Nut Growing in the Northeast

By L. H. MacDaniels

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The cover shows shagbark hickory, variety Wilcox. Note that the nuts are borne in threes, which results in heavy yields.
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Planting nut trees is particularly appropriate because of the loss in recent years of the American Elm to the Dutch Elm disease and the decline of the white ash and hard maple in some areas. Fence rows and other areas, now growing up to weeds and brush, if planted to appropriate nut trees, would contribute substantially to a sure food supply, erosion control, wildlife refuges, and, in the case of black walnut, to a valuable lumber resource.

There is, to be sure, little assurance of a profitable nut industry in New York. High labor and other overhead costs cannot be met by the sale of the products raised. Only a few areas, such as the lower Hudson Valley where nearness to bodies of water or local topography lengthens the growing season or increases the summer heat, have a climate favorable to commercial nut growing. Even with these favorable conditions, the grower must be an experimenter as well because there are so many gaps in our knowledge of the soil and climatic requirements of varieties, of the need for cross-pollination, of the best method of soil management, and of similar problems.

Whatever the limitations of commercial nut culture in New York, the planting of nut trees for noncommercial purposes should be encouraged. If, during the past 50 years, a large part of the shade trees planted had been nut trees of the better varieties, New York home owners would have at the present time not only shade but also a good supply of nuts for food and the enjoyment which comes from raising superior varieties of nuts on home grounds. Many of the trees that failed to bear good nuts would be shade trees, and even their failure would contribute to our knowledge of nut growing. Wherever a shade tree is planted, it might as well be a nut tree of one of the better varieties.

Climate

Climate is most important in determining whether nut trees will grow and fruit satisfactorily. With the exception of chestnut, black walnut, butternut, several species of hickory, and native hazelnut, the important species of nut trees are outside their natural range in most parts of New York. They are native either to the South and West or to other countries. Thus, if Persian walnuts, pecans, European hazels, and some others are planted, they are in a new environment to which they may not be suited.

The following maps, figures 1–3, are helpful in showing where nut trees can be grown.

Often the particular planting site is of great importance, in that within a fairly small area the climate may differ greatly. In certain locations near Cayuga Lake at Ithaca, the climate is favorable for growing peaches. A mile away at an elevation 300 feet higher, the climate is quite unfavorable. These local conditions, including air drainage, frost pockets, slope and wind protection are referred to as micro-climate and should be considered in choosing the site of a planting. In general, however, the growing of any species of nut tree will be limited by low winter temperatures, length of growing season, and average temperature for the growing season, possibly better referred to as the total summer heat or growing degree days. Drought, too, may be important in some seasons.

LOW WINTER TEMPERATURES

Figure 1 shows the lowest temperatures recorded in New York. Except in a few favorable local sites, the temperature in most of the state can go below −20°F. This temperature is critical for some Persian walnuts,
Figure 1. Lowest temperatures recorded in New York State. A temperature of $-20^\circ$ F may injure some Persian walnuts and filberts. Temperatures of $-30^\circ$ F or below may injure all except the butternut and some hickories.

Figure 2. A freeze-free season of 150 days or more is favorable for nut growing.

Figure 3. Areas favorable for nut growing have 2250 or more growing degree days above base 50$^\circ$ F.

LENGTH OF GROWING SEASON AND CUMULATIVE GROWING DEGREE DAYS

Two other limiting climatic factors in the north are the length and mean temperature of the growing season between killing frosts (figure 2). Together these determine the total amount of summer heat available for growth, cumulative growing degree days (figure 3). To these can be added another climatic factor: length of day response. The growth cycle of most northern plants including nut trees is governed by the number of hours of daylight, particularly in the early spring and late fall before frost. Thus, a short season variety may mature before any frost has occurred with a minimum of summer heat whereas another may not mature until later because of its relation to daylength, regardless of its heat requirement.

In general, growing nut trees successfully in the north is limited to those areas with minimum temperature of $-25^\circ$F, a freeze-free season of about 150 days, and cumulative growing degree days (base 50$^\circ$F) of about 2250 or more. These, of course, are only approximations and vary from year to year. Because of the complexity of the relation of plants to climate, horticulturists find it useful to relate the probable success of a plant to that of some familiar crop. Thus, areas favorable for nut growing are, in general, those in which medium season corn varieties mature their grain in most years and where the Concord grape matures its crop before frost.

At the present time, probably the greatest need for northern nut growing is the discovery and use of varieties that will mature in a season of average length.
and heat. Unfortunately for the nut-growing interests of New York State, the most valuable species that once thrived in the colder areas — the native chestnut — has been all but exterminated by the chestnut blight. The butternut, which is suited to poorer soils and the most rigorous climate of any of the nut species, has no well-established commercial value and is not propagated in quantity by nursery operators.

Kinds of Nuts

BLACK WALNUT

The eastern black walnut (Juglans nigra) is the most valuable nut tree for planting over a wide area in New York State. Although many of the named varieties of black walnut are suited only to the lower Hudson Valley or regions even farther south, some varieties and seedling trees mature their fruit rather generally throughout the state with growing degree days of 2000 or more. The variety most propagated by nurserymen is the Thomas. At Ithaca, where the average cumulative growing degree days are about 2200, Thomas has been by far the most satisfactory. Recently, good cracking varieties of northern origin have been selected and named. Of these, the Snyder, originating near Ithaca, New York, is promising, as are also Sterling and Cochrane from Minnesota. Sparrow matures early and cracks about as well as Thomas.

Stambaugh and Elmer Myers are excellent nuts which should be satisfactory for the more favorable parts of New York State, but they have not been hardy at Ithaca. The trees of some varieties are hardy in the north, but the nuts fail to develop satisfactory size and quality in most seasons.

Varieties of nuts differ considerably not only in their hardiness and response to length of growing season and summer heat but also in their disease resistance and susceptibility to insect damage. None is without defects of one kind or another. Thus, the Thomas, the most widely planted variety of black walnut, is valuable for its hardness, good size, good cracking quality, heavy bearing, ease of hull removal, and relative freedom from husk maggot infestation. On the other hand, it is very susceptible to anthracnose, a leaf disease which may defoliate the trees in midsummer or early fall with resulting poorly filled nuts. The trees also are susceptible to Nectria trunk cankers which may do considerable damage. The Thomas is a long-season variety which fails to produce good nuts in short or cool seasons.

The Ohio variety of black walnut is resistant to the anthracnose disease and usually holds its foliage late in the season. A large percentage of the hull of the nut is spongy, difficult to remove, and usually infested with husk maggots. The northern grown nuts are likely to be small with poorly developed kernels. A truly satisfactory variety of black walnut has yet to be developed or discovered.

