Cultivars as Consumer Brands: Trends in Protecting and Commercializing Apple Cultivars via Intellectual Property Rights

James J. Luby* and David S. Bedford

ABSTRACT
For many fruit and vegetable crops, consumers are unaware of the cultivar they consume. Thus, cultivars, the ultimate products of breeding programs, have no special recognition by the consumer. Apple (*Malus domestica* Borkh.) is unusual in that individual cultivars are readily recognized by consumers based on their appearance, flavor and texture. Consequently, variety denominations or trademarks are used to represent cultivars as brands to consumers. Apple cultivars are asexually propagated and were historically developed from feral or planted open-pollinated seedlings. New cultivars are now mostly derived from planned breeding programs. U.S. apple breeding in the 20th century was mostly funded by state and federal government appropriations. Cultivars developed under this model were made widely available to producers as “open” cultivars. Fruit quality and quantity were difficult to control leading to devalued brand images for some cultivars and decreased profitability for producers and marketers. In response to these problems, some new apple cultivars are commercialized as “managed” cultivars using exclusive licensing of intellectual property rights to manage the cultivar’s market entry and introduction to the consumer as well as fruit quality and production volume.

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Abbreviations: PBR, plant breeders’ rights; USPP, United States plant patent.

Fruit and vegetable cultivars as the products of plant breeding are largely anonymous to consumers. Most produce has been offered by crop type (e.g., peaches, strawberries, blueberries) or broad categories (e.g., green or red seedless grapes) by most retailers in the U.S. and many other countries. Apple is unusual among temperate fruit crops and many other supermarket produce categories in that individual cultivars have long been recognized and sought by consumers. Many consumers can readily recognize and distinguish cultivars because of the large range of genetic variation among commercial apple cultivars for pattern, hue and intensity of coloration, and other visible features such as fruit shape and russetting. Differences among cultivars are further reinforced in the eating experience. Flavors can range from sweet and mild to acidic or even astringent. Texture of the flesh may be crisp and juicy, hard and dry, or soft and pulpy.

Apple marketers have capitalized on consumer recognition by offering multiple cultivars presented under the cultivar denominations and/or trademarks. Examples include both older cultivars discovered as feral seedlings (and their derived mutations), like ‘Delicious’, ‘Golden Delicious’, and ‘Granny Smith’, as well as cultivars from breeding programs, like ‘Gala’, ‘Fuji’, and ‘Honey-crisp’. For newer cultivars, breeders and marketers often exploit trademarks to develop consumer-recognized brands and capture greater returns in the marketplace (Clark and Jondle, 2008; Jondle et al., 2015). Both trademarks and cultivar denominations, as used in U.S. plant patents (USPP) and plant breeders’ rights (PBR) in other countries, have functions and properties in intellectual
property management and commercialization of apple cultivars (Table 1), usually agreed to by a cultivar owner, growers, and marketers under specific terms in contracts (Jondle et al., 2015).

Examples of the use of generic cultivar names, specific cultivar denominations, and trademarks recognized as brands by U.S. consumers are illustrated in Table 2. Generic cultivar names or specific cultivar denominations were used for centuries. The first widespread example of trademark use is the Pink Lady® trademark, which has been used in marketing fruit of the ‘Cripps Pink’ cultivar (Cripps et al., 1993) and at least two of its mutations in the U.S. and other countries beginning in the 1990s.

The cultivar denomination or trademarks associated with the fruit become a brand that requires the same consumer loyalty as with any other branded food product to maintain shelf space and market share. Using apple as a case study, which could possibly be applied to distinctive cultivars of other crops, we describe the rationale, evolution, and current state of this unusual situation in which cultivars, as the products of plant breeding, become consumer-recognized brands.

### BREEDING AND DEVELOPMENT CYCLE FOR APPLE CULTIVARS

Apples are highly heterozygous and usually self-incompatible so propagation by seed usually gives a diverse array of progeny. Cultivars of apple, like those of most other temperate tree fruit crops, are asexually propagated with long breeding and commercialization cycles (Brown, 2012; Kumar et al., 2014). Fruit tree grafting and asexual propagation is ancient, dating to at least 2000 yr ago (Janick, 2005). Apple breeding with planned, controlled pollinations began in the 19th century (Janick et al., 1996), but was not widely and systematically performed until the 20th century (Brown and Maloney, 2003). Apple cultivars before that time, such as the well-known U.S. cultivars ‘Delicious’, ‘Golden Delicious’, and ‘McIntosh’ (Table 2), occurred mostly as chance feral seedlings found in orchards, fencerows, or woodlots or from planting of open-pollinated seeds of favorite cultivars (Hampson and Kemp, 2003). Desirable seedlings were cloned and distributed regionally or nationally.

