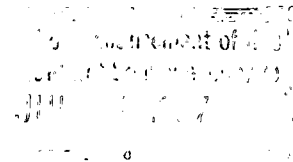


Propagating

Clonal Rootstocks

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**Agricultural Experiment Station
Oregon State College
Corvallis**

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Propagating Clonal Rootstocks

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Increasing use of vegetatively propagated rootstocks in fruit tree nurseries has focused attention on cheaper methods of reproducing these clonal stocks. As clonal rootstocks cannot be reproduced true-to-type from seeds, it is necessary to resort to asexual methods of propagation.

During the past 10 years the Oregon Agricultural Experiment Station has distributed large amounts of foundation stock of vegetatively propagated rootstock of apple, quince, cherry, and plum to Pacific Northwest nurserymen, using Douglas fir sawdust instead of soil in the mounding operation of these layering beds. This method has increased the number of rooted layers produced and materially cut labor required. Since there is a great deal of interest in more efficient methods of propagating such stocks, described below are the methods now being used.

Layering

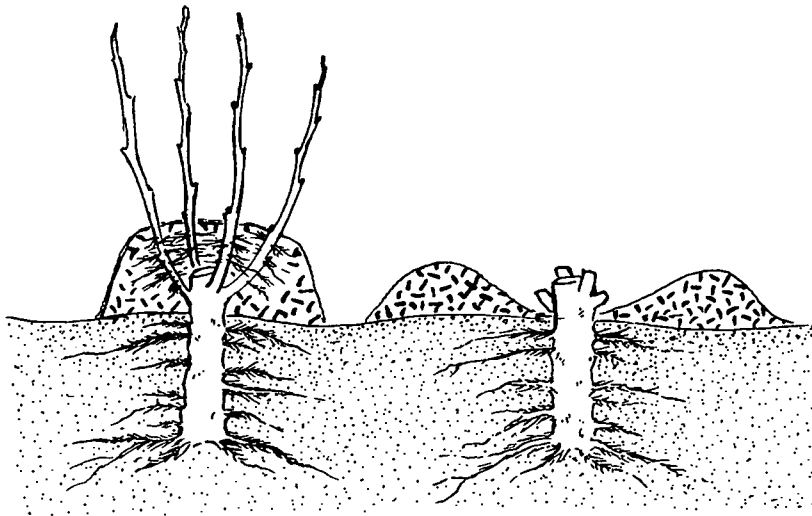
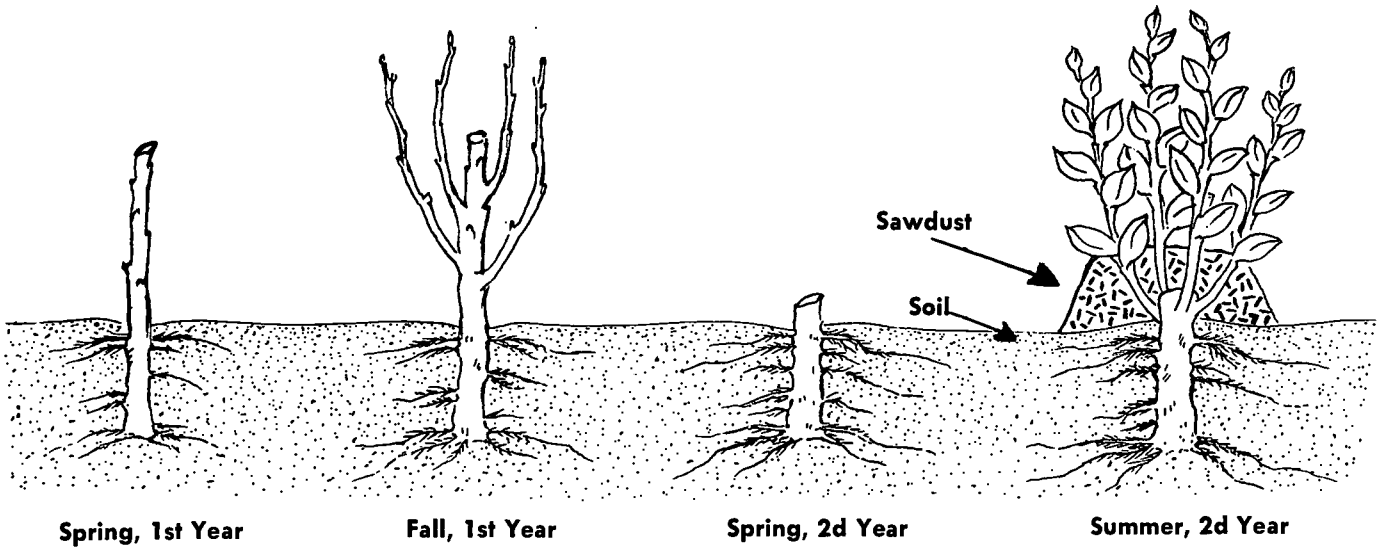
The usual method of propagating these clonal stocks commercially is by stooling (mound layering) or by layering. The two methods are similar in some respects but will be discussed separately. In either case, a fertile, well-drained soil should be used in establishing the stooling or layering beds. If irrigation is not available, the soil must have adequate water-holding capacity. Incorporating large amounts of peat moss or similar organic materials in the soil before planting the beds, as suggested by numerous writers, has not been found necessary at the Oregon Station when sawdust is used as the mounding media.

