

## **Strawberry Production in the United States**

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The discussion below is a greatly abbreviated version of what I had hoped to present at the strawberry conference in April 1999. Hopefully, this presentation will give you an overview of strawberry production in the U.S. and at some point in the future I can come visit and expand on these points. I welcome any of you to come visit our research program in the Pacific Northwest United States.

### **I. History**

The wild strawberry species were always a valuable crop when harvested from the wild by native people of the northern hemisphere and the Pacific coast regions of South America. The first evidence of a concerted effort to cultivate and improve strawberries (*Fragaria chiloensis*) can be traced back to the Mapuche and Huilliche people of current day Chile. During the Spanish Conquest these improved forms of *F. chiloensis* were spread north. In the 1700s, some of these elite *F. chiloensis* genotypes along with those of *F. virginiana* from North America were brought to Europe. Hybrids between these two species, whether they were

accidental or planned is unknown, are the basis for the current strawberry industry worldwide. The cultivated strawberry, is given the name *Fragaria x ananassa*; the “x” indicating its species hybrid origin.

The strawberry industry grew in North America as the population grew and until early in this century was concentrated in the eastern United States. As the agricultural industry developed in California, the University of California working closely with the industry, whole new ways of growing strawberries in a mild Mediterranean climate were developed. Since, the mid 1900's California has been the leading producer of strawberries in the U.S. As refrigeration and air transport became commonplace, California has grown from being the leading producer to the dominant producer in the U.S. and worldwide, growing about 90% of U.S. strawberries.

The Pacific Northwest industry has had a somewhat unique history. The Pacific Northwest [Oregon (US), Washington (US) and British Columbia (Canada)] was becoming recognized as mild climate suitable for the production of a large number of fruit crops at the same time as the “canning” industry was becoming important. “Canning” fruit meant that fruit produced on the west coast could be shipped to the population centers in the eastern U.S. In the first half of this century, tens of thousands of hectares were devoted to production of fruit for canning and later when freezing became an option, the Pacific Northwest industry naturally slipped into the role of a major supplier for this processing industry.

## **II. Current situation.**

### ***A. Major production regions***

Today, US production is dominated by California and Florida, with North Carolina becoming more important recently for fresh market production. California is the leading producer of berries for processing followed by the Pacific Northwest (primarily Oregon). What government statistics typically fail to capture are the thousands of acres produced across the US for local sales or small scale processing. These berries for local sale are often produced on farms that have one hectare or less of strawberries and sell their fruit as “pick-your-own” or pre-picked during a short, 3-5 week season.

### ***B. Major markets for these regions***

Southern California (Los Angeles area) typically begins to ship fresh fruit early in January and northern California (Watsonville area) begins to ship in April. The fruit are shipped nationally and internationally but not surprisingly they try to hit the most valuable markets (i.e. New York, Boston, Washington, D.C.) as soon as they can. When northern California begins to ship, the quality of the fruit is usually better than what is coming off of the plants that have been in production for four months in southern California. The berries from southern California that are no longer competitive in the fresh market, are shifted to processing until production ceases in June. Northern California continues to produce for the fresh market until

late Fall, October or November, and ends when the rains and cold of winter begin. Therefore, California, as a whole, is in production for about 10 months a year for the fresh market.

Florida has fruit in production for the fresh market from November to March. When they are the only domestic fruit on the market, they ship throughout the US. However, when California fruit comes on the market, the Florida industry begins to focus mostly on the eastern U.S. market where they can transport the fruit more cheaply than California producers.

North Carolina has taken and modified the California annual production systems and is becoming a significant supplier of fresh fruit on the East coast from April to June. As with Florida, they take advantage of being 5000 km closer to the high value eastern markets than California.

The Pacific Northwest industry is almost completely geared toward the processing market. Fruit is harvested during a fairly short 4-6 week season and then frozen. Because processed fruit from the Pacific Northwest demands a higher price than processed fruit from California, it is typically used in products that have a lower content of actual fruit for instance ice cream or yogurt whereas California processed fruit is used in jams and jellies where the product is 50% fruit and 50% sugar.