The development of a new apple cultivar from crossing to first commercial planting in contemporary breeding programs can range 15 to 20 yr with an additional 5 to 10 yr before substantial fruit is available for consumers (Hancock et al., 2008; Kumar et al., 2014). This research and development period represents a substantial investment by breeders and cultivar owners. Furthermore, apple breeding programs are inefficient relative to many other crops due to the large size of mature, fruiting plants.

A typical apple breeding and commercialization program has several stages of testing depicted in Fig. 1. Seeds are generated by controlled pollinations. They are harvested from ripe fruit and germinated following a cold stratification period. In the first stage of evaluation, each seedling line is usually evaluated as a single tree grown on its own roots or grafted on rootstock. Apple seedlings have a juvenile phase typically ranging from 3 to 8 yr. Juvenile phase culling, based on disease screening, plant growth habit, or DNA markers, is commonly incorporated to reduce population sizes before fruiting. Upon fruiting, the most desirable seedlings are selected and cloned by grafting on rootstocks to make multiple trees for the second stage of testing. Following confirmation of performance in clonal testing, a third stage of expanded pre-commercial testing is usually undertaken over broader ranges of geography and management systems. Additional pathogen indexing and clean stock maintenance steps are needed in this stage to ensure that stock free of certain viruses and other known pathogens is propagated for pre-commercial testing and commercial planting.

New apple cultivars also have a substantial lag period of 5 to 10 yr from commencement of commercial planting to production of sufficient fruit for market development and penetration. Thus, the period from crossing to substantial amounts of fruit in the hands of consumers can easily be 25 to 30 yr. This extended testing and market development period means that long term investments by the breeder/cultivar owner and producer/marketer groups are substantial and must be recovered in commercialization.

Following introduction of a new cultivar, nurseries and growers usually practice somatic selection to ensure true-to-type of the buds used to propagate new trees. Budwood is selected only from limbs that have already

### Table 1. Functions and properties of U.S. plant patents (USPP) and plant breeders’ rights (PBR) and their associated cultivar denominations and trademarks in intellectual property management and commercialization related to apple cultivars.

<table>
<thead>
<tr>
<th>Function or property of intellectual property</th>
<th>USPP and PBR with cultivar denomination</th>
<th>Intellectual property</th>
<th>Trademark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal utility</td>
<td>Provides basis for owner to seek remedy for unauthorized propagation</td>
<td>Provides basis for owner to seek remedy for unauthorized fruit sales</td>
<td></td>
</tr>
<tr>
<td>Term of protection</td>
<td>Defined term of 20 to 30 yr depending on country</td>
<td>Indefinite term with proper use</td>
<td></td>
</tr>
<tr>
<td>Licensing</td>
<td>Cultivar owner may license ability to propagate asexually</td>
<td>Cultivar owner may license for branding fruit in marketplace</td>
<td></td>
</tr>
<tr>
<td>Quality assurance</td>
<td>Used to indicate true-to-type tree in sale from nursery to fruit grower</td>
<td>Used for fruit meeting quality specifications (e.g. color, sugar, firmness, russet)</td>
<td></td>
</tr>
</tbody>
</table>
Remaining public sector programs began to protect new cultivars in the 1970s using USPP and PBR and generally made them widely available with small royalties being collected for each plant sold (Clark and Jondle, 2008; Byrne, 2012). The U.S. Plant Patent and PBR in other countries typically grant cultivar owners a limited monopoly by providing legal protection against unauthorized propagation for a period of 20 to 30 yr depending on the country, but do not prohibit use of the cultivars, if legally obtained, for breeding.

Another trend that emerged in the late 20th century affecting fruit cultivar commercialization is global sourcing of produce for year-round supply to consumers. Year-round supply was largely made possible by technical advances in production, storage, and shipping technology. For an apple cultivar sold in the U.S., for example, fruits may be harvested in the fall in the U.S. and marketed from cold storage for up to 12 mo. Fruits produced in a southern hemisphere country, such as Chile or New Zealand, can be imported to supplement U.S. production. Global movement of apples led to more widespread recognition of new cultivars by nurseries, growers, and marketers.

Table 2. Examples of apple cultivars recognized as brands in U.S. supermarkets and their origins, cultivar denominations, and associated trademarks used in marketing.

