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Tree Planting in Michigan
Michigan State University
Cooperative Extension Service
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Tree Planting in Michigan

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Tree Planting in Michigan

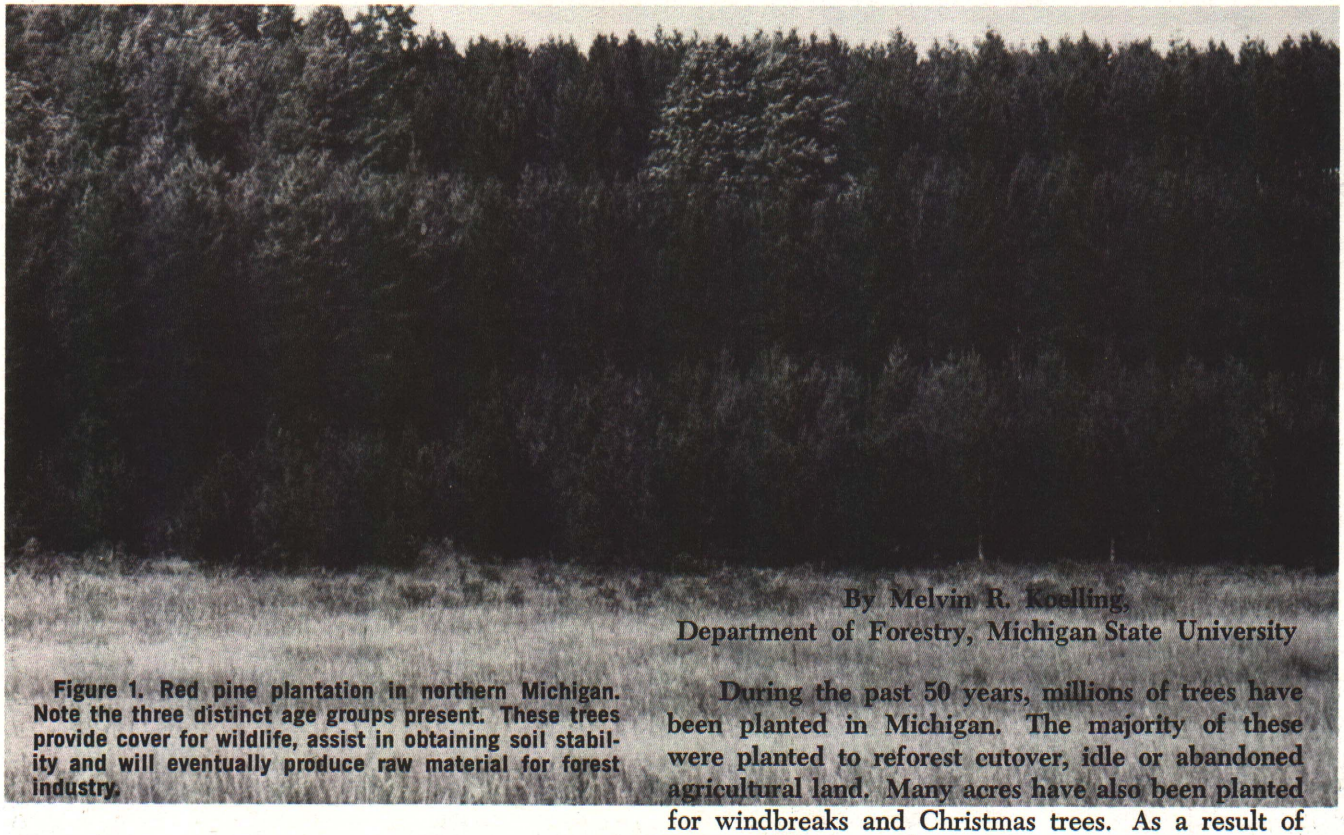

Figure 1. Red pine plantation in northern Michigan. Note the three distinct age groups present. These trees provide cover for wildlife, assist in obtaining soil stability and will eventually produce raw material for forest industry.

By Melvin R. Koelling,
Department of Forestry, Michigan State University

During the past 50 years, millions of trees have been planted in Michigan. The majority of these were planted to reforest cutover, idle or abandoned agricultural land. Many acres have also been planted for windbreaks and Christmas trees. As a result of these plantings, several thousand acres have been successfully reforested and millions of Christmas trees produced. These plantations enhance the natural beauty of our state, control soil erosion, protect watersheds, furnish cover for wildlife, and supply pulpwood, poles, posts, logs, etc. which contribute to our total economy.

The demand for forest nursery stock persists. But, as opposed to earlier plantings on large acreages, many plantings are now made on small land areas which are owned by absentee or non-resident owners. Their purpose in ownership and tree planting is variable. Some may plant to provide wildlife cover, others to improve aesthetic or recreational values, or the prevention of soil erosion may be of more importance than providing raw materials for forest industries (Figure 1). Walnut plantings are frequently made for future investment purposes. In such plantings particular emphasis must be given to the use of good planting techniques, since quality stock is often used and maximum survival and growth are desired.

This bulletin discusses some concerns which should be considered before planting. It also describes techniques which will help in successfully establishing plantings of forest trees.

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Things to Consider Before Planting

Why Are You Planting?

Trees are planted for many different purposes. Trees are somewhat unique since they are useful and provide benefits and value both while living and when harvested and converted to lumber or other products. Objectives and purposes for planting trees must be determined before the trees are ordered or planted. Species differ in their suitability for specific uses. Most of the objectives in planting forest trees are included under one or more of the following:

(1) Wood production–sawlogs, posts, pulpwood, poles, Christmas trees, etc.
(2) Provide soil cover and protection–to prevent or reduce wind and water erosion and stabilize soil.
(3) Windbreaks – for protection of farmsteads, exposed buildings, fields, orchards, etc.
(4) Provide wildlife habitat – to provide browse, food, and improved environmental conditions for wildlife.
(5) Improvement of recreational and outdoor living areas – to provide shade and enhance the the aesthetics of recreational property.
(6) Investment purposes – to provide for future income.

What Kind of Trees to Plant?

Many kinds of trees can grow under a wide range of site and environmental conditions. However, some species grow better on certain kinds of soils than others. For example, Jack pine grows fairly well on sandy soils while most hardwoods planted on similar sites will grow poorly, if at all (Figure 2). However, hardwoods may do very well when planted on good sites (Figure 3).