### **III. Production systems**

#### ***A. California System***

California is blessed with a mild climate (winter and during the season), good soils, and very little rain during harvest. Their system of production has radically changed the way strawberries are produced worldwide. Traditionally, strawberries were produced in perennial “meadows”, where it was a solid stand of strawberries. Today, strawberries are produced in an annual production, plasticulture system. The California industry is so successful because of their integrated system of production; each of the components contributes to make the process work. The basic system involves fumigating the soil with methyl bromide (research is being conducted at a furious pace to try to find replacements for methyl bromide), ridging the soil, planting plants, laying irrigation and a plastic mulch, and then managing the water, fertilizer and pests until the crop is produced. The cultivars that are suitable, typically have a balance of vegetative vs. reproductive growth that is more reproductive than vegetative. Therefore, the plants are moderate in size and vigor and produce few runners. The cultivars repeatedly, produce a small number of very large fruit. So the production of a given plant for a short time frame is small, however, at high plant densities and when this production cycle is repeated for months, the yields can approach 110,000 kg/ha in commercial fields. Timing of plastic mulch application or removal and the type of mulch (black, clear, other colors) can be manipulated to affect timing, quality and quantity of harvest. The source of the nursery plants is also critical. For southern California, where

earliness is essential, the plants are grown at high elevation in northern California where they can accumulate chilling. Then in October, they are quickly dug and transplanted to production fields. Growers and nurseries are always weighing the advantages of leaving the plants in longer to accumulate more chilling against getting them transplanted as soon as possible. Typically, short-day cultivars such as 'Camarosa' are planted in southern California and day-neutral cultivars, such as 'Selva' are planted in northern California.

Florida production is largely similar to California however along with California cultivars even earlier cultivars such as 'Sweet Charlie' are used.

The advantages of the California system are its high yields of high quality fruit over a very long season. The disadvantages are the tremendous inputs, and costs associated with these inputs, that are required. There are also environmental concerns with fumigation, disposal of plastic and irrigation water supply.

## 2. "North Carolina System" (Much of this information from Gina Fernandez and Eric Bish at North Carolina State University)

While often billed as new and novel, the North Carolina annual production system is really just taking the California system and modifying it for a different environment. This production system became popular in North Carolina about 10 years ago and has spread as far north as New Jersey. In this system, runner tips are sent from Canadian nurseries to North Carolina in August where they are rooted in plug trays. The plugs are planted (in fumigated, ridged soil with irrigation and plastic mulch) from August to mid-October; the plants must be planted early

enough to get good growth in the fall. The plants overwinter and receive chilling in the field. In the spring, row covers are often used to advance ripening. The plants typically need frost protection during bloom and produce from April to June. The plants are removed soon after harvest is complete to try to reduce disease problems, particularly anthracnose. The system was developed around 'Chandler' but has been successfully used more recently with 'Camarosa'. The advantages are earlier, larger, higher quality fruit than traditional matted row production but the input costs are much higher. Earlier ripening, when fruit prices are high are often essential to recoup your investment.

3. *Matted row system*; used in eastern U.S. and for the processing industry in the Pacific Northwest

The narrow matted row, perennial production system is the most popular system for much of the eastern U.S. and the Pacific Northwest. In this system, plants are established one year with runners encouraged. Cultivars developed in California are generally not well adapted to this system or to the areas where this system is used. The following year after harvest, the fields are renovated (foliage removed, light tilling, fertilization, irrigation) and they are kept for a total of 2-4 harvest seasons with renovation after each harvest. This is a reliable system that is well adapted to areas with harsh winter climates. In the Pacific Northwest, it is the preferred production system because the input costs are relatively low. The disadvantages of this system are primarily the lack of production during the establishment year and the decline in yield and fruit quality in the fruiting seasons

after the first fruiting season.

#### **IV. Cultivars**

The cultivars I will present are the most popular, available cultivars. Particularly in California, private companies have developed breeding programs to develop cultivars that only those in the company can grow. The most widely known example of this is Driscoll Associates. These cultivars are becoming an increasingly important part of the strawberry industry.

##### ***Short-day cultivars for annual production***

‘Camarosa’- High yields of early ripening, very firm, fruit, consistent production over the season (no strong up-and-down cycling over the season)

‘Chandler’- Has been completely replaced by ‘Camarosa’ in California, rapidly being replaced in east as well. High yields, very firm fruit, consistent production, good quality for processing.

‘Sweet Charlie’- Grown primarily in Florida. While the fruit characteristics are not outstanding, it is a good quality berry that is grown due to its earliness.

‘Sweet Charlie’ allows Florida to come into production 7-14 days earlier than in the past. These first few weeks of harvest are when fruit is sold for very high prices.

##### ***Day-neutral cultivars***

‘Selva’ has been an important cultivar for about 15 years, an incredibly long



stretch for a California cultivar. It is known for its production of large, attractive, firm fruit.

