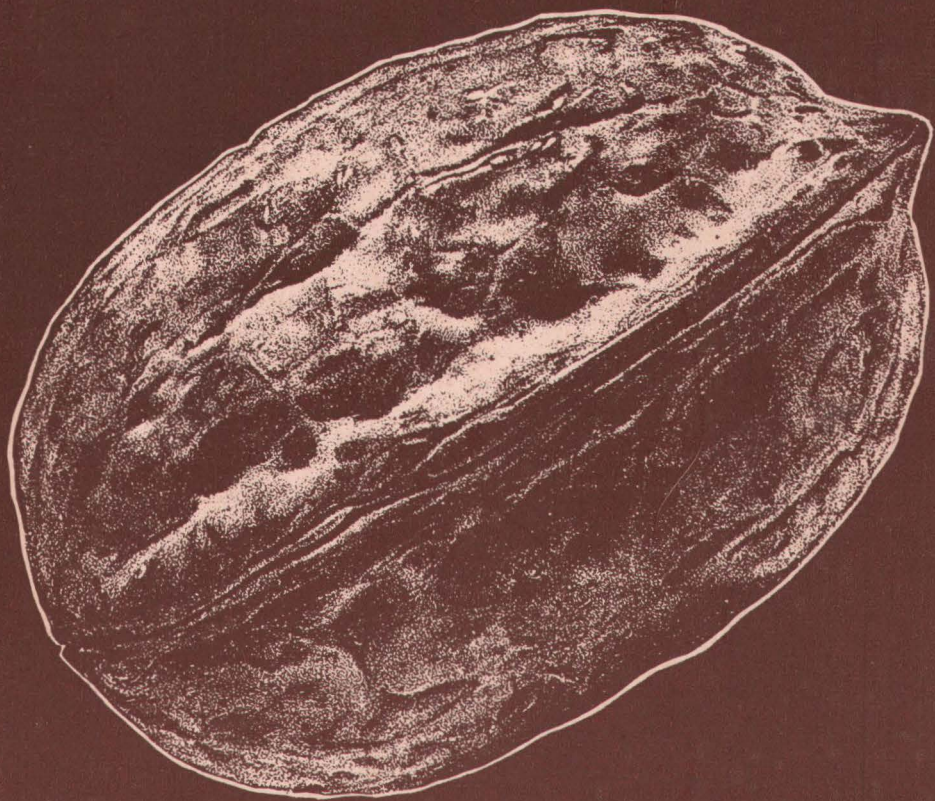


Producing Walnuts *in Oregon*



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Producing Walnuts

In Oregon

COMMERCIAL WALNUT production in Oregon began about 63 years ago when Thomas Prince started an orchard in Yamhill County. The first orchards consisted entirely of trees grown from Persian (English) walnut seeds (*Juglans regia* L.) imported from France. Prince was active in the promotion of walnut growing in Oregon, and some of the orchards he planted are still producing.

It soon became apparent that orchards of seedling walnut trees had most of the objectionable features of those of other kinds of seedling trees. Extreme variation existed between trees—difference in time of bloom, size and form of nuts produced, and yield. Before the turn of the century some grafted trees were introduced into the Pacific Northwest, but grafted trees were not preferred by growers to seedling trees until the Vrooman

Franquette became established as a desirable variety. Since 1920 practically all the nursery-grown walnut trees planted in Oregon have been grafted.

In 1950 there were approximately 27,650 acres of walnut orchards in Oregon, less than one-fifth of the total walnut acreage in the United States. This acreage has decreased somewhat because some orchards were removed following severe freeze damage in 1955 and others were lost through residential developments. New orchards are being planted, but the new plantings probably will not offset the losses.

During the past 63 years many discouraging problems have beset walnut growers in Oregon. Even so, some growers have managed to sustain high yields at relatively low costs. The purpose of this bulletin is to describe the methods by which walnuts can be profitably produced.

Walnut-growing Districts

The principal walnut-growing districts are in western Oregon, extending from Washington County south to Douglas County.

The coastal area has a cool growing season with considerable fog and cloudy weather, conditions favorable for development of blight and unfavorable for production of good-quality walnuts.

East of the Cascade Mountains pro-

duction is limited by low winter temperatures and late-spring and early-fall frosts.

Most of the walnut orchards are located between the valley floor and an altitude of 800 feet. Until the 1955 freeze orchards on river terraces or valley floors had sustained greater losses from cold injury than those on hillside soils. Except for these losses orchards on the valley floor have borne

more heavily than those on hillsides. Valley soils are deeper, more fertile, and better supplied with moisture, including irrigation water if needed. In 1955 damage from a mid-November cold spell was almost catastrophic in hillside orchards, especially in Washington and Yamhill counties, but relatively light in the valley-floor orchards. In these counties many old, productive trees were killed and others injured so seriously that 5 years later they had not recovered. This freeze was in the form of a fast-moving mass of cold air coming down from the Columbia River Gorge. Periods of cold weather

that have injured walnut trees in the valley-floor orchards have mostly been radiation freezes or a "still cold" as opposed to a fast-moving cold. While incidents of "still cold" injury are most common and upland orchards are less subject to them, no walnut orchard planted in Oregon is free of this hazard. Probably the safest climatic district for walnut growing in Oregon is from Benton County south. Most of this area has valley-floor soil types with good productivity capacity, but these lands are usually more expensive than hillside sites in the more northern counties.

Soil Requirements

Walnuts do best on soils where roots can develop evenly to a depth of 8 to 10 feet. In addition to good topsoil, this means that subsoil must be free of rock, impervious clay, or layers of gravel.

Oregon's walnuts are commonly found on the Newberg and Chehalis soils of river bottoms, on Willamette soils of the valley floor, on Olympic and Aiken basaltic soils, and Sites and Melbourne shale and sandstone soils of the hills. Few orchards are profitable or even surviving on such soil types as Polk, Amity, and Carlton. In Newberg and Chehalis soil types sand and gravel subsoils are common. If these subsoils are located close to the surface the land must be considered unsuitable for walnuts. Olympic and Aiken soils are sometimes underlain by a tight, compact, impervious subsoil. If these layers are much less than 10 feet below the surface the suitability of the soils is questionable.

Soil type alone is not sufficient to determine a satisfactory site for a walnut orchard. An auger, soil tube, or

posthole digger should be used to check to a depth of 10 feet or so. A few feet beneath the surface, solid rock may be found or compact subsoils with a mottled color indicating poor aeration and drainage. Besides affording few or no pores large enough for roots to enter, this kind of subsoil layer often supports a water layer that further restricts root growth. Some excellent surface soils are underlain by loose gravel and coarse sand with such large pore spaces that excessive aeration and drainage permit little or no root growth.

Unfortunately, not much can be done to improve unfavorable soil conditions. Blasting has not been effective. Often it merely increases the trouble by compacting the soil further. In a few cases "subsoiling" has helped where the impervious layer is not thick and is close to the surface, but generally this practice can not be recommended. If the orchard is already established and is declining because of subsoil problems, thinning the trees is about the only helpful practice.

Temperature Requirements

Walnut trees are sensitive to both low and high temperatures.

High temperatures

Excessively high temperatures are not a limiting factor in any part of the state, but occasional temperatures around 100° F. may cause sunburn on the hulls of the nuts and poor quality of the kernels. Sunburn may result in dark-colored kernels, kernels with black specks on them, or even complete failure to develop, depending on the time in the season when the high temperature occurs. Lack of excessively high temperatures has helped give Oregon-grown walnuts more of the desirable light-colored kernels than are produced in the hot areas of California. A certain amount of warm weather, however, is needed to produce good-quality kernels. Temperatures of 80°-90° near harvest time have resulted in well-filled kernels with high oil content. The entire summer of 1948, for example, was cool and walnut kernels were excessively shriveled and had a low oil content. Walnuts produced by the same trees in warm seasons had kernels with a high oil content and little or no shriveling.

