

AN EXHAUSTIVE STUDY
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comes as to whether these varieties can be safely planted in large blocks alone or whether it would be better to plant several varieties together. If the latter is the case, what varieties shall we plant together? The Bing cherry will not pollenate the Royal Anne and the Royal Anne has no effect on the Bing. Perhaps there are similar relations among the walnuts.

The Franquette is at least partially self-fertile, and in some seasons like the past one, it seems to be perfectly self-fertile. We know of one young orchard of solid Franquettes that produced so heavily that limbs were broken from the tree by the weight of the nuts. One could not ask for a heavier crop. Perhaps another season the presence of some foreign pollen in this orchard might result in an increased crop. The catkins of the Franquette have a tendency to fall before all the pistillate flowers are receptive, so possibly the presence of another variety whose catkins shed a little later, might result in an increased crop, especially in unfavorable seasons. There is room for a lot of experimental work in working out such problems as these.

Growing the Young Tree.
Fall planting is to be preferred to spring planting. The ground is prepared as for other fruit trees, being well plowed. If harrowed the staking out will be more easily done. Sub-soiling previous to planting in the fall is a good practice on sites where plowing for a number of years had formed a plow pan or hardpan. Most of the old red hill lands are benefited from such a practice.

The walnut is usually planted with fillers, the prune and the filbert making the best trees for this purpose. On the "wheated out" hill lands where vegetative growth is not rank, 50 feet is none too far apart to space the nut trees, with the fillers on 25-foot centers. On newly cleared lands we would plant at least 60 feet apart, while on the retentive bottom lands 60 to 70 feet apart, with fillers half way between would be the minimum spacing. The tendency is to plant all trees too closely. We forget that the root systems spread farther from the trunks of the trees than do the branches. If we spaced the trees farther apart we should be able to keep up our sizes better, as the trees grew older. We would lose a little on the first few crops, but

this would soon be made up.

In planting the tree the holes cannot be dug too large. The broken roots are trimmed back and the tree planted at about the same depth it grew in the nursery. Don't plant a tree 10 or 15 inches deeper than it came from the nursery with the idea that it will be nearer the moisture and therefore grow more rapidly. This practice often results in death to the tree from smothering. Dynamite is frequently used in planting trees. Our observation leads to the belief that while this practice is beneficial at times, it may also be harmful at other times. If shoot-ang is to be done in red hill soils, it should be done in early fall after the top soil is wet down a foot or so; but before the subsoil has received any of the fall rain water. Winter and spring shooting will simply pack the soil around the hole. Even in early fall shooting there is a tendency toward packing, the heavy clay sub-soil. Half a stick of 20 per cent stumping powder, placed three to five feet deep, is used. The explosion will leave the top soil but will leave a pocket where the powder was placed. This pocket must be filled before planting or the trees will dry out.

After planting, cut the tree back to a height of about two feet. The root system, or absorptive system of the tree, is greatly checked in transplanting, so one must remove much of the top, or the part of the tree where transpiration occurs, or else the root system will not be able to supply sufficient water and plant foods to the top and a weakly tree will be the result.

Select the strongest of the buds, after growth is well started, and remove the others. The bud is preferably on the side of the prevailing winds. The shoot resulting from this bud should be trained to a stake, tying it to the stake at frequent intervals during the summer, where growth is rank. A stake seven feet long and two or three inches square will do nicely. It should be driven into the ground close to the tree on its windward side. Prevailing summer winds are the ones to be considered. Winter winds, coming at a season when the leaves are off and the growth is already stiffened, cannot influence the growth of the tree, but summer winds, coming at a season when the growth is as tender as asparagus, must be combatted.

Walnut trees are headed at various heights. The old-timers ran their trees up eight to 12 feet before allowing branches to form.

This "bean-pole" system is a poor practice. Constant removal of the side branches, with the consequent removal of leaf surface, tends to stunt the growth of the tree, for the leaves are both stomach and lungs to the tree, and growth is usually proportionate to the amount of healthy leaf surface, with young growing trees. A tree will not come into commercial bearing until it has sufficient bearing surface. This system retards the development of bearing surface and hence delays the time when the trees will come into commercial bearing, being in part responsible for the popular misconception that the walnut will not come into bearing until it is 12 or 15 years old. The evil effects of this system are less apparent on rich soils where heavy winds are not prevalent during the season of its growth.

Another system of heading is to bring out the scaffold branches along the trunk from 24 to 40 inches from the ground. This method of handling requires a lot of tying and should be undertaken only by the skilled orchardist who is willing to go over his trees once a month during the first four or five growing seasons. In windy locations and in hill orchards which may not produce a rank growth, this system will be of most value. With it the scaffold branches can be formed during the second growing season generally, or the third at the latest, while with the other systems the time at which these branches can be formed will be from one to three or four years later, depending upon the height of heading and on the richness of the soil. The time at which a tree will bear commercial crops is determined more by the number of years that its scaffold branches have been formed rather than by the number of years that the tree has been growing.