<table>
<thead>
<tr>
<th>Marketplace brand</th>
<th>Cultivar(s)</th>
<th>Origin</th>
<th>Fruit trademark</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generic cultivars as brands- originally derived from feral seedlings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Delicious</td>
<td>‘Hawkeye’ or ‘Delicious’ and over 50 mutations</td>
<td>Feral seeding, Madison County, Iowa, 1880</td>
<td>none</td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>‘Golden Delicious’ and mutations</td>
<td>Feral seeding, Clay County, West Virginia, 1914</td>
<td>none</td>
</tr>
<tr>
<td>Granny Smith</td>
<td>‘Granny Smith’ and many mutations</td>
<td>Feral seeding, Eastwood, New South Wales, Australia, 1868</td>
<td>none</td>
</tr>
<tr>
<td>McIntosh</td>
<td>‘Mcintosh’ and many mutations</td>
<td>Feral seeding, South Dundas, Ontario, Canada, ca 1820</td>
<td>none</td>
</tr>
<tr>
<td><strong>Empire</strong></td>
<td>‘Empire’ and several mutations</td>
<td>Cornell University, 1966</td>
<td>none</td>
</tr>
<tr>
<td><strong>Gala</strong></td>
<td>‘Kidd’s D-8’ (corrected from ‘Gala’ in USPP 3637) and many mutations</td>
<td>New Zealand, 1974</td>
<td>none</td>
</tr>
<tr>
<td><strong>Fuji</strong></td>
<td>‘Fuji’ and many mutations</td>
<td>Fujisaki, Aomori, Japan, late 1930s</td>
<td>Kiku® (see below)</td>
</tr>
<tr>
<td><strong>Honeycrisp</strong></td>
<td>‘Honeycrisp’ (USPP 7197) and several mutations</td>
<td>University of Minnesota, 1991</td>
<td>Honeycrunch® used outside US</td>
</tr>
<tr>
<td><strong>Pink Lady®</strong></td>
<td>‘Cripps Pink’ (USPP 7880) and mutations ‘Rosy Glow’ and ‘Lady in Red’</td>
<td>Dep. of Agriculture and Food, Western Australia, 1992</td>
<td>Fruit of Cripps Pink and some mutations that meet quality standards may be marketed as Pink Lady® apples</td>
</tr>
<tr>
<td><strong>Jazz</strong></td>
<td>‘Scifresh’ (USPP 13,888)</td>
<td>Horticulture and Food Research Inst. of New Zealand, 2003</td>
<td>Fruit of Scifresh and mutations that meet quality standards may be marketed as Jazz apples</td>
</tr>
<tr>
<td><strong>SweeTango®</strong></td>
<td>‘Minneiska’ (USPP 18,812)</td>
<td>University of Minnesota, 2006</td>
<td>Fruit of Minneiska that meet quality standards may be marketed as SweeTango® apples</td>
</tr>
<tr>
<td><strong>SnapDragon®</strong></td>
<td>‘NY1’ (USPP 22,228)</td>
<td>Cornell University, 2013</td>
<td>Fruit of ‘NY1’ that meet quality standards may be marketed as SnapDragon® apples</td>
</tr>
<tr>
<td><strong>Cosmic Crisp®</strong></td>
<td>‘WA38’ (USPP 24,210)</td>
<td>Washington State University, 2014</td>
<td>Fruit of ‘WA38’ that meet quality standards may be marketed as Cosmic Crisp® apples</td>
</tr>
<tr>
<td><strong>KIKU®</strong></td>
<td>‘Brak’ (USPP 15,261) and ‘Fuji Fubrax’ (USPP 18,761) mutations derived from ‘Fuji’</td>
<td>South Tyrol, Italy</td>
<td>Fruit of specific ‘Fuji’-derived mutations that meet quality standards may be marketed as KIKU® apples</td>
</tr>
</tbody>
</table>

fruited and exhibited true-to-type fruit. Alternatively, producers may select for mutations, or “sports”, that represent improvements compared to the original cultivar. The most common type of apple mutation selected has greater red coverage of the skin. Intellectual property rights may be granted to the developer of a sport as a new cultivar in the U.S. if it is uniform when reproduced by asexual propagation and sufficiently distinct from the original cultivar and other mutations (Clark and Jondle, 2008).

