Filbert Production

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INTRODUCTION

The filbert, *Corylus avellana* L., is a primitive angiosperm plant that, when compared to other fruit trees, possesses many unusual traits:

1) It is monoecious, self-sterile, and wind pollinated. Its female flowers lack petals, nectaries, sepals and ovary. At the time of pollination the rudimentary flower consists of 2 styles joined at their base by a few meristematic cells that ultimately become the ovary.
2) In areas of commercial production the filbert blooms in midwinter. In Oregon, bloom usually occurs from mid-January to mid-February.
3) As much as half a year can elapse between pollination and fertilization. The pollen tube grows to the base of the style and becomes quiescent until the ovary and ovules are developed in June and July.
4) Because the flowers initiate in August of one year, and the nuts develop in August of the next year, the apex of the nut is more than one year older than its base.
5) The filbert plant habit is bushy, but in the United States filberts are trained to grow as single trunk trees.
6) In mild climates the filbert appears to be growing throughout the entire year. This is due to the separately timed activities of the male catkins, the female flower clusters and the vegetative buds. Defoliation in November is followed by early blossoms in December.

While the filbert is a minor nut crop in the United States, supplying only 3% of all the nuts produced, it is the largest nut crop world wide. Turkey produces about 71% of the world production of filberts which in 1983 is estimated at 451,000 tons. This is 108,000 tons more than the 1981 record world almond crop. Italy is the second largest filbert producing country having 21% of the world market, followed by Spain with 5% and the U.S. with 3%. Filbert trees can grow and reproduce throughout much of the temperate zone, but commercial nut production is limited to the four counries mentioned above. Each of these major growing areas are close to large bodies of water which provide relatively mild winters and cool summers.

Since the Oregon (U.S.) filbert industry is so small in comparison to that of Turkey, it is interesting to compare production methods. In Turkey, a small sized filbert nut is produced on short multi-trunked trees that usually grow on steep hillsides adjacent to the Black Sea. The crop, which ripens in August, is hand harvested from low growing trees and the nuts are dried in the sun. Ninety percent of the farms are less than 4 acres in size, are not mechanized and have limited transportation.

Oregon's Willamette Valley produces 98% of the U.S. filbert production. In Oregon, a large sized nut is produced on tall single-trunked trees grown on river bottom loams. The Oregon crop ripens in early October and is mechanically harvested from the ground. Since October is rainy, artificial drying is essential. To support the high cost of mechanization, farms must have a minimum of 50 acres. Smaller filbert orchards usually exist as part of larger, diversified farm operation.

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From 35 to 55% of the U.S. filbert consumption must be imported annually due to a lack of adequate product to meet the demand for this nut. The pricing structure of Oregon filberts is dominated by Turkey's annual production. In 1980 (a good crop year), U.S. growers were paid $0.60/lb while this year (a short crop year) the price is $0.30/lb. Several other factors work against the U.S. filbert industry: 1) filbert production in Turkey is government subsidized; 2) the 1983 dollar is strong, which tends to limit exports and favor imports; and 3) the low U.S. tariff of $0.08/lb on imported filberts is only half the tariff charged for other nut crops.

The Oregon filbert industry has been growing steadily but very slowly since 1920. About 25,000 acres in filbert orchards are in production annually and nurseries produce enough trees to plant about 1,000 acres each year. Nut production per acre has increased due to improved cultural techniques and to higher density plantings. The filbert is biennial in bearing habit which makes an orderly marketing system difficult. In 1982, Oregon produced 18,400 tons of filberts, but in 1983 the crop is estimated at only 6,500 tons. The total annual filbert production is not sufficient to supply the U.S. demand or to explore new market outlets. For the past two decades, about 5,000 tons of inshell filberts were used during the Thanksgiving and Christmas holidays and this market is not likely to increase. Nut production in excess of 5,000 tons is shelled and sold in bulk as kernels to bakers and salters. No convenience packs of filberts for home use or snack packs for the retail consumer exist; such products would require the industry to double in production.

Over 80% of the European filbert production goes into chocolatae manufacture. The larger sized nut produced in Oregon is not as readily acceptable for this use. However, in recent years, an export market to Germany has increased from a few hundred tons to 4000 tons. This export market is now in jeopardy because France has started growing the larger Oregon varieties. In France, they will have several advantages over Oregon filberts: 1) their filberts mature earlier; 2) they are closer to the consuming market, and 3) they have available more favorable currency exchange rates with their European common market partners.

