Establishment of Shelterbelts in the Middlewest.

by

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INTRODUCTION

A large number of the pioneer farmers of the middlewest were great tree planters. Their activity in this respect was encouraged perhaps largely by force of necessity rather than by choice. Most of these people came from districts lying to the east, where they had been actively clearing lands for agriculture, and had been accustomed to the benefits of tree growth around the homesites. So with the settling of the great plains it was to be expected that a large number of shelterbelts would be established.

The establishment of shelterbelts in this area was for the prime purpose of protection -- protection of fields and protection of home sites from the rather adverse weather conditions prevalent in the middlewest.

In general, shelterbelt planting is advisable where climatic conditions do not prohibit tree growth and where there is a desire of the people to have them. In the light of past experiences, shelterbelt planting is advisable east of a line marked by sixteen inches of annual rainfall in the north and twenty-two inches in the southern portion of the middlewest. West of this line tree planting is considered rather hazardous.

In most of this section conditions for tree growth are rather favorable; agriculture has long been established; many groves have already been planted, and this condition will undoubtedly continue in the future. Between the western climatic limit, which is generally unfavorable to tree growth, and the eastern portion of the middlewest, where planting is relatively easy and already well established, is a zone of fertile prairie soil. This zone is an important part of the
gain.ary of the United States and also it is in this zone that shelterbelts -- because of the soil, rainfall, and other natural conditions -- have in the past been successful. Due to the present condition of agriculture and the present desires of the people one can readily see the urgent need for more tree plantings in the middlewest.

In the past, as at the present, private initiative has been stimulated along these lines by governmental aid. The Timber Culture Act of 1873, the Agricultural Appropriations Act of 1911, and various tree-bounty laws accounted for the planting of 700,000 acres of trees in the middlewest -- chiefly in the form of shelterbelts and a few timber claims. Many of these tree plantings received little or no care and have since disappeared; many others stand today as witnesses to the foresight of the country's great tree-planting pioneers.

At one time the Plains Shelterbelt Project was a subject of national interest. However, there were a large number of people who believed that trees would not grow on the prairies and they succeeded in raising enough public doubt in the minds of the American people that the 74th Congress abolished the project. So in 1937 a great forestry project -- right or wrong I do not attempt to say -- unable to weather the storm of public criticism or political adversion slipped quietly into the background of national conservation.

Although the Plains Shelterbelt Project no longer exists, it did bring to the people's minds one thing -- the increasing need of the middle western states for trees. Neither was this need for trees developed in the last few years. It was first recognized by the settlers, and as early as 1873 Congress enacted the Timber Culture Act which resulted in the planting of millions of trees -- many of which
are growing today. Fifty-one years later the Clarke-McNary Act was passed, providing, among other forestry measures, for the distribution of tree planting stock to farmers. Thus, for more than half a century there has been existing a recognized need in the middlewest for a forestry program not theoretical but practical and one that would bring about an increase in the general welfare of the middlewest.

In view of the past conditions, it is quite obvious that tree planting in this region could not and would not cease with the abolition of the shelterbelt project. So out of the conservation movement there grew a new plan known as the Prairie States Forestry Project; which, less spectacular than the former plan, has gained a great deal of esteem in the middlewest.

This new project was outlined and legalized under the Farm Forestry Act which was passed by Congress in 1937. It provides for a planting program requiring a high degree of cooperation between the Federal Government and the landowner. The landowner's part is to furnish the land to plant -- which in good agricultural regions is a considerable sacrifice -- prepare the land for planting, provide fencing material to exclude livestock, and cultivate for a period of from two to five years.

It is the plan of the Forest Service to expand the cooperative requirements as the value of the planting becomes more evident and ultimately to confine the activities of the government to furnishing trees for planting instead of supervising and administering the entire project as is now the case.

Thus we see that the people of the middlewest -- although basically agricultural in occupation -- do have a forestry problem.
IMPORTANCE OF SHELTERBELTS

Increased Value of the home.

Often we have heard the familiar phrase "It isn't a home till it's planted". The value, both materially and personally, of tree planting about the home is attested by the high expenditure of time and money that has gone into the establishment of farmstead shelterbelts throughout the entire middlewest. Except for the south, the settlers first wish was for shelter of his house, and next his barn, from the cold, by which is meant the driving cold of penetrating winds. On this account a good windbreak can take an actual financial rating, for its protection can be translated into a substantial saving of fuel.