***Short-day cultivars for perennial production- Processing***

‘Totem’- 70-80% of production in the Pacific Northwest is in ‘Totem’.

Productive, disease resistant, outstanding processing quality (holds integrity when thawed, excellent internal and external color, high acid levels, high sugar levels, excellent flavor, and caps well [green calyxes remove easily when fruit are picked in the field])

‘Hood’- Excellent processing quality, particularly flavor. Susceptible to viruses so seldom produces more than one crop. Also widely sold locally for the fresh market.

‘Redcrest’- Excellent processing quality, late, high acidity, large fruit and yield. Plants are not long-lived.

***Short-day cultivars for perennial production- Fresh market*** (Much of this information from Stan Hokanson (USDA-ARS, Beltsville, Maryland).

‘Earliglow’- Medium-small fruit, moderate production, outstanding flavor and very early. Phytophthora root rot (red stele) resistant.

‘Honeoye’- Large production, med-large fruit. Early mid-season. Most widely planted eastern cultivar. Can be very early in some environments.

‘Jewel’- Reliable producer of high quality fruit in the late season.

‘Allstar’- Large production of high quality fruit in the mid-season. Phytophthora root rot (red stele) resistant.

## V. Processing industry

While this has been touched on throughout this document, I will briefly touch on it again.

Berries for the fresh market must:

- Ship well

- Be firm

- Be attractive

- Be large

- Be colored (an “under ripe” bright red is preferred to a full ripe but darker fruit; while some white is acceptable too much is not)

- Be sweet (This is usually due to low acidity rather than high sugars)

- Have an attractive “cap”, the green calyx.

Berries for processing must:

- Be fully red on the exterior and interior

- Have excellent flavor

- Have high acid levels; anthocyanins (red pigments) are more stable in an acidic state.

- Have high sugar levels

- Have a low “drip loss” - When fruit is thawed the fruit must not lose so much liquid that it loses its integrity.

- Cap- Berries for processing are picked with their “caps” off. Too much fruit is

lost when these have to be cut off in a processing plant.

Having said all this, today's consumers are not necessarily interested in the highest quality rather they are interested in good quality and a cheap price. For many years, the processors were willing to pay \$US 0.22 to 0.44 more per kilogram for Pacific Northwest fruit than for California fruit. Because Pacific Northwest fruit were more expensive, they went to higher value markets (i.e. the Japanese) or into products that did not have a high fruit content (i.e. yogurt and ice cream). While the Japanese and the ice cream companies still buy in the Pacific Northwest, many yogurt producers now buy California berries and dye them (i.e. red beet juice) to get an acceptable product. The long-term outlook for strawberry growers in the Pacific Northwest producing strictly for the processing market is not good. In a good year they receive \$US 1.10-1.20/kg. With rising labor costs (\$US 6.50/hr minimum wage) and low production per hectare (a good yield would be 22000 kg/ha and when you only produce fruit for 4-5 weeks/year instead of 6-8 months/year you will have lower yields), it will be difficult to stay economically viable.

Strawberries are a very popular item in processed products and they can be found in every department of a grocery store (juices/carbonated drinks, dried in cereal, in yogurt in the dairy section....). So the long term future for the industry as a whole in the U.S. is excellent.

## **VI. Trends for the future**

- A replacement for methyl bromide as a fumigant must be found. Methyl bromide was originally supposed to be taken off the U.S. market in 2000. An extension has been granted and the industry now has until 2005 to find a replacement. While some people thought that the removal of methyl bromide from California would cripple the industry, this is not true. If methyl bromide were to be lost tomorrow, yields might be reduced by 10-20% and some land would come out of strawberries, but the industry as a whole would continue.
- New cultivars will continue to drive increases in yield and earlier and later ripening season.
- More private companies will have their own cultivars that no one else can grow.
- More “unique” licensing agreements will be devised. For instance, some grocery chains now have agreements where certain cultivars will only be sold through their stores.
- California will continue to be the world leader. California has been a good example of what cooperation between the private industry, grower organizations, and the research community (Univ. of California-Davis and USDA) can do when working toward a common goal. The cultivars and systems they developed and continue to develop are being exported to Mediterranean Europe and Africa, where they will supply the European fresh market, to Australia, South America and around the world.

- The North Carolina system will become the standard practice in the eastern states with mild winters.
- The matted row system will continue to be the main production system in the Pacific Northwest and the northern U.S.

I hope to someday come and present this to you in person. Until that time, if you have any questions please don't hesitate to contact me.