Important soil and site factors which affect the selection of species to plant include air temperature (both average and minimum and maximum), exposure, soil moisture and fertility. Soil and air temperatures are particularly important when trees not native to the area are used. This is true of most strains of Douglas fir, a very desirable Christmas tree species. Due to early bud break, new growth on this species is often killed back by late spring frosts. Low temperature injury can often be avoided or at least reduced by restricting plantings to upland areas away from natural depressions and frost pockets. Similarly, planting on south and west slopes (which warm up early) should be avoided with species susceptible to late spring frosts. When Douglas fir is not damaged by frost it is capable of growing and developing into a very salable product.

Figure 2. Hardwood seedlings are more demanding in their site requirements than conifers. On this eroded upland site, conifers such as red or Jack pine would have grown considerably better than these white ash seedlings.

Figure 3. Thirty-five year old yellow poplar plantation in southern Michigan. These trees, planted on a well-drained, loamy soil, have made excellent height and diameter growth.

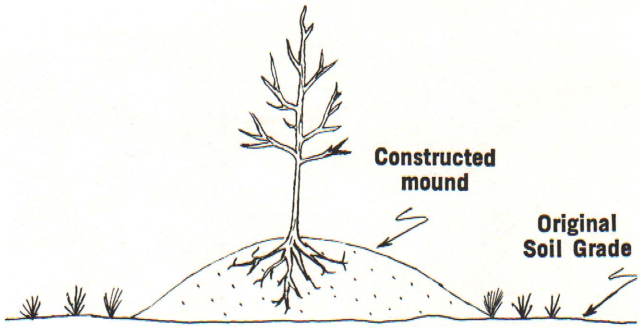


Figure 4. Trees may be successfully established in wet areas by constructing a small soil mound and planting the tree on top. In this way better drainage and increased soil aeration will be available to the roots of the tree.

Soil drainage and moisture are also important in deciding what kind of trees to plant. As a general rule, hardwood trees are better adapted to heavier, loam-type soils where soil moisture and fertility are generally higher. Although conifers (evergreens) will grow on heavier soils, they are more commonly planted on drier, less fertile soils which are usually coarser in texture. They often thrive on sites too poor to produce quality hardwood trees. Good soil drainage and little or no competition from grasses and weeds favors rapid growth of most conifers. This is also true of hardwoods.

It is difficult to establish forest plantations on poorly drained soils, or soils that have a very high water table. Trees also do not grow well on soils subject to prolonged flooding. Few species of trees can be established in wet areas so they are usually better suited to other types of vegetation. If only a few trees are to be planted, select the highest location in the area. In some instances, trees have been established when planted on top of a thick furrow slice or on small soil mounds (Figure 4).

Many species of trees are adapted to planting in Michigan. A brief description of the most commonly planted species follows. Table I contains a list of these and other species and their suitability to planting in different locations.

Red pine is probably the most extensively planted tree in the state for general reforestation purposes. It grows well on a variety of upland soil types and is relatively free of serious insect and disease pests. Thinnings from red pine plantations find a ready market in the pulpwood industry. The volume of red pine of saw timber size is relatively small at present. But, as older plantations mature, they will supplement production from natural stands so that this species can be expected to serve as an important source of logs for local sawmills.

White pine once occupied large areas in the virgin forests of our state. It has been widely planted and grows well on well-drained sandy loam or clay loam soils. This species is not as well suited to dry sites as red pine. It is also bothered by white pine blister rust, a serious canker disease of the trunk and branches. In some locations the leader or terminal branches are killed by white pine weevils, thus resulting in the growth of trees with crooked stems. Nevertheless, white pine is a fast growing tree and will do well when planted on good sites in the southern part of the state.

Jack pine is well adapted to growing on droughty, infertile sandy soils. It is often planted on near-sterile sandy sites where other trees cannot grow. Jack pine, an important pulpwood species, has been planted extensively on such areas in the northern part of the state. The wood from thinnings in Jack pine plantations and from harvests in natural stands provides an important source of raw material for the state's pulp and paper industry. This tree may occasionally be damaged by larvae of the Jack pine sawfly and Jack pine budworm. Deer will occasionally browse on Jack pine foliage.

White and black spruce are well suited for planting on fairly acid clay loam soils. They should not be planted on dry upland soils, especially in the southern part of the state. Of the two, black spruce is preferred for planting on poorly drained or wet sites, particularly in the northern part of the state. White spruce has been planted for Christmas tree production but is also widely used for pulpwood. In the years immediately following planting on heavy soils, some weed control may be necessary to reduce competition from grass and weeds to increase tree survival and favor early growth.

Within the past few years, considerable interest has developed in planting hardwoods. *Black walnut* and *yellow poplar* are among the most popular species in the southern portion of the state (Figures 3 and 5). Farther north, *northern red oak, sugar maple* and *black cherry* have occasionally been planted. While it is more difficult to successfully establish a hardwood planting than a conifer plantation, it is not impossible. Difficulty is increased due to differences in the growth characteristics of the two classes of trees, especially in soil requirements. In general, hardwoods require a more fertile soil than conifers. This means increased competition from grass and weeds can be expected since they will thrive in such areas. Some hardwoods possess a taproot which makes them more difficult to plant. Hardwoods may also require protection from rodents and certain weather conditions such as drying winds when planted in exposed locations or open fields. For this reason

Table 1. Planting Guide for Various Forest Trees and Shrubs under Michigan Soil and Climatic Conditions.