A third and the most used method of heading and probably the best system for average growers and for average situations is the practice of heading at from four and a-half to six feet. The tree is here also tied to a stake during its early years. The scaffold branches here require some tying up, but much less than with the low-headed system. Where the soil is fairly rich and retentive of moisture this is usually the best system of heading to use.

The contention that high heading is necessary for keeping the branches out of the way of cultivation is incorrect. The main branches of a low headed tree that has been prop-

erly tied up will arch upwards and will not spring down in the way of cultivation for many years, while the high headed tree will throw out branches at right angles with the trunk, and they will soon be drooping down in the way.

Regardless of the system of heading used, the trees are all treated alike the first season. If the growth at the end of the first season has been sufficient to bring the tree up to the height at which it has been decided to head it, the terminal growth is cut off some time during the dormant season, so that scaffold branches may be forced into growth. These branches should be spaced some distance apart and should radiate about the trunk as an axis at nearly equal space intervals. Three to five branches are left for the main branches. The pruning for the first four or five years is much like that of the apple, the growth each year being headed in enough to make the main limbs stocky and to make a balanced, symmetrical tree. No heading back should be done during the growing season, as this will force into growth buds on growth of the current season. A growth of this kind always makes sharp angles with the parent branch, and the resulting unions are invariably weak. Any summer pruning should be limited to thinning out.

After the head of the tree is three or four years old, little pruning will be needed for several years. Heading back should be largely discontinued and only corrective pruning done. This will tend to throw the tree into bearing. The walnut bears from terminal buds and our aim should be to develop top lots of them. A heavily pruned branch will make two or three strong laterals, while an in-headed one will make shorter laterals and more of them.

A study of walnut trees in the valley shows that the central leader type of tree has much to recommend it. This tree is handled the same as the above described ones the first growing season. The terminal bud of the leader, however, is never cut off as in the other system. No strong scaffold limbs are formed here, the central leader instead carrying the main load. The laterals come out along the trunk, wherever the grower desires to leave them. The shoots are kept removed until one comes out at the minimum height desired, which one is allowed to remain. Branches coming out above this should be spaced at regular intervals, both as to height and to radiating direction. After

the first three or four laterals have grown out the future laterals should be spaced several feet at least apart so that sunlight will have access to the inner branches for as many years as possible.

The mature nut tree does not require as much pruning as does the apple and other fruit trees. It should be given regular annual attention, however. New growth must be kept coming on and the tree should be kept as open as possible so light and air will be able to strike the inner spurs. Remember that the best bearing nut trees are isolated specimens and those located on the outside rows of orchards. The fact that these have plenty of light and air is partly responsible for this condition. Carefully paint over all large pruning wounds, for this tree is very susceptible to heart trouble.

Yields.
The walnut is popularly held to be a tree to plant for one's children rather than for one's own use. It is a fact that many trees do not come into bearing until they are quite aged, but this need not be. Grafted varieties properly selected and cared for will give a sprinkling of nut at four to seven years of age. We have record of an eight-year-old orchard at Eugene that produced 11 pounds per tree, and of a nine-year-old one in the red hills near Sheridan, that yielded 25 pounds per tree. Clyde LaFollette at Wheatland got 23 pounds per tree at 10 years, besides getting a splendid crop of peaches from his fillers. The average old seedling orchard at Dundee produces about 800 pounds per year. Grafted orchards of the same size should produce at least 1500 pounds per acre where good care is given. A single immense black walnut tree that was top worked to English walnuts in California, produced over 700 pounds one season. Many top worked black walnut trees in Oregon are bearing 200 to 500 pounds of nuts annually.

Diseases.
Walnut blight, a bacterial disease, is the most serious disease that threatens the walnut. This disease attacks the young growing shoots and the nuts. The bacteria live over in the blighted shoots. Ooze drops from these shoots in wet weather and the spread of the disease is probably due to this feature. Insects are thought to have considerable part in the spread of the disease by spreading this ooze. The bacteria enter the growing shoot and spread therein, killing the cells and causing blackening. They usually enter the nuts at the stigma end first when they fall quickly. The disease is usually worse in wet, damp years, but sometimes in dry years if insects are extremely plentiful the trees may blight badly. The black, sunken areas on shoots and nuts is usually the blight. Spraying has not succeeded in controlling the disease in California. Any hope of eradication by spraying lies in repelling the insects that spread the drip and spatter.