Far beyond this consideration is the invaluable benefit of an enjoyable home surroundings, not expressed in federal appropriation acts but deeply implied in all their provisions that have made tree planting stock cheaply available to farmers. The tree planting programs that are in force at the present time do not specifically state that the trees be used for farmstead plantings, but that is, for the present, the most logical use to which they could be put. There is no doubt that living conditions are enhanced in many neighborhoods by the establishment of shelterbelts. Even in medieval times inscriptions on the walls of the ancient Egyptian temples show that the Pharaohs sought to improve living conditions for their subjects by planting trees. Enthusiastic farmers frequently state that they would not take a thousand dollars (or some other considerable sum) for their groves. That such statements are something more than thoughts of imagination is reflected by the fact that practical real-estate men add several hundred dollars to the value of a farm upon which thrifty groves occur.
Shelter for Livestock.

A great benefit to the farmer's livestock will result upon establishment of shelterbelts. Under many conditions cattle get along very comfortably with only the protection of a good windbreak. In connection with feed lots the value of such a shelter in terms of feed saving has been fully recognized by livestock feeders in the corn belt. Horse and cattle particularly are very sensitive to wind, and unless driven by hunger will rarely remain in the open pastures on a windy day when they find any degree of protection. Protection from driving rain is always welcome to stock, and in hot weather the shade of trees is eagerly sought.

Shelter for Orchards and Gardens.

Farmers in the middlewest are also able to point out very distinct benefits to flower and vegetable gardens and a somewhat lesser benefit to orchards as a result of tree planting. Gardens are often planted between two or inside of four rows of trees, which act as a snow trap in winter and release the accumulated moisture rather gradually in the spring. The response of garden plants is marked since they are heavy users of water -- much more so than the cereals, which, as a group, represent one of nature's highest adaptations to wind and drying.

A high demand for water does not wholly characterize orchard trees. Apricots and some varieties of apples can be set down as decidedly drought resistant. Yet fruit trees in general show favorable reactions to shielding from desiccating winds. Protection against late spring frosts is also a large factor in fruit bearing. It is said that benefits to orchards are to be expected if there is a cold storm or a sudden cold snap accompanied by wind such as is very common in the
middlewest even after spring is well advanced. Planting too close to the windbreaks, however, may result in root competition and loss of vigor of fruit trees.

Prevention of Soil Blowing.

There is no doubt as to the adequacy of almost any type of shelterbelt to prevent soil blowing within the area in which its effects on wind movements is appreciable -- even dead trees can catch large amounts of wind blown material. The reasons for this are: 1) it requires a wind of considerable velocity to cause any serious soil movement, 2) that blowing soil almost certainly gathers intensity with travel, the movement of the coarser particles at one point tending to abrade and loosen soil farther on, 3) any obstruction in the path of the blowing soil will tend to lessen the wind velocity with the result of less movement of soil particles.

It is therefore of prime importance to protect the points of weakness where soil is most likely to start moving, but if the soil does start moving it is possible with the proper location of the shelterbelt to stop the major portion of the soil before it can do much damage. The importance of a shelterbelt lies in the fact that both degree of reduction that is accomplished by the obstruction and the width of the area in which some reduction is felt are greater with a strong wind than with a moderate wind. Since the winds which cause soil blowing in a given locality are rather commonly from one direction, it follows that the zone of influence of a properly oriented shelterbelt is both more certain and more extensive as a preventative of soil blowing than as a factor to conserve moisture through all the variable conditions of a growing season or year.
These benefits are by no means inconsiderable items in the economy as well as the comfort of the farm, and they have long been appreciated in regions of severe climate -- such as is prevalent in the middlewest.

**SHELTERBELT PLANS**

Size and Location.

Before a detailed plan for a shelterbelt can be made, it is necessary to decide on the location and size of the planting with reference to the location and size of the area to be protected. The size of area that can be protected by a windbreak is shown in Figure 1.

![Diagram showing air currents and shelterbelt composition](image)

**Figure 1.** -- The colored portion represents the distance from the shelterbelt that beneficial effects can be noticed.
With the principal requirements of a shelterbelt being sufficient height and density, one must also, when making shelterbelt plans, determine the spacing distance and species of the tree to be planted. To obtain the maximum amount of benefits, the tallest growing species should be planted in the center of the planting and closely planted adjoining trees will force them to attain their maximum height growth. The shorter growing trees should be used along the sides of the taller trees and shrubby growing species should be used on the extreme edges of the shelterbelt. This shape of windbreak, similar to a hip roof, will tend to guide the surface wind currents upward. Evergreens can be used near the edges of the planting because they retain their branches near the ground and, thereby, give greater assurance for the upward sweep of the winds and provide protection during both winter and summer. Thus the mass effect of tall and sheltering trees and shrubs with a combination of evergreen and deciduous trees will create an effective and dense barrier against the elements.