Low temperatures

Under the mild climatic conditions of Oregon walnut-growing sections, trees are slow in attaining full dormancy in fall or early winter. As a consequence early cold periods may injure or kill many trees, as on November 15, 1955. In 1935 a temperature of 15°, when the trees were in full leaf, caused a heavy loss of walnut trees but very little injury to other fruit trees. In 1919, when -15° was recorded just after the foliage had fallen, walnut trees were injured just about as much as other trees. Late-winter freezes seem to cause less injury to walnut trees than to other fruit trees. In all events frosty areas must be avoided. Varieties that leaf out very early may be injured by spring frosts and should not be considered for Oregon. Even late-leaving varieties such as Franquette can be injured by late spring frosts if trees are located in a frost pocket. Frosts occurring in early or even late fall can injure immature shoots. This injury may not be noticed until the shoots fail to leaf out the following spring. Much of this type of injury has probably been charged to winter killing instead of frost damage.

Varieties of Walnuts

After having determined that a site is satisfactory for growing walnuts, the next step is to decide what variety or varieties to plant. This is not an easy decision.

Most walnuts are sold "in-shell." For this trade the size of nuts and good sealing and other shell characteristics are more important than kernel content or quality.

Sales of shelled nuts in cellophane bags or in vacuum-packed cans are increasing, however, and this trend affects variety requirements. Freight costs on shelled nuts are reduced substantially. Many present-day housewives prefer to use cracked nuts for cooking. In fact, many want nut kernels not only picked out but sliced and measured. For the shelled-nut trade,

bleaching is no longer necessary, and shell characteristics that do not affect the quality of the kernels are of minor importance. Chief requirement is a heavy producing variety, suitable for shelling, with a high percentage of good kernels.

Early maturity is desirable. Walnuts in California mature nearly a month earlier than they do in Oregon, giving California shippers an advantage in getting nuts on the market to meet the early demand. Oregon growers cannot achieve this early maturity by planting a variety that blooms early and consequently matures early, because varieties that bloom early in Oregon are extremely subject to injury from spring frosts. In Oregon growers need a variety that does not bloom too early but has a shorter growing requirement. Some progress has been made in the search for such a variety. Oregon growers must continue to search for a variety more resistant to cold injury than any now grown commercially. Progress has also been made in this direction. A description of several Oregon varieties follows.

Franquette

Up to the present Franquette has been the standard walnut variety in

Oregon. Franquette has several good points in its favor, but also has some objectionable characteristics. It is a reasonably heavy producer, and the kernels are exceptionally light in color. The tree leafs out very late in the spring, and is less susceptible to spring frost damage than most varieties grown in Oregon. Franquette has the following undesirable characteristics: it matures too late for harvesting and processing in time to meet early market demands; the kernels are inclined to be somewhat astringent; and the tree is very susceptible to cold injury because it becomes dormant so late in the fall.

Whole nuts average about 42 percent kernel. The light color of the kernels is probably the best selling point for the Franquette as grown in Oregon. This same variety grown in California under higher temperatures does not produce kernels as light in color. California nut buyers are eager to get Oregon-grown Franquettes for mixing with darker-kerneled California varieties to improve the color grade.

Franquette is our standard variety to date, and is the basis by which other Oregon varieties are judged. It is still worthy of consideration for planting, and probably will be grown and sold in

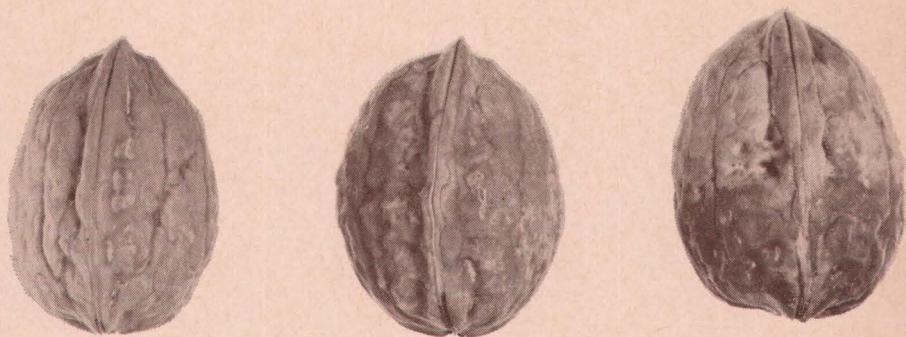


FIGURE 1. Franquette walnuts (natural size).

Oregon as long as walnuts are produced. Figure 1 shows some hulled nuts of the Franquette variety.

Mayette

Some growers have done well with another of the older varieties, Mayette. Mayette has two principal advantages; a larger nut and a sweeter kernel. It does much better in the southern part of the state than in the northern. Mayettes, although larger, do not have as high percentage of kernel as Franquettes. They average about 40 to 41 percent. The shells are not sealed as well as those of Franquettes. The Mayette tree is even more susceptible to cold injury than the Franquette.

The principal objection to the Mayette variety is that the tree is not as consistently a heavy bearer as Franquette. It is alternate bearing, with a heavy crop followed by an extremely light one. The Mayette is a round nut, generally not as acceptable to processors as the longer Franquette nut. For other than home or local use it is doubtful whether the Mayette variety should be given much consideration in future plantings. Figure 2 shows hulled nuts of the Mayette variety.

Hartley

One of the newer varieties origi-

nating in California is the Hartley. It is a good variety for California. Main advantages are large nuts, reasonably light-colored kernels, good flavor, and a lateral bearing habit which helps increase production. So far tests have not been very satisfactory in Oregon. The nuts do have good size, but they are often poorly filled. The good nuts contain between 42 and 43 percent kernel. Hartley probably requires a warmer growing season than is generally experienced in Oregon. The grade-size of the nuts is large primarily because their shape is large at the base and somewhat top-shaped. This wide base prevents their passing through the smaller grade rings, even though their weights may not be as much as those of Franquette nuts of smaller grade size.

Nuts of the Hartley variety have an opening in the base end about the size of a good-sized pin hole. In Oregon, where the nuts are usually harvested under wet conditions, this opening has resulted in yellow discoloration of the kernels.

Hartley does not seem to differ much from Franquette with respect to cold injury.

The Hartley variety has been much more seriously affected by blight than

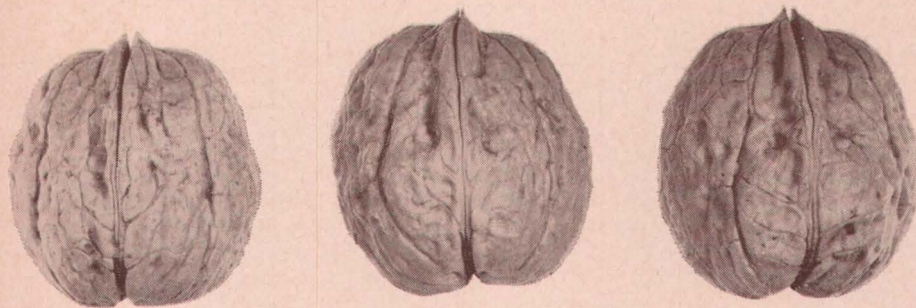


FIGURE 2. Mayette walnuts (natural size).

the Franquette, probably because the trees were sprayed in accordance with the schedule for Franquette. In an orchard of mixed varieties, blight control is complicated unless the varieties bloom at the same time. Hartley blooms before Franquette. (Susceptibility of Hartley or any other variety to blight should not be held against it, because blight can be controlled if a solid planting is made.) At present the Hartley variety cannot be strongly recommended for planting in Oregon. Figure 3 shows hulled nuts of the Hartley variety.