Nearly a hundred varieties of black walnut have been selected and named, but only a few have been propagated and tested for suitability to New York State. Among the more promising are the Bowser, Clermont, and Patterson. Those interested in new varieties will render a real service to northern nut growing by planting them and recording the results.

The black walnut is best suited to deep, rich, slightly acid or neutral soils with good drainage. It does not succeed on infertile upland soil or on soils with poor drainage. Because of its excellent timber, black walnut is being planted commercially as a dual purpose tree furnishing both timber and nuts. The tree naturalizes easily on suitable soils and will produce salable logs in about 40 years.

There is good evidence that the roots of black walnut are toxic to many garden plants, particularly tomatoes. The trees grow to a very large size and should not be planted on a small lot where other desired plants are to be grown. Walnut does not interfere seriously with lawn grass and some other plants.

BUTTERNUT

The butternut (Juglans cinerea) is the hardiest of any of the northern nuts, but it has the disadvantage of being short-lived under some conditions, apparently because of a fungus and a virus disease. A virus causing what is known as bunt disease kills butternut trees in some areas, particularly in the South. Although it will succeed fairly well on poor upland soils, it thrives best on fertile, slightly acid or neutral soils with good drainage. Among the varieties that have been selected for superior shelling quality and named are Kenworthy, Kinneycan, Buckley, Helmick, Craxey, Herrick, Johnson, Love, Sherwood, Thill, and Van der Poppen.

The butternut can be grafted either on seedling butternut or on black walnut stocks. Black walnut stocks are reported to give earlier bearing trees.

PERSIAN, OR ENGLISH, WALNUT

The Persian walnut (Juglans regia), sometimes erroneously called the English walnut, was formerly limited to the most favored fruit regions of western New York, the lower Hudson Valley, and Long Island. Prior to 1933–34 there were thriving plantings in the western New York peach belt and elsewhere in favored locations; a planting near Aurora, New York, on Cayuga Lake, was notable among these. That severe winter killed or severely damaged all these trees except in a small area near the Niagara River where the minimum temperature did not fall below −20°F. At present the most promising Persian walnut varieties are of Carpathian origin; they have been introduced from Poland. There they have endured temperatures
below what has ever been recorded in the fruit belt of New York. Also, trees of this origin have withstood temperatures in the United States that have killed or severely damaged other Persian walnut trees.

One defect of the Carpathian walnut is that it starts growth early in the spring, with the result that in many seasons the new growth is damaged by late frosts. Some varieties are better than others in this regard, and it is likely that one will be found that starts growth late enough to escape all but the exceptionally late frosts. Of the slower starting sorts, Broadview is a named variety that has been outstandingly hardy. Superior varieties recently named are the Schafer, Littlepage, McKinster, Metcalfe, Colby, Jacobs, Somers, Lake, and Hansen. Seedling trees from all sources show great variation in hardiness, type of nut, age of bearing, and fruitfulness. The Persian walnut thrives best on rich, well-drained, slightly acid or neutral soil and responds well to cultivation and fertilization. In situations where hardiness is a problem, the trees should not be forced into excessive vegetative growth.

**JAPANESE, OR SIEBOLD, WALNUT**

The Japanese, or Siebold, walnut (Juglans sieboldiana) is a good shade tree. It makes rapid and luxuriant growth even in rather poor soils. It is fairly hardy in most parts of New York although the foliage is sometimes injured and the season’s crop destroyed by late spring frosts. The trees vary considerably in hardiness. The same sort of variation in hardiness is often observed with seedling Persian walnut trees as well. The nuts resemble the butternut somewhat in flavor and difficulty of cracking but are considered inferior to it. There is great variation in the size and roughness of the nuts, suggesting hybridity. In some parts of the state the tree suffers from the attacks of a beetle which burrows in the terminal shoots. No named varieties are being propagated.

**HEARTNUT**

The heartnut (Juglans sieboldiana var. cordiformis) is a variant of the Japanese walnut and resembles it closely in foliage and growth habit. The shells of the nuts, however, are much smoother, and the nuts have better shelling quality. Seedlings of the heartnut do not come true to type. Some of the varieties propagated are not hardy enough to withstand the winters, except in the more favored sections of the state. Among the varieties propagated are Bates, Canoka, Faust, Fodermaier, Gelliaty, Ritchie, Stranger, Wright, and Walters. The Japanese walnut and the heartnut are somewhat susceptible to bunch disease, which may seriously weaken or kill the tree. The quality and flavor of the kernels resemble the butternut but are not considered as good.

**HICKORY**

At least 5 species of hickory are native to New York. Of these, the mockernut (Carya tomentosa), the bitternut (Carya cordiformis), and the pignut (Carya glabra) are widely distributed and nearly worthless. The shellbark, or kingnut (Carya laciniosa), although native to the western part of New York State, is at the eastern limit of its range there. The shagbark (Carya ovata), the most valuable of all the species of hickory except the pecan, is widely distributed except in the extreme north; but it often fails to grow satisfactorily because of lack of proper pollination, short seasons, or lack of summer heat. The quality of the kernels of the shagbark hickory is excellent, and many varieties have been selected and named. However, because it bears late and is difficult to propagate and transplant, grafted varieties of this nut are probably grown less than are most other nuts. Good results are obtained by grafting established seedling trees in place.

Of the many varieties grown at Ithaca, New York, the Wilcox and Davis have yielded well and are excellent nuts. Among the named varieties that have originated sufficiently far north to be promising are Davis, Fox, Glover, Goheen, Mann, Miller, Neilson, Abscola, Romig, Weschcke, Whitney, and Wilcox. Some varieties of hickory are hybrids between two or more species, the exact make-up of a hybrid being difficult to determine. The eating quality of hybrids with the bitternut, for example the Beaver, is not good enough to warrant growing them. Most of the hybrids do not yield good crops of nuts but may be good shade trees.

**PECAN**

The pecan (Carya illinoensis), so far as it has been tried, has not been satisfactory in New York. The trees are hardy enough to withstand the winter cold, but the nuts do not mature in the relatively short, cool seasons.

The so-called northern pecans are well suited to the southern parts of the states of Indiana, Illinois, and Iowa where good commercial crops are secured from such varieties as Major, Chief, Peruque, Greenriver, Busseron, and others.

Hybrids between a pecan and a hickory, known as hicanes, grow rapidly and make beautiful shade trees. They are usually not sufficiently fruitful to warrant planting them except for shade. A possible exception is the Burton which has yielded well under some conditions. The varieties Burlington, Clarksville, Gerardi, and Rockville have been propagated.