CULTIVARS

Of the few filbert cultivars available to an emerging industry during the 1920's, Barcelona appeared to be the most productive (Fig. 1). Today, 87% of Oregon's production comes from Barcelona, 7% from its pollinizer, Daviana, and the remaining 6% from all other cultivars. As with any monoculture, the faults of the cultivar become the problems of the industry. Barcelona kernel yield is only 40%. Some selections in the Oregon State University breeding program have 65% kernel yields, have higher quality kernels and are much more productive cultivars than Barcelona. Barcelona produces from 10 to 25% blanks (shells without kernels) which reduces potential yield and creates processing problems. Barcelona is also one of the few cultivars subject to a physiological disorder called brown stain. This disorder appears at the time of shell lignification, causing a breakdown of cell membranes and the release of phenolic substances whose subsequent oxidation results in the brown stain. The interior of the nut and the developing kernel are affected. In 1983, brown stain reached the most serious proportions ever observed, affecting 84% of the nuts in two Oregon orchards. Statewide, losses ranging from 20 to 40% were commonly recorded. The

cause of brown stain has not been determined and to date the disorder has not been artificially induced. Brown stain has occurred in serious proportions in 1931, 1939, 1963, 1969, 1982 and 1983. The disorder occurs throughout the Willamette Valley, yet can be as discrete as one nut in a cluster of three. This problem has now occurred two years in a row and is generating a lot of research interest.

Improved filbert cultivars have long been needed in the Pacific Northwest. Before 1935 numerous seedling selections were named and introduced by private growers and nurserymen. In 1960 a variety collection was assembled by Dr. Quentin Zielinski. In 1970, Dr. Maxine Thompson took over this collection and started the O.S.U. filbert breeding program. Many improved selections have developed from that program and are being evaluated in orchard tests throughout Oregon.

During the 1960's, Oregon State University Extension Service and U.S.D.A. personnel made an effort to locate superior filbert clones. Of those found, the five most promising were selected for further testing. The cultivars Ennis and Butler resulted from these five grower selections and became the first Oregon filbert cultivars to be named in 40 years. Ennis is a larger nut than Barcelona and better suited to the inshell trade. Ennis' yields have been 30% greater than Barcelona with blanks averaging only 4% and negligible brown stain. Another Ennis advantage is the 45% kernel yield. The disadvantages of Ennis include one week later maturation, and a less acceptable size and quality of kernel for bakers and salters.

Butler was introduced to replace Daviana as a pollinizer for Barcelona. Daviana yields poorly and has several other faults. Butler yields exceed those of Daviana two to three times.

Fig. 1. Barcelona, the most commonly cultivated filbert cultivar in the Pacific Northwest.

Butler pollen is compatible with both Barcelona and Ennis; however, the time of dehiscence only covers the first half of the late blooming Ennis flowers.

No new selections are available for introduction in the near future due to the long time required for evaluation. Once a selection is chosen, nurserymen need 5 to 8 years to propagate trees by simple layerage in sufficient quantities for sale. About 50,000 Ennis trees and about 250,000 Barcelona trees are now available annually. During the next 10 to 15 years nurserymen will probably increase production of Ennis while reducing that of Barcelona.

FILBERT CULTURE

Compared to many other orchard crops, filbert culture in Oregon is rela-

tively simple. Every operation from tree planting to harvesting is mechanized. Every modern orchard employs non-tillage orchard management, i.e., chemical weed control in the tree row and mechanical weed control in the aisles. The aisles are mowed with a flail mower 5 to 6 times each growing season. An orchard float is used once just prior to harvest to level the orchard floor.

Mature Oregon filbert trees are not irrigated. However, either mulch or irrigation or both are beneficial during the first three years of the tree's life in the orchard. In contrast to other orchard crops, insect and disease pests are relatively minor. In some years as little as a single spray can be applied for insect control. Most progressive growers use 2 or 3 tree sprays per year plus sprays for weed and sucker control. Although grown as a single trunk tree, the filbert sends up suckers throughout the growing season. These suckers must be sprayed 3 to 5 times each year.

Young filbert trees are susceptible to sunscald injury and bacterial blight, *Xanthomonos corylina* (Miller, et al.). Sunscald is prevented by the use of tree guards, but now more commonly by the use of exterior white latex paint. Leaning the tree slightly toward the southwest is also recommended. Bacterial blight appears to be a relatively weak pathogen that is only expressed on weak, injured, or stressed trees. Vigorously growing, but infected trees, appear symptomless. Trees over 4 years of age are rarely killed by bacterial blight. In older trees injury is expressed as a girdling of smaller stems. Control measures involve one or two copper sprays during the first few years, while mature trees are untreated.

Most Oregon filbert growers participate in an annual foliar analysis program during August. The results are returned to the growers during early winter along with county agent fertilizer recommendations. Nitrogen and potassium are the primary elements applied. If foliar boron levels drop below 50 ppm, spring foliage applications of B are made to improve nut set.

In the mild climate of western Oregon, filberts can be pruned all winter. Pruning is a practice that was often ignored in the past, but is now receiving increased appreciation. A scheme followed for many years advocated pruning every 5th row every 5th year, removing about 70% of the bearing surface via thinning-out cuts. This method opens up the tree, permits entry of sunlight, and stimulates vigor. Unfortunately, a significant yield reduction occurs in the two years following pruning. Heavy pruning is an excellent way to rejuvenate old, nonvigorous, non-productive orchards, but is too drastic for productive orchards. The goal in filbert growing is to maintain a supply of stems from 6 to 12 inches in length because this wood is most productive. Eighty percent of Barcelona nuts are set on large sized flower clusters. These clusters occur predominantly on vigorous shoots.