Spurgeon (Spurgeon Special; Bruce)

A variety originating in Clark County, Washington, more than 50 years ago is receiving considerable renewed interest in Oregon. This was a chance seedling found by John F. Spurgeon in an orchard then owned by Edward Detrick. Spurgeon called it *Spurgeon* and started propagating and distributing it under that name. Following the death of John F. Spurgeon, this variety was distributed by his son, John R. Spurgeon, mostly to growers in Clark County, and he called it *Spurgeon Special*. One of the original orchards owned by Spurgeon came into

the hands of J. B. Bruce of Vancouver, Washington, and Bruce, recognizing the good points of the variety, started propagating and selling trees of this variety under the name of *Bruce*.

The nuts of this variety are large, and the size of the nuts does not seem to decline with increasing age of the trees as do Franquettes. Shells are well sealed and kernels have good flavor, and, if handled correctly, the kernels are reasonably light in color. The nuts have approximately 46 percent kernel. The nuts bleach well and make a very attractive package in cellophane containers. Spurgeon trees are possibly more resistant to cold injury than Franquette, but proof is not well established. The nuts do not mature much earlier than Franquette. As yet they have not been extensively propagated, but probably such propagation will follow soon. This variety may well be worthy of serious consideration for use in the Pacific Northwest. Figure 4 shows hulled nuts of the Spurgeon variety.

Manregian

The name Manregian is given to a seedling walnut of *Juglans regia*, the

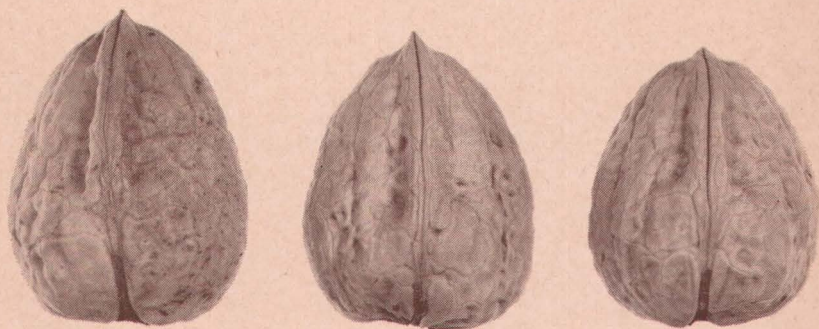


FIGURE 3. Hartley walnuts (natural size).

seed of which originated in Manchuria. The name is a combination of Manchuria and *regia*, from its latin designation. This variety was introduced into the United States by the United States Department of Agriculture, and was grown at the United States Plant Introduction Station, Chico, California. Grafted trees were distributed by the United States Department of Agriculture in 1927 under the number P. I. 18256. Scions from one of these original grafted trees located in West Salem, Oregon, have been used for further propagation. The nuts are large and round, with approximately 50 percent kernel, but the kernels are too dark for commercial use. The tree has considerable resistance to cold.

It has been found that the open-pollinated nuts of this tree produce a high percentage of vigorous seedlings. As a result its prime value is as a source of seedling rootstocks. Some open-pollinated seedlings of the mother tree have produced nuts that offer considerable promise as commercial varieties—for example the variety Adams.

Adams

The Adams variety is a daughter of the Manregian tree grown by Moses Adams at West Salem, Oregon. It is

a chance, open-pollinated seedling. Nuts have a shape more resembling Franquette than Manregian, and although the kernels are not as light-colored as Franquettes, they are satisfactory to processors. Adams nuts have contained 47 to 49 percent kernel, and taste-test panels have rated them superior to Franquettes in flavor.

Adams matures 10 days before Franquette, and seems to have at least some resistance to blight. The tree has a tendency to bear on lateral shoots, a quality conducive to heavy yields. Several nurserymen are now propagating this variety on seedling Manregian rootstocks, and it looks promising at present. Figure 5 shows hulled nuts of the Adams variety.

Promising seedlings

Since the Adams variety was just a chance seedling, Moses Adams has grown other Manregian seedlings to fruiting and 2 of 26 such trees appear promising. These two have not been sufficiently tested to warrant specific recommendations, but the nuts produced in several crop years have averaged better than 56 percent kernel, and all other characteristics are satisfactory to the trade. The color of the kernels and (in some instances) the heavy



FIGURE 4. Spurgeon walnuts (natural size).

venation are the only questionable features. In very warm seasons the dark color seems to be more pronounced, but the heavy venation seems to be hereditary.

Several Oregon walnut growers have become so interested in seedling trees of the parent Manregian variety that they are growing them to fruiting in hopes of finding one that will be better than any variety now available. In one planting of 80 seedling trees fruiting in 1959, the nuts from 10 trees contained more than 50 percent kernel and were otherwise satisfactory for marketing either in-shell or shelled.

Most of the seedling Manregian trees are earlier in maturing their nuts than Franquette. The trees likewise appear to be more resistant to cold than Franquette. A few of them, however, do leaf out a little too early in the spring for Oregon. Efforts are being made to find a variety that will excel Franquette from all standpoints, but as yet none of the seedlings can be recommended for propagation and planting.

Some other seedling selections are

being studied and observed. A Kirk seedling, tentatively being called the Howe walnut, is being watched, as it appears to have noticeable resistance to blight. Certain trees of the Carpathian race are being observed, interest being particularly centered on their resistance to cold injury.

California varieties and selections

Most California varieties leaf out too early in the spring to escape Oregon frost injury. Frost injury reduces yields. Among these varieties are the standard California Eureka and Payne, and the Nugget, which has received considerable notice recently in California.

The United States Department of Agriculture and the Oregon Agricultural Experiment Station are testing numerous controlled crosses developed by E. F. Serr, of the California Agricultural Experiment Station at Davis. Many of these crosses, however, have Payne as one of the parents, and all but one or two selections have a tendency to leaf out too early for Oregon.

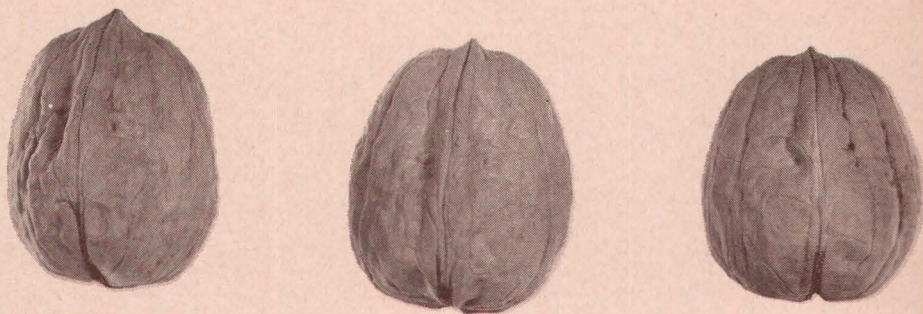


FIGURE 5. Adams walnuts (natural size).

Rootstocks and Propagation

Rootstocks

Because of their vigorous growth, northern California black walnut (*Juglans hindsii* Jeps.) seedling rootstocks were largely used for Persian walnuts. In addition several other species, Eastern black (*J. nigra* L.), Southern California black (*J. californica* S. Wats.), as well as hybrids between the black species and those between the black and the Persian species, were tried. In about 1928 a few trees, then more than 20 years of age, were found to be dying from a girdling or breaking apart of the wood at the point of union between the black walnut rootstock and the scion, or top. Later investigations show that a thin line of black powdery substance develops in the graft union and slowly extends around the entire tree until it eventually girdles it and causes its death. Sometimes this girdling is rapid (3 or 4 years) and sometimes it is slow (8-10 years), but once it starts it never disappears, and no treatments tried so far have corrected it.

