanding within the trade and in the minds of the public as to the whole concept of plant patents" (White 1975, 254).

26. This decline cannot be due to truncation: our data continue until 1978, and roses that were registered by 1970 were patented within two years of their registration date.

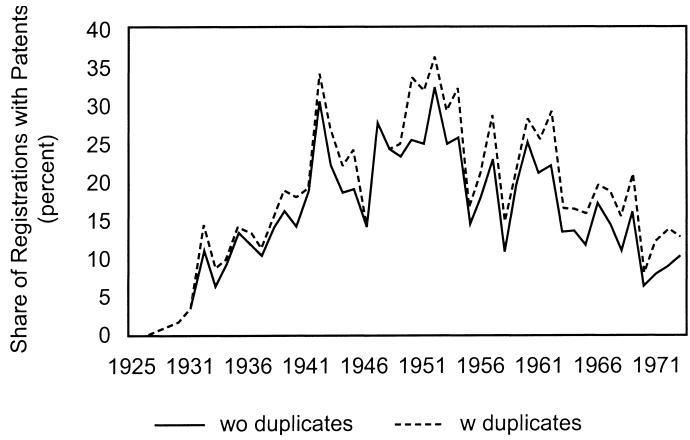

Fig. 8.5 Share of registrations with patents

Notes: Data on rose patents from American Association of Nurserymen, *Plant Patents and Common Names,* 1963, 1969, 1974. Data on rose registrations from the *American Rose Society.* Some new varieties of roses were registered more than once, using alternative abbreviations or spellings or translated names. To account for this, the line "w duplicates" includes multiple registrations for the same rose, and "wo duplicates" counts multiple registrations as one. The *x*-axis measures the year of registration.

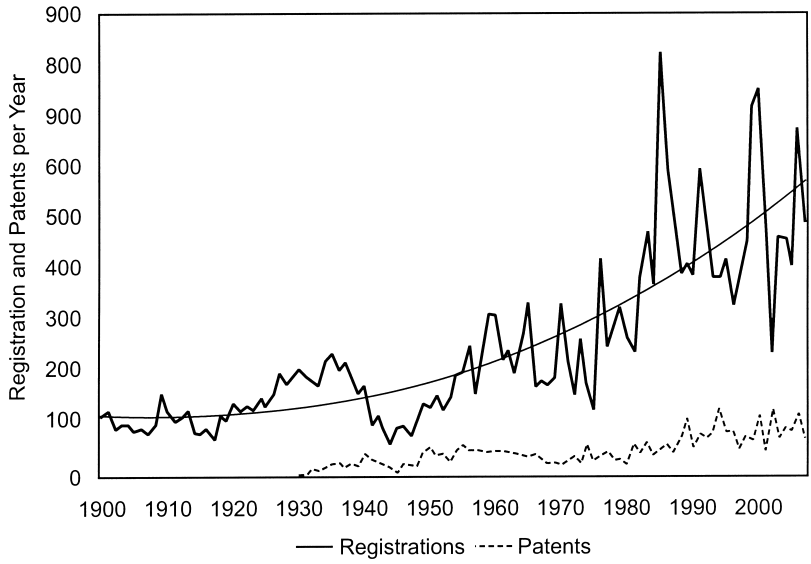

Fig. 8.6 Registrations and plant patents for roses

Notes: Data on rose registrations per year from the records of the *American Rose Society.* Patents are plant (PP) patents for roses from www.uspto.gov.

States and abroad. As World War I devastated the European rose industry, registrations declined to less than 100 per year until 1950; registrations did not go back to the prewar path of growth until the 1960s.

8.5.2 Europeans Create Most Varieties After 1931 While US Varieties Decline

Data on the national origins of breeders reveal that European breeders continued to account for the majority of new varieties. Consistent with historical accounts, the data indicate that, until the turn of the twentieth century, nearly all new roses were created by European breeders (fig. 8.7). Moreover, all except two of the top ten breeders in terms of new varieties are European (table 8.2). Wilhelm Kordes Söhne leads the list with 259 registrations. Including 133 registrations by the younger Reimer Kordes (no. 10) increases the number of Kordes registrations to nearly 400, twice the number of registrations of the French nursery Gaujard (with 201 registrations).

Eugene Boerner is the only American in the list of the top ten breeders, with 198 registrations (no. 3). Francis Meilland of the French family firm Meilland follows with 178 registrations (no. 4), then the German breeder Mathias Tantau (no. 5, 172 registrations), the Spanish breeder Pedro Dot (no. 6, 154 registrations), the French breeder C. Mallerin (a retired railway worker who acted as a mentor to the Meillands, no. 7, 153 registrations) and Delbard-Chabert (no. 8, 145 registrations). Sam McGredy, the Irishman who immigrated to New Zealand, is no. 9, with 135 registrations.