SPECIES	DRY UPLANDS				WELL DRAINED UPLANDS						WET LOWLANDS	
	Very Coarse	Moderately Coarse			Medium			Fine			Mineral Soils	Organic Soils
		Loamy Sand, Sandy Loam			Fine Sandy Loam, Loam, Silt Loam			Sandy Clay Loam, Silty Clay Loam, Clay				
	Dune Sands, Sands	Level	Exposure[1]		Level	Exposure		Level	Exposure		Sands to Clays	Muck or Peat
			N&E[1]	S&W[1]		N&E	S&W		N&E	S&W		
CONIFERS (Evergreen)												
Douglas-fir			Yes		Yes	Yes	Yes	Yes	Yes	Yes		
Fir, balsam					Yes	Yes		Yes	Yes		Yes	Yes
Larch, European					Yes	Yes						
Pine, jack	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Pine, red	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Pine, scotch	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Pine, white			Yes		Yes	Yes	Yes	Yes	Yes	Yes		Yes
Spruce, black			Yes			Yes		Yes	Yes	Yes	Yes	Yes
Spruce, Norway[4]			Yes		Yes	Yes		Yes	Yes	Yes		
Spruce, white			Yes		Yes	Yes		Yes	Yes	Yes	Yes	
White-cedar, northern					Yes	Yes		Yes	Yes		Yes	Yes
BROADLEAVES (Deciduous)												
Ash, green					Yes	Yes	Yes	Yes	Yes	Yes		
Ash, white					Yes	Yes		Yes	Yes			
Basswood					Yes	Yes		Yes	Yes		Yes	
Cherry, black[4]					Yes	Yes		Yes	Yes			
Cottonwood	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Elm, American					Yes	Yes		Yes	Yes		Yes	Yes
Hickory, shagbark[4]					Yes	Yes	Yes	Yes	Yes	Yes		
Honeylocust[4]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Locust, black[4]					Yes	Yes		Yes[2]	Yes[2]	Yes[2]		
Maple, soft		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Maple, sugar					Yes	Yes		Yes	Yes			
Oak, red					Yes	Yes	Yes	Yes	Yes	Yes		
Oak, white					Yes	Yes		Yes	Yes			
Walnut, black[3]					Yes	Yes		Yes	Yes			
Willow	Yes	Yes	Yes	Yes							Yes	Yes
Yellow-poplar[4]					Yes	Yes		Yes	Yes			
SHRUBS												
Ash, mountain					Yes	Yes		Yes	Yes	Yes	Yes	
Blackberry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Black-haw[4]					Yes	Yes		Yes	Yes		Yes	
Coralberry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Crab, wild		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Dogwood, gray					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dodwood, red-osier					Yes	Yes		Yes	Yes		Yes	Yes
Dogwood, silky					Yes	Yes		Yes	Yes		Yes	Yes
Elder					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hawthorn		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Hazel		Yes	Yes		Yes	Yes	Yes					
Honeysuckle		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Juniper, prostrate		Yes	Yes	Yes	Yes	Yes	Yes					
Nanny-berry					Yes	Yes		Yes	Yes		Yes	
Ninebark					Yes	Yes	Yes	Yes	Yes	Yes		
Olive-Russian		Yes	Yes	Yes	Yes	Yes	Yes					
Pea, Siberian		Yes	Yes	Yes	Yes	Yes	Yes					
Plum, wild		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes		
Rose, wild	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Shadbush		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Snowberry		Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes		
Sumac		Yes	Yes	Yes	Yes	Yes	Yes					

[1] Pronounced slopes facing north and east (N&E) or south and west (S&W)
[2] Not recommended when subsoil is compacted or impermeable
[3] Plant in mixture with other species on fertile soils in southern Michigan only
[4] Southern Michigan

Figure 5. Black walnut is probably the most commonly planted hardwood in Michigan. This four-year old plantation is being intensively managed to eventually produce high quality saw and veneer logs.

success has been greatest for plantings made in small openings within natural woodlots or plantations. The use of weed control chemicals has also contributed to increased success and interest in hardwood plantings within recent years.

Plant More Than One Kind of Tree?

Forest plantations may be established using only a single species, or a mixture of two or more kinds of trees. Each type of planting has both advantages and disadvantages which should be considered before planting.

Plantings consisting of only one species are normally easier to establish, maintain and harvest. On open, fairly level land, tree planting machines can be used very effectively with single species plantings. They may also be used to establish mixed plantings if species are alternated between successive rows. Pruning and thinning in single species conifer plantations, such as red pine, can often be completed easily since uniform tree size and spacing allows for use of mechanized equipment. Since growth rates for all trees in a single species plantation can be expected to be fairly uniform, thinnings and final harvest cuttings should yield material of similar size, making harvesting easier and more profitable. On the other hand, plantings of a single species are probably more susceptible to serious insect and disease problems than are mixed plantings. Similarly, if an infestation develops, greater losses can be expected.

In addition to a lower risk loss from disease or insects, the total growth of trees in mixed plantings may be better on certain sites. However, it is important that all species used in mixed plantings have nearly the same rate of growth. Mixed plantings of hardwoods may also result in trees with better form and potentially higher timber quality. Black walnut, in particular, grows and develops better in mixed than pure plantings (Figure 6).

In mixed plantings, particular emphasis must be given to selecting the species. All species must be adapted to the site and potential growth rates must be considered, as one species may tend to outgrow and thus crowd-out the other species. While mixtures of hardwoods are generally desirable, conifer-hardwood mixtures usually do not develop satisfactorily. Differences in the rate of growth, tolerance of shaded conditions, and soil and site requirements are most commonly responsible for uneven and unsatisfactory development.

When Should You Plant?

Bare rooted trees or seedlings must be planted during the dormant season if good survival is expected. Weather conditions in early fall after growth has ceased, and in late spring after the soil is free from frost are favorable for planting. Of these two times, the spring season is generally a better time to plant, especially in heavy loam or clay soils.

Figure 6. Small openings in established forests are excellent sites for planting black walnut. Lower branches on this three-year old seedling are being removed to produce a clear bole.

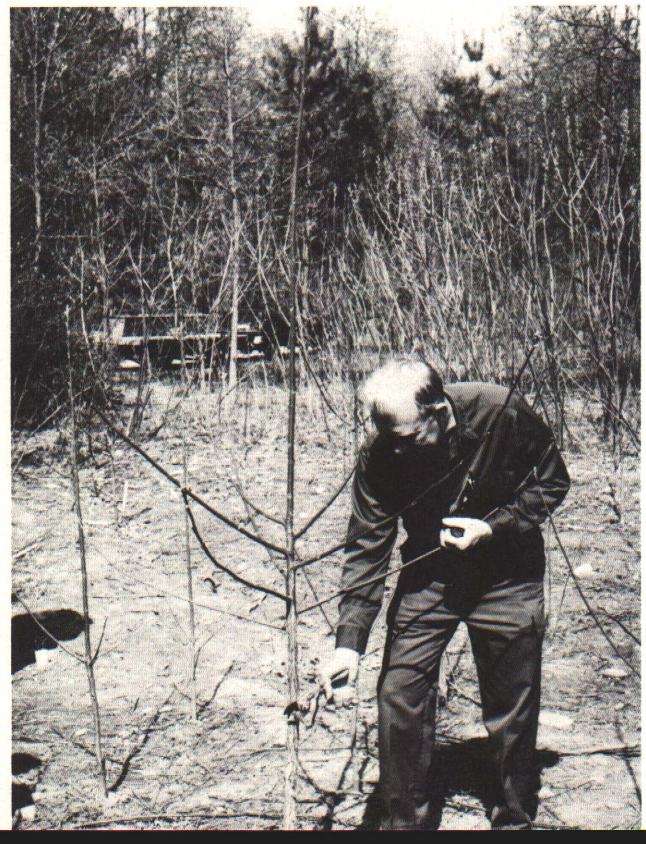


Figure 7. When planted on a wide spacing, pruning and fertilization will contribute to the production of high quality trees. A chemical weed control treatment has been applied to this black walnut plantation in an attempt to reduce grass and herbaceous competition.