At first it was hoped that tree losses from this disorder might be few, and the fear of harmful effects of mushroom root rot on Persian rootstocks kept research men from ruling out black walnut rootstocks even though no such graft-union disorders had been found when Persian rootstocks were used. Recent studies and surveys in many Oregon walnut orchards show that the blackline disorder is very serious. About 7 of every 8 walnut trees dying in Oregon were found affected by blackline.

As to the concern originally felt for oak root fungus on Persian roots, studies show northern California black rootstocks are more susceptible to in-

fection by oak root fungus, (*Armillaria mellea*) than Persian rootstocks. The loss of trees on all rootstocks from this disorder was negligible compared with the loss due to blackline. Trees of Persian varieties propagated on paradox rootstocks, sold extensively in California, are also affected with blackline. Paradox trees are hybrids of the Persian and black walnut species. In California, Persian walnuts on paradox rootstocks are slightly less susceptible to blackline than when they are on northern California black rootstocks. Since Paradox rootstocks are known to have been affected with blackline, they are not recommended for use in Oregon.

Because rootstocks grown from seed of the Manregian variety grow vigorously and are of the Persian species, they are being used extensively at present for understocks for Persian varieties in Oregon. Manregian rootstocks are more cold-hardy than seedlings of the French varieties such as Franquette and Mayette.

Other promising rootstocks are Persian seedlings grown from seed nuts produced by trees of the Carpathian race. These seedlings are perhaps even more cold-resistant than the Manregian seedlings, and some nurserymen prefer them for that reason. In addition these seedling rootstocks are almost as vigorous as the Manregian seedlings.

Propagation

Regardless of the rootstock, grafting is the common method of propagating varieties of Persian walnut. Experience with budding in Oregon has not been satisfactory. Spring buds force out so late that the shoots do not ma-

ture before fall frosts and do not survive over winter. Fall-placed buds live over winter but very seldom force out the following spring.

Any one of several methods of grafting usually results in a high percentage of living scions when the work is done by experienced operators. However, for unexplained reasons, even experienced propagators have had var-

ied percentages of living scions from year to year.

Most growers buy trees already grafted. They should obtain the best available stock from a reliable nurseryman. Satisfactory trees for planting should have 1-year old tops and 3-year old roots. They should be 6 to 8 feet high.

Pollination and Set of Nuts

Pollination of Persian walnuts is not a problem under Oregon conditions. The Franquette variety, while young, often sheds catkins before pistillate flowers are visible. As the trees become older, the tendency is for catkins to be retained longer. When the trees are old enough for the inside wood to be weak and devitalized, many late catkins will be found on this weak wood. Receptivity of the flowers is believed best when the stigmas of the flowers are in the red-tip stage, just about the time when the stigma lobes are separating. By the time the stigmas are full grown and most conspicuous, they are practically incapable of set-

ting nuts if pollen is placed on them. There are enough catkins to shed pollen to pollinate the female flowers of mature Franquette trees at the red-tip stage of the stigmas.

Experience with other varieties indicates that pollenizers are not needed for them. This may be due to the presence of so many Franquette trees, which may be pollenizing them.

Conditions other than the lack of pollen, such as boron deficiency, may affect the set of nuts. Continuous rains during pollination time can destroy pollen grains by water absorption and by preventing distribution of pollen.

Planting the Orchard

Soil preparation

As soon in the spring as the soil is workable, the land should be disked and harrowed. The smoother the land, the less difficulty in aligning trees in rows. Depressions in the soil make it difficult to use either a steel tape or planting wire to align trees.

Tree spacing

Mature walnut trees need spacings of 50 to 60 feet on the square. Since trees take considerable time to reach maturity, planting additional walnuts

or filberts as filler-trees is a common practice. These trees should be removed as the basic orchard reaches maturity. Planting the same variety avoids complications in spray schedules and harvest time. (Other trees used as fillers are discussed under intercropping.)

Filler-trees are used to increase early income and reduce production costs and capital investment. They encourage the grower to allow adequate initial spacing of permanent trees, but they must be removed before they become

large enough to crowd the permanent orchard.

A common method of spacing the semi-permanent trees is to place one in the center of each of the squares. For example, if the permanent trees are set on 50-foot spacings on the square, the diagonal distance will be nearly 71 feet, and if the semi-permanent trees are set in the center of each of these 50-foot squares, the resulting planting will then be a little more than 35 feet on the square. At this planting distance, using walnuts for both the permanents and the semi-permanents, the semi-permanents could be kept for approximately 25 years before they caused excessive crowding. Double planting in this manner will allow 34 trees per acre.

Laying out the orchard

The first step in laying out an orchard is to establish base lines and right-angled corners. This can be accomplished by the triangulation method (60-80-100 feet) to get the right angle after the base line has been established. For the novice, however, the best way to lay out an orchard is to have the work done by a surveyor, who can mark the position of the trees with stakes. Some orchardists are able to utilize other methods, such as sighting both ways to align the tree position, but it is difficult to align stakes or trees on the rolling sites commonly used for orchards.

Planting boards

After position of the trees has been marked by stakes, a planting board is useful to get correct alignment of trees. This is a board 4 to 5 feet long with a notch cut near each end and one in the center. To insure accuracy, the notches in the center and at the ends should be cut the same depth, along a

straight edge of the board. Before digging the hole, the board with the center notch should be placed against the stake where the tree is to be set. Then a stake is driven at each end notch and the center stake and board are removed. After the hole has been dug, the board is replaced in contact with the two end stakes. When the tree is planted at the center notch it will be properly aligned. After the tree has been planted, the planting board and the end stakes should be removed and moved to the next tree. If a tree-hole auger is used to insure an even hole, planting boards may not be necessary.

Planting on contour terraces on hill lands is not common in Oregon for several reasons. Heavy summer rains that cause erosion of tilled land do not occur. Usually cover crops are adequate control for erosion in winter and spring. Contour terraces interfere with preparation of the soil for harvesting and also with the use of mechanical harvesters and tree-shakers.

Planting the trees

Walnut trees should be planted before the first of April or as early in the spring as possible, before the dry season begins. If the hole is dug with a shovel, the top and subsoil should be placed in separate piles. Digging holes in advance with a tree-hole auger is probably cheaper than digging with a shovel, but the soil may dry out before planting time. Regardless of how the holes are dug, they should be wide enough to accommodate the lateral roots without bending.

Trees should be planted 1 to 3 inches deeper than they stood in the nursery. Then the bottom of the hole is filled with top soil. Roots are placed at the proper depth in the hole; some top soil is added, worked around and on top of the roots, and then tamped

well. Filling and tamping should be repeated until the hole is filled a little above the ground level. It can then be finished off with the subsoil removed from the hole. No chemical fertilizer or barnyard litter should be put in the bottoms of the holes. Many trees have been injured or even killed by excessive fertilizers placed in tree holes. Roots should not be pruned except to cut off any that are dead or broken. About half of the top of the trees should be pruned to reduce the oncoming leaf area until the root system can become established and supply moisture to the leaves and branches.

Be sure roots do not dry out before planting. They should be kept in moist sawdust, peat moss, or a tub of water. Planting on a cloudy or overcast day

helps. Trees can be heeled-in at the orchard site and removed just before planting, or the roots can be covered with wet burlap until ready to plant.