When locating the field shelterbelt one should not expect a strip of trees to protect an entire field of any considerable size. Considering a shelterbelt forty feet high it is possible to notice some beneficial effects up to eight hundred feet on the leeward side of the planting and also some effect can be noticed for a distance of three hundred to four hundred feet on the windward side of the planting. However, there is a sapping effect of the trees up to a distance of fifty feet from the planting. The field windbreak should be placed on the windward, considering the prevailing wind, side of the field.

When locating a shelterbelt for buildings and yards the important consideration is winter protection. As winter storms in the middle-
west usually come from a northwesterly direction, the shelterbelts should be placed on the north and west sides of the buildings, thus forming a uniform strip of trees in the shape of a right angle around the buildings and yards. In some places where plenty of land is available it is advisable to extend the north side of the shelterbelt a hundred or so feet east of the buildings so as to give added protection in case of snows from the northeast. Where there is not enough land available for a strip of trees on both the west and north sides of the yards it is advisable to set out a single strip on either the west or the north side of the yard.

Ordinarily a space of fifty to one hundred feet should be allowed between the buildings and the inside edge of the shelterbelt.

If sufficient land is available, the shelterbelt should be seventy five to two hundred feet wide so that it may include a snow trap like that illustrated in Figure 2. However, in some places enough land is not available and the planting must necessarily be less than that wide. In these cases one should go ahead and plant a solid strip of trees without a snow trap -- even two or three rows of trees will prove to be beneficial.

When considering protection for orchards or gardens one has to take into consideration the strong winds in the spring and summer months. Although protection is usually needed most on the west and south sides it is also advisable to afford some protection on the east and north sides. The width of the orchard or garden shelterbelt is not necessarily as wide a planting as that needed for buildings and yards. Beneficial results can be obtained from a single row of trees around the orchard or garden but it seems more practical to plant three or four rows. See figure 3.
Figure 2.-- Plan of a shelterbelt recommended for buildings and yards (1) snow hedges, 10 to 30 feet wide; (2) snow trap 20 to 60 feet wide; (3) shelterbelt, 40 to 80 feet wide; (4) space 50 to 150 feet between shelter and buildings.

In places of very porous soil or scanty rainfall a method of laying out windbreaks with reference to gardens has been used with varying degrees of success. Usually it is used in conjunction with the west side of the shelterbelts for buildings and yards. A short strip of trees are planted at right angles to the west side of the main belt -- leaving a space between the two strips of about thirty or forty feet. As the prevailing winter winds in this region are from the northwest, there is a largesnow bank deposited to the southeast of the opening. See Figure 4. This snow has proved to be very beneficial in furnishing moisture for the gardens during the summer months. In some cases it would be alright to plant small trees or shrubs across the opening in
order to make the snow drift closer to the shelterbelt.

As trees send out roots for some distance beyond the row in which they are actually planted, fruit trees and garden crops should not be planted closer than thirty-five to fifty feet -- depending on the size of the trees -- from the inside row of the shelterbelt.

Figures 3 and 4 illustrate the location of shelterbelts in relation to orchards and gardens.

Figure 3. -- Recommended plan of a complete shelterbelt for a orchard or garden; 1) shelter on the west and south, of first importance; 2) shelter on the north and east, of secondary importance; 3) a space of 35 to 50 feet between shelterbelt and orchard and garden.
Preparation of the Soil.

Under conditions prevalent in the mid-west, trees have a better chance of success when planted in moist soil that is free of weeds and sod. The best way to put land in this condition is to summer fallow it the year before the trees are to be set out.

The purposes of summer fallowing land in preparation for tree planting are, 1) to work down the soil into a smooth, firm condition and kill all the grass and weeds, and 2) to keep the surface of the soil in a rough or ridged condition so that it may readily absorb as much as possible of the season's rainfall.

When summer fallowing land for tree planting the following rules...
should be followed:

1) Plow in the spring to a depth of six or eight inches. This should be done not later than the first of June. As soon as the plowing is finished go over the ground with a harrow or disk.

2) Cultivate the land as often as necessary during the summer months to keep the land free of weeds and grass.

3) Use a shovel or duck-foot type of cultivator to work the land during the summer. This leaves the surface in the best condition for soaking up rainfall and preventing soil from blowing.

Selection of Species.

The survival, growth, and effectiveness of the shelterbelts depends to a large extent on the proper selection of species and their use in certain combinations on the different planting sites. In past practices, better results have usually been obtained where two or more species of trees have been used in combination than where a single species has been used. It is advisable to plant trees that form a dense growth close to the ground along the outside of the planting and the taller growing trees in the interior of the shelterbelt.