Trees planted in the fall on heavy soils are susceptible to frost heaving and possible winterkill. Losses from frost heaving are most severe when plantings are on fine textured soils which have a high clay content. Fall-planted seedlings, unless protected by snow cover, are also exposed to drying winter winds and severe low temperatures.

Such conditions can dry out the seedling to a point where death may occur. This is more of a problem for seedlings with large tops which are not well established, but losses can be expected from seedlings of all types. Winter damage from rodents and other wildlife is also greater in fall-planted than spring-planted seedlings.

Spring plantings may be started as soon as the soil is free of frost. Do not plant when the soil is excessively wet, or on hot, windy days. Dull, overcast, cool days are most favorable since evaporation and moisture loss from the seedlings is reduced.

If containerized planting material is available, plantings may be continued into the growing season without serious difficulties (see page 12).

How Far Apart?

The distance between planted seedlings is to a large extent determined by the species and the purpose for which the planting is made. No single spacing is ideal for satisfying all planting objectives. For most species, a distance of 6 to 12 feet apart will result in maximum growth and maintenance of tree quality. Very close spacings, such as 5 feet by 5 feet or smaller, will require thinning before the trees are of commercial size and value if good vigor and growth are to be maintained. Wide spacings such as 12 feet by 12 feet or more do not result in utilization of the growing site while trees are young. Wide spacings may also contribute to the development of limby trees with poor form. Thus, corrective pruning must be completed if high quality stems are desired. Nevertheless, hardwood seedlings may require wide spacings followed by weed control, fertilization and pruning to produce trees of high quality (Figure 7).

Some general spacing recommendations for specific planting purposes are given as follows:

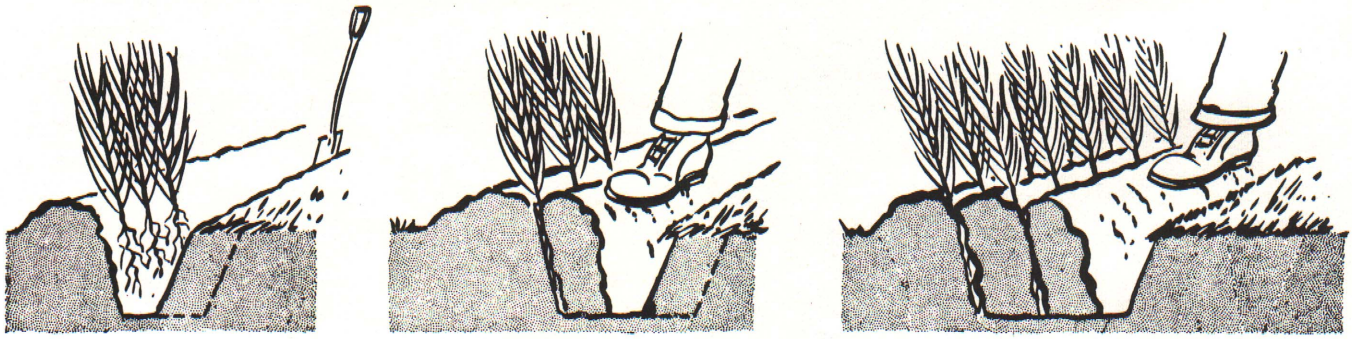
	SPACING (Distance ft.)
Pulpwood & sawtimber (Jack, red, white & Austrian pine, white & Norway spruce)	6 x 6 to 7 x 10
Christmas trees (All species)	6 x 6, 7 x 7 or 7 x 6
Windbreaks	3 rows – 8 ft. apart; trees 10 ft. apart in rows; stagger trees between any two rows.
Hardwoods	10 x 10 and wider–use widest spacings for black walnut.

The following may be used to determine the number of trees required per acre for various spacings.

Distance apart (ft.)	Number of trees per acre
5 x 5	1742
6 x 6	1210
7 x 7	889
8 x 8	680
9 x 9	538
10 x 10	435
12 x 12	303
14 x 14	222
16 x 16	170
18 x 18	134
20 x 20	109

Forest planting stock is available in a variety of seedling and transplant age conditions. Planting stock is usually described as 1-1, 2-0, 2-2, etc., stock. The first number refers to the number of years in the seedling bed and the second to the time spent in the transplant bed. When the two numbers are added together, the age of the young tree is determined. As an example, 1-0 refers to a 1-year old seedling and 2-2 to a 4-year old transplant. When planted, survival and initial growth is often better for transplant stock, especially when much competing vegetation is present. Weed control practices are highly recommended in such situations.

Figure 8. When seedlings cannot be planted within a week after they are received, they should be unpacked and "heeled-in." The procedures to follow are illustrated below. The seedlings should be watered after they are heeled-in.



1st Cut

Dig trench with shovel or spade. Place trees against back side of trench.

2nd Cut

Place earth from 2nd cut on roots of first row of trees. Pack soil with foot.

3rd Cut

Place 2nd row of trees in 2nd cut and pack soil from 3rd cut on roots.

Some seedlings may be sold by height class. This has the advantage of establishing a plantation which should develop uniformly. This is important for Christmas tree plantings where uniform growth is desired. Available sizes may range from 6 inches for spruce to 10 to 12 inches or more for pines.

Improper care of planting stock upon receipt often contributes to poor survival in the plantation. Best success is obtained when the seedlings are planted as soon as possible after arriving from the nursery. If planting will be delayed, steps should be taken to prevent drying out which may lead to death of the seedlings. Seedlings not immediately planted must be kept moist and should be stored in a cool shady location. If planting is delayed more than 2 to 4 days, the seedlings should be "heeled-in" (Figure 8). This consists of digging a shallow trench in a shady area with one side sloping at approximately 45°. The seedlings are distributed alongside the sloping edge of the trench and the roots are covered with moist soil. When kept moist, heeled-in seedlings will remain in good condition for several days. However, they should be planted before growth begins, if possible.

Some tree seedlings are now packaged dry and shipped in airtight sealed containers (Figure 9). All prescribed recommendations on the packaging container must be followed when handling and storing such stock. These packages, especially, *must not be opened* until the seedlings can be planted immediately.