**CHESTNUT**

The native chestnut (Castanea dentata), which on was abundant throughout the eastern United States, has all but disappeared through the ravages of chestnut
blight. Blighted trees continue to sprout from the stump for many years, but the sprouts eventually succumb to the disease. Efforts to find immune or resistant strains have so far failed to give varieties considered safe to plant. The European chestnut (Castanea sativa) is equally susceptible to the disease. The Japanese chestnut (Castanea crenata) is somewhat blight resistant and has large attractive nuts, but their flavor and quality are poor. The Stein Japanese seedlings have been grown in central Pennsylvania for many years and have produced good crops.

The most promising species for planting is the Chinese chestnut (Castanea mollissima). This is not immune to the blight, but is sufficiently resistant for the trees to persist and bear crops. Varieties of the species and its hybrids are about as hardy as the peach and may be planted in any area where peaches succeed fairly well. Some of the varieties in the trade are Abundance, Orrin, Nanking, Meiling, Kuling, and Crane. Some of the grafted Chinese chestnuts have shown troublesome stock-scion incompatibility which causes the grafts to fail. Such failure may occur the first season of the growth of the grafted or after vigorous growth for 4 to 6 years. The failure of established grafts seems to be related to winter injury and is more frequent in the North than in the South. At the present time, seedlings of selected trees are being grown with success in Maryland and New Jersey and succeed in the warmer parts of New York where the peach can be grown. Seedlings of the variety Nanking have been found to come nearly true to type and are being planted commercially in the South.

Most commercial orchards in the South, however, are being grown as grafted trees. Chestnuts grow naturally on light-textured, acid soils, but show a considerable range of tolerance for well-drained soils of different textures. Two or more varieties or seedlings should always be planted near each other for cross-pollination.

FILBERT, OR HAZELNUT

The European filbert or hazelnut (Corylus avellana), though commercially successful in parts of Oregon and Washington, has not been generally successful in the East, chiefly because of winter injury. In this area, the dormant staminate catkins may be killed by winter cold; or the expanding catkins, by spring frost. Varieties differ greatly in their susceptibility to winter injury. In tests of European varieties at Geneva, New York, the varieties Barcelona, Medium Long, Kentish Cob (DuChilly), and Italian Red have shown some promise. Over a period of 10 years, however, frequent crop failure due to winter injury does not encourage commercial planting.

One of the American filberts (Corylus americana) has been propagated in the varieties Rush and Winkler. Rush makes a good-sized plant and at Ithaca has produced fair crops of small nuts. Winkler is harder, produces large nuts but makes only a small bush that produces stolons, or runners. Probably the most promising filberts for New York are hybrids between Rush and varieties of the European filbert. These were first introduced by the J. F. Jones Nurseries with the named varieties Bixby and Buchanan. Reed and Potomac are promising varieties originating with the United States Department of Agriculture. These hybrid plants grow as vigorous bushes about 15 feet tall. Two varieties must be planted near each other to provide cross-pollination.

HARDY ALMOND

Hardy almonds are advertised in some nursery catalogues usually as Hall's Hardy or Ridenhower. The trees resemble the peach in growth habit and succeed in areas where the peach can be grown. The hard shell nuts resemble peach pits. The kernels make up 10-15 percent of the nut and have the strong bitter flavor of peach pits due to amygdalin and prussic acid which may be toxic to some people. Growing hardy almonds is not recommended except possibly as an ornamental.

Propagation of Nut Trees

Like other fruit plants, nut trees can be propagated by seeds, by layering, by budding, or by grafting. Budded or grafted trees of named varieties should be planted whenever possible. Nursery operators can furnish only a limited number of varieties. The newer sorts will have to be grafted upon suitable stocks by the grower. Scions of unusual varieties can be obtained from nursery operators or other nut growers through the Northern Nut Growers Association.*

The choice of a suitable understock is important in budding or grafting. The safe practice is to use a stock of the same species as the scion to avoid stock-scion incompatibility (figures 4 and 5). Thus, scions of black walnut varieties are grafted on black walnut seedlings. Butternut scions can be worked on butternut or black walnut stocks. Persian walnut, when grown in the North, is usually grafted upon eastern black walnut stocks. In the West, failure at the graft union is causing severe losses of bearing Persian walnut trees grafted on eastern and northern California black walnut rootstock. Such incompatibility, however, has not been observed under eastern conditions.

In the hickory group, the most generally successful stocks are the shagbark and the shellbark. The butternut, the pignut, and the mockernut have given poor results with many varieties of shagbark (figure 4).

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*Spencer B. Chase, Secretary, 4518 Holston Hills Rd., Knoxville, Tenn. 37914
though they are suited to some. The northern pecan makes a good stock for some hickories. Hybrid varieties are a special problem, but usually can be grafted successfully on the more vigorous of the parent species.

SEEDLINGS

Although growing vegetatively propagated clones is essential for producing high quality nuts, seedlings are produced in quantity for grafting stocks, breeding new varieties, wildlife preserves, and timber production, especially walnut seedlings. In the North, seedling Chinese chestnuts from selected sources may be used because of graft incompatibility.

Seed nuts for growing seedlings must not be allowed to dry out excessively at any time before planting. For good results, special treatment known as stratification is necessary. The Persian walnut and pecan are apparently exceptions since the stored nuts will germinate when planted without special treatment. Stratification provides conditions suitable for the so-called afterripening process to take place in the seeds. The physiological changes involved progress most rapidly at temperatures 3 or 4 degrees above freezing and can best be brought about by keeping the moist seeds constantly at this temperature in a cold storage.

Chestnuts require special care to prevent the nuts from becoming dry. Fall planting is desirable. Otherwise the freshly harvested nuts can be stored at 35°–38° F in sealed plastic bags (freezer bags) with the nuts mixed with nearly dry peat moss. Small lots can be held in the refrigerator in friction-top cans with a few small holes punched in the lids.

Without special storage facilities this procedure is not practical; the desired result is obtained by exposing the nut seeds to outside temperatures. In the course of the northern winter, there is enough cold weather within the required temperature range to give the desired result. Soon after harvest, the hulled nuts are packed one layer deep between layers of sand, peat, or sawdust in a box or in some other container covered with wire netting to prevent theft by rats or squirrels. Holes are bored in the bottom of the box to prevent the accumulation of water about the seeds. A good practice is to place wire netting over both the top and the bottom of the container. The container is sunk into well-drained ground, level with the top, where the nuts will be exposed to winter temperatures and moisture. If theft by rodents is not likely, the nuts can be planted in nursery rows in the fall. Walnuts and other large nuts should be spaced 8–12 inches apart and covered 3 inches deep with soil. Chestnuts and filberts can be planted less deep. The stratified nuts are planted in nursery rows in early spring in the same way.