Species of trees that could be planted in this region in shelterbelts will be discussed as to the characteristics that make these species desirable for a shelterbelt tree.

Western Yellow Pine (Pinus ponderosa)

Native to western United States. Its resistance to adverse climatic conditions has been largely responsible for the extension of its range by planting. It is found under a variety of soil and moisture conditions -- doing best in moist and well drained sites, but able to
resist drought. Crowns are rather dense in youth but becoming more open as the tree increases in size. Seedlings develop a long tap root and nursery stock, unless transplanted early, is very difficult to handle. Recommended spacing distance is 8 feet by 8 feet on the moister sites and 10 feet by 12 feet on the drier sites.

**Norway Spruce (Picea excelsa)**

A tree introduced from northern Europe and Asia. Suitable for planting in most of the region where rainfall is not a limiting factor and where the tree is not exposed to any great degree. It is one of the most efficient shelterbelt trees with rather dense foliage -- even under relatively dense shade. It reaches a good size, even on upland soil. For sites that have plenty of moisture it is better than the White or Black Hills spruce due to its thrifty growth. Its soil requirements are not exacting -- being able to thrive on poor soil if the moisture is sufficient at the ground surface for the shallow root system. It will withstand wet situations but not stagnant or swampy areas. Recommended spacing distance is 10 feet apart in the rows which are 12 to 14 feet apart.

**White Spruce, Black Hills Spruce (Picea canadensis)**

The White spruce and Black Hills spruce are varieties of the same species of tree. The white spruce is a native of northeastern United States while the Black Hills spruce is the variety which comes from the Black Hills country of South Dakota. They are adapted to slightly different uses.

White spruce resembles the Norway spruce in appearance. It has a more compact, denser foliage and gets to be a much older tree than Norway spruce but does not make such a rapid growth. It will grow better
on good and moist soils, but will also thrive in areas where moisture is none too abundant. It is a good substantial tree that should be used more for shelterbelts because of its greater permanency.

The Black Hills variety has been introduced from the Dakota region. When grown in the prairie region it is small in size, of pyramidal form, and is fairly easy to handle. Although in its native habitat it is found in the moister locations it has by experiments proved itself to be very drought resistant. It is a tree that resists to a marked degree the drying effects of winter winds. Because of its slow growth, wind-breaks of this species should be reinforced with a row or two of faster growing species. The spruce will endure the shade of other trees, and after reaching a fair size, the temporary trees may be removed to permit the full development of the spruce. This tree may be planted in combination with western yellow pine, austrian pine, Scotch or Jack pines. In such cases the spruce should make up the interior rows and the intolerant pines the outside rows. The approximate spacing distance for Picea canadensis is 8 feet in the rows and 10 feet between rows.

Blue Spruce (Picea pungens)

This tree has been planted a great deal for ornamental purposes, but also has a distinct value for shelterbelt planting. The trees have a pyramidal form and dense foliage which varies in color from green to a distinct bluish-white. The branches are usually slightly drooping and extend well down the bole to within a foot or two from the ground. With its moderately wide-spreading and rather deep root system it can be classed as a very windfirm tree and also moderately drought resistant. It grows best on deep rich, clays with a spacing of 10 feet by 10 feet.
White Cedar, Arborvitae, (Thuja occidentalis)

Although native to the northeastern part of the country and generally found in moist sites around limestone outcroppings, it does have some very desirable characteristics for shelterbelt plantings. It stands considerable shading and carries its branches well down toward the ground. It should not be placed more than 8 feet apart in the rows because the crown is narrow and if spaced farther apart, especially in a one or two row windbreak, the crowns will not meet -- thereby decreasing the efficiency of the shelterbelt.

One chief objection to this tree is its tendency to sear or die back. It very seldom kills the entire tree and can be reduced to a minimum by giving them a good supply of water. As watering trees in the middlewest is not a very practical operation it is advisable to keep a good mulch of leaves or old straw between the rows.

Jack Pine (Pinus banksiana or Pinus divaricata)

Only under the most adverse conditions is Jack pine recommended as a shelterbelt tree because its crown is very open and thin -- especially in the older trees. There are some considerations, however, under which Jack pine is a good tree to use. It is a rapid grower when young and gives quick results. It will endure the poorest sandy soils -- often even thriving in almost pure sand. It has a moderately widespread and deep root system resulting in a rather windfirm tree. There are places that Jack pine is the only tree that can be grown. If this tree is planted it should be placed about 8 feet apart in the rows and the rows should be approximately 12 feet apart.