Stooling or Mound Layering: Some clonal rootstock materials produce rooted layers more readily from "stools" than from layered mother plants. In other cases, rootstocks produce more rooted layers from layered mother plants than from "stools." Only experience with new materials will determine which method is best. With the exception of M XII--which roots poorly in young beds--all the Malling series of apple rootstocks, the new Malling-Merton series, the quinces (Malling A, B, C and other selected clones) and certain mazzard clones (East Malling F. 12-1) are easily propagated by the stool method. Layering demands more care and attention than stooling and is far more costly, but distributes growth over a larger number of shoots, thus tending to give more uniform layers.

In stooling, vigorous, well-rooted plants are set 12 to 18 inches apart in rows placed sufficiently far apart to accommodate whatever equipment will be used in managing the beds. Four to six feet between rows will be ample in most cases. Where soil is used for mounding, more space is necessary than with sawdust. Setting the plants in a shallow (2 to 4 inch) trench or furrow will help keep the crowns of the "stools" low and easier to mound in later years. However, this is not a serious problem in sawdust mounding as it is with soil.

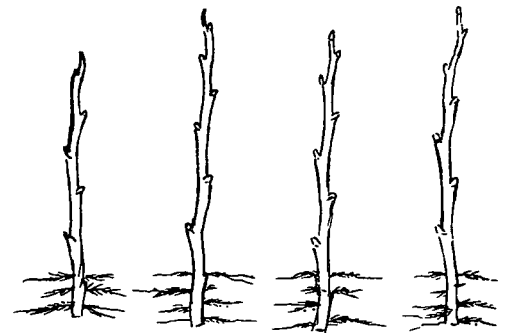
Although beds can be planted in the fall in certain areas, spring planting is preferred. This permits a full growing season for the development of an ample root system under the stools before mounding operations are started the next year. The second spring after planting, cut back all top growth to the ground line before new shoot growth starts. These tops can be used for nurse-root grafts or hardwood cuttings if such material is needed. In February and March, several shoots--depending on the vigor of the stool--will start to develop from the crown of the plant. Larger numbers will develop in successive years as the stools increase in age and vigor. As soon as these new shoots (layers) are 4 to 6 inches in height, sawdust is mounded up around their base until only half of the shoot remains exposed. Early mounding is essential, since successful

Mound Layering



Late Fall, 2d Year

Spring, 3d Year
Parent Stock



Spring, 3d Year
Harvested Layers

rooting depends on bringing about certain changes (etiolation*) in these shoots before they become woody and hard. This mounding operation is repeated once or twice more during the early growing season, taking care not to cover up any growing points that are slow to elongate. By late June or early July the mounds should be 12 to 15 inches high and the sawdust thoroughly worked in around each individual shoot by spreading them outward. Sawdust can be spread from the back of a vehicle moving over the rows.

The number of layers thus produced and the time and extent of their rooting varies with the rootstock, season, and soil fertility. Although the sawdust used in mounding may be pulled back at digging time and used over and over again for several years, some new additions are necessary each year. This can create problems in available nitrogen and phosphorus if sawdust is not properly managed. The application by broadcasting of approximately 100 pounds of actual nitrogen per acre in the form of ammonium phosphate (16-20) has taken care of this problem in Experiment Station plantings at Corvallis. More or less can be used depending on the vigor of the shoots and their leaf color. Poor vigor will result in undersized layers and poor rooting. Too much vigor also must be avoided, since vigorous shoots do not root as well as moderately vigorous ones. Also, if too large at digging time these shoots are poor material for budding the following season. The decomposing sawdust in the beds leave little to be desired in the way of organic matter and soil structure.

Anytime after leaf fall, sawdust can be pulled back and the rooted layers removed by severing the shoot near its point of origin on the stool. Be careful and leave a healthy well-developed crown for the crop the following year. Under Western Oregon conditions, considerable rooting takes place in the mounds up until Christmas and again in early spring depending on soil temperatures. For this reason early spring removal of the rooted layers is preferred and has been the practice in Station plantings. At this time any spaces left in the beds can be replanted. Rooted layers are graded for size and quality, depending on the use to which they will be put. Strong shoots that are etiolated at the base but without roots can often be rooted in the nursery row after lining-out, if favorable growing conditions are maintained. Otherwise, these unrooted layers can be used for nurse-root grafts, hardwood cuttings, etc. Often, hardwood cuttings taken from near the etiolated base of these shoots will root in the propagating frame.

After removing the layers, sawdust is raked back into mounds between the rows for use during the current season. This exposes the stools or crowns to the sun's rays and new shoots will appear year after year. It has been our experience that sawdust in the row and between the rows during early spring reduces the weed problem to a minimum and also greatly reduces irrigation requirements.

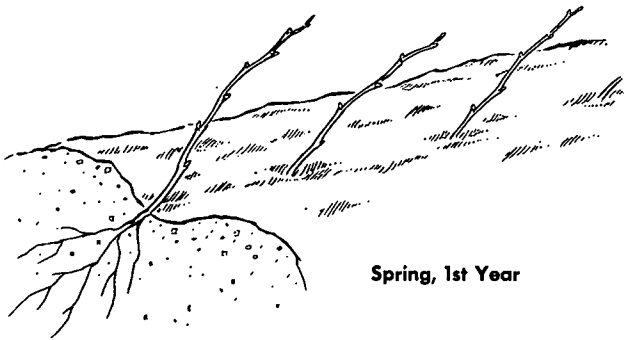
The stool beds established at the Station have produced excellent stands of rooted layers annually