During the growing season the nursery rows should
be kept free from weeds. Seedlings come up the first year. Some species, for example, the black walnut and heartnut, may make enough growth in 1 season to be grafted, but 2 years' growth is usually necessary for field grafting. Hickories take 2 or more years to make a tree large enough to graft. Hickories form such a long taproot that they are difficult to transplant. The stratified nuts can be planted in the spring in the place where the trees are to remain permanently. Several nuts are planted in one spot to ensure at least one tree in a place. These can be topworked when they are large enough. Only a single tree is left at one place after one good tree has become established.

**LAYERING**

The filbert is the only nut tree that is propagated by layering. Sometimes the sprouts or suckers that come up about the trunk take root at the base and can be cut free and planted. Also, these suckers can be bent to the ground, pegged down, and covered with 3 inches of soil, leaving 15–18 inches of the tip to project beyond the soil. If this is done in early spring with the European varieties, the shoots may be rooted by the following spring and then can be transplanted. Varieties of American origin take 2 years to root satisfactorily. If the suckers are poorly rooted, they should be planted in a nursery row where they can be cultivated a year before they are set in their permanent position. Many variations of this method are practiced.

**BUDDING AND GRAFTING**

Most kinds of nut trees are propagated by some form of budding or grafting. These are essentially the same process and involve placing a part of the plant to be propagated, bearing one or more buds, on a suitable stock in such a way that the growing layers or cambium of the two unite. The cambium is a layer of living cells between the bark and the wood. With most kinds of budding or grafting, the bark separates easily from the wood at the cambium when conditions are right. In budding, only a single bud of the variety to be propagated is used; whereas in grafting, a scion bearing several buds is grafted on the stock. The variations of the process are many, and only a few of the most useful are described here.

**Ring and Patch Budding**

One of the most successful methods of budding nut trees is known as ring, or annular, budding; a modification of it is called patch budding. Ring budding is suited to stocks of about the same size as the budstock; patch budding is used with larger stocks. The method involves removing a ring or a patch of bark from the stock and accurately fitting a ring or a patch of bark bearing a bud from the scion into this space. The process is illustrated in figure 6. A handy tool for annular budding can be made from a pair of safety razor blades or knife blades (figure 7).

Budding of this type must always be done when the bark of both stock and scion can be separated easily from the wood. The time of year depends on the type of budwood used, and can be either in the early spring just as growth starts, with buds from the previous season's growth, or in midsummer, with buds from the current season's growth.

Scions of the previous season's growth must be cut while the buds are still dormant, usually in late February or early March, and stored in a cool place. About 48 hours before the budding is to be done, these scions are placed in a warm room (about 70°F or above), with their cut ends in water. This should start growth processes in the inner bark, or cambium, so that the bark can be separated readily from the wood.

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Figure 6. Patch budding and ring, or annular, budding of black walnut. A. Patch of bark with scion bud. B. Stock with patch of bark removed to accommodate patch bud. C. Bud tied in place with raffia. The outer bark of the stock has been shaved off to the same thickness as that of the scion bud, and all cut surfaces and the bud itself are covered with wax. D. Stock with ring of bark removed to accommodate scion bud. E. Bud tied in place with raffia. F. Ring of bark with scion bud.
as does spring budding. The difference is that the scion buds used are from the current season's growth. Vigorous shoots that have well-developed buds in the axil of the leaves near the base of the shoots are selected. The leaf stalks, or petioles, are cut close to the bud as soon as the budsticks are cut. In midsummer budding, the bud that is set on the stock unites with it within a week or 10 days, but remains dormant over winter. If the bud is set on the stock near the ground, it can be protected by mounding the earth over it. The following spring the bud is forced into growth by cutting off the stock above the scion bud and removing all other buds that begin growth. In any budding operation, the buds should not be allowed to dry out even slightly between removal from the budstick and insertion of the stock.

**GRAFTING**

For most amateurs, grafting is a more successful method of nut-tree propagation than is budding. Both budding and grafting are more difficult with nut trees than with other fruit trees. Even experts experience many failures; so the amateur should be satisfied if even a few buds or grafts live as a result of his first attempts. The causes of failure are often not obvious and sometimes not well understood. The principles involved in grafting both fruit and nut trees are basically the same. Nut-tree grafting, however, requires greater skill in accurately fitting scion to stock and matching cambium layers, greater care in preventing grafts and stocks from drying out, and, particularly with the walnuts and hickories, some provision for drainage of the wounds or control of sap flow in the stocks.

Often a combination of several types of graft can be used on the same stock. The kind of graft used depends mostly on the actual size of the stock and on the relative size of the stock and the scion.

**Modified Cleft Graft**

For stocks up to about 1 inch in diameter, the modified cleft graft is probably the most useful. In this graft, illustrated in figure 8, the scion is cut accurately to a wedge somewhat thicker on the side of the basal scion bud than on the other. It is best not to split the stock but to cut diagonally from a point halfway between the pith and the bark on the cut end of the stock, downward and toward the center, to a depth of about 2 inches. The depth of the cut depends on the length of the cut surface of scion. A strong, sharp knife, such as that shown in figure 7, is a great advantage in cutting the stock. The scion is inserted in the cleft with the thicker part of the wedge on the outside and the cambium of that side of the scion matching that of the stock. The open cleft in the stock on the side opposite the scion is then covered with a narrow strip of waxed
cloth extending about 1 inch below the end of the cut on the side of the scion. The stock is bound tightly with raffia, waxed cloth, tape, or some other suitable binding material and covered with wax. In waxing, all cut surfaces and all parts of the scion, including the buds, are covered. This is important. The bottom edge of the cloth strip below the graft is not waxed. This provides an outlet for any sap that may get into the wound.

**Side Graft**

The side graft is a modification of the cleft graft in which the cleft is cut on the side of the stock. The top of the stock is not cut off until the scion has started to grow or at least shows signs of uniting with the stock. For this graft (figure 9), the scion is cut in the same way as in the modified cleft graft or with a somewhat shorter wedge. After setting the scion, the base of the scion and the stock where the scion has been inserted are wrapped with tape in the same way as in the modified cleft graft, and all cut surfaces and the scion are covered with wax (see figure 8). This type of graft is suited to stock about 1 inch in diameter and has the advantage that the stock is not cut off unless there is an indication that the scion has united with it.

**Splice Graft**

The splice graft is a modified form of the whip graft, or bench graft, commonly used in nursery practice, and differs from it only in that there is no "tongue" cut on the contact surfaces. It is useful only where stock and scion are of about the same size. In this graft, stock and scion are cut with one flat diagonal face. These faces are placed together so that the cambium layers of both are closely matched. The graft is then tightly wrapped with raffia or tape and carefully waxed.

**Inlay Graft**

In topworking larger trees with stubs from 1 to 3 inches in diameter, the inlay graft is one of the best. This method is shown in figures 10A,B. For this graft, 2 parallel slits are made in the bark at the end of the cut stub of the stock, just far enough apart to match the
Figure 10A. Inlay or bark graft on black walnut. A. Scion cut ready to insert. B. Strip of bark removed to accommodate scion. C. Scion nailed in place. D. All cut surfaces and scions covered with wax.

width of the scion. The bark between the slits is then pried loose at the top. The scion is cut with a flat face about 2 inches long to fit next the stock. The opposite side of the scion is cut to make a short wedge. The scion is then shoved downward in the slot so that cambium contacts are made on both sides of the scion next to the wood of the stock and on the bark flap (figure 10A). The scion is held in place with small nails 5/8 or 3/4 inches long of 18- or 20-gauge wire. All cut surfaces of the stock and scion are covered with wax. With hickory and walnut stocks which bleed when fresh-cut, better results are obtained if the stocks are cut off about 2 weeks before grafting. By this time bleeding will have stopped, and the grafts can be set in the stub without cutting it off again. If there is difficulty in making flat cuts on the face of the scions with a knife, a sharp, low angle plane can be used to advantage. A knife sharpened with a bevel on one side only, so that the flat side can be held next the scion, is helpful.

Another way to protect the inlay graft is to use aluminum foil and a plastic bag. In this, the graft is made as shown in figure 10B. Instead of waxing, all cut surfaces of the grafted stub are covered with foil. The procedure is to cut a slit half way across a 8-10-inch square sheet of aluminum foil. The uncut half of the sheet of foil is wrapped around the grafted stub with the slit next to the scion. The 2 loose flaps of the foil are wrapped snugly around the base of the scion and over the cut end of the stub. Further protection is given by cutting a small hole in the corner of a plastic bag (pint or quart size), placing the bag over the grafted stub with the scion projecting through the hole, and tying the bag to the scion at its base and also to the stock 4 or 5 inches below the graft. The cut tip of the scion must be waxed, but no other waxing is necessary.

Figure 10B. Inlay graft using aluminum foil and plastic bag. A. Scion cut same as figure 10A except for cutting through bark on outside surface of scion (see arrow). B. Slit foil wrapped around stub of stock. Scion is fastened to stock in the same way as in figure 10A, C. C. Foil wrapped over cut end of grafted stub fitting tightly around base of scion. Stub and scion base covered with plastic bag, fastened around base of scion and stub with rubber bands or light string (see arrows). The tip of the scion should be covered with wax.

Care of Grafted Stock

After the scions are set and waxed, it is good practice to cover the grafted stubs with white ventilated paper bags. A 5-pound-size bag with the corners cut out for ventilation serves the purpose well.

All buds that start to grow on the stock should be rubbed off; otherwise, the buds on the scion will prob-
ably not start. The grafts should be inspected every week or 10 days during the first growing season; and all new growth that starts from the stock, removed. As the graft grows, the new shoot should be tied to some support to keep it from being blown out by the wind or otherwise knocked off. Such support may be necessary until the grafts are several years old and the cut stub of the stock is healed over. A vigorously growing graft tied to a lath splint is shown in figure 11.

**Time to Graft**

In New York the most favorable time for nut tree grafting is late May through June after growth of the rootstock has started. Chestnuts can be grafted early, as soon as growth starts. Hickory and walnut apparently do better if grafted when the stocks are in nearly full leaf. Grafts can be made later in the season, but in the North they may not mature their growth sufficiently to withstand the following winter. Also, fewer grafts take in the late spring, probably because the scions are in poor condition.

**Scion Wood**

A frequent cause of failure in nut tree grafting is the poor condition of the scion wood at the time of grafting. This may be due either to the kind of scion wood or to poor storage conditions.

The best scion wood is from vigorously growing shoots, about 1 foot long, which have a large proportion of solid wood in comparison with the amount of pith. One-year shoots are preferable, but 2-year wood with well-developed buds and good body is better than pithy 1-year-old shoots (figure 12). Often there is no suitable
scion wood on old slowly growing trees, and it is necessary to make the best of what is available. Usually an old tree can be made to produce good scion wood the following growing season by severely pruning the top and fertilizing the soil.

To reduce the time of scion storage, scion wood should be cut in the spring just before the buds start. In New York this is in late February and early March. There is some evidence that it should not be frozen at the time of cutting. Placing the scions in polyethylene freezer bags and storing them at 32°–40°F has given excellent results. If such facilities are not available, other conditions of low temperature and high humidity should be sought. Placing the scions on a damp dirt floor in an unheated cellar and covering them with a tight box or packing them in damp moss in a nearly tight container gives good results. Storing in moist (not wet) sawdust or peat moss in a cold storage at a temperature of about 32°F is satisfactory. Coating the cut ends of scions with melted paraffin is helpful, particularly if the scions are to be sent through the mail.

Equipment

If much grafting is to be done using hot wax, a melter of some sort is needed. Several types of commercial wax-melters are available. It is not difficult to rig up a melter that will meet requirements. Heat can be supplied by an alcohol lamp.

A formula used by some of the most successful propagators of nut trees follows:

Resin .......................... 6 pounds
Beeswax ........................ 2 pounds
Raw linseed oil ................. ½ pint

This is the Jones formula, advocated by the late J. F. Jones of Lancaster, Pennsylvania. All the ingredients are melted together over a slow fire. If the mixture is heated too hot, it may catch fire; so it must be watched closely. The wax can be applied to the grafts with a cheap brush about an inch wide.

Good results have been obtained with water-soluble asphalt emulsions in nut tree grafting. This has the advantage of application without heating. Grafts should be shaded to prevent the direct rays of the sun from striking them, for the black asphalt absorbs heat. An ideal wax should be opaque and at the same time reflect heat.

Planting Trees

One of the chief obstacles to the spread of nut culture has been the difficulty experienced in making transplanted trees live. Stated briefly, the essentials of successful nut tree planting are to: (1) Plant only trees that have a good root system; hickories and walnuts should have a taproot 15–20 inches long. (2) Prevent the small roots from drying out at any time before planting. (3) Dig a hole that will contain the roots readily, then work the topsoil in among the roots carefully. (4) Tamp the soil firmly about the roots with a tamping stick; this is of the greatest importance. The soil should not be wet enough to puddle at planting. (5) After planting, thoroughly soak the soil about the roots with water. (6) Keep the weeds from growing around the tree, by mulching or cultivation, until the tree is established. (7) At the time of planting, cut back the top of the nursery tree about one-half or two-thirds to balance top to root, but make sure that several good buds remain; cover the cut surfaces with wax. (8) If the season is dry, water the tree weekly until it has become established. Wrapping the trunks with paper may be helpful in preventing sunscald.

Results of recent experiments with fruit and shade trees indicate that mixing moist granulated peat moss with soil (about one-third peat to two-thirds soil) at the time of planting greatly benefits the trees. Coating the trees at planting time with melted paraffin has proved injurious under some conditions and is not generally recommended. Early spring planting is preferable though fall planting is sometimes successful.

Nut trees respond to fertilization and good soil management as do other fruit crops. Although, in the wild, many trees apparently do very well in competition with other vegetation, outstanding growth yield is associated with an unusually favorable situation as to soil fertility, moisture supply, or some similar condition. It is a mistake to think that nut trees will thrive under adverse conditions. Neglect, especially before the trees are well established, will usually result in the loss of trees.

After trees are planted, weeds can be controlled by cultivation or by mulching heavily with hay, straw, sawdust, or wood chips. On mulched trees extra nitrogen must be given the tree to prevent nitrogen deficiency. Black polyethylene sheets spread under the trees will control weeds. They must be held in place by some other mulching material. After the trees become established, a weed killer such as simazine can be used to control weeds.

Pruning

The pruning of nut trees is aimed primarily at building a strong framework which will support crops of nuts and resist breakage from wind or other causes. The principles involved in building a strong tree are the same as for other orchard trees and consist of (1) avoiding narrow angles between scaffold limbs, (2) avoiding balanced crotches in which the main trunk divides into essentially equal parts (figure 13), (3) spacing scaffold branches on the trunk so that no 2
they thrive best in well-drained soils that are neutral or on the acid side. Strongly alkaline soils make zinc and iron unavailable, and trees on such soils frequently show deficiency symptoms and poor growth. In their native habitat, black walnuts and pecans are found on rich bottom land or limestone residual soil that is neutral or slightly acid. Chestnuts, on the other hand, grow naturally upon acid upland soils usually of light texture. The butternut and some of the hickories are found on upland soils.

The different kinds of nut trees vary in their fertility requirements, but, in general, the walnuts, both Persian and black, require a more fertile soil, particularly one rich in nitrogen, than do the hickories and the butternuts. All do best under conditions of a high level of fertility and a good nitrogen supply. Trees already well established, particularly walnuts growing in sod, might receive about ¼ pound of ammonium nitrate, or nitrogen equivalent, annually for each inch of diameter of the trunk until they have attained a diameter of about 6 inches, and then about ½ pound for each inch gain in diameter, up to a maximum of 15 to 20 pounds per tree.

If the soil is generally low in fertility, a complete fertilizer of the 5–10–5 or 10–10–10 formula is beneficial. This is applied at the rate of 2 pounds of 5–10–5 for every inch in diameter of the tree. If 10–10–10 is used, apply only half as much. These fertilizers are broadcast on the ground under and somewhat beyond the spread of the branches of the tree. This is, of course, only an approximation; the actual needs of the tree depend on the natural fertility of the soil and on other conditions. Nut trees may suffer from lack of potassium or of some of the minor elements, particularly boron, zinc, and copper (page 17). The best time to apply fertilizer is in the spring just as growth starts.

Trees should be watched to detect unfavorable conditions such as excessively vigorous growth, which may lead to winter injury, or an under-vegetative condition, indicated by yellow, sparse foliage, premature defoliation, and short terminal growth (less than 6–10 inches). Too vigorous growth can be checked by withholding fertilizer or by allowing weeds or a cover crop to grow around the trees; weak trees can be stimulated by cultivation and fertilization. In general, trees suffering from a lack of soil fertility are much more common than those suffering from too much.

Cross-Pollination

It is definitely known that many nut varieties need cross-pollination to mature nuts properly. Filberts and Chinese chestnuts must have a suitable second variety to supply pollen. The pollen requirements of the different varieties of walnuts and hickories are not known definitely. Self-unfruitfulness is prevalent enough to

Soil Requirements

Although much is yet to be learned about the soil requirements of nut trees, it is well established that scaffold branches arise at the same level on the trunk. To accomplish these objectives corrective pruning should be done while the tree is young. Branches forming angles of less than 40 degrees with the main leader should be removed; one side of a balanced crotch should be cut off or suppressed by pruning it heavily. As the tree develops, scaffold branches should be chosen that have a vertical distance of 18 to 24 inches between them. If logs are wanted, a clean trunk for at least 9 feet is sought. Other branches are suppressed or removed. Because the growth of a young tree is determined by the amount of leaf surface, pruning should be as light as practicable to achieve the objectives sought. Usually it is better to suppress an unwanted branch by pruning it to give permanent branches room and to remove it later when the tree attains bearing size. If the tree is being grown for logs, side branches should be removed from the trunk before they attain a diameter of about 2 inches. Of course, all cuts should be made close to the trunk so that they will heal over.

Figure 13. Two nearly equal branches with a narrow angle result in a basically weak crotch structure on this shagbark hickory. The smaller branch should have been removed when the young tree was being trained.
make advisable more than one variety of each species in the same planting. With the Persian walnut, the difficulty may be, not that the variety is self-unfruitful, but that the pollen of the variety may be shed too late to be of value or that flowers bearing pollen may not form at all. This is often the difficulty with young trees which may at a later age produce flowers of both types and fruit satisfactorily. The safe practice with all nut trees is to plant at least 2 varieties together, with the possible exception of the Japanese walnut and the butternut.

**Harvesting the Crop**

Nuts are allowed to mature fully on the trees and to fall naturally or with mild shaking. Beating the branches is seldom justified. The nuts should be gathered from the ground as soon as possible to prevent discoloration of the shell and the kernel. This is of particular importance with the Persian walnut and the chestnut, which mold quickly if they remain in the hull on the wet ground. Black walnuts should be hulled before the hull turns black to secure a light-colored, high-quality product. With small quantities this is not difficult; the nuts can be tramped or beaten out of the hulls. If black walnuts are thoroughly washed in water as soon as the hulls are removed, the nuts will be more attractive when they are dried. For large quantities, mechanical hullers are used.

All nuts, except chestnuts, should be well dried before being stored. When the kernels will break with a snap when broken between the fingers or bitten between the teeth, they are dry enough to store well at a relative humidity of 70 percent. Failure to dry the nuts properly will result in a moldy, poor-quality product. All nuts because of their high fat content will become rancid after about one year if stored at room temperature (70°F) and hence should be stored in the coldest place available. Satisfactory practice is to extract the kernels and store them in polyethylene bags under refrigeration.

**Marketing**

The marketing of northern-grown nuts is still mostly a local problem. Black walnuts, butternuts, and hickory nuts are offered in farmers’ markets. Chestnuts are sold in grocery stores. Persian walnuts and filberts compete with western-grown and imported supplies, and their price is determined by them. The only other product for which there is an established market is black walnut kernels. These have a good demand in the baking and confectionery trades at prices depending upon current price levels.

Some growers sell the cracked nuts with their shells in plastic bags. A large proportion of the black walnut kernels are of poor quality because of faulty treatment of the nuts in husking and curing. Dry black walnuts or hickory nuts will shell much better if they are moistened before cracking. It is satisfactory to soak them for 15 minutes in water and hold them overnight in a damp burlap sack or tight container. Kernels must be thoroughly dried before storing in tight containers. To bring top prices, kernels must be bright colored, carefully graded, and free from shells and dirt. Federal regulations require that nut kernels be pasteurized if they are to be sold on the general market. Several effective power and hand walnut crackers are on the market. Most black walnuts are best cracked by pressure from the ends. A nut that has poor cracking quality when cracked on the side with a hammer will often give good results with this method.

**Failure of Trees to Bear Crops**

Like all other fruit trees, nut trees sometimes fail to bear crops. It is often difficult to determine why this occurs. Seedling trees normally do not bear nuts at as early an age as grafted trees. Hickory seedlings may take 20 years before the first nuts are borne. Persian walnut seedlings fruit at 8 to 10 years of age and chestnuts somewhat earlier. Probably the most frequent cause of unfruitfulness is lack of cross-pollination as discussed on page 15. Other causes are poor soil and poor drainage, lack of fertilizers, defoliation by insects and diseases or direct damage by insects. Young nuts, overbearing one year with no crops for several years following, and late spring freezes that destroy the blossoms. Usually if the trees are growing under favorable conditions and the grower keeps them vigorous and healthy, she or he will eventually be rewarded with crops of nuts.

**Poorly Filled Nuts**

One of the most common difficulties experienced with nut trees in the North is that the nuts fail to mature their kernels. In New York, pecan nuts may be frozen on the trees before they even attain full size. Black walnuts, heartnuts, and some hickories may suffer from severe freezes in early fall, which defoliate the trees and stop the development of the nuts so that they are worthless because of shrunk Cherokee kernels. In some seasons with no early freezes, the nuts may be full-sized and otherwise appear normal but, on husking and curing, have shrunk kernels of no value. Many causes contribute to this condition such as the following:

**Too short a growing season or too little summer heat**

In the northern states probably the most frequent cause of shrunk kernels or poorly filled nuts, par-
particularly hickories and walnuts, is either too short a growing season or too little summer heat. In such a season the kernels do not fill before leaf fall. Since the leaves are the source of the food material that goes to make up the kernel of the nut, the development of the kernel stops with leaf fall; and the immature kernel shrivels on drying. Nothing can be done to remedy this situation except to grow earlier maturing varieties. At Ithaca, some varieties that fail to mature in the usual short season will mature in the occasional long growing season.

Drought

Because of its effect on the functioning of leaves, severe drought is sometimes the cause of nuts failing to fill. A dry, sunny season will, however, produce better filled nuts than will one with excessive moisture and little sunshine, which keeps the trees in a vegetative state of growth. Early drought reduces the size of the nuts, whereas drought late in the season may prevent the kernels from maturing. Unless the drought is long and severe, it causes no damage.

Lack of adequate pollination

Lack of pollination often results in the production of nuts without kernels, although this usually results in failure of the nuts to set. The shells of chestnuts and filberts may continue to develop but contain no kernels.

Lack of minor elements

Research with pecans and Persian walnuts has shown that a frequent cause of poorly filled nuts is a lack of potassium, magnesium, or some of the minor elements: copper, zinc, iron, and boron. Nut trees apparently use more of these elements than do most other fruit trees. Severe deficiency is shown by mottled leaves and witches-broom growth. If such symptoms are seen, or nuts are poorly filled for no other recognized reason, a complete fertilizer high in potassium (10-10-10) can be used at the rate of 1 pound for each inch in diameter of the tree. It should be spread under the branches, not concentrated around the trunk.

Magnesium can be supplied to the trees by applying dolomitic limestone or Epsom salts. On soil that is very acid (below pH 5.5 by the soil testing service analysis provided by Cooperative Extension), dolomite broadcast on the soil surface at a rate to raise the pH to 6.0-6.5 can be helpful. Such liming should not be used where the pH is already above 6.0. Epsom salts at 10 pounds per 500 square feet of soil surface, broadcast at the time of liming, can correct severe magnesium deficiency more rapidly than the use of lime alone.

Boron deficiency can be remedied by applying borax at the rate of ½ pound for each inch in diameter of the tree. To correct zinc deficiency, zinc sulfate can be applied at the same rate. If other deficiencies are indicated, one of the minor element mixtures available in the trade can be used according to the manufacturer’s directions. The amounts of minor elements needed will vary widely with the severity of the deficiency and with the soil type. The recommendations are well within the limits of safety to the trees and can be expected to correct the deficiency.

Insects and diseases

Insects and diseases that destroy or injure the leaves of the trees are a frequent cause of poorly filled nuts, because the reduced leaf surface is not enough to manufacture the carbohydrates needed to fill the kernels. Thus, any conditions that injure the leaf surface may give poorly filled nuts.

It is impossible to describe here the many different kinds of insects and diseases and to give detailed instructions for their treatment.

Most home owners lack the equipment to spray large trees and in some years have to accept considerable damage from diseases and insects. In the home plantings, except under conditions of unusual infestation, reasonably good crops can be expected with a minimum of disease and insect control. In any commercial venture, special attention must be given to a spray program aimed at the specific pests and diseases that are present.

In many locations squirrels and blue jays are the most important pests and, where abundant, may take the nut crop if there are only a few trees. If other food is scarce, they will take all Persian walnuts, hazelnuts, and hickories long before they are ripe enough to harvest. Where shooting is illegal, trapping is about the only recourse, but often fails unless the nut trees stand apart from other trees so that the squirrels cannot come in through the treetops. Black walnuts are usually not taken until late in the season. Blue jays are most troublesome with filberts when only a few bushes are grown.

Government regulations of the use of pesticides change rapidly as new information becomes available. Growers with special problems of insect and disease control can get up-to-date information from Cooperative Extension agents or from the New York State College of Agriculture and Life Sciences, Cornell University, Ithaca.

Reflections on Nut Trees, World Food, and Soil Erosion

Long before the present world food shortage was widely recognized, the late J. Russell Smith wrote the book Tree Crops, a Permanent Agriculture. From worldwide personal observation and documented historical
and current evidence, he showed that the productive soils of the earth had been and are being destroyed rapidly by erosion. This destruction of soils was related to the growing of cultivated crops on sloping land where the exposed soils are eroded rapidly by heavy rain, particularly during thunderstorms. He noted that when trees occupied the land, erosion was checked and recommended an agriculture based on tree crops grown without cultivation to save the land. In the book, the kinds of trees that produce human and animal food are named, and their possible use in a tree-based agriculture is described.

Since the publication of J. Russell Smith's book, erosion and land degradation in the United States and elsewhere have continued at a rapid rate, compounded by an increase in population and loss of agricultural lands by urbanization and abandonment. The present trend is toward greater mechanization, bigger machines, larger farms, and cultural practices that give short-term increased yields, but in the long run will result in a decline of productivity.

The erosion problem has been recognized by various federal agencies such as the Soil Conservation Service, but their emphasis is on growing timber and wildlife habitat improvement rather than food production. More recently, as food shortages have become a reality on a global basis, several books have been written relating the rise and fall of civilizations to the loss of the soil and warning of impending food crises unless drastic measures are taken to conserve the soil. The suggested measures to increase food production, however, are concerned mostly with the grain crops that require plowing and intensive cultivation and hence will, in the long run, only aggravate soil loss from erosion. Little or no recognition is given to the fact that tree crops can be grown without cultivation and, under most conditions, will halt erosion or reduce it to a minimum. At the same time, the energy used in mechanization of growing cultivated crops is greatly reduced or eliminated. Substituting human labor for machines is out of step with modern economics; but as the cost of energy increases, less mechanization may be acceptable. Recent studies show that the energy used in growing a crop of corn, for example, may be more than that received from the crop itself.

Tree crops that produce food and forage fall into several groups. Most important are the nut crops that are described in this bulletin. These are a source of protein and fat. Then, there are the sugar-producing plants, the honey producers, the oaks producing starch, and plants producing fruits for human and wildlife consumption. Several leguminous trees produce pods valuable as forage for cattle, and research is under way that promises to make cattle food from soft woods such as the aspen and other poplars. In northern climates, the number of kinds of trees producing food is relatively limited with the number of species increasing in the climatic zones toward the south.

Although the destruction of agricultural lands by erosion and the increasing need for food to feed an increasing population are established beyond question, the feasibility and procedures for developing significant food supplies from tree crops have not been worked out in detail. Little attention has been given to the improvement of the native American plants that are a potential source of food and forage. An exception is the pecan which has been much improved over its wild state. It is highly probable that with modern plant-breeding techniques rapid progress could be made with other nut crops together with the oaks and other kinds of trees producing sugar and starch. Some selections of high-yielding trees have already been made, and it is projected that acre yields from tree crops may equal or exceed that of the grain crops.

Unanswered Questions; Research Called For

At the present time there are unanswered questions as to the best procedures to follow in establishing tree crops on rough land without cultivation. Planting young trees among other growing trees is rarely successful, and clearing the land before planting may expose it to erosive forces that should be avoided. Then too, the food-producing trees needed to establish a tree crops venture are not immediately available from nurseries, and growers would have to resort to growing seedlings and graft them to the superior clones desirable for a successful project. What is needed at the present time to assure the development of viable tree crops agriculture is more long-term research concerned with some basic questions including among others (1) the improvement by plant breeding of potentially valuable species adapted to different climate zones in the United States; (2) the introduction, propagation, and testing of kinds of trees from other areas with similar climate requirements; (3) working out efficient methods for establishing young trees in mixed plantings without soil cultivation; (4) working out methods of harvesting and processing new products for use as food and fodder; (5) finding ways to control pests and diseases without excessive spraying, preferably by biological control; (6) finding feasible ways to control or utilize wild life that most certainly will compete for food crops raised in woodland or other land not under close supervision.

In the past, attention to the use of tree crops as a permanent agriculture has been given almost entirely by individuals whose work has lacked continuity and permanence. What is essential is to establish research projects sponsored and funded for many years by a federal agency or university or other ongoing organization. It is recognized that growing tree crops without mechanization is out of step with the present trends, and there little possibility that they can be grown at a profit. Estab-
lishing a viable tree crops project is a long-time venture and can only serve the future, probably 30–40 years into the future. However, with population increase, energy shortages, and food shortages in prospect, producing food and forage in any way possible will be relevant to the situation that will certainly develop.

Immediate Possibilities

Because of high labor costs and land values and uncertainty as to procedures and results, it is doubtful if any large shift to a tree-based agriculture will occur in the near future. However, thousands of acres of land around suburban homes and farmsteads and rough lands owned by part-time farmers can be developed to contribute to the food supply by planting tree crops. Of these, the more important and available are the nut-bearing trees described in this bulletin. It is not claimed that growing nut trees in the northern states will be commercially profitable. A possible exception is the black walnut which, under favorable conditions, will produce a marketable log in 35 to 40 years in addition to nut crops. However, as a hobby, growing nut trees and other food-producing trees can be an absorbing interest suitable for those who can develop a managed woodland or any areas not suitable for cultivation.

In a broader sense and for the future, a much more important use for tree crops, is to develop, as a national long-term policy, lands not suitable for cultivated crops as a food and fodder resource. There are hundreds of thousands of acres of land in the United States too rough or sloping to cultivate or already abandoned because of erosion where food-producing trees could be grown.

On a global basis the problem is even more acute because not only have vast areas of productive land been destroyed in the past but the population pressure in the underdeveloped countries is destroying the remaining unspoiled lands at an accelerated rate. This is not an academic question. As has been pointed out much earlier and emphasized more recently in current writing, when a culture or a nation loses its agricultural base of support through erosion or other mismanagement of soil, that culture is in deep trouble. This has already occurred in many parts of the earth. The United States is fortunate in having no real food shortage as yet; but its soil resources that feed the nation are being destroyed at an alarming rate, and the time will come when such food shortage will occur unless the trend is reversed.

Though not now economically feasible, in the long run use of tree crops may be feasible, and even necessary, to achieve maximum food production. In the short run, the planting of nut trees is encouraged as a hobby interest which in the aggregate will add appreciably to our food supply.

Sources of Additional Information on Nut Trees and Tree Crops


Zones of plant hardiness in the United States. Plants available for tree crops culture are few in zone 3 and northward and consist of only a few honey crops and aspen, which is being developed as a cattle food. In zone 4 the sugar maple, various nut trees, oaks, and the honey locust will grow. In zone 5 and southward, the number of suitable plants increases to include persimmons and other fruits and nuts. (From Plant Hardiness Zone Map, Agricultural Research Service, USDA, Mis. Pub. No. 814, Gov. Print. Off., Wash. D.C.)

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