Douglas fir (Pseudotsuga taxifolia)

Douglas fir, monarch of the Pacific Northwest forests, has been used
to a large extent for shelterbelts in this region with unusually good success. In recent observations in the state of Iowa Douglas fir showed a great resistance to drought as well as being able to withstand severe cold. When grown under prairie conditions it forms a conical shape with long sweeping branches. It has a large spreading root system that stabilizes the tree in case of high winds and grows on moderately moist to dry soils. When planted in the interior rows it should be spaced approximately 10 feet by 14 feet but on the outside rows a spacing distance of 10 feet by 12 feet is permissible.

**Scotch Pine (Pinus sylvestris)**

The Scotch pine was brought from Europe for planting in this country. In its native haunts, on good soil, it makes a fine tree of good form but in this country the crown is more pyramidal in shape -- especially in older trees. Although many describe it as unsightly, due to its poor form, it has and will continue to be used for shelterbelt purposes because of its drought resisting characteristics. It should be spaced 12 to 14 feet apart in rows which are 10 to 12 feet apart.

Some characteristics of deciduous trees that can be used for shelterbelt plantings.

**Chokecherry (Prunus virginiana)**

A small sized tree or shrub that is found in almost every section of the country and is classified as a forest weed, has proved itself to be a very desirable species to plant in outside rows of the shelterbelts. In areas where rabbit damage is bad chokecherry flourishes unchecked. It is also known to be very drought resistant as well as being able to survive on very poor soil at very low temperature. Their habits of growth, however, indicate the use of a spacing distance of two feet in
the rows on the windward side of the shelterbelt and four feet on the leeward side of the planting. The rows should be approximately eight feet apart.

**Green Ash (Fraxinus lanceolata)**

This tree is exceedingly hardy to extreme climatic conditions and although it is naturally a moist land tree, it will grow on dry sterile soils. Due to its ability to grow relatively fast and its symmetrically formed top it is advisable to plant it in the interior rows of a planting. It will grow well in a spacing distance of 5 feet by 5 feet when planted in adjacent rows and in a distance of 5 feet by 10 feet when planted in single rows between faster growing species.

**American Elm (Ulmus americana)**

Probably no other tree in North America is so easily recognized or is better known than the American elm. The vase-shaped crown and almost perfect symmetry distinguishes it from all other trees.

The root system is rather large but shallow and grows best on well drained fertile fields, but if there is a sufficient amount of moisture it will grow quite well on sterile soils. It is rarely found on extremely sandy soil. When planted in shelterbelts it should be planted in the interior rows and spaced about 14 feet apart.

**Chinese Elm (Ulmus pumila)**

This tree was introduced into this country from the Orient and has gained such popularity as a shelterbelt tree that it is at the present time planted more extensively than any other broadleaf tree. It is a rapid growing tree. It grows better on moist fertile soils but is also being grown on dry sandy soils with varying degrees of success. Being a much finer tree than the American elm, it is more susceptible to wind
and snow damage than the former. It appears to favor a spacing distance of 6 feet by 8 feet but under some conditions 4 feet by 8 feet seems to be satisfactory. However, very little side branching has occurred in a spacing distance of 4 by 8 feet -- the fact being somewhat of a detriment, as side branches diffuse the wind entering the belt and helps in the development of shade for prevention of undergrowth.

**Black or Yellow Locust (Robinia pseudoacacia)**

Black locust is a medium-sized tree and on good sites develops a clear straight bole. The root system is shallow and wide-spreading, and the crown is open and irregular. It does better on moist, rich, loamy soils of limestone origin, but can be grown on many different types of soil with varying degrees of success. The rapid rate of growth is one characteristic that makes it desirable for shelterbelt purposes. On favorable sites it can be expected to increase in diameter one-quarter to one-half inch a year. An average good spacing for locust seedlings or sprouts is 6 feet by 6 feet, but if better formed trees are desired a spacing distance of 8 feet by 8 feet should be used.

**Lombardy Poplar (Populus nigra var. italica)**

Lombardy poplar, one of the easier trees to be recognized, was imported from Europe and has since gained much popularity due to its narrow columnar crown with ascending branches. A fast growing tree, short lived, and best adapted to soil with plenty of available moisture. In small windbreaks of three or four rows it can be planted eight feet apart in the rows which are approximately ten feet apart.

**Honey Locust (Gleditsia triacanthos)**

Honey locust is a medium-sized tree with a rather short bole and an open, narrow or spreading crown. The root system is wide and deep.
Although commonly found on rich, moist bottom lands or soils of limestone origin, this species is very hardy if planted elsewhere -- especially on open fields. When trimmed, honey locust makes a very desirable tall hedge which soon becomes impassable because of the many forbidding thorns. If a thick hedge is desired, they can be planted 6 feet by 6 feet, but if larger trees are desired they should be planted at 8 feet by 10 feet or 10 feet by 12 feet.