If the roots of the seedlings have not been pruned, it is recommended that this be done on arrival. Generally, pruning the roots on seedlings and transplants to a standard length of 8 inches from the root collar will make planting easier and increase survival rates. Slightly longer root lengths should be kept on hardwood seedlings with taproots such as walnut and various oaks.

Figure 9. Seedlings may be packed and shipped in airtight bags. The instructions on the bag must be followed to prevent drying-out and death of the seedlings.

Preparing the Soil for Planting

Success in establishing a forest plantation is enhanced when steps are taken to prepare the area before planting. Removal or suppression of competing trees, brush, grass and weeds will increase the ease and speed of planting as well as provide less competition and more favorable conditions for growth of the seedlings.

The extent to which preparation of the site is needed will depend on the characteristics of the area to be planted, and the objective in planting. On many sites, such as abandoned agricultural land with sandy soils, little or no advance preparation is needed. On the other hand, rough, burned-over or understocked natural forest areas may require considerable work to prepare a satisfactory site both for planting and seedling growth.

Since the objective in site preparation is to reduce competition and provide a favorable environment for seedling growth, several different procedures may be used. Scalping, plowing and furrowing of the soil before planting have all been used to eliminate or reduce competition from other plants. On areas which are heavily sodded, plowing and discing or harrowing is sometimes done a year or so before planting. While desirable, this may not be economically profitable. In areas with less sod, furrowing or scalping the soil may be completed prior to hand planting. However, this may be done by the planting machine at the time of planting (Figure 10).

Practices such as scalping may provide some relief from competition, but they often create additional problems. On soils with a thin layer of topsoil, scalping removes most of this fertile layer from immediately around the seedling which results in the seedling being planted in the subsoil. This soil is often low in fertility and lacking in good physical properties. Furthermore, furrowing results in the development of small ridges on the soil surface which hampers the movement of men and machines in care of the plantation. Under sloping conditions furrows may also encourage erosion since they form ready channels for water runoff. Likewise, furrows often provide natural runways and hiding places for rodents. Field mice, in particular, find furrows attractive living places. High mouse populations can be very damaging to both newly planted and established young trees.

Because of the many problems associated with furrowing and scalping, and since better weed control can be obtained by chemicals, many tree planters now use chemicals to control unwanted vegetation. Several types of herbicidal chemicals are available for use before, during, and after planting. Some may be applied at the time of planting by attaching spray equipment to the planting machine (Figure 11). Others may be applied after planting is complete. Chemical herbicides are very effective in controlling unwanted vegetation without causing the physical problems associated with furrowing or scalping. Depending on the purpose of the planting, one or more applications may be needed. A summary of several planting situations with recommended weed control is presented in Table 2.

Figure 10. Scalping or furrowing is done by the planting machine just before the seedlings are planted. While this practice reduces grass and weed competition, it effectively removes the topsoil from the young seedling, may contribute to erosion, encourages rodent damage and hampers vehicle movement during harvest operations.

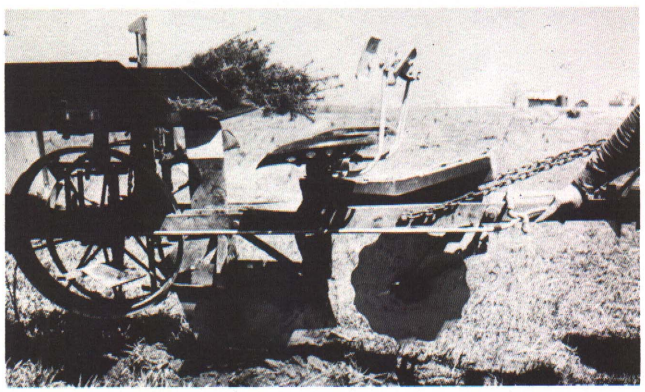


Figure 11. An alternative to scalping or furrowing is the use of a planting machine equipped with chemical weed control equipment. This machine (note nozzles in front of the coulter arrow) applies a chemical herbicide to the soil just ahead of planting.

Table 2. Chemical Herbicide Recommendations for Control of Unwanted Vegetation Under Several Field Conditions.*

FIELD CONDITIONS	CONTROL MEASURES	REMARKS
1. **NEW PLANTINGS** in annual weeds and grasses when trees are planted in clean tilled soil, furrows or scalps.	Four to eight lbs. per acre of active simazine for preemergence control of new weeds (Five pounds of 80W has 4 lbs. of active simazine). On very coarse sands low in organic matter use 2 lbs. per acre rate. Use the higher rate on silt to clay-loam soils, also on organic soils.	Apply with flat fan nozzle in coarse, low pressure (25 to 30 psi) water spray in 24 to 30 in. band over planted trees right after planting. Not necessary to keep spray off trees. Use enough water to obtain coverage (about 1 lb. in 10 gal.). Note that sprayer must be calibrated.
2. **NEW PLANTINGS** in heavy sod.	If at all possible, kill the sod in planting rows (24 to 30" wide) with a chemical in the fall before planting. Planting in dead sod is much more successful. 4 to 8 lbs./acre of simazine; 2 lbs. simazine + 2 lbs. atrazine; 2 lbs. simazine + 2 gal./acre amitrole. If strips can be mowed before herbicide is applied, the treatment will be more effective and more visible in the early spring. For spring planting use combination of simazine with atrazine or amitrole. Treatment before planting (7 to 10 days) is best. If trees are planted first (more difficult in living sod) use directed spray.	If there are broadleaved weeds in sod use amitrole-simazine combination — vegetation should be green and actively growing. Fields that contain woody perennials such as Rubus sp., vines, ferns or sedges are not likely to be seriously affected by atrazine or simazine. Amitrole will give some control. Use paraquat at the rate of 2 qt./acre for rapid control of tops and repeat as needed. For bracken fern, mid-summer applications of amitrole to mature leaves will be most effective. Spring application of dichlobenil at 6 to 10 lbs./acre is also effective on bracken fern (don't use with newly planted conifers). After planting, treatments with simazine alone have only a limited chance of success.
3. **ESTABLISHED PLANTINGS**	Most herbicides recommended for new plantings can be used and at somewhat higher rates on well established trees. All except the triazines (simazine and atrazine) must be used as a directed spray (keep off tree foliage). Except for the brush-killers (2,4,5 T and 2,4 D), herbicides may touch stems or handles without harm. Dichlobenil at 4 to 8 lbs./acre in granular form in the fall for broad-spectrum of weeds — use only with well established deep-rooted conifers.	Simazine + atrazine may be sprayed over tops of trees before buds break dormancy. Simazine will not hurt foliage at any time, atrazine should not be sprayed on growing shoots. Paraquat may be used to control shoots and adventitious buds on handles. Controlling weeds between rows by mowing is helpful. Granular formulations are most useful in this situation as solid material can fall through foliage to soil.
4. **WEED TREES, WOODY BRUSH AND SHRUBS** in new or established plantings.	Before planting, cut stems. Use a low volatile ester of 2,4,5 T and 2,4 D "brush killer" (4% concentration in light oil, i.e. 4 gal. of concentrate in 96 gal. of oil) as stump spray. If large numbers of multiple stems make cutting impractical, use a basal spray to thoroughly wet root collar zone with same material. Individual trees may be killed also by stem injection with cacodylic acid (Silvisar) at rate of 1 cc per 2 in. of diameter.	If spraying after planting, or in existing plantations, spray only during dormant season (October to March) with care to avoid getting spray on crop trees.