Pruning by the aisle, rather than by the row is being tried. This results in pruning one side (or ¼th) of each tree in every row. With this scheme, even numbered aisles are pruned in one direction, e.g., north to south in the first year. In the second year, the odd numbered aisles are pruned. This process is repeated in the east-west direction during the third and fourth years. This scheme allows for annual pruning of one side of every tree in the orchard on a four year cycle. All the brush is dropped into alternate aisles for easy removal. The aisles are opened up to allow entry of sunlight to the sides of the trees. This scheme is easily mechanized so it is rapid and

economical. In summary, a system of annual pruning sufficient to stimulate the right length of wood, maximizes filbert production. Growers are slowly accepting this concept.

AREAS OF RESEARCH

Since 1960, filbert variety trials and breeding have been carried out by Oregon State University personnel while cultural and physiological research has been done by USDA personnel. The very active state breeding program, headed by Dr. Thompson and supported by Filbert Commission funds, continues while the USDA research was largely curtailed December 1982, with the transfer of the author to the National Clonal Germplasm Repository at Corvallis, Or. However, three USDA filbert research projects are continuing.

One project involves developing new propagation techniques. A more rapid way of propagating filbert trees is needed. Layerage is slow, inefficient and limits the rapid increase of the filbert industry, and rapid introduction of new cultivars. Past research has included the development of a one-year layerage technique which starts with a dormant scion and results in a self-rooted tree. This technique is carried out in the greenhouse between January and November. Although unsuitable for commercial tree production, this technique can save several years in preparing self-rooted layer beds.

Another technique developed as part of the propagation research involves the hot callusing pipe. This pipe was introduced in 1980 as an aid to healing graft unions of bench grafted trees. In addition to filbert trees, the hot callusing pipe has proven to be beneficial in the grafting of other nut trees, fruit trees, woody ornamentals and certain conifers. The hot callusing pipe can only be used during the dormant season and functions by localizing heat at the graft union, while permitting scion buds and rootstock to remain dormant at existing ambient air temperatures.

A third propagation research technique, filbert micro-grafting, was started in 1981. This involves grafting growing shoot tips into germinating seedlings measuring 1 mm in diameter. A cleft is made in the tiny potted rootstock and the union is wrapped with parafilm. The graft is covered with a glass bottle and placed under continuous fluorescent light. A union may form in as little as 7 days in these succulent tissues and growth of the shoot tip resumes after about 28 days. Seeds for the rootstock are obtained from a red leafed tree, *Corylus avellana* var. *fusco-rubra*, which produces about 50% red leafed seedlings. The red seedlings become marker rootstocks for the green scion shoot tips. With this technique, 500 tiny grafted trees will fit on a desk top. Trees grafted between March and May can be transplanted and grown to a height of 3 feet by fall. By use of micrografting, thousands of trees can be placed with nurserymen within a year for the rapid introduction of a new cultivar.

At least 11 different laboratories throughout the world are attempting to micro-propagate the filbert. With one exception, all are having problems with contamination and poor multiplication. The exception, Dr. Wilbur Anderson in Mount Vernon, Washington, will have about 1,000 cloned filbert trees ready to plant next spring.

The second research project involves the development of a filbert rootstock. This work was started in 1968 with the non-suckering characteristic assigned greatest importance. Other desirable characteristics are easy rooting, yield enhancement, growth control and red foliage. Few candidate trees were available at the

start, but through breeding, several hundred non-suckering rootstock selections are now being screened. Screening is a very time consuming process as each rootstock selection must be cloned via simple layerage. Multiples of each clone are topworked with Ennis as the common scion cultivar. The grafted trees are then planted with cooperating growers for subsequent yield evaluation. About 600 grafted rootstock selections are planted each year and some of the first test trees are just beginning to bear. As yet, no rootstock selection has been named or released.

The third project is a cooperative one involving evaluation of advanced selections from O.S.U. breeding program and is being done in cooperation with Dr. Thompson. Seventy-five trees of each of 3 advanced selections and Barcelona are grafted to Daviana rootstocks annually. The 50 best trees of each clone are then planted, 10 each at 5 locations, for evaluation of growth and yield performance. In the future, this project will result in the naming and introduction of improved kernel type Oregon filbert cultivars.

The filbert industry in the U.S. is favored by a number of advantages that should make it an enterprise with a bright future. Nut flavor and keeping quality are excellent and filberts can be used in any nut recipe. The Pacific Northwest coastal valleys provide an ecological niche optimally suited to commercial filbert production. An abundance of fertile soils would permit the industry to double in size several times before land would become limiting or the U.S. demand for this nut was satisfied. The industry is firmly established with a 70 year history of experience, with knowledgeable growers, with a good research and extension service program, and with a progressive leadership. That leadership recognizes that continued industry growth is essential to providing momentum for marketing, legislative and research programs. Compared to other orchard crops, filberts have relatively few disease and insect pests. Almost every cultural management practice is fully or partly mechanized so production costs are relatively low. Important contributions to the long term growth and prosperity of the U.S. filbert industry will be made by research via new varieties, beneficial rootstocks and improved propagation techniques.