Sugar Maple (Acer saccharum)

This tree is one of the longest lived trees of the Maple family. When grown in open or shelterwood conditions the trunk often branches near the ground and a large, dense, rounded or ovoid crown is produced. The root system is shallow but very wide-spreading. Best growth is obtained on moist, rich, well-drained soils, but it will also thrive on very infertile soils. When planting sugar maple it should be given adequate room for root development. If planted in a broad shelterbelt a spacing distance of 16 feet by 16 feet is none too large. If planted in single or double row windbreaks they can be spaced 12 or 14 feet apart, but no closer. In narrow plantings it is advisable to plant a row of smaller shrub-like trees on the sides.

Cottonwood (Populus deltoides)

This species is of medium size. It has a wide-spreading open crown, supported by a rather massive trunk which divides some place near the ground when grown in open stands. It has an extensive root system -- at times a tap root is developed. Its natural habitat is on moist alluvial soils throughout the great plains. Although not found naturally on dry sites, this species was planted extensively around homesteads by the early settlers and when once established has proved
to be very resistant to drought conditions. On the better sites it grows exceedingly fast -- young trees adding four or five feet in height yearly. They should be planted approximately 14 feet apart in rows which are approximately 16 feet apart.

**Siberian Pea Tree (Caragana arborescens)**

The pea tree is a small shrub-like tree that has been used rather extensively in shelterbelt plantings in the drier regions of this country. It is better suited for planting along the sides of the large belts where the branches of the larger trees do not come close to the ground. It will maintain satisfactory growth when planted in a spacing distance of two by eight feet or four by eight feet. The former distance being helpful in the development of a dense hedge near the base of the tree, which is necessary for wind and snow protection.

**Selection of Planting Stock.**

When selecting trees for shelterbelts purposes one should select trees small enough to make the cost reasonable and handling relatively simple. However, where the cost is not prohibitive it would be permissible to select larger seedlings so that the time required to get the desired benefits would be shorter. In general, smaller trees are less costly, cheaper to plant and can be moved or transplanted with greater success than larger trees.

For broadleaf or deciduous species, seedlings one or two years old and from one to two feet high or one year old rooted cuttings make the best stock.

For conifer or evergreen species transplants six to twelve inches high should be used. However, these are not set rules to insure success with planting stock. If it is desirous to get quicker results,
it is permissible to use conifer seedlings up to two feet and broad-leaf transplants up to three and one-half feet in height. For larger
trees to be planted it is rather hazardous and should not be undertaken
under average conditions.

A good shelterbelt tree should have received at least two trans-
plantings before being put into the shelterbelt. Each transplanting
has the effect of producing a greater quantity of fine, fibrous roots
up near the base of the tree, so that when it is dug and moved it con-
tains a large amount of the feeding system. More transplantings have
the tendency to produce even more compact root systems, and make higher
quality trees but for the average farmer the shelterbelt should be as
economical as possible. This can be accomplished by using a tree which
has received just enough attention in the nursery to insure a good root
system and yet has not had its cost raised excessively by additional
handling.

PLANTING METHODS

Time of Planting.

The best time for planting is during the dormant season. Plantings
should be arranged so as to be accompanied or promptly followed by a
rainy season, because a plentiful supply of water to seedlings is es-
sential to their survival.

In the middlewest the planting should be started as soon as the
frost is out of the ground and before the trees start growing. If the
trees were planted in the fall they would be subject to injury caused
by heaving and cracking of the soil.
Care Before Planting.

When trees are obtained from a nursery they are usually packed so that they will keep well during shipment. As soon as they are received it is best to place them in a cool place where they can be unwrapped and have the roots dampened.

If the trees are not going to be planted for a week or ten days they should be "heeled in". To heel in trees a trench about twelve inches deep is dug with one side sloping. The trees are set in the trench and leaned against the sloping side. The roots should be completely covered with firmly packed dirt and then watered. If the trees are in large bunches, they should be cut open and spread out because there is danger of the trees beginning to rot.

It should be remembered that this is only a means of temporary storage and that as soon as the trees begin sending out leaves they should be planted at once.

Planting the Trees.

As a rule trees should be planted as soon as they are received from the nursery.

Before any trees should be planted, the rows should be marked out on the ground. Use any method desired -- just so the proper spacing distance is obtained.

If time will permit, select a cloudy day when there is little or no wind. Also remember that coniferous trees will not stand as much handling and jostling around as will broadleaf trees. At the time of planting they should be carried so that the roots do not become desiccated or injured.