*Chemical herbicides can be very effective in controlling unwanted vegetation. But, recommendations must be followed precisely if satisfactory results are to be obtained. (Contributions by Dr. D. P. White, Department of Forestry, MSU, East Lansing. Recommendations are for the Northeastern States and the Lake States region of the U.S. and Canada, 1973).

How to Plant

Seedlings may be successfully planted using either hand or machine methods. Where conditions are favorable, machine planting is generally advantageous because it reduces both the time and amount of labor required. On particularly steep, rough or stoney areas, or for interplanting between established trees, hand planting is often the only practical method. Hand planting is also somewhat better suited for planting certain hardwood species, such as walnut and various oaks, which have long taproots.

Hand Planting

There are two general methods of hand planting; the hole method and the bar or slit method.

The hole method consists of digging a small hole in the soil to hold the roots of the tree (Figure 12). This hole should be deep enough so the roots of the seedling will not be crowded or twisted together, but spread out in a natural position. After placing the seedling in the hole, soil is added around the roots and tamped firmly to exclude air and establish a firm

contact with the roots. Some variations of this method involve the use of a mattock or shovel to establish a straight sided hole. The seedling is then placed along this straight side and soil replaced. Tamping of the soil must be completed to exclude air.

Planting seedlings by the slit method consists of making a vertical slit in the soil, inserting the roots of the seedling and re-closing the slit, both top and bottom (Figure 13). Planting bars or dibbles are available for use in this method of planting. As with the hole method of planting, it is important that the roots of the seedling are not crowded together, and that the soil is firmly replaced around the roots of the seedling to exclude air.

Machine Planting

Planting machines consist of a device pulled behind a tractor which creates a slit in the soil as it moves along (Figures 10 and 11). The seedling is placed in this slit and packing wheels on the planter close the slit and firm the soil around the seedling. Many types of machines are available, and each has some special advantage. Some are equipped with furrowing attachments to prepare the area for planting. Others, of more recent design, have spray attachments to apply chemicals for controlling grass and weed growth around the newly planted seedling. Planting machines are very helpful and efficient when planting large areas. During operation, they should be checked occasionally to make sure seedlings are being planted at the correct depth and that the soil is being firmed around the roots. Changes in soil type and topography may also call for minor adjustments.

Regardless of the method of planting used, the following should be kept in mind:

(1) The roots of the seedlings must not be allowed to dry out before or during planting. Keep them cool and moist.

(2) The roots of the seedling when planted must be in a natural uncurled position. Make certain the planting hole is deep and large enough.

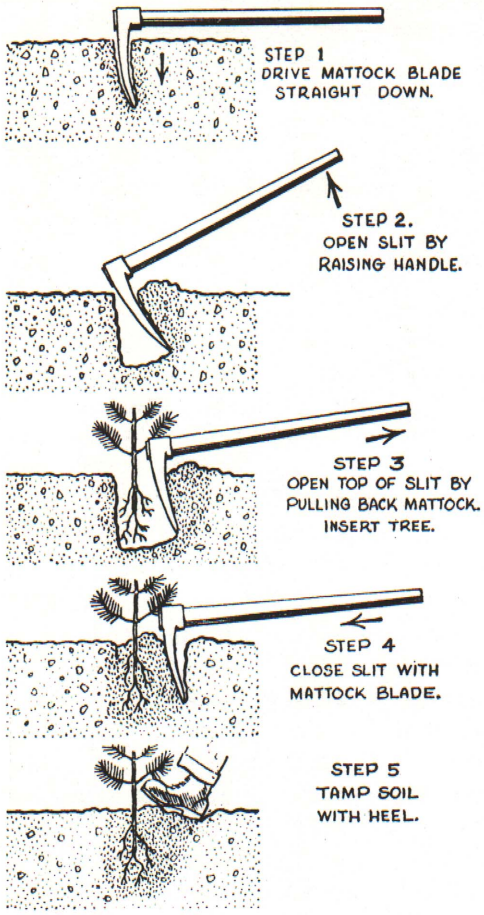


Figure 12. Planting seedlings using the hole-method. This procedure is well suited for use with large transplants or taprooted hardwoods such as oak and walnut. A spade, shovel or mattock (illustrated) may be used.

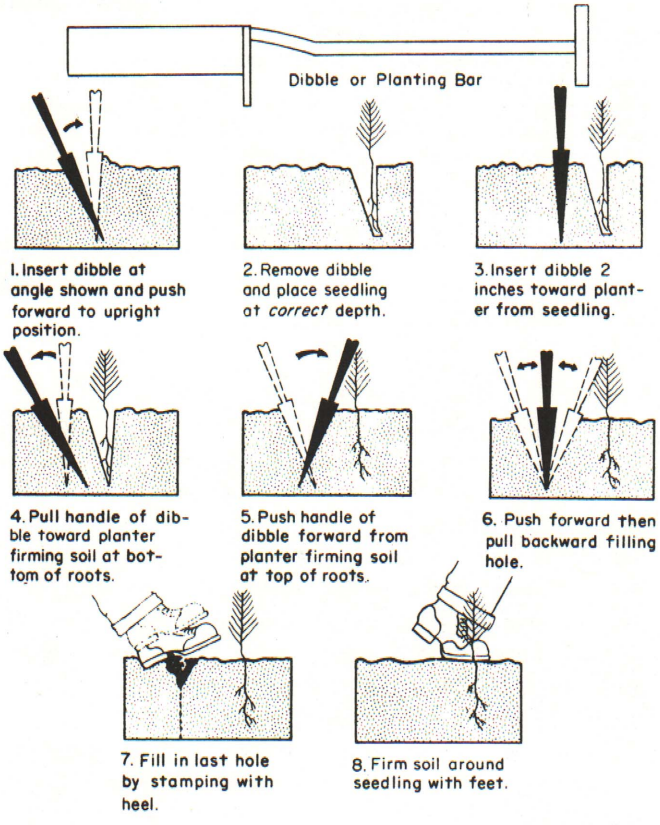


Figure 13. Planting bars (dibbles) are commonly used when hand planting seedlings in rough areas.