Most strikingly, the data indicate that US breeders contributed *fewer*

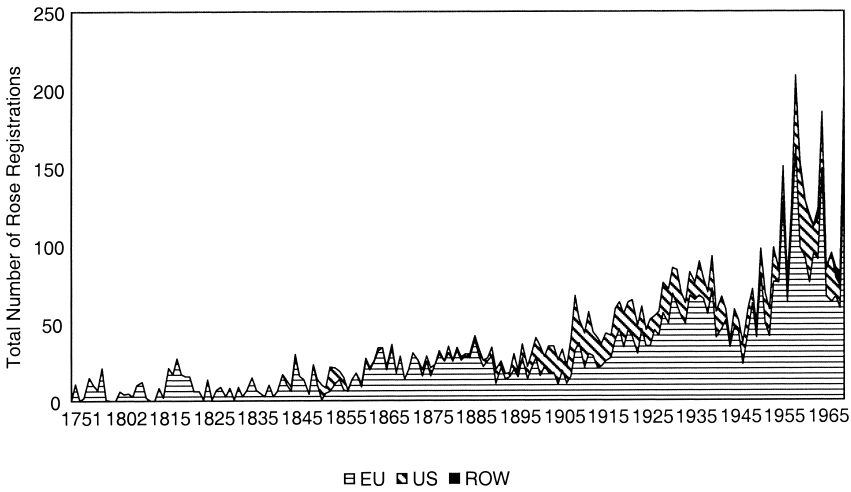

Fig. 8.7 Rose registrations by breeder's national origin: European Union (EU), United States (US), and Rest of World (ROW)

Note: Data on the number of new registrations per year from the records of the *American Rose Society.*

Table 8.2 Breeders with the largest number of rose registrations, 1931–1970

Breeder	Country of origin	Registrations
Wilhelm Kordes Söhne	Germany	259
Gaujard	France	201
Eugene Boerner	United States	198
Francis Meilland	France	178
Mathias Tantau	Germany	172
Petro Dot	Spain	154
Charles Mallerin	France	153
Delbard-Chabert	France	145
Samuel McGredy IV	New Zealand	139
Reimer Kordes	Germany	133

Source: Breeders' names were extracted from lists of registered roses in Young, Schorr, and Baer (2007).

varieties after the creation of patents in 1930. In the early decades of the twentieth century, when Van Fleet and other public sector breeders and hobbyists were active, registrations by US breeders increased to account for 39 percent of all new varieties between 1900 and 1930. After the passage of the Plant Patent Act, registrations by US breeders declined to 21 percent between 1931 and 1970, when the next Act extended patent rights to sexually-propagated plants.

8.6 Conclusions

Did the Plant Patent Act of 1930 help create the modern American rose breeding industry? Using plant patents as the sole indicator of innovation suggests that the answer is yes: large-scale breeding efforts of American firms, such as Jackson & Perkins, Armstrong, Weeks, and Conard-Pyle contributed a staggering share of US plant patents grants between 1930 and 1970, and large commercial breeders dominated the list of the top ten patentees.

A closer look, however, suggests that patents played at best a secondary role, and that US breeders mostly used patents strategically to protect themselves from litigation. Data on registrations of new varieties reveal that only a small share of new varieties, less than 20 percent, was patented. Moreover, European breeders continued to contribute the large majority of new varieties, and only one US breeder, J&P's Gene Boerner, is among the top ten breeders in terms of new varieties. In fact, the share of new varieties created by US breeders dropped after the introduction of intellectual property rights from nearly 40 percent from 1900 to 1930 to slightly over 20 percent from 1900 to 1970.

Notably, some of the most successful American roses, including Walter Van Fleet's hardy American climbers, were creations of the prepatent period.

Other prominent American roses such as Conard-Pyle's *Peace* rose, or J&P's *Pinnocchio* were originally bred by European firms. American breeders began to propagate these roses when World War II suspended European imports, leading them to improve the existing imported roses to create the American rose.

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Comment

Jeffrey L. Furman

I have learned many things from reading this chapter. One key lesson is that my public high school biology course was sadly inadequate to the task of understanding sexual reproduction in roses. In case there are others in the room with similar challenges in basic plant biology, I include in the talk a slightly extended primer on rose propagation. As a second note before I begin, I should also apologize that there are an embarrassing number of opportunities for word play on this project, so I ask for your tolerance if I

Jeffrey Furman is associate professor in the Strategy and Policy Department at Boston University School of Management and a research associate of the National Bureau of Economic Research.