THE EVOLVING BUSINESS MODEL OF APPLE CULTIVAR DEVELOPMENT AND COMMERCIALIZATION

Through much of the 20th century in the U.S. and many other countries, taxpayers collectively funded tree fruit breeding (Byrne, 2012). Cultivars were introduced as “open cultivars”—they were made widely available to parties that wanted to grow or propagate them. In the latter third of the 20th century, state and federal investments in public fruit breeding programs waned and many were terminated starting about 1960.
The cultivar ‘Gala’, for example, was introduced to U.S. consumers by New Zealand marketers in the late 20th century and subsequently was also heavily planted by U.S. growers. Concomitantly, global peddling of cultivars by breeders and cultivar owners was enabled by widespread adoption of laws granting PBR for asexually propagated crops in the late 20th century in various countries, mainly following guidelines in the treaties of the International Union for the Protection of Cultivars (Jondle et al., 2015).

With the demise of public sector programs, private sector breeders emerged, especially in tree fruit crops that have shorter breeding cycles and concentrated production areas—notably the Prunus crops (peach/nectarine, plum, apricot, cherry) and their interspecific hybrids (Byrne, 2012). Private sector breeders protected their cultivars with USPP, PBR, and trademarks and often licensed their cultivars exclusively or semi-exclusively to nurseries or grower/marketer groups that paid royalties on propagated trees and, in some cases, on fruit sales (Clark and Jondle, 2008). Exclusively or tightly controlled cultivars are often referred to as “club varieties” or “managed varieties” in the apple industry and are referred to in this paper as managed cultivars. For managed cultivars, nurseries, growers, or marketers gain exclusive access to a new cultivar in return for contractual promises to meet investment milestones in orchard establishment and fruit marketing as well as obligations to meet quality specifications.

**CULTIVAR MANAGEMENT: “OPEN” CULTIVARS**

Apple cultivars in the U.S. were historically offered as “open” cultivars to growers by nurseries, breeders, or other cultivar owners with few restrictions from the 18th century through most of the 20th century. Examples of popular U.S. cultivars managed in this way include the original clones and many derived mutations of ‘Delicious’, ‘Golden Delicious’, and ‘McIntosh’ (Table 2). Some new cultivars are still introduced as open cultivars. Since the mid-20th century, the owner of an open cultivar often seeks protection of propagation rights through a USPP or PBR in other countries. The main advantage of open cultivar management is a relatively simple licensing scheme.
Propagation rights are typically licensed by contract to one or more nurseries in a country that may pay the cultivar owner an up-front fee in return for the license. Beyond the up-front payment, the cultivar owner typically receives a nominal royalty for each tree sold by the nursery to a fruit producer. Other than the tree royalty and propagation restrictions pursuant to the USPP law or PBR law in other countries, cultivar owners usually place no restrictions on the number of trees that may be purchased, where they may be planted, how they are managed, and how or where the fruit are marketed.

The open cultivar presents risks for both cultivar owners and fruit producers. For cultivar owners, open cultivars are often slow to be commercialized because a lack of consumer knowledge of the cultivar in turn provides a lack of incentive for fruit producers to plant trees of the cultivar. Much of the monopoly period granted by USPP or PBR may be exhausted before a cultivar gains consumer awareness resulting in depressed royalty-generating tree sales. In the case of ‘Honeycrisp’, which was introduced by our University of Minnesota breeding program in 1991, tree sales languished in the 1990s when few consumers had heard of the cultivar. The cultivar gained popularity in the early 2000s so that when the USPP expired in 2008, tree sales in the U.S. had built to over 1 million per year. Tree sales in the U.S. have remained at that level though the University of Minnesota no longer captures any further return on its investment in breeding through this cultivar.

Royalty income for open cultivars is usually limited to a one-time collection of a modest fee when a tree is sold. This allows the cultivar owner to capture only a very small fraction of its value to the producer or the consumer. Again, the case of ‘Honeycrisp’ is instructive. The typical royalty of $1 to $1.50 per tree in the U.S. through the life of the patent was nominal relative to the downstream value of fruit sold. A ‘Honeycrisp’ tree producing 500 lb of fruit over a 15 to 20 yr orchard life provided the University of Minnesota with a $1 to $1.50 return for its investment of 30 yr of breeding and testing. This is less than $0.005 per pound for a fruit that may sell at wholesale for $0.75 to $1.50 per pound or at retail for as much as $3 to $5 per pound.