The only permanent relief from this disease will be in new varieties that are immune to its ravages. Watch your seedlings in this respect as you may have a valuable blight-proof one. Certain varieties blight much worse than others, which fact should be borne in mind in selecting varieties for planting.

Mushroom Root Rot.—This fungus disease is known also as oak fungus. It is a disease that works entirely underground out of the light. It is found on the roots of a long list of plants which it attacks with varying severity. Newly cleared land, especially where oaks have been present, is usually full of it, and it remains as long as there are any roots remaining. It lives on the dead roots, but has the facility for attacking live roots of certain kinds.

The writer lost nearly 200 walnut trees from a planting of 4000 in three years. The trees were all grafted ones. The point of attack was always in the interval between the California black roots and the surface of the ground, the English walnut wood alone being attacked and this being completely girdled by the disease. The black walnut root system in no case was attacked. The large wounds left in the grafting afforded an easy access to the tissues of the tree for the fungus. Whether English walnut seedlings with no graft wounds would suffer from attack in similar conditions is not known. The fact that the California black is immune to attack and that the disease works entirely under ground makes it possible to avoid loss by planting trees grafted high so that the English wood will be entirely above ground. Where grafted trees are planted on ground later found to be infested with the root rot fungus, they may be protected by removing the dirt around them to a depth that will expose all the English wood to the light. A 12-inch tile may be slipped over the tree or a cylinder of tin or very heavy roofing paper may be so placed that the dirt will not work back around the English wood. We saved ten acres planted on newly cleared land in this way.

Nurserymen at present are not propagating many of this type of high grafted trees, but will do so when sufficient demand is made for them by growers. Where this type of tree cannot be had it may be wise to plant the California black seedling and later top work it in the field where newly cleared land is to be planted.

The root rot will kill a tree any time during the year. It does so by girdling the tree. It can be identified by its black, shiny root, like strands of rhizomorphs, as they are called. These can be distinguished from rootlets of other plants by the fact that they keep the same diameter instead of tapering as do roots, and their insides are white. They are about the size of the lead in a pencil.

Die-Back.—One cause of this condition, which is simply the dying back of the tips of the branches in early spring, has been described under the subject of wet lands. Another cause may be severe drought in summer, which causes the death of many of the smaller root-

lets, with the result that when the upper parts of the tree begin to transpire moisture in the early season, the root system is unable to supply the needed water and the tips being farthest from the source of supply must suffer.

Top-Grafting.
The walnut is a more difficult tree to graft than many of our fruit trees. It is more difficult to get a good stand of grafts in nursery grafting than in top working. We will discuss top-working alone. Many growers having seedling trees should weed out the non-profitable ones by grafting them to clones of some desirable variety. Many fine black walnut trees are growing in this vicinity. To cut into these seems a sacrilege at first, but after a few years of growth the English clones will develop a new top that in time will be as beautiful as was the original black seedling, and in addition will yield a paying crop of nuts.

The clones are generally cut during the dormant season, January or February preferred, and are stored in damp sawdust or sand in a cool place. Clon wood should have a minimum of pith in it and should be fairly straight stuff, with buds fairly close together. All branches not to be grafted should be cut off at the trunk and the wounds painted over. The branches to be grafted are cut off when they are two or three inches in diameter. A cleft is made by means of a strong butcher knife and a mallet, the cleft being on one side of the center of the stub so as not to cut through the pith. The knife should be driven in only about an inch and then should be depressed on either side so that the bark may be cut before the balance of the splitting is done, otherwise the bark will be torn. Split stub about three inches deep and then spring it with a wedge. Reveal the edges slightly, the bevels meeting at a point about half to three quarters of an inch from the edge and also about three inches down from the top of the stub. The cleft should have two or three buds. They are cut wedge shape with the inner part of the wedge cut thinner than the outer part. The cutting must be carefully done so that the cleft will fit into the stock as perfectly as possible. It should fit in such a way that when the wedge is removed the stock will hold it into position, pinching it a little harder on the outside than on the inner side, and the cambium layer, which is the layer between the bark and wood, should fit against the cambium layer of the stock in as many places as possible. The clones should not be exposed to the air after being cut, and the stub should be waxed over with warm wax as soon as the clones are set. A paper bag is then tied over the graft so as to prevent too great a transpiration of moisture. It is torn open after growth has started. Sometimes instead of bagging the clones they are simply coated with wax.

The standard grafting wax is made by melting together five pounds of resin and one of beeswax, and after these are melted, stirring in one gill of raw linseed oil and

half a pound of floor or of finely powdered charcoal. Grade B asphaltum, which is very much cheaper, is often used. Care should be used not to use the latter too hot

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