Staking the trees

Staking newly planted trees is advisable. During the period of rapid growth, the wood is often too soft to withstand the wind, especially if it is mainly from one direction. Stakes 7 to 10 feet long are satisfactory. They should be set on the windward side, 6 to 8 inches from the tree, and tied with strips of burlap, unbleached muslin, or similar material. The strips should be looped around the tree, crossed between the tree and the stake, and tied firmly to the stake with a double wrap and tie.

Cultural Practices

Cultivation

The main object of cultivation is to keep down weed and grass growth to conserve soil moisture and nutrients. Hoeing or some other cultivation may be necessary 2 or 3 times during the growing season.

Cultivation should begin early, whenever possible by the first part of April. Delay may allow cover crops or other vegetation to remove more water from the soil than is replaced by rains. Disks have replaced plows in many orchards. Disking is faster than plowing and has resulted in better soil tilth, as the work has been done more nearly at the proper time. The disk should not cut too deep, as this increases evaporation and loses much of the benefit of cultivation. Soil should be cultivated only as required to keep down excessive growth of weeds and grass. Frequent shallow cultivations are better than less frequent deep cultivations.

Cover crops

Winter cover crops are grown to maintain or even increase the fertility of the soil. They also aid in the absorption of rains and in preventing runoff and erosion. If the winter cover crop is to improve fertility of the soil, a legume should be used to increase nitrogen. If the primary purpose of the winter cover crop is to control soil erosion or to maintain the organic content of the soil, nonlegumes may be better because it is difficult to get a heavy early cover of a legume. Legumes commonly used in Oregon are Austrian peas, vetch, crimson clover, and subterranean clover. Various varieties of rye and barley are commonly grown as nonlegume cover crops. Abruzzi rye is common because it is a fast grower, stools well, produces large amounts of organic matter, and consequently checks erosion. One trouble with rye planted in early

September is that it often grows so high so quickly that it interferes with the nut harvest.

Cover crops may not be necessary where erosion is not a problem, or where soil is neither extremely sandy with little organic matter, nor extremely heavy and compact. Most orchard soils in Oregon have enough natural fertility to produce a good stand of native vegetation (weeds and grasses), and when these are turned under the following spring considerable organic matter is furnished.

Some growers sow a strip of Abruzzi rye in the tree-row middles early in the fall so that it will be tall enough in the late fall and winter to help hold the fallen walnut leaves in the orchard. With the addition of leaves and walnut hulls, considerable organic matter and potential plant food are returned to the soil.

If a fall-seeded cover crop is desired any of the following crops and seeding rates are recommended: crimson clover, 15 pounds per acre; subterranean clover, 12 pounds; hairy vetch, 30 pounds; common vetch, 60 pounds; winter field peas, 90-100 pounds; and rye, 80 pounds. These should be seeded in early September in Oregon.

Nitrogen fertilizers should be used on orchard cover crops. Yearly application will range from 40 pounds of actual nitrogen on annual cover crops in young orchards to an extreme of 200 pounds of actual nitrogen on permanent cover crops in some older

irrigated orchards. Part of this nitrogen should be applied at the time of seeding; the remainder should be applied in late February or mid-March.

In walnut orchards not more than 25 to 30 pounds of actual nitrogen per acre at seeding time is suggested. Too much nitrogen in the fall can keep the trees active so late in the season that a sudden freeze can cause serious cold injury.

Phosphorus is also needed on many orchard soils, particularly in western Oregon. Phosphorous applications should be made in the fall at the time annual cover crops are seeded or as a top dressing on permanent cover crops. The minimum application for phosphorous fertilizers should provide 60 pounds of actual phosphorous per acre. Ammonium phosphate is a convenient and economical means of providing phosphorous, since both nitrogen and phosphorous can be applied at one time.

Sulphur is low in most Oregon soils, and since many crops, particularly legumes, have a high sulphur requirement, it is advisable to provide some sulphur on the fertilizer program. On acid soils lime should be added to grow legume crops.

Since applied phosphorous becomes unavailable rather quickly in certain soils, application to the cover crop is a good way to supply the trees with phosphorous when the cover crops have been turned under.

Tree Fertilization

To date only two mineral elements applied to the soil as fertilizers have resulted in increased walnut yields. These are nitrogen and boron.

Nitrogen

Oregon experimental work with nitrogen has been confined entirely to mature Franquette walnut trees 23-25

years of age. In this experimental work, with a blanket application of 4 pounds of agricultural-grade borax per tree per year, nitrogen was the only element that resulted in significant increase in yield and quality of the nuts produced. This increase amounted to an average of 26.1 pounds of nuts per tree per year over a 5-year period and indicates that nitrogen applied to Franquette trees in Oregon can result in profit to the grower.

Fertilizers need not be applied to trees for the first 3 or 4 years after transplanting, unless grown on extremely unfertile soil. Young walnut trees heavily fertilized with nitrogen frequently become leggy, with long, wide-angled branches that are a continuous source of trouble. Some growers have had to prop their tree branches during cultivation and harvesting, as the ends lay on the ground 8 to 10 feet from the trunks of the trees.

Research-proved information is not yet available as to the best amounts of nitrogen for trees less than 23 years of age. From the 5th to the 10th year, 1 pound of actual nitrogen per tree is suggested; from the 11th to the 15th, 2 pounds; from the 16th to the 22nd, 4 pounds; and from the 23rd to at least the 30th year, 6 pounds. Higher levels of nitrogen have not been tested; so on the basis of experimental work, 6 pounds of elemental nitrogen is the maximum amount recommended.

To furnish nitrogen the following amounts of two of the more commonly used nitrogen fertilizers may be applied to trees 23 years of age or older: 18 pounds of ammonium nitrate, 29 pounds of ammonium sulfate. With 17 trees to the acre this represents 102 pounds of nitrogen per acre. If the grower wants to broadcast the material down the middle with a spreader in-

stead of applying nitrogen to individual trees beneath the drip of the branches, he should use 305 pounds per acre of ammonium nitrate or 486 pounds of ammonium sulfate.

Boron

In 13 years' work with mineral nutrition boron alone gave results that justified continuous studies. Recent experiments show that nitrogen and boron give better results than boron alone. Oregon State studies show that the effects of boron applications are not always consistent. Walnut trees on some soils failed to show any response to boron applications, possibly because of heavy textured soils and the unavailability of the boron. In some cases, however, walnut trees receiving liberal applications of agricultural-grade borax (8 pounds per tree) produced very heavy crops of nuts of small size at maturity. Some of these crops were so heavy that the trees broke down, and the grower was left with broken trees and nuts so small that payment for them was reduced. Application of agricultural-grade borax of 4 pounds per tree per year (trees 23-25 years of age) was found to correct boron deficiency and did not tend to set excessive crops of nuts.

- *Boron-deficiency symptom:* The only definite symptom of boron deficiency in walnut trees is a condition known as "snakeheads." These snakeheads are long, leafless shoots with flattening terminals that twist at right angles to the shoot, forming what looks like the heads of snakes. These terminals die the following winter.

- *Boron-toxicity symptoms:* Excessive boron causes necrosis of the leaflets. This is in the form of brown circular areas that appear first along the leaflet margins and later may coalesce



FIGURE 6. Dieback of a walnut shoot of current season's growth due to boron deficiency.

and cause a continuous marginal scorch. In severe cases this scorching will show up later along the midveins. When these circular necrotic leaf spots appear along the leaflet margins, further applications of boron should be stopped. Nitrogen applications will

gradually reduce boron-toxicity symptoms and in about 3 years they may be completely eliminated.

