Critical Factors in Establishing Chestnuts in the Pacific Northwest

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ABSTRACT. Chestnuts are a highly productive orchard crop that can be grown in the Northwest on better soils. Small planting and individual trees were brought to western Oregon by pioneers and British sailors, where they have grown well for over 100 yr. Ideal orchard soils should be deep, well drained sandy loam or loam mixture. Irrigation is recommended in Oregon due to tree establishment and nut sizing in late fall when weather is normally dry. Chestnuts can be harvested mechanically and improved varieties can produce from one-to-two tons per acre yearly at maturity, if planted and grown properly. Marketing fresh chestnuts can be extended for several months through cold storage. Dried or frozen products can be marketed year round. Although acreage is growing slowly, some growers are enthusiastic about potential with $4 to $6 per kg versus $84 for hazelnuts. Multiple harvests in October would place high quality fresh products in the market before exports arrive from Korea and Europe. Available varieties include `Colossal,"Layeroka,' `Myoka,"Skookum,"Silver Leaf' and others. Italian and Euro-Japanese hybrids were recently released from the Extension Service to nurseries. Although relatively free from insects and blight, *Pseudomonas* spp. and secondary fungi have presented problems. Propagation studies showed early summer wire ringing of juvenile shoots surrounded by moist sawdust was the most successful and commercially acceptable propagation method of trees.

The Northwest maritime climate west of the Cascade Mountains has the potential for several thousand acres of chestnut production. Some excellent well-drained soils make this area comparable to other chestnut production areas of Asia and the Mediterranean area of Europe. The lack of summer rainfall, however, necessitates irrigation as nut size increases primarily in the last 5 wk before harvest.

Small plantings have thrived with minimal attention for over 100 yr having been brought overland by pioneers and via water by British sailors. Although acreage is growing slowly, farmers are always interested in potential new crops. Presently, hazelnuts command $90 per kg and produce 290 to 360 kg per ha. Chestnuts are expected to yield as much as 50% more nuts, especially for improved varieties and large sizes, and bring $4 to $6 per kg.

An applied research grant enabled me to study varieties and production factors in northern Italy during September and October 1989 (University of Torino, Instituto di Frutticoltura Industriale, Asprofruit Experiment Sta-

tion, and Piemonte region) and also to visit the INRA experimental station at Bordeaux, France.

ORCHARD ESTABLISHMENT

Chestnut trees begin to reproduce in 4 yr, produce a commercial crop in about 7 yr, and should produce a full crop of 360 to 540 kg of nuts per ha in 12 to 15 yr. Conditions for their growth include well-drained soils, irrigation and good fertility. Landowners have few pests and diseases in Oregon that require control measures. They could use chestnuts to replace several hundred ha of hazelnuts infected with eastern filbert blight, and replace unprofitable cherry, berry or nut plantings.

Most chestnut plantings in Oregon have been established on a 6 x 6 m spacing. A filler system with timber-type chestnut trees or other varieties is practical. A second chestnut variety would be planted in the middle of a 9-m square, and upon crowding, the least valuable would be removed.

White latex paint applied post-plant to the trunks has been found to prevent sunscald. This also helps prevent the invasion of European shot hole borer.

VARIETIES

Initially, varieties with good nut size, yield, flavor and pellicle removal are recommended. Although chestnut blight is not known in the Northwest at this time, varieties resistant to the disease are ultimately needed. `Callosal' is becoming the major variety due to the large size of its nuts and good production. The pellicle of the nut is easily peeled, especially when pollinized by a specific "Callosal Pollinizer" variety. It has good flavor and appearance. `Silver Leaf' has not been readily available, however, it has been observed in California to be unaffected by chestnut blight, while European chestnut trees scattered throughout the area were frequently infected. It has a medium to large nut. layeroka,"Myoka,"Skookum' and 'Dunstan' hybrids and other varieties have been planted. Several Italian, French and Euro-Japanese hybrids also have completed quarantine and were made available to nurseries for propagation in 1992.

DISEASES AND INSECTS

Although chestnut blight *(Cryphonectria parasitica* [Mum] Barr) has not been reported in the Northwest since 1934, several other organisms have killed branches and weakened trees. Those cankers have been caused by *Pseudomonas syringae* van Hall, *Cytosporella sp., Cryptodiaporthe castanea* (Tul.) Wehm. and *Libertella sp.* Bordeaux or fixed copper dormant sprays are recommended for control of these canker diseases.

Few insects have affected this crop. Filbert worm was found in a few chestnuts near abandoned hazelnut trees. European shot hole borer has been the most destructive insect in the Northwest. An early spring application of Thiodan is necessary, especially near wooded areas to control these pests.

CHESTNUT HARVEST AND PROCESSING

Commercial-sized chestnut plantings of five acres or more can be machine harvested with a McNair Harvester, a machine commonly used in hazelnuts. After one day curing at room temperature, the nuts may be shipped directly, or put into 0-3 C cold storage to preserve freshness and to extend the marketing season beyond Christmas. A converted walnut huller has been used to separate nuts from persistent burrs. Nuts should be sized and graded with prime sizes and quality for fresh market, and the remainder for dried nuts and flour. There currently is a surplus of cold storage facilities in the Willamette Valley, enough to hold 180 mt or one-half of the crop from about 120 mature ha (one-half shipped soon after harvest during most of October). Depending on the acreage or yield success, there may be opportunity for additional storage or handling facilities at related businesses.

Processing business opportunities should arise for candied, frozen or dried nut products. The latter is a very practical consideration due to the ease of shelling and peeling the brittle exterior. The remaining hard nut can be stored in clean, room temperature facilities for months. Dried chestnuts can be easily handled in the retail markets and quickly rehydrated for many culinary uses.