(3) The seedling should be planted in an upright position at the same depth or only slightly deeper than it was growing in te nursery.

(4) The soil around the seedling after planting should be firmed to prevent the roots from drying out.

(5) Some provision should be made to remove or suppress competing vegetation if it is present.

Planting in Containers

In the past several years, the concept of containerized planting has been developed. An individual seed is planted in a small container which may contain soil or an organic soil substitute. After germination, the seedling is permitted to grow in this container for 6 to 10 weeks (Figure 14). Then, the entire container is set into the ground in its permanent location. This procedure reduces the time period (usually one year or more) which seedlings normally spend in the nursery, thereby reducing much of the labor and care required. It also makes it possible to plant seedlings at times other than fall and spring with less planting shock, since the roots of the seedlings are not disturbed when it is outplanted. In fact, containers can be planted when the seedling is actively growing. Containerized planting is well adapted to taprooted species such as black walnut and various oaks since the shock of transplanting is reduced or eliminated due to little or no disturbance of the root system. Likewise, container planting is well adapted to high value species such as walnut where considerable loss to rodents can be expected when nuts are planted.

Figure 14. Container-grown seedlings offer many advantages to the forest planter. These eight-week old black walnut seedlings are ready for outplanting in their bio-degradable containers. Minimal transplant shock will occur, even when plantings are made in mid-summer.

Planting for Special Purposes

Many individuals plant trees for purposes other than producing forest products. Trees and forests contribute greatly to the quality of our environment.

Soil stabilization: Trees are well adapted for use instabilizing soil in open areas. The extensive root system of a tree tends to hold soil particles together and form root channels that increase percolation of water into the soil. Deposit of needles, leaves, twigs, and other litter serves to protect the soil surface by providing a mulch layer. When several trees are growing together, they are effective in reducing the velocity of the wind which will reduce the loss of soil particles by wind erosion.

On open areas of exposed soil such as blow sand, it is difficult but not impossible to establish trees. If beach grass is established first, survival of tree plantings will be greater. Once established, trees will be very effective in helping to stabilize the area. On such sites, the first tree to be planted should be placed on the windward edge of the area. Three or four rows can be planted at first and then in succeeding years, additional rows of trees can be planted on the leeward side of the first planting. After planting, it is advisable to cover the exposed soil among the trees. Brush from nearby woodlands can be scattered or beach grass planted to provide good cover. For small areas, heavy plastic or wood chips or asphalt-straw mixtures can be placed over the open soil.

Wildlife habitat: Many kinds of wildlife depend on the cover, food and local environment which trees provide. In fact, the amount and diversity of wildlife in many areas is determined by the amount, type, variety and extent of local forest conditions. Large and varied wildlife populations are not the product

of barren areas, nor are they found in old-growth forests which occupy large areas. Rather, greater abundance and variety of wildlife will be present where forest conditions are variable, with several types and ages of trees represented.

Several types of conifers can provide winter cover for wildlife. White cedar is a preferred winter browse for deer. The seedlings may require some protection from deer immediately following planting, until the trees reach larger size. Several species of low-growing shrubs produce berries and other fruits which can serve as food for small game (Figure 15). Oaks and their acorn crops provide food for both deer and small game.

Plantings for wildlife need not be large. In fact, they will be of highest value when present in scattered locations throughout the property with some open areas in between. Plantings of a single species will not be as valuable as mixed group plantings which contain hardwoods, conifers, and food-producing shrubs. Such packets are available from the Michigan Department of Natural Resources. Since the composition of these packets is varied in accordance with the location in the state where they will be planted, their use is recommended.

Christmas trees: Within the past three decades, Michigan has become a leading producer of plantation grown Christmas trees. While growing Christmas trees is largely a commercialized business, many may wish to plant a few trees for local use.

Several species of conifers have been used as Christmas tree stock, although most plantings now consist of either Scotch pine, Douglas fir, or white spruce. Scotch pine is well suited for planting on abandoned agricultural land or low fertility soils. White spruce and Douglas fir will grow best on heavier soils such as those containing loam. Because it is sensitive to late spring frosts, Douglas fir should be planted only on upland sites which have good air drainage.

Most Christmas trees are planted on a 6 x 6 or 7 x 7 foot spacing with access lanes every 12 rows (Figure 16). Weed control measures are highly desirable to permit uniform rapid growth and reduce the likelihood of fire. After planting, Christmas trees require annual shearing beginning the fourth or fifth year and protection from insects and disease if a high quality product is to be produced. More information on the production of Christmas trees can be obtained from your local county extension director or state extension forester.

Windbreaks: Trees are often planted around farmsteads and other buildings to break the force of the wind (Figure 17). When planted according to

Figure 15. Wildlife habitat may be improved by planting food-producing shrubs. This young shrub will be effective in furnishing food within a few years.

Figure 16. Seven-year old Scotch pine Christmas tree plantation. This well-managed plantation will produce several hundred salable trees per acre within the next few years. The access lanes facilitate insect control and shearing, provide an effective fire break, and will make harvesting easier.

recommended designs, tree windbreaks can be very helpful in reducing the speed of the wind. The amount of protection which windbreaks afford is dependent on the height, density, and width of the planting. A general rule of thumb holds that some benefits will extend on the leeward side for a distance equal to 40 times the height of the trees. The greatest benefits, of course, occur much closer to the windbreak.

In Michigan, windbreaks are usually located on the southwest to northwest side of the building or area to be protected. Normally they consist of 3 rows of trees planted about 8 feet apart, with some 8 to 10 feet between rows. Trees in alternate rows should be staggered to achieve a solid barrier. The windbreak should be between 80 and 150 feet from the building to be protected. Coniferous species are best suited for windbreaks since they provide for year-round protection. Various species of spruce and pine are most commonly used. Low growing shrubs may be planted along the outside row of trees to provide for increased protection and food value for wildlife which may inhabit the windbreak.