Boron is seldom needed until the trees come into bearing. No more than 1 pound of agricultural borax should be applied per year before trees are at least 15 years old. Trees 16-22 years of age may require 2 pounds, and older trees not more than 4 pounds per year until the first toxicity symptoms appear or until the deficiency symptom has disappeared.

Other nutrients

On the basis of leaf-analyses the principal elements other than nitrogen and boron seem to be adequate. No benefits have been derived from the use of phosphorous, potassium, magnesium, calcium zinc, and manganese so their usage is not advised at this time.

Time and method of application

The best time to apply nitrogen fertilizers to walnut orchards is between February 15 and March 15. Phosphorous, potassium, and boron, may be applied without harm to the trees at any time of year except during the dry season. Boron applications, for example, made on April 1 have still been visible on the surface of the soil on July 15. Fall applications of nitrogen as discussed on page 15 can be injurious to the trees if in excess of 25-30 pounds of actual nitrogen per acre.

Fertilizer materials may be applied to individual trees beneath the drip of the branches. They may be drilled or spread in the tree-row middles if the trees are crowded. In the latter case, fertilizers should be drilled or spread both lengthwise and crosswise down the middle so that areas on all sides of the trees receive the material.

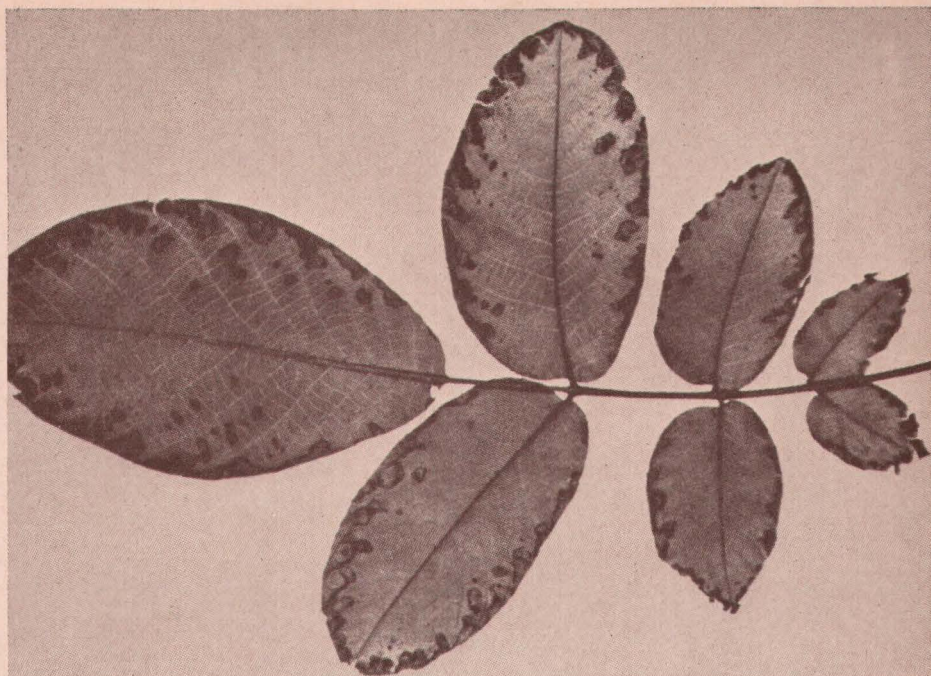


FIGURE 7. Injury to a walnut leaf caused by an excess of boron.

Irrigation

Water is not readily available for irrigating most orchards on hillsides. Some orchards on the valley floor and river bottoms are irrigated with sprinklers. In trials of irrigation on mature walnut trees at the Lewis-Brown Horticulture Farm of the Oregon Agricultural Experiment Station during certain dry seasons with relatively high temperatures, irrigation improved yield, size of nuts, and degree of filling. When the entire growing season was cool and summer rainfall more than normal, trial irrigation did no good and increased shrivel or poor filling of the kernels.

Experience shows that if irrigation

is used, at least 6 inches of water should be applied per irrigation, with a minimum of 3 irrigations per season—roughly May 15, June 15, and July 15. If late July and early August are hot and dry, a final irrigation about August 15 (but no later) may be advisable.

The first two irrigations tend to increase nut size; the last one or two irrigations assist in filling the nuts, since size is well established by July 15. All irrigations help produce vigorous wood for the following season's fruiting. Irrigation would be very helpful to trees on shallow soils or those in closely planted mature orchards.

Pruning and Training

After planting, the tree tops should be headed back to compensate for roots lost in digging. Trees with tops in balance with roots will make longer shoots and fewer of them.

Most growers remove about half of the tops of the trees. A 10-foot tree would be cut back to 5 feet and a 6-foot one to 3 feet. Few growers cut back walnut trees at the height they hope ultimately to have the head of the tree. They gradually raise the height to the desired level by later pruning.

Heading back should be done regardless of the original height of the tree, even if 2-3 foot trees are planted. When such short trees are planted and headed back, only one bud is allowed to grow into a shoot. This shoot forms the trunk of the tree. Growth rate is very rapid and the shoot is succulent and easily distorted by wind and other forces, so extra care in staking and tying is necessary to prevent breakage. This method has been almost entirely discarded in favor of higher heading, which results in a type of growth that is more easily handled.

Training newly planted trees

The object of training is to avoid large cuts by making small cuts when shoots are small. Removal of a shoot just after growth starts causes much less loss to a tree than when the shoot is allowed to grow for one or more seasons and is then removed. Whenever any wood growth is removed by pruning it is a loss to the tree. The smaller the loss, the larger the tree at the end of a given period of time. Removal of wood by pruning or otherwise results in a smaller tree. The less a tree is pruned the larger it will be. However, some pruning must be done in order to build a strong, sturdy tree.

The branches that are to form the main framework of the tree should be selected during the first and second growing seasons, and excess branches should be removed at that time.

Three to five main scaffold branches form a good tree. Except when trees are in the 8- to 10-foot grade, these scaffold branches usually cannot be obtained the first year on the trunk. Sometimes even trees headed back to 5 feet after transplanting require 2 seasons' growth before permanent scaffold branches can be developed. Buds that start to grow near the base of the tree should be cut off. If left they will grow at the expense of the scaffold buds higher up on the trunk. The top bud after the tree has been headed back will form an upright terminal shoot upon which to develop desired scaffold branches. These should be well spaced making a central-leader tree with wide-angled scaffold branches. A vase-type tree, with lateral buds left to grow on the cut-back trunk forms closely spaced branches with sharp angles, making a structurally weak tree.

Sometimes, even though a central-leader type tree is desired, the upper shoot fails to develop. In that case the tree should be accepted as it is and no attempt made to change it. Time and tree growth may be lost when an attempt is made to force a tree into a predetermined shape.

Pruning nonbearing trees

Pruning of nonbearing trees is more or less a continuation of training. If shoot growth seems excessively long, laterals may be tipped back, especially in lower, scaffold branches. Without this pruning they may grow so long that in later years the ends of the first

scaffold branches will rest on the ground when weighted with a heavy crop. Cultivation and harvesting will then be difficult.

Pruning bearing trees

Little pruning is recommended after trees come into bearing. Drooping limbs that interfere with cultivation should be removed. It may also be desirable to remove some of the weak wood in the center of the trees. Not all growth of this type should be removed. Often late-developing catkins are produced on this wood and they shed pollen late which may pollinate late-pistillate flowers.

The most extensive pruning of mature walnut trees in Oregon has been necessary because of cold injury. Following the freeze on November 15, 1955, many old walnut trees had to be pruned severely, in some cases so heavily that rebuilding of the framework was necessary. Dead wood will

eventually fall off the trees, but unless big dead branches are removed they will interfere with the direction of growth of the new branches. Also, wood-rot fungi may enter through dead wood.