PROPAGATION STUDIES

Italian and Euro-Japanese varieties were obtained and held in quarantine at the USDA Plant Germplasm Repository, Corvallis, Ore. Propagation studies were conducted to increase budwood trees for commercial nurseries and to avoid root-scion incompatibility problems by vegetative scion rooting.

METHODS AND MATERIALS

Hardwood (one year shoots) and softwood (current season growth) cuttings were dipped into commercial "Dip N' Grow," a mixture of 1% Indole-3-butyric acid (500 to 3000 ppm IBA) and 0.5% napthaleneacetic acid, for one minute. Cuttings were placed into 2.5 cm deep perlite expanded mineral media, in 3.0 cm deep propagation boxes. These were placed into chambers and misted at the rate of 15.2 1 per h.

STOOL BED

Two- to three-yr-old dormant trees were pruned 5 cm above the soil in spring 1991. The resultant crown shoots were girdled in July and August with wire "hog rings" near the soil. IBA rooting hormone (1,000 ppm) was applied with fine steel wool at the bark constriction. Twenty cm of sawdust was heaped around the shoots and kept moist throughout the summer.

RESULTS

Table 1 summarizes the rooting results over a 2-yr interval. Etiolated callus initially looked promising, developing callus tissue, but did not develop roots. This may have been due to late application of shade material (foil). Poor results with dormant cuttings may have been due to

Table 1. Summary of Rooting Results.

Type	Variety/ Origin	Date	# of Samples	Number Rooted	Percent
greenwood	Italian	6/90	46	2	4.3%
greenwood[1]	Korean	6/90	54	7	13%
greenwood	LB farm	7/90	282	18	6.4%
greenwood	Wesserman	7/90	28	4	14%
greenwood	Olson	7/90	54	0	0%
etiolation[2]	Smith farm	8/90–10/90	15	0	0%
etiolation[2]	LB farm	8/90–10/90	18	0	0%
dormant[3]	Italian	12/90–2/91	68	0	0%
dormant	LB farm	12/90–4/91	365	0	0%
greenwood[4]	LB farm	91	25	0	0%
greenwood[5]	LB farm	91	120	12	10%
greenwood[6]	LB farm	91	77	10	13%
greenwood[7]	LB farm	91	55	0	0%
stooling	Colossal	90	32	24	78%
stooling	Silver Leaf	91	30	15	50%
stooling	Colossal	91	47	28	60%
stooling	Colossal	91	46	20	43%
budding[8]	Italian	91	253	103	41%

[1]Parent plants larger, older and grown in screen house
[2]100% callus but none rooted
[3]Root upside down
[4]Sawdust medium
[5]100% perlite medium
[6]Peat moss:perlite medium, 1:3
[7]Peat moss:perlite medium, 1:5
[8]Apparently viable buds after 2 months

Table 2. Summary of Budding Results.

Variety	# of Buds	# of Survivors	Percent
Maraval	29	23	79%
Primato	28	13	46%
Bouche de Bétizac	26	12	46%
Tsukuba	20	5	25%
Précoce Migoule	30	12	40%
Ginyose	20	5	25%
Marone di Luserna	27	10	37%
Belle Epine	20	5	25%
Ishisuki	20	4	20%
Marigoule	34	14	41%

the unusually cold period in which the cuttings were taken. We did not have a second winter season in which to test dormant cutting methods. Cuttings placed close to the bottom of the box rooted poorly due to excess water from a perched water table in the one-half-inch zone on the bottom. Cuttings should be no closer than 1.8 cm to the bottom. Summer stooling, spring and summer whip grafting and fall bud grafting appear to have commercial potential.

A significant result not indicated in Table 1 is the success rate in transplanting rooted cuttings from propagation boxes into the field. None of the 1990 crop survived transplanting while all of the 1991 crop survived. This may have been due to longer time spent in propagation boxes and, hence, greater maturity.

Table 2 presents results from the budding experiments that were summarized in Table 1. Buds from the indicated varieties were grafted onto 'Mapleton' and 'Colossal' seedlings. There was little difference in the survival rate between the two rootstocks. 'Mapleton' seedlings originated with British sailors over 100 yr ago and appear to be of European origin. `Callosal' tree is of unknown origin; it has large nuts and was found in the Nevada County foothills of California.

CONCLUSION

Throughout the experiment, a major problem was the availability of plant material. This is seen especially in the small number of samples shown in sections of Table 1. Sample lots might have been "below average" or "above average" with regard to rooting; there is simply no way to tell. Furthermore, results that are based on one or two seasons data may not be indicative for all seasons since the annual variation in environmental conditions may be significant. As the plant source materials mature and grow in size, they will provide additional material for rooting studies. Larger samples over longer time intervals are needed for statistical treatment.

Our observations indicated that a large percentage of cuttings that developed callus fail to develop roots. It is possible that callus development may not be an accurate

indicator for chestnuts. A second possibility is that our propagation methods were deficient in promoting the development of roots from callus.

Most reported research has used juvenile shoots from quite old parent trees. In some cases, parent plants had been pruned heavily to promote shoot growth for periods in excess of 10 yr. Most of the material available for this experiment was only a few years old and not maintained in a heavily pruned condition. It is possible that older plants would develop stronger shoots that are more suitable to certain propagation methods. Ringing or girdling of the crown suckers was most successful, and similar to commercial practices for hazelnut propagation. Shoots that rooted partially in soil had better root development but were more difficult to harvest than those confined to sawdust.

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