A hole, large enough to allow the roots to rest in their natural
position, is essential to proper planting of the tree. After spreading the roots out carefully, fine soil should be worked in firmly about the roots. When the tree is planted it should stand at about the same depth as it did in the nursery -- maybe a little deeper. If the hole is too deep it should be filled in to the proper depth before planting. The surface soil about the tree should be left loose to prevent excessive evaporation of moisture from the soil. In some cases it is advisable to add a mulching of leaves or straw for the purpose of conserving moisture but at no time is a thick layer of manure placed about the roots to be recommended. Under most spring conditions in the midwest it is not best to use water in the hole when planting. Whenever the plant is "soaked up" during planting, care should be taken not to tamp the dirt after water is applied because of the danger of puddling and baking.

CARE AND PROTECTION OF SHELTERBELTS

Cultivation.

Although most trees will survive if not cultivated when planted in shelterbelts it is advisable to cultivate the land because a tree's growth can be considerably retarded by the presence of weeds, sod or brush. With slow growing evergreens it is possible to have the seedlings completely killed by the overtopping of grass and weeds. With broadleaf trees there is not as much danger of overtopping but the danger lies in the fact that weeds or brush take a tremendous amount of water. Therefore, in all cases give the plantations frequent cultivation until the branches hinder the operation. Trees will respond to culti-
vation the same as corn or garden crops.

In some places it is often possible to grow some kind of root crop between the rows. This only permissible as long as the trees are not big enough to completely shade out the crop.

It has often been the idea that the mulching of trees with straw or manure could be used as a substitute for cultivation to keep the weeds down and prevent the loss of moisture from the ground through evaporation. This, however, can not be recommended. In addition to the fact that no beneficial results can be noticed, some harmful effects can be observed. The harboring of mice, the introduction of weed seeds, and the preventing of light rains from reaching the soil are some of the detrimental effects of mulching.

In some places a well balanced fertilizer that meets the soils needs has been used with some success. A nitrogen fertilizer is beneficial in the increasing of vegetative growth and for that reason has been the most used fertilizer on trees.

Protection From Animal and Insect Damage.

It is practically impossible to secure a good shelterbelt if livestock are allowed to graze in the planting. When the trees are small there is danger of the tender shoots or leaves being eaten. When the trees are larger they may be injured by the rubbing of animals against them or suffer from the trampling and packing of the soil about the roots. Livestock invariably damage the lower branches making the tree rather ineffective as a shelterbelt tree.

Although animals do considerable damage to the shelterbelt trees, insects also present a problem that is far harder to control than the damage by animals. There are several different forms of insects that
do more or less damage to the tree. The two kinds of insects that are most harmful are the leaf-eating insects and the leaf-sucking insects.

For the control of leaf-eating insects on a small scale, as in shelterbelts, a lead arsenate spray is probably the most effective. Use one pound of lead arsenate powder to fifty gallons of water. (three teaspoonfuls to one gallon of water). Mix just enough water with the powder to form a thin paste and then add the full quantity of water required. Mix thoroughly. Apply to trees less than eight feet high with a small orchard pump while the larger trees can be sprayed with a compressed-air sprayer.

For the control of leaf-sucking insects a different type of spray is used. The contact sprays -- the most effective control of leaf-sucking insects -- are sprays that have a caustic or clogging effect on the insects and are particularly adapted to the control of soft-bodied insects such as scales and aphids. To be effective the spray must actually cover or touch a large number of individuals. The most common contact sprays are nicotine sulphate, lime sulphur, and oil emulsions.

**Nicotine sulphate** is commonly used for the control of aphids or plant lice. It is used in a mixture of one-half pint of 40% nicotine sulphate to 50 gallons of water. (two teaspoons of nicotine to one gallon of water).

**Lime sulphur** is most frequently used as a dormant or early spring spray on deciduous trees, since the toxicity is greater than is safe to use on green foliage. It has the advantage of cheapness but the disadvantage is that it will discolor paint so it can't be used on windbreaks near buildings. The commercial concentrate should have a
density of 30 degrees B' e. and at this strength should be diluted at the rate of one part of concentrated solution to nine parts of water.

Oil emulsions are also used as a dormant spray in the control of scale insects as well as other soft-bodied forms. Since all of the preparations sold commercially are proprietary formulas, directions for their dilution are found on the containers.

In certain sections of the middle west there may be considerable damage done by rodents. Rabbits, field mice, and pocket gophers are the worst rodent enemies of young trees in the shelterbelts. Directions for destroying these rodents as furnished by the Bureau of Biological Survey are as follows:

Jack Rabbits.