Rejuvenation pruning requires cutting back into good, live wood. Following winter injury this heavy cutting back should not be done until late spring, at which time it is possible to determine the extent of injury. Cuts should be made to retain all live wood and maintain the head of the tree. When the tree is in full leaf it will not bleed as much following pruning as it will in late winter or very early spring. Bleeding does not seem to cause any serious injury to the trees.

Cuts over 2 inches in diameter should be painted with a wound dressing such as Bordeaux paste, asphaltum emulsion, or similar material. Cuts on upright branches should be slanted to shed moisture. Wound dressing should not be applied until bleeding stops.

Intercropping

Intercropping is a practice designed to provide some income during the long wait for a walnut orchard to come into bearing.

Trees as intercrops

Several kinds of fruit trees have been used as intercrops in walnut orchards. Sweet cherries have proved least satisfactory, the trees are too large, and they are incompatible with walnut-spray materials containing copper.

Prunes and filberts have both been used. Prunes have been more satisfactory since they are more upright in growth and produce earlier than filberts. Filberts are as long-lived as wal-

nuts and gradually increase in size and bearing. Growers often put off removing them until damage has been done to the permanent walnut trees. An advantage is that filberts may be dried in the same equipment used for walnuts.

Peaches would make an ideal intercrop, but in most of our walnut-producing areas they often have complete crop failures due to spring frosts. The 1955 fall freeze killed peach trees outright but did not injure old prune trees grown in the same general area.

Interplanted filler trees may retard the growth and bearing of walnut trees to a certain extent, but the income derived from the intercrop should

greatly overbalance this slight loss. When filler trees begin to crowd walnut trees they should be removed. The balance in income can be maintained by removing larger filler trees first, as the walnuts begin to come into bearing.

In recent years walnut trees of the same variety as the main orchard have been tried as fillers (See "Tree Spacing," page 12).

Small fruits as intercrops

Small fruits are well suited for intercropping, and they may be removed gradually as they encroach on walnut trees. If the small-fruit intercrop requires trellises, as do most cane berries, difficulty in orchard cultivation will be increased, since it can be carried on in only one direction. The objection to strawberries is that they need considerable nitrogen in late summer and early fall, which is not desirable for walnut trees. Black and red

raspberries have been satisfactory as intercrops since nitrogen applications to them are made early in the spring. Black raspberries are particularly well suited because they generally are not grown on trellises, though supporting stakes may be used.

Vegetables as intercrops

Some cultivated annuals are satisfactory as intercrops. They are well suited because the soil can be kept in best condition, the land can be more effectively used while the trees are young, and the area devoted to the intercrops can be adjusted more easily each year to the needs of the walnut trees. Since many vegetables require irrigation in Oregon, however, their production as an intercrop is more or less restricted to orchards on valley floors where a water supply is available. Sweet corn, beans, and beets have proved satisfactory.

Harvesting Walnuts

Harvesting walnuts in Oregon is more complicated than in California. In Oregon, fall rains usually begin before harvesting is completed. Mud, fallen wet leaves, and fragments of split hulls all increase the harvesting problem. Machine harvesting in Oregon has not been practiced to any appreciable extent because of the difficulty of getting machinery through wet orchards. Wet leaves are difficult to remove by present field-cleaners or harvesting machines. Most walnuts in Oregon are still hand-harvested.

The orchard floor must be prepared for harvesting, whether nuts are hand-picked or machine-harvested. For machine picking a smooth orchard floor is required.

Preparation of the orchard floor for

harvesting usually consists of a thorough cultivation about mid-September. This cultivation is followed by rolling or dragging. All walnuts do not mature and fall at the same time, so either shaking or several pickings are required. Sometimes a second harvesting is necessary even when tree-shakers are used.

Oregon walnuts drop freely from their hulls if moist enough during nut maturity. The first picking usually includes the poorest filled nuts; so they should be harvested before the main crop. Walnuts should be harvested as soon as possible after they drop. Nuts that drop on wet ground, leaves, and green hulls rapidly become so discolored that they are not acceptable to the trade. The same is true of harvested

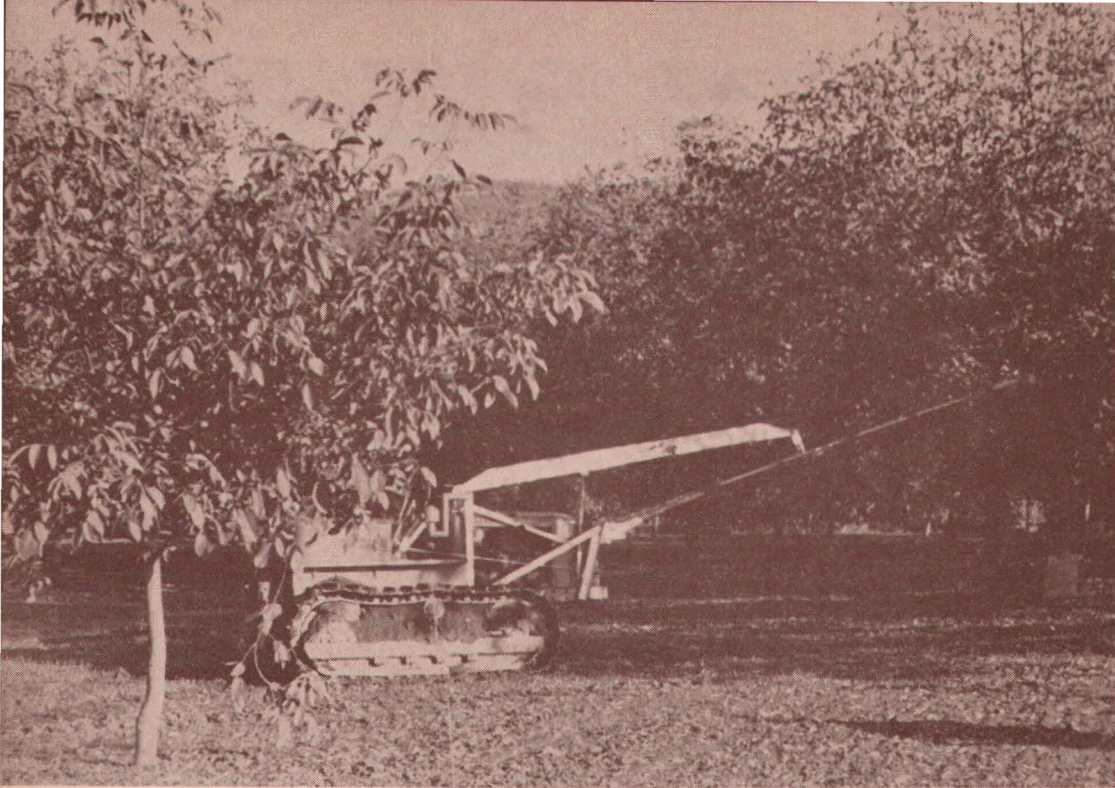


FIGURE 8. A mechanical walnut-shaker in operation.

nuts left wet in the sack for more than a day or so. Kernels may mold and turn black, brown, or yellow. (The yellow stain comes from the divider membrane between the two halves of the kernels and the old packing material that lines the shell.) While the yellow stain does not affect flavor, it detracts from appearance and is objectionable to the trade. It can be removed by soaking kernels in water and drying them immediately. In this process, however, much of the bright sheen of the kernels is lost.

Mechanical tree shakers have become fairly common in Oregon. When approximately 75 percent of the nuts on the trees show split hulls, the trees should be shaken and the nuts harvested immediately. Under these conditions some nuts will drop with the hulls still adhering, so general prac-

tice is to run all the nuts through a walnut huller and washer before drying.