Aesthetic considerations: Trees and forests add to the attractiveness of rural and urban landscapes. They not only increase the beauty and interest, but make the surroundings more pleasant for living and working. Where natural forest vegetation is not present, it may be desirable to plant trees to create a more enjoyable setting. Trees are very well suited for screening unsightly views such as highways, salvage yards, and buildings. When planting trees to improve aesthetics, it is well to plan for future growth of the trees. Mixing species such as conifers and hardwoods will lend to diversity. Planting low growing and tall trees in different locations will add contrast. Growth form, flowering habits, foliage patterns, and fall coloration should be considered when selections are made since these features will increase the attractiveness of any planting in later yars.

Environmental benefits: Trees and forests contribute greatly to the quality of man's environment. Trees serve to moderate air temperature, suppress loud sounds, collect dust and dissipate odors, balance carbon dioxide and oxygen levels, and warn of dangerous levels of air pollution. To illustrate their influence on air temperatures, recall stepping from the open into the forest on a hot summer day. The air temperature inside may be as much as 8° to 10°F. below that in the open. This reduction is the result of shading from the rays of the sun and absorbing of heat in the process of moisture loss from the foliage. Sound levels are appreciably reduced by the presence of a group of trees. It has been determined that sound passing through each 100 feet of forest may be reduced by 6 to 8 decibels. Trees and forests will not eliminate sounds, but may be very effective in reducing high levels of unpleasant sounds to tolerable levels.

When planting trees to contribute to a quality environment, many of the same considerations mentioned for aesthetic improvement should be followed. In particular, planting several kinds of trees in small or large groups will be of more value than individual trees in scattered locations. In congested urban areas, trees which possess some tolerance or resistance to certain pollutants will be more satisfactory.

Figure 17. Trees can be very effective in reducing wind velocities when planted according to recommendations. Properly designed windbreaks modify wind speed and direction on the leeward side for a distance equal to approximately 40 times the height of the trees.

Care After Planting

Care given the newly planted seedling during the first few growing seasons after planting will often determine whether it will survive and may influence the eventual success or failure of the plantation. The development of trees with poor form, or those characterized by slow growth rates is often the result of too much competition by weeds and grass for soil moisture and nutrients. Physical damage from rodents or insects will usually be greater on trees which are growing poorly. Frequent inspection followed by care as needed, including weed control, can mean the difference between success and failure of the planting.

Care in the first few years following planting usually consists of eliminating grass and weed competition, and protecting the plantation from fire, grazing, rodents, disease and insect problems. When soil nutrients appear to be lacking, it may be necessary to fertilize the soil to maintain good growth. This may be more important for certain types of plantings, such as high value hardwoods, windbreaks, and Christmas trees than for others. Fertilizing pine for reforestation is seldom recommended.

Competition from weeds, grass and other woody plants can result in nearly complete failure of the plantation unless measures are taken to reduce their effects. When plantings are made on fertile soils, competition from weed and grass growth can be expected to be severe. Mowing and cultivation can provide some control; however, chemical weed control has been demonstrated as a more satisfactory method of preventing weed growth rather than removal by cutting or tilling (Figure 18). If weed control chemicals were not applied before or at the time of planting (p. 9) their use after planting is strongly recommended. Not only will improvements in soil moisture and nutrient supplies be noted, but cover and habitat for destructive rodents such as mice and rabbits will be reduced. A summary of weed control recommendations for varying planting situations is presented on page 10.

Newly established forest plantations must be protected from fire, domestic grazing, insects and disease. Occasional examination of the trees for off-color, needle droppage, and broken or consumed foliage will be helpful in determining if insects are present. Once detected and identified (assistance on insect and disease identification may be obtained from your local extension agent, area forester or nurseryman), chemical or other types of control measures may be needed to prevent serious damage.

The establishment and maintenance of fire lanes about 10 to 12 feet wide and 80 to 100 feet apart throughout the plantation will prevent the spread of fire and also provide access for thinning, spraying, harvesting and other operations. Weeds and grass must be controlled in these lanes, or they will lose much of their effectiveness in preventing the spread of fire. The establishment of fire lanes around the edge of the plantation is also recommended, especially along major highways and railroad right of ways.

Figure 18. Weed control chemicals can be effective in increasing the growth rate of established trees as well as those in young plantations. In this black walnut plantation, herbicides have reduced grass and weed competition for both moisture and nutrients.

Fencing the planting may be required to prevent grazing from domestic animals or damage by snowmobiles. Such control is especially necessary early in the life of the planting to reduce seedling losses and to prevent the development of seedlings with poor form.

Rodent control measures are often expensive and not always effective. Mowing and the use of herbicides can greatly help in rodent control by eliminating or reducing the amount of grass and weeds that harbor rodents. Mice populations may be controlled through the use of poison baits; however, any poisons must be used with much care. The use of certain chemicals to repel rodents in general has not been very effective.

Insect and disease infestations are difficult to prevent. The first step in control is early detection and correct identification by noting the symptoms mentioned earlier. Application of appropriate spray materials at the proper time and in the correct amounts can be very effective in reducing losses in most cases.

Precise fertilizer formulations are difficult to recommend for trees. Soil tests have been used in some

stands, although it is not easy to establish what represents an optimum fertility level. While nitrogen is the element most likely to give the greatest response, it is better to use a complete fertilizer for most applications. Due to poorly established root systems it is advisable not to fertilize newly planted seedlings the first year, but rather concentrate on site improvement, good planting techniques, and weed control. During the second to fourth seasons, 1/4 pound of a complete fertilizer (12-12-12), may be applied to each seedling. Avoid placing fertilizer within 6 inches of the stem. If only nitrogen fertilizer is used, the amount of dry fertilizer applied should be reduced to 1 ounce of urea or other high nitrogen fertilizer for two-year-old trees, and 2 ounces for four-year-old trees.

To be most effective, fertilization of young trees must be accompanied by weed control. Without adequate weed control, fertilizer applications will merely result in encouraging the growth of competing vegetation which may actually harm the tree.

Where to Get Help

Assistance in any tree planting program can be obtained from the local county extension agent, the local area forester or local soil conservation district office. Advice on species selection and evaluation of the area prior to planting is available. Sources of planting stock including the state forest nursery are maintained at these offices.

Financial assistance with planting programs and improvement of existing woodlands is available through the local county office of the Agricultural Stabilization Committee.

General information on forestry and tree farming is available from the State Forester, Michigan Department of Natural Resources or Extension Forester, Department of Forestry, Michigan State University.

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