Open cultivars pose some challenges in managing intellectual property rights. Infringement of propagation rights is difficult to monitor with the cultivar in the hands of multiple licensed nurseries and potentially hundreds or thousands of fruit producers. Another intellectual property issue for a cultivar owner is the almost inevitable discovery of somatic mutations, or sports. Growers and nurseries routinely search for sports of apple cultivars with better color or appearance or altered growth habit. Sports are usually considered as “essentially derived” cultivars under the regulations of many countries that are signatories to 1991 UPOV (Jondle et al., 2015). In these countries, commercialization of sports must proceed through the owner of an original cultivar that is protected by PBR. In the U.S. and some other countries, sports may be protected and commercialized without the permission of the original cultivar owner in some cases. Although the owner of the original cultivar can control ownership of sports of open cultivars through contracts with nurseries and fruit producers, such a scheme entails considerable paperwork and documentation and has not commonly been practiced.

Open cultivars usually attain market share and volume slowly. The period of protection afforded by USPP and PBR can be exhausted before the cultivar owner realizes any significant return. A successful cultivar needs to have strong consumer awareness that is often built with multiyear, multimarket and multimedia promotion and marketing efforts. These efforts must be coordinated with convenient availability of high quality fruit at a price perceived as a good value. Without marketing or promotion, consumers are less likely to become aware of a new cultivar. Without consumer awareness many producers are not inclined to take a risk of planting a new cultivar. Most cultivar owners lack the expertise or resources to market their cultivar to consumers. Even if they can do so, cultivar owners typically do not control production and logistics resources to bring the fruit to market. Fruit producers and marketers who have the knowledge and means to bring high quality fruit to the consumer may be deterred from taking the initial investment risk in producing, marketing and promoting a new open cultivar if they feel their competitors will simply come later into the market, at less risk, with unrestricted volume and perhaps at lower quality or price.

Open cultivars also pose risks for fruit producers. Ideally for a fruit producer, a new cultivar could be sold at a price that provides a substantial positive return on production and marketing investment for as long as possible. The lack of management of an open cultivar means that the volume of fruit going to market is uncontrolled, which can result in oversupply. Some suppliers may lack incentive to provide high quality fruit, which results in an inconsistent product presented to the consumer. Uncontrolled volume and quality can result in lower prices and decreased profitability for producers, which in turn may shorten the cultivar’s commercial lifespan.

Although the open cultivar is available to any fruit producer, it usually receives little promotion to consumers. This can limit a producer’s enthusiasm for planting. Despite the lack of promotion, a new cultivar that is attractive to a consumer may command a high price if quantity is limited. If a cultivar becomes popular with consumers, tree sales are usually limited only by nursery production capacity. Fruit producers are incentivized to rapidly plant as many trees as they can obtain. Volume
of fruit produced is essentially unlimited. Overproduction that may ensue can destroy profitability for the fruit producer. A further problem in the rush to market for a popular cultivar is maintaining high quality of fruit in the marketplace. Quality assurance is left to the individual producer, packer, or marketer who, in a rush to profit on a popular, high-priced cultivar, may relax quality standards and offer inferior fruit at a lower price. All these factors can potentially lead to the premature demise of a cultivar.

CULTIVAR MANAGEMENT: “MANAGED” CULTIVARS

The problems and risks described above for open cultivars led to the development of a more structured management and restricted licensing system for some apple cultivars over the last 20 yr (Clark and Jondle, 2008). Management strategies can vary in their details but usually have the objectives of rapidly introducing a new cultivar to the market, maintaining consistently high quality for consumers, and managing production volume so that demand is not exceeded to provide better returns to fruit producers, marketers, and cultivar owners.

As with open cultivars, the cultivar owner usually obtains a USPP or PBR in a producing country. The cultivar owner usually also registers one or more trademarks to brand the fruit for marketing in each of the countries where fruit will be sold. Examples of trademarks used to brand fruit are provided in Table 2. A trademark, unlike a USPP or PBR, can potentially have value indefinitely in the marketplace (Table 1). Maintaining a trademark requires that it be continually and consistently used in selling a product (Clark and Jondle, 2008; Jondle et al., 2015). The cultivar owner and licensees must also perform constant surveillance of commercial sectors (not necessarily limited to fresh fruit or produce) for potential infringement by other parties. Legal counsel is often needed to conduct actions against alleged infringers.

License agreements governed by contract law (Jondle et al., 2015) are important tools for managed cultivars. The rights for tree propagation and fruit production are usually licensed to one or a few producers or marketers in a production territory along with rights to use a trademark(s) to market fruit in one or more countries. In return, the cultivar owner usually receives an exclusivity payment, a royalty for each tree propagated, and a proportion of the fruit sales. The producer agrees to milestones for orchard establishment and fruit production and maintenance of quality standards.