Poisoned alfalfa leaves. -- Dissolve 1 ounce of strychnine sulphate in 2 gallons of hot water and sprinkle over 12 pounds of clean alfalfa hay leaves. Mix the poisoned leaves thoroughly until all moisture is absorbed. Should strychnine alkaloid be used, 1 quart of vinegar should be substituted for 1 quart of water in preparing the solution, and equally good results will be obtained.

Poisoned oats. -- Mix 1 tablespoonful of starch in one-half cup of cold water and stir into 1 pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of powdered bicarbonate of soda and stir with the starch to a smooth creamy mass. Stir in 1 teacup of table salt. Apply to 12 quarts of good clean oats and mix thoroughly to coat each kernel. Each quart should make from 25 to 30 baits.

The poisoned baits should be distributed in the evening by placing small handfuls in lines a few feet apart along the rabbit runways. If all baits remaining uneaten are removed the following morning, there will be less danger of poisoning domestic livestock.

Field Mice.

Starch-coated grain bait. -- Mix 1 tablespoonful of gloss starch in one-half teacup of cold water and stir into three-fourths pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of baking soda and stir into the starch to a smooth creamy mass free of lumps. Stir in one-fourth pint of heavy corn sirup and 1 tablespoonful of glycerine. Apply to 12 quarts of wheat or to 20 quarts of steam-crushed whole oats and mix thoroughly to coat each kernel.
Steam-crushed whole oats are preferable, as they may be distributed promiscuously over the infested area without endangering bird life. The poisoned bait should be scattered along runways and within entrances of burrows, a teaspoonful at a place. Wheat, however, in order not to endanger birds, should be placed inside the mouse tunnel openings, under dense cover, or in poison stations.

Pocket Gophers.

Pocket gophers are readily caught in any one of several makes of special traps commonly on the market. For ridding alfalfa fields, orchards, and long stretches of ditch embankments of them, a very successful and much more practical method is to poison them by use of baits of vegetables, or by using poisoned grain. Either the vegetable or the grain bait gives excellent results, but about one pocket gopher out of ten will not eat a poisoned bait, and these individuals must be trapped.

**Vegetable baits.**—Cut carrots, sweet potatoes, or parsnips into pieces about 2 inches long and one-half inch square, and wash and drain. From a pepper box slowly sift one-eighth ounce of powdered strychnine (alkaloid) and one-tenth ounce of saccharin (ground together in a mortar) over about 4 quarts of the dampened baits, stirring to distribute the poison evenly.

**Grain baits.**—Dissolve 1 heaping teaspoonful of dry gloss starch in a little cold water and add to three-fourths pint of hot water. Boil, stirring constantly until a thin clear paste is formed. Mix together 1 ounce of powdered strychnine (alkaloid) and 1 ounce of baking soda, sift into the hot starch paste, and stir thoroughly to a smooth creamy mass. Add one-fourth pint corn sirup, 1 tablespoonful glycerine, and one-tenth ounce saccharin, and stir well. Pour this mixture over 13 quarts of oats, rolled barley, milo, or feterita, and mix thoroughly so that each kernel is evenly coated. Allow it to dry before it is used. (It is important that only the best grade of thoroughly clean grain be used, as chaff absorbs and wastes much valuable strychnine, and poisoned weed seeds imperil useful bird life.)

By forcing down an iron rod near pocket-gopher workings, or a foot or two back of fresh mounds, the open tunnel can be felt as the point breaks into it. The blunt end of the instrument is then used carefully to enlarge the hole, and a vegetable bait or two, or a tablespoonful of grain bait, is dropped into the run, and the probe hole closed. If a shovel is used instead of a probe to locate the runways, care should be taken not to disturb the runway more than necessary. Close the hole made so as to keep out the light, taking care that loose dirt does not fall upon the baits placed in the runway.
CONCLUSION

We have seen that shelterbelts have been a topic of interest in the middlewest in the past and that the interest has not died out as time went by -- but has increased. The interest has been stimulated by the government as well as the people who would receive the direct benefits.

We have seen that shelterbelt benefits are not only measurable in dollars but also in the intangible values of a better home life.

Before a maximum amount of beneficial results can be obtained from the shelterbelts, a rather long period of time will have undoubtedly elapsed so it is logical that all the care possible is not excessive when the planning and planting of a shelterbelt is carried on. Even with all the care taken in the establishment of a planting one must not overlook the necessity of care while the trees are growing.

Although it will take considerable time and money to establish and grow a shelterbelt, in the future one will be able to look back and see a direct benefit in both money and comforts in the planting. Probably no paraphrase will be more true than, "If it is worth doing it is worth doing right".
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