In recent years some growers have used hand rakes with wooden pegs to rake walnuts into piles, eliminating the need for pickers to crawl over the entire ground area. Some growers scoop these piles of nuts into portable field cleaners, but these machines are not perfected, so they are not in general use.

If trees are shaken too early, many immature nuts will be harvested. When dried, they often have a reddish shell, and cannot be bleached satisfactorily.

Hand pickers are usually paid either by weight or measure. Some growers pay by the hour, but payment on a piece-work basis has proved to be more satisfactory to all. Pickers are often given a bonus if they stay until the harvest is completed.

Drying

Artificial drying of walnuts is necessary in Oregon. Often this is a commercial operation, but some growers maintain their own walnut driers, or use driers purchased for other purposes.

Many methods of drying are in use, but the underlying principle usually is the same. Warm air, at a temperature not higher than 90° to 100° F., is circulated around the individual nuts. Commercial driers finish to a moisture content of about 8 percent. Walnut kernels containing this moisture or less will snap when broken.

Drying too fast, at too high a temperature, will cause darkening of kernels and increase any tendency for shells to open at the ends. Drying too slowly, at low temperatures, often results in yellow and moldy kernels.

The common bin-drier with a fan will dry the average lot of walnuts in 18 to 24 hours. Tunnel driers, such as used for drying prunes, often will require 60 to 72 hours to accomplish the same results. However, with a good fan, they will do fairly satisfactory work.

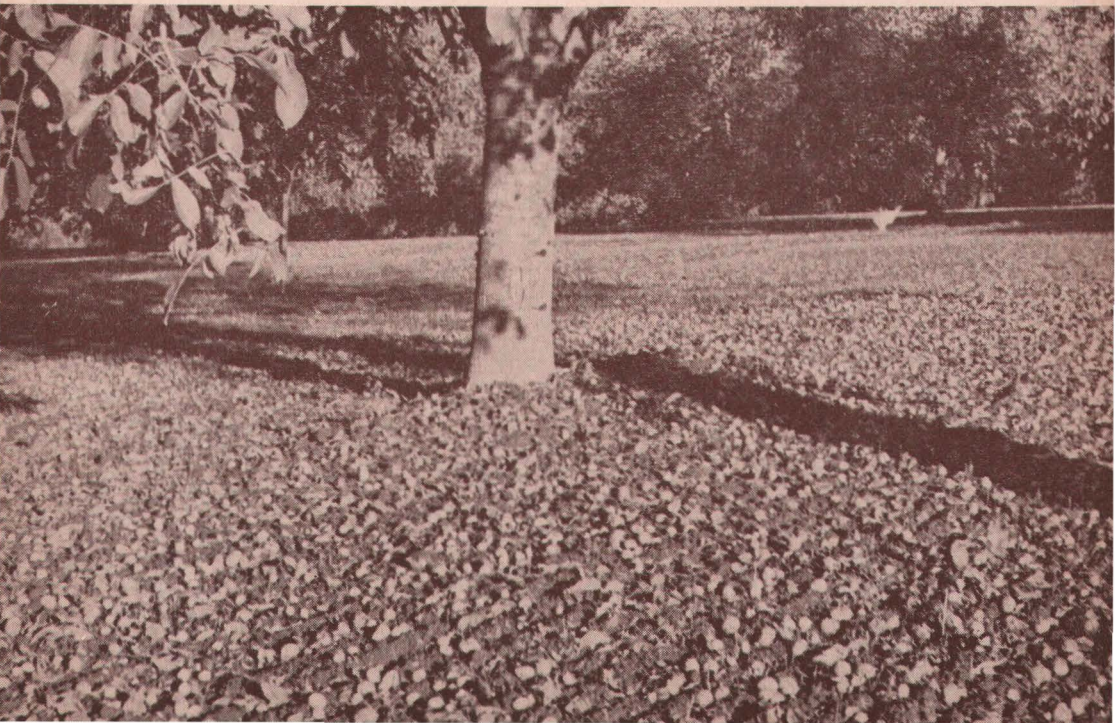
Bleaching

Commercial processing establishments usually bleach walnut shells. The nuts are completely dried first, then bleached and re-dried.

Clorox or a similar product can be used for small-quantity home bleach-

ing at the rate of 1 part to 20 parts of water. The dry nuts should be soaked in this solution for 20 minutes, then rinsed thoroughly with clean water, and dried again. Nuts with split or unsealed shells should not be bleached.

FIGURE 9. Walnuts on the ground after shaking the tree with a mechanical shaker.



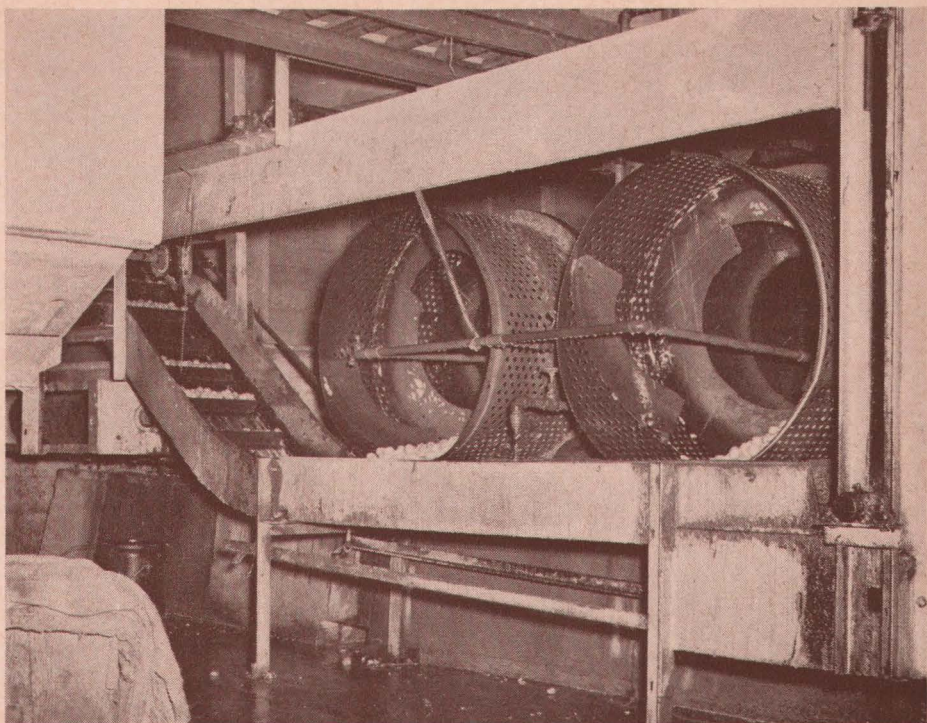


FIGURE 10. Oregon walnuts are usually cleaned and graded by commercial processing plants.

Insects and Diseases

See your county extension agent for current information on control of insects and diseases of walnuts.

Walnut blight is the most widespread disease of walnuts in Oregon.

Extension Circular 646, *Control of Walnut Blight*, was completely revised in April 1961. It contains current recommendations for both spray and dust programs.

Marketing

Most Oregon walnuts are processed and sold by cooperative marketing associations, or they are sold to independent buyers who process and resell them. Usually either buyer will accept the nuts whether dried or not. Independent buyers often make a definite offer for the nuts and may pay in full upon delivery. Cooperative associations

may make a partial payment on delivery of the nuts, with the final payment based on the price at which the cooperative disposes of the crop. Growers who wish to sell walnuts direct to consumers or retailers should get advice from the Oregon State Department of Agriculture, as restrictions on direct sales change from time to time.