The managed cultivar approach potentially offers several advantages to the cultivar owner and the producer/marketer.

1. The exclusivity offered to the producer encourages rapid investment in orchard development and marketing programs because the producer is assured of being able to offer a unique product.
2. Rapid entry into the market helps the cultivar owner realize more of the potential of the cultivar during the monopoly period afforded by plant cultivar protection.
3. Quality of fruit going to market can be managed through contract terms specifying that planting is limited to regions where pre-commercial testing has indicated that high quality fruit can be reliably produced.
4. Quality of fruit going to market can also be managed through contract terms for trademark use which specify that only fruit meeting certain quality standards may be marketed using the trademark brand.
5. Trademarks used in branding fruit can be maintained indefinitely so their continued licensing and use can provide prolonged returns to the cultivar owner even after plant cultivar protection has expired.
6. Intellectual property management is simplified, as relatively few contracts are required compared to an open cultivar.
7. Infringement is more easily monitored because of the limited number of identified licensed growers and marketers.
8. Contracts with the limited number of production partners can specifically cover the discovery, protection, and commercialization of sports.
9. The licensing of the trademark in fruit sales provides a marketer with incentive to build the value of a brand that can contribute to a lengthy and indefinite exclusivity period of the cultivar with proper management of intellectual property and fruit production and quality.
10. Income earned through royalties on the use of trademark in fruit sales can have sustained and potentially larger and indefinite value to the cultivar owner.

The managed cultivar approach is not without risks and potential problems. For the producer/marketer the greatest risk is in the choice of cultivar to license. The extra cost to a producer/marketer for exclusive licensing limits the approach to cultivars with exceptional market traits and reasonable cost of production. Not every new cultivar will excite consumers sufficiently to earn the premium in the marketplace needed to cover the high investment needed to obtain exclusive production and marketing rights, develop and manage productive state-of-the-art orchards that consistently produce high quality fruit, and develop expensive marketing programs. For example, in 2006 the University of Minnesota introduced ‘Minneiska’ as a managed cultivar in the U.S. (Bedford and Luby, 2008a). At the same time, ‘Wildung’ was introduced in the U.S. as an open cultivar (Bedford and Luby, 2008b). Both cultivars produce fruits with excellent...
eating quality. However, ‘Wildung’ fruits do not have the storage potential and shipping capability needed to facilitate an extended sales season that would have provided the return on investment needed for a large regional or national marketing program.

For the cultivar owner, the greatest risk is choosing the right producer/marketer partner(s) for a specific cultivar. The partner needs to own or otherwise have access to sufficient physical facilities for producing and packing the fruit and delivering it to market. The partner also needs capital for investment in new orchards required for a new cultivar and to obtain access to supermarket shelf space to introduce the fruit to the consumer. Perhaps most importantly, the partner has to have the desire and passion to want to succeed in marketing an exclusive product as part of their overall marketing and sales strategy. The managed cultivar may also yield less income to the cultivar owner in early years because of limited initial plantings and disciplined growth based on projected returns on investment. By deferring a large share of potential revenue by several years from tree sales to fruit sales royalties, the cultivar owner is placing a large bet on the long-term success of the cultivar based on fruit marketing programs and consumer appeal.

Managing production volume is another large concern. Apple orchards require substantial capital investment for fixed costs of trees, trellising, irrigation, and other inputs and scale decisions must be made years before fruits are marketed. For example, grafted apple trees typically require 2 to 3 yr to produce in the nursery and, following transplanting to an orchard, will not reach full production for several more years. If a cultivar is planted on too small a scale, the producer/marketer and the cultivar owner incur an opportunity cost. Alternatively, production in excess of fresh market demand may force the producer to reduce the price and/or divert fruit to less profitable processing channels to maintain price. Either practice can negatively affect return on investment for the producer/marketer and the cultivar owner. Thus, the scale of initial plantings and subsequent expansions, either as benchmarks established by contract or decisions of the producer/marketer, have enormous consequences.

In summary, apple cultivar owners have employed intellectual property rights, usually USPP and PBR to manage and protect tree propagation for many decades. In recent years, trademarks have also been used to assure quality of marketed fruit, as well as to develop consumer-recognized brands. For cultivars with exceptional consumer appeal, exclusive licensing of intellectual property can be used to manage more rapid entry of a new cultivar into the market and develop market share through a concerted marketing program and management of production geography and fruit grade specification to ensure consistent fruit quality.