NUT GROWING IN THE NORTHEASTERN STATES*

The Northeastern States have a rich heritage of native nut trees. Among the species occurring in the fields and woodlands are six hickories, the black walnut, the butternut, two species of filberts, the beechnut, and formerly the chestnut. At the present time, however, the species have not been developed in the horticultural sense and so do not form any commercial industry, nor have they been improved by selection and breeding in a way comparable to the Persian walnut or the pecan. The nuts that are grown commercially in America such as the Persian walnut, the pecan, the European filbert, and the almond have all originated either in foreign countries or in the region to the South and West where the climate is better suited for their growth.

The planting of improved nut trees in the northeastern states is thus a comparatively recent development. To be sure nut trees have been given a sort of culture in that they have been left in the fence rows and in the fields that were cleared of other species, and seedling trees have been planted around the home grounds from which nuts have been harvested from time to time. Except with the chestnut it is only within the last quarter century that there has been any attempt to improve the nuts grown and to encourage nut culture in any real sense. Such improvements as have taken place have been the discovery of varieties that bear superior nuts and their propagation and testing. In the Northeast this process is still in the exploratory stage and there is yet much to learn as to the adaptation of the various kinds of nut trees to this region.

As the work has progressed it has become evident that the successful production of improved nuts in the Northeast is largely dependent upon the discovery of varieties that are adapted to this region. Most of the varieties of nuts which have been selected, named and propagated have originated to the South and

* Referring specifically to New England, New York and Pennsylvania. Of course the information would also apply to other regions with similar climate.
West and when brought into the northeastern states have not produced good crops mostly because the climate is not warm enough and the growing season long enough for the normal development of the variety. It seems obvious that for the most part in this region nut culture must be developed from varieties which have originated in the North or in parts of other countries which have a similar climate. The search for varieties adapted to the North has been going on for some time and a considerable number have been named. The time is now ripe for more extended planting of nut trees to determine their adaptability to growth in northern locations. Planting nut trees for shade and as a hobby is to be greatly encouraged because not only are trees of assured hardiness and landscape value available but the grower by testing varieties is contributing to our knowledge of nut culture in the Northeast.

Climatic Factors

With nut trees, as with all other plants, the most important determining factor in their survival and growth is the climate of the region where they are planted. Apparently the limiting factor with many species is winter cold, particularly the absolute low temperatures reached in any one season. Most nut species are long lived trees and although the winters of several decades may not be injurious the occasional exceptional winter may entirely wipe out a given species or variety. This has occurred in parts of the North with the Persian walnut. Previous to 1933-34 there were a considerable number of these trees flourishing in the fruit belt of western New York State, many of which had grown to a bearing size. The unprecedented cold of that season killed most of the trees outright except in a very limited area where the temperature did not fall below 

Another climatic factor that is of real importance in the growing of nut trees is the length of the growing season or the number of days between freezes. Practically no species will stand a hard freeze after the growth starts in the spring. These spring frosts rarely kill the trees outright but destroy the new shoots and with them the year's crop. At Ithaca, N.Y., it is probable that this killing of the new growth on hickories and walnuts is responsible for crop failure more often than any one other factor. The leaves come out from other buds after the freeze and during the growing season the trees appear normal except for the fact that there is no crop. Most of our nut tree species require a growing season of at least 150 days between frosts although butternuts and filberts may require less. The length of the growing season for the various parts of the northeastern states is shown on the accompanying map. (Plate VIII)
PLATE VII. Note: The maps have been prepared from data supplied from the U.S. Weather Bureau publications modified in the light of other known climatic and geographical features. The zones are only approximate and local conditions such as altitude, exposure and nearness to bodies of water may have an important effect on the growth of trees.
Somewhat less damaging than late spring frosts are freezes which occur in early fall. Black walnuts are particularly likely to be damaged at this time. The nuts on the trees will not be hurt by light frosts but if the temperature goes to \(+25^\circ\) F. or below there is likelihood that not only will the leaves be frozen off the trees but the nuts themselves will be frozen so as to make them poorly flavored and useless. In many cases if the leaves are frozen from the trees the development of the nuts will stop and the nuts are poorly filled. Early fall freezes, if the drop in temperature is rapid and occurs before the growth on the trees has hardened, may cause serious damage to both trees and nuts.

Associated with the same problem as the length of the growing season between frosts is the mean summer temperature sometimes expressed as total summer heat. Varieties of fruit trees, nuts included, require a certain amount of heat above a base temperature in order to develop well-filled nuts. Thus, even though the growing season may be sufficiently long, if the temperature during the growing season is too low, nuts will not mature. This is particularly important with those species that normally grow farther South such as the northern pecan from Illinois and many of the black walnut varieties. These trees may be perfectly hardy as far as winter low temperatures are concerned but they rarely mature a crop because of cool summers and the short growing season. Sometimes exceptionally warm seasons will mature nut varieties in a region where they usually fail to ripen. The same thing is also true of grapes and other fruits.

Local variations in climate are often important in determining the suitability for growing nut tree species on a particular site. On the accompanying maps the climatic zones are indicated in a general way. Within these zones, however, there may be certain sites which are more favorable for the growth of nut trees than others. These sites are related to proximity to bodies of water, good air drainage, protection from winds or other favorable factors. An example of such a site has been observed at Aurora on Cayuga Lake, N. Y. Here on a certain bench close to the lake and surrounded by rather high banks, a number of species were growing for many years that were not adapted to the surrounding region. These included a California redwood, a number of Persian walnuts and a few northern pecans. These trees had grown to considerable size and had produced satisfactory crops but in the winter of 1933-34 the lake froze over for the first time in many years and the temperature on a single night dropped to an unprecedented low point. All of the trees except the pecans were either killed or badly damaged. Advantage should be taken of such locations wherever they occur. On the other hand exposed hillsides, frost pockets, and high elevations should be avoided.

From the above discussion of climate and an examination of the maps, it becomes evident that parts of the Northeast differ greatly in their suitability for growing nut trees. In northern New England, particularly Maine, New Hampshire and Vermont, only a few of the most hardy kinds such as the butternut can be grown. In southern Pennsylvania, however, most species and varieties will
succeed. In between these areas conditions become increasingly less favorable from South to North, the suitability of any locality being influenced by local factors that effect temperature, air drainage, and the like.

Species and Varieties

As before indicated, the problem of growing nut trees in the northeastern states is largely a matter of varieties and their adaptation. The greatest concentration of the more valuable native species, particularly the black walnut and the shagbark hickory, is in the Mississippi River basin, particularly the Middle West. Named sorts originating in these regions are probably not adapted to northern New York or New England and should be planted with the realization that it is an experimental project or else there should be assurance based on tests that the varieties will succeed. The probable solution of the problem is to obtain varieties that have originated locally or under similar climatic conditions and are of proven worth.

BLACK WALNUT. The black walnut, although primarily a plant of the Mississippi River basin and the region of the Great Lakes, is hardy in most parts of the Northeast and one of the most valuable nut trees for the region. It is extensively planted around the farmsteads in southern New England and southward and has escaped along the fence rows and in waste places where it is not native. Most of the varieties which have been named and propagated originated to the West and South of New England and have not proved suitable here. At Ithaca, New York, the variety "Thomas" has been one of the most successful but apparently this is about the limit of its northern range and even here there are seasons when the nuts do not mature. Other varieties extensively propagated such as "Ohio" and the "Stabler," do not mature at Ithaca or farther North. Varieties of northern origin have as yet not been sufficiently tested to be sure of their behavior in New England. They are, however, the most promising for this region and are well worth a trial. Among these can be mentioned the "Snyder" from the Ithaca region, the "Wiard" and "Allen" from Michigan, the "Huber" and "Cochrane" from southern Minnesota and the "Cresco" from northern Iowa. These are being propagated sparingly by nurserymen and could be propagated to order if the grower so desires.

Varieties successful in southern New England, central Pennsylvania and southward are the "Thomas," "Elmer Myers," "Stambaugh" and "Sparrow." These are available from nurserymen.

Those interested in nut culture should observe trees growing in the northern part of the black walnut range and select those which produce the best nuts over a period of years. These can be propagated by nurserymen on order or grafted by the individual himself. It is only by such selection from trees that are successful that progress will be made in the varietal adaptation of nuts to a northern environment.
Map showing the average July temperature in the Northeastern states for the years 1895 to 1909. July temperature is a good indication of amount of heat necessary for maturing corn crops.

PLATE IX. See Note under Plate VII.
The variation in cracking quality and size of black walnuts is great. Some of the better sorts may have as high as 35% kernel although 20% kernel is good and most common seedlings have considerably less. Black walnuts are best adapted to deep, rich, slightly alkaline or neutral soils with good drainage. They are found growing naturally in alluvial soil in the river valleys. In the North such sites should be avoided if they are "frost pockets."

**BUTTERNUT.** The butternut extends the farthest North in its natural range of any of the important nut trees and in fact in northern New England is about the only nut which will succeed. Here it should receive much more attention than it has in the past. It has the disadvantage of being rather short-lived under some conditions. The cause of this in some cases is a parasitic fungus but in others it is apparently related to the nature of the tree itself.

Although the butternut will succeed fairly well on the poorer upland soils it thrives best on richer neutral soils with good drainage. A dozen or more varieties have been selected but only a few have been propagated commercially. Some of the named sorts that are propagated by nurserymen, at least in small quantities, are the "Kenworthy," "Irvine," "Love," "Craxezy," "Thill," and "Craxezy Van der Poppen." For some unknown reason the butternut is not easily propagated. Named varieties certainly deserve much more attention than they now receive because of their very superior cracking quality as compared with the ordinary run of seedlings.

**PERSIAN WALNUT.** Attempts have been made to grow the Persian or English walnut in the Northeast for many years with recurring damage from winter cold. Trees in the protected fruit region of New York became large enough to bear good crops until the extreme cold winter of 1933-34. At that time practically all Persian walnuts in the East were either killed outright or very severely damaged. Apparently the temperatures of -20° F. becomes critical for most trees of this species and quick drops in temperature in spring or fall may be injurious at higher temperatures.

At the present time there is a very real interest in what is known as the Carpathian walnuts which have been introduced from Poland by Mr. Paul Crath of Toronto, Canada. These trees are grown from seeds or grafts from trees in the Carpathian Mountains which have withstood temperatures as low as -40° F. Some of these trees have been growing in North America in both Canada and the United States for fifteen to twenty years and show promise of successful culture. Many seedling trees have now fruited and a few varieties have been named and propagated among them the "Littlepage" and the "Metcalf." A recent contest discovered a number of other superior types that should soon be available. Trees are available mostly as seedlings in both the United States and Canada. It should be borne in mind that even though the Carpathian walnut is hardy there may be other climatic factors which are limiting in their culture, such as length of growing season or the amount of summer heat available. Indications are, however,
PLATE X. Black walnuts. The nuts at the left show large and small variations. The one at the right is the Snyder variety, originating near Ithaca, N.Y., and has good cracking quality. The disk is slightly larger than a twenty-five cent piece.
that they are adapted to relatively short seasons and they have shown little killing back from winter cold. They have however been damaged by late spring frosts.

**JAPANESE WALNUT.** The Japanese walnut (*Juglans cordiformis ailantifolia*) makes rapid and luxurious growth even in rather poor soils and is well adapted for use as a shade tree. It comes into bearing early and has a tropical appearance which is very pleasing. Seedling trees vary considerably in their hardiness but for the most part withstand winter cold in all except the most severe parts of the Northeast. At Ithaca, many have withstood temperatures of \(-35^\circ\) F. without damage. On the other hand there are some seedlings which have been damaged at \(-20^\circ\) F., and early fall freezes may be damaging at higher temperatures. The nuts of the Japanese walnut resemble the butternut in flavor of the kernel, but in general are not so highly flavored. Some types of this nut are fairly smooth whereas others are rough much like the butternut. It was thought that these rough nuts were hybrids with the butternut, but the fact that such rough nuts occur in Asia where there are no butternuts indicates that they are probably only a form. The name *burrnut* is used for Japanese walnuts of the rough shelled type. As yet there are no named varieties of this nut.

**HEARTNUT.** The heartnut (*Juglans cordiformis*) is a sport or mutation of the Japanese walnut resembling it closely in foliage and growth habit. The nuts have much better cracking quality, however, and with most of the named sorts kernels can be recovered in whole halves. The shells of some of them can be split apart with a knife inserted in the base of the nut. The nuts are smooth and attractive in appearance and although usually smaller, they are much superior to the ordinary forms of the Japanese walnut. There is variation in hardiness of the different named varieties and at the present time it is impossible to give a well substantiated opinion as to the adaptation of the named varieties to northern culture. The "Lancaster" has not been hardy at Ithaca. Other sorts in the trade are the "Bates," "Faust," "Ritchie," "Stranger," "Walters," and "Fodermaier." Anyone interested in planting this nut will do a real service by keeping records of their performance and giving the information to experiment stations or the Northern Nut Growers' Association.

**HICKORY NUT.** A number of species of hickory are native in the Northeast. Among these are the mockernut (*Carya alba*), the shagbark hickory (*C. ovata*), the red hickory (*C. ovalis*), the pignut (*C. glabra*), the bitternut (*C. cordiformis*), and the shellbark hickory or kingnut (*C. laciniosa*). Of these the shagbark hickory is by far the most important. Mockernuts are gathered to some extent from the wild but are undesirable because of their thick shells. The pignut is usually not bitter but with few exceptions is of such poor cracking quality as to be of little value. The bitternut is intensely bitter, astringent, and quite inedible. Some of the hybrids with the shagbark hickory have been propagated because of their thin shells but are of poor cracking quality and flavor. The problem of growing hickory nuts in the Northeast is much the same as with the black walnut. Al-
though many sorts have been named a large part of them have their origin in the South and West, and when brought into the Northeast are not successful because of the short growing season and lack of heat. The Northeast must rely on varieties which have originated in the northern states. Among these may be mentioned "Davis," "Fox," "Glover," "Goheen," "Kirtland," "Mann," "Miller," "Nielsen," "Whitney," "Beeman," "Bridgewater," and "Wilcox." Most of these were reported in some of the nursery catalogs in 1939 and many of them could be propagated on order.

One factor standing in the way of increased planting is the difficulty of propagating the trees. Young hickory stocks have a very large tap root, making the trees difficult to handle in the nursery. This can be surmounted by cutting the tap root about 18 inches underground at least a year before transplanting, thus forcing lateral roots to form. Well managed nurseries provide for this and such trees are much more likely to succeed than those transplanted from the wild.

PECAN. The pecan so extensively grown in the cotton belt and extending in its natural range into parts of Indiana and Illinois, has not been successful in the Northeast. This is not because of tenderness to winter cold but rather to the relatively short, cool growing seasons which do not mature the nuts.

There are a number of hybrid varieties which make good shade trees. Among these the "Burlington" is particularly attractive. It has been perfectly hardy at Ithaca, has good clean foliage and occasionally has matured a few nuts. Usually they have been frozen on the trees before maturing. Other hybrid sorts such as the "Gerardi," the "Des Moines," and the "Pleas" have attractive foliage and make good shade trees.

In favorable locations in southern Pennsylvania some of the northern varieties of pecans occasionally mature crops of nuts. Anyone planting these should use varieties which are of northern origin. Among these are the "Greenriver," "Major," and the "Posey."

CHESTNUT. In the past the chestnut has been by far the most valuable of the nut trees in the Northeast. The wild groves of this species have, however, been almost completely destroyed by the chestnut blight. This disease, coming into the New York area about 1900 has now covered practically the entire native range of the chestnut in North America. Sprouts from old stumps may live from year to year, their usual history being that they grow until they are about two or three inches through and 10 to 15 feet high. At this stage the bark forms fissures through which infection occurs with the result that the sprouts are killed and are replaced with suckers from the base. Sometimes these sprouts become large enough to bear a few nuts and there are constant rumors that the chestnut is coming back in the forests. This, however, does not seem to be the case as there are no recorded instances of real immunity among trees of the native chestnut. There has been a persistent attempt on the part of the federal government and some state forestry departments to introduce or develop other species
or hybrid varieties of the chestnut which would be resistant or immune to the blight. In this some success has been achieved. The Chinese chestnut (*Castanea mollissima*) and the Japanese chestnut (*C. crenata*) although not immune to the blight are highly resistant. Hybridizing these with each other and with the native American species to obtain blight resistant types is underway. There are at the present time a number of varieties that are distinctly promising. Among these are "Abundance," "Carr," "Hobson," and "Yankee." These are available from nurserymen and are well worth a trial. Newer sorts developed by the U.S.D.A. are the "Nanking," "Meiling," and "Kuling," are excellent for size and quality and are worth a trial. Some stock-scion incompatibility has appeared with Chinese chestnut varieties so that planting seedlings of good strains is being done. Many of the nuts are fully as sweet as the native chestnut, and considerably larger. The trees are not as hardy as the native chestnut and may be damaged by temperatures ranging around -25° F. There undoubtedly is great variation in hardiness in these varieties and they should be tested further.

**FILBERT.** Two species of native filbert occur in the Northeast. One of these is the beaked filbert (*Corylus cornuta*) and the other the American filbert (*C. americana*). These, however, are relatively inferior as compared with the European species, *C. avellana* and *C. maxim*, which together with their hybrids are the basis of the world’s commercial industry. In New York tests have been made at the Geneva Experiment Station where a large number of varieties of European filberts have been grown. The limiting factor with most of these has been winter cold and late spring frosts. Temperatures of -20° F. have seriously injured many of the European varieties and late frosts frequently destroy the staminate catkins or pollen producing flowers and thus prevent a crop. The variety recommendations G. L. Slate based on experience at Geneva, New York are as follows:

"Cosford" and "Medium Long" are two of the hardiest varieties and with the exception of "Italian Red" are the most productive. Both are vigorous, upright trees. "Cosford" nuts are of medium size and thinnest shelled of all varieties tested. The nuts of "Medium Long" are slightly larger than those of "Cosford" and the shell is of medium thickness. The pellicle or fiber on the kernel is rather heavy.

"Italian Red" has thus far produced more nuts than any other variety tested, but at the Geneva Experiment Station in recent years the tree has not been as hardy as it appeared earlier and the variety is placed third on the list. The tree is vigorous and upright.

"Barcelona" in the earlier years of the test was the most productive variety, but recently the trees have experienced so much winter injury that the variety is recommended for limited trial only. The nuts are large, thick-shelled, and the kernels are covered with a heavy pellicle, but the tree is less vigorous than others, not productive, and is lacking in hardiness.

"Red Lambert" is as hardy as "Cosford" and "Medium Long" and produces
PLATE XI. Hickory nuts of various types. The large nut is the kingnut or shellbark hickory (*Carya laciniosa*). The nuts on the right are superior types with good cracking quality. The disk is slightly larger than a twenty-five cent piece.
a fine large nut, but the tree is unfortunately very unproductive and of value only as a pollinator. Its spreading habit of growth makes it unsuitable for planting in a hedge with other varieties, most of which are of upright habit.

More recently a promising development in the filbert situation is the hybridization of American with European varieties. The varieties "Rush" from Pennsylvania and "Winkler" from Iowa of the American species are the varieties most used. "Rush" is a tall growing shrub and has borne well at Ithaca. "Winkler" is hardier, more productive and bears larger nuts, but makes a low growing shrub. Of the hybrid varieties the "Bixby" and "Buchanan" are now regarded as being the most promising because of their size and other merit of the nuts and hardiness of plant. Many other seedlings are being tested and seem promising.

Cultural Practices

It is not the purpose of this bulletin to give details as to the propagation of nut trees. In general the same principles are involved with this crop as with other fruit trees but the material is somewhat more difficult to manipulate and wholly efficient methods of budding or grafting have not been developed. It should be emphasized here, however, that in common with other fruit species, grafted trees are very much superior to seedlings. Nut varieties might very well be compared to apple varieties in this regard. Anyone who is familiar with the small, hard natural apple fruit which is found in the pastures of New England and knows of its bitter, astringent flavor can appreciate the difference between these and the better named grafted varieties such as the "Baldwin" and "McIntosh." The same differences exist with the nut trees also. The great majority of seedling nut trees have nuts that are so difficult to shell that there is little incentive to grow them. The named and grafted varieties, however, may be said to be as superior to the ordinary run of seedlings as the grafted apples are superior to natural fruit. Better varieties of nut trees should bear nuts of good size which have a high proportion of good quality kernels which are easily shelled out. It is not difficult to imagine what a difference it would make if the many millions of wild trees bore nuts of as good quality as the selected and named sorts.

Obtaining trees of desirable varieties may be something of a problem. Many varieties are already in the trade and are being propagated by nut tree specialists. It is also possible to have particular varieties propagated to order. It must be realized, however, that nut trees are much more difficult to produce in the nursery than are apples or pears and in justice to himself, the nurseryman is compelled to charge more for the nut trees than for other fruit trees.

For one really interested in the growing of nut trees a good practice is to top work established stocks by grafting. It is not too difficult to learn the technique and in many localities there are nurserymen and plantmen who will make grafts as desired.

To grow seedling stocks it is necessary to stratify the seeds before planting.
This should be done in the early fall before the nuts have been allowed to become very dry. The process of stratification involves keeping the nuts at temperatures slightly above freezing. Best results are obtained by keeping nuts buried in moist peat moss at a constant temperature of about 35-40°F. Such conditions may be found in cold storage houses. For the grower, successful stratification can be attained by exposing the nuts to winter temperatures. This is done by burying the nuts in sand and leaving them in an exposed place which should be well drained. Protection with wire netting is necessary to keep rodents from destroying the seeds. If danger from theft by rodents is not likely and the soil is well drained, the seed nuts may be planted in the nursery row in the fall or they may be planted in their permanent location in the fall or the stratified nuts planted out in the spring.

Those desiring only a few nut trees of named varieties may best purchase them from nurserymen who are specializing in nut tree propagation. There are a number of these in the Northeast and Middle West. A list of nurserymen can be obtained from the Northern Nut Growers' Association. If nut growing is to be carried on as a hobby and a considerable number of trees are to be involved, a good practice is to raise seedlings and get them established in their permanent location and then graft the most vigorous individual trees to well-chosen varieties. Scions may be obtained from trees locally or from nurserymen who furnish scions.

Soils suitable for nut trees are the same as those required for almost any other fruit crop. The first requirement is that they shall be deep and well drained. Thin topsoil overlying impervious subsols which remain soggy will not grow good trees. Often rocky soils are very good because they usually are well drained unless the underlying rock is impervious. The most favorable soils are friable loams of good organic content and good moisture holding capacity. Fertility can be easily supplied to poor soils which are suitable in texture and drainage by the use of leguminous cover crops, and by application of barnyard manure or complete commercial fertilizers. It is a mistake to plant nut trees on heavy, worn-out soils that are not good agricultural lands. On the other hand they may very well be planted in rocky lands incapable of cultivation provided other conditions are favorable.

The planting of nut trees does not differ essentially from planting trees of other kinds except possibly that most nut trees have few fibrous roots and hence must be planted with unusual care. Hickories are difficult to transplant because of the scarcity of lateral roots and the slow rate at which new roots are formed. If the taproot has not been cut a year previous to digging or the tree transplanted in the nursery row once or twice, there are likely to be practically no fibrous roots and the chances of survival of the tree are slight. If seedling trees are to be brought in from the woods, it is of great advantage to cut off the taproot about 18 inches below the surface of the ground a year before transplanting and thus stimulate the formation of the lateral roots near the surface. There is an advan-
tage in buying trees from nurserymen skilled in the propagation of nut trees because attention is given by them to developing a good root system.

While the trees are out of the ground, care should be taken not to allow the roots to become dry before planting. Keeping them covered with wet burlap or puddling them in a moist clay is highly important. Some trees can be bought balled and burlapped but this is expensive and should be unnecessary. The hole should be dug large enough so that all of the roots can be accommodated readily and the topsoil should be worked in carefully around them. One of the most important practices is to firm the soil about the roots with a tamping stick of some sort. At the time of planting the soil should be moist but not wet enough to puddle or cake when firmed with the tamper. After planting, the trees should be well watered and weeds kept down about the trees either by cultivation or by mulching. This is particularly important until the trees become well established. At the time of planting the tops of practically all nut trees should be cut back to about one-third or one-half of the wood present in the nursery, making sure that at least several good buds remain. This is important because even with carefully dug trees a large proportion of the root system is destroyed or damaged in digging and the top must be cut proportionally. After planting, if the season is dry, the trees should be watered during dry periods of at least the first season or longer if necessary until they become established.

On soils that are low in organic matter a good practice is to work in granulated peat moss with the soil about the roots. Care should be used that the peat is well soaked with water either before or after the planting, otherwise it will be of no benefit. Covering the trees with wax has been recommended by some authorities but under conditions of hot sun this practice has proved injurious and is not recommended.

After the nut trees become established not much care is needed. Pruning is of less importance than with most fruit trees. With walnuts and hickories it is sometimes necessary to correct faulty crotch structure and space the limbs about the trunk. The most common fault is the development of two leaders which are about the same size. If this occurs one should be removed or at least pruned severely to dwarf it with relation to the other. Hickories and walnuts should be so trained that central leaders, or modified central leaders will develop. For best yields filberts should be trained as standard trees without suckers at the base. In removing a sucker, the soil is dug away from the base of the tree exposing the base of the sucker where it joins the root and the sucker removed with a sharp saw, cutting close to the main root.

**Fertilizers**

Nut trees respond to fertilization and good soil management much as do other fruit trees although many wild trees apparently do well in competition with other vegetation. Outstanding growth or yield is usually associated with an unusually
favorable situation as to soil fertility, moisture supply or other soil conditions. It is a mistake to think that nut trees will survive under adverse conditions. Neglect, especially before the trees are well established, will often result in the loss of the trees. Nut trees do particularly well under cultivation which keeps weeds and other growth away from the soil over the roots. This, however, is rarely practical with nut trees in the fence row or around the home. The benefits of cultivation can be largely secured by mulching the area under the trees so that the weeds are kept under control. Any plant material such as old hay or straw or garden refuse is suitable for mulching purposes.

On soils low in fertility nut trees will respond to applications of nitrogen. Either sodium nitrate or ammonium sulfate may be used, the former probably being preferable with the walnuts which are adapted to neutral or alkaline soils. Trees growing in sod may be fertilized at the rate of $\frac{1}{4}$ pound of ammonium sulfate or sodium nitrate for each inch of the diameter of the trunk until they have attained a diameter of about 6 inches when about $\frac{1}{2}$ pound may be used for each inch in diameter up to the maximum of 15 to 20 pounds per tree. With large trees that are well established, much more fertilizer should be added. The above is of course only an approximation. The actual needs of the tree will depend upon the natural fertility of the soil and other conditions. The trees should be observed carefully to avoid either excessive stimulation of growth, which would make the trees liable to winter injury, or the other extreme of an under-vegetative condition as indicated by yellow, sparse foliage and poor yields. In general trees suffer much more from the lack of fertility than from too much. If trees are to yield regular crops they must be fertilized regularly and adequately. There is some evidence to show that some of the minor fertilizer elements, particularly zinc, are deficient in some of the soils of the Northeast.

Zinc deficiency shows up as weak yellowish growth late in the season. The leaves are small with the edges curled upward. Application of zinc sulfate is usually an effective control.

Insect and Disease Troubles

Insect and disease troubles are about as common for nut trees as for any other shade trees. The problem is complicated by the fact that most home owners can not have their trees sprayed. There are a number of caterpillars which destroy the foliage. Among them, most commonly encountered is the walnut caterpillar which appears about mid-summer and may seriously defoliate the trees one or more times in a single season. These may be controlled with arsenate of lead. Where the trees are not sprayed it is often possible to destroy the worms by collecting them when they gather on the trunk in a mass to shed their skins. These caterpillars and others on hickories can often be destroyed before they attain large size on small trees by picking off the leaves upon which they are feeding. They usually feed in groups close together. Hickories and chestnuts sometimes
have the nuts destroyed by weevils. The control here is to destroy all nuts which
drop to the ground before the weevils emerge. This may be fairly easy if the
trees are in the lawn but difficult if the ground is rough. The Persian walnut is
attacked by the codling moth, which is similar to that which damages apples.
Spraying with arsenate in mid-summer when the moths appear is an effective
control.

Diseases are usually not troublesome with nut trees although under some con-
ditions they may be. There is a blight which sometimes attacks the filberts, ap-
ppearing as dead and brown shoots. If affected parts are cut out promptly and
burned, the trouble is usually easy to control. Some varieties of walnut, particu-
larly the "Thomas," become infected with a perennial canker. This is relatively
less damaging on trees that are growing rapidly so that good cultural practice is
a means of control. Of course the chestnut blight has been the most devastating
disease of nut trees which has practically wiped out the chestnut in its natural
range. Methods of controlling this disease in the American and European chest-
nuts have not been developed. Of the blight resistant Chinese and Japanese
species, it is worthwhile to cut out blighted limbs as they occur and to cut away
bark cankers on the trunk. The cut surfaces should be painted with some good
antiseptic solution.

Nut trees, particularly the hickories and walnuts ordinarily bear only in alter-
nate years. This is a natural tendency which is to be observed also with other
fruit trees. There is apparently little that can be done to control it although it
may be lessened somewhat by an adequate fertilizer and soil management pro-
gram. Thinning the nuts while still green should also be of help but is not prac-
ticed. What happens is that during the bearing year the crop is such a heavy
drain on the food manufactured in the leaves or possibly other substances, that
there is not enough for bud formation for the following year. Different varieties
vary in this respect. The chestnut and the filbert do not alternate as seriously
as the walnut and the hickory.

Cross Pollination

Most kinds of nuts require cross pollination. From a practical standpoint this
means that at least two varieties of each species which flower simultaneously
should grow together. With kinds that are frequently planted this may offer no
problem to the individual home owner as neighbors may have trees which will
be a source of pollen. With the filbert and chestnut, however, two varieties should
always be planted together. To a somewhat lesser degree this is the case with
the Persian walnut and the hickories. The pollination requirements of black wal-
nut are not well understood but it is highly probable that cross pollination is
necessary for this species also. In small areas where several trees cannot be
planted, a part of the tree may be top worked to another variety. The pollen of
the walnut, filbert and hickory is wind borne and may be carried over a consider-
able distance. It is impossible to state with accuracy how close together it is necessary for trees to be planted for cross-pollination. Anywhere within the radius of 100 feet should be satisfactory.

**Harvesting Nuts**

Nuts should be allowed to become fully mature on the trees and preferably to fall naturally. Mild shaking is sometimes practiced to bring down the last of the crop but clubbing the branches is seldom justified. Nuts should be picked up as soon as they fall. This is particularly necessary with the Persian walnut which discolors if allowed to lie on the ground and with the black walnut, the husks of which may disintegrate into a brown mass if not picked up within a few days after falling. Black walnuts should be shucked soon after harvesting to prevent discoloration of the kernels. Small quantities of black walnuts are beaten or trampled from the husks. With larger quantities the old fashioned corn sheller may be adjusted to remove the husks satisfactorily. Black walnuts that are washed immediately after removing the husks will remain an attractive brown color instead of turning black. Nuts of all species should be allowed to dry after the husks are removed. Small quantities can be spread out on the floor of a well ventilated shed or attic. With larger quantities some sort of racks with screen bottoms can be devised. The drying room must have a free circulation of air.

One of the commonest difficulties experienced with nut trees in the North is that the kernels fail to fill. There are a number of causes which contribute to this condition. Probably the most frequent, particularly with the hickories and walnuts, is too short a growing season or too little summer heat. Under these conditions the leaves are frozen from the trees while the nuts are still immature and no further development of the kernels take place. The problem may be better understood when it is realized that in the development of most kinds of nuts, the growth of hull and shell to full size takes place early in the season. During the latter part of the season the kernels are developed from the carbohydrates which are manufactured by the leaves. It is thus obvious that any condition which cuts down the effectiveness or destroys the leaf surface will effect the filling of the nuts. This may be due to loss of leaves by insects or diseases or to interference with their effective function by drought or inadequate nitrate supply. Another condition is found in trees in an over-vegetative condition where the growing shoots use up the food materials which otherwise might go into the kernels. This is apt to be found with young rapidly growing trees or trees kept growing with frequent irrigation. There is little that can be done to control the failure to fill except to grow varieties which are adapted to the locality as to length of growing season and protecting the leaf surface from pests and disease troubles. Supplying water at time of drought and a good fertilizer program are also helpful.

**Summary**

In the foregoing pages an attempt has been made to outline the requirements
for growing nut trees in the Northeastern states. There is nothing in the situation which should encourage anyone to try to establish commercial plantings in this area unless possibly with some of the newer chestnuts and some varieties of black walnuts. On the other hand it should be emphasized that there is real value in planting grafted trees throughout the Northeast both for shade trees and for the nuts which may be produced for home use. The fact that at the present time we do not know which varieties will succeed best over a period of years only adds to the interest of the problem. Enough is known to assure the growing of good shade trees and certainly in some measure improved nut crops will result. Nut kernels are a product that is without equal for food value and palatability, and producing a supply for home use merits the attention of all who have land at their disposal.

All home owners in the villages and on the farms may be encouraged to plant nut trees for shade with the realization that even though the large crops of superior nuts may not result, the testing of the varieties will be a real service in developing our knowledge of nut growing in the Northeast.

It should also be emphasized that at the present time there are undoubtedly many superior varieties of nut trees that are adapted to growing in various localities but which have not been propagated and tested. They are standing as wild trees in the fields and along the fence rows on the farms or in dooryards. Trees which bear nuts of outstanding value and which bear crops fairly regularly should be brought to the attention of some agency which would be capable of judging the relative merit of the variety and seeing to it that the tree is propagated and tested further. The Northern Nut Growers' Association, J. C. McDaniel, secretary, Dept. Horticulture, University of Illinois, Urbana, Illinois, has been organized to do this sort of thing. Some of the state experiment stations and the United States Department of Agriculture are also equipped to test the merit of new varieties. Anyone knowing of superior trees will do a real service by calling them to the attention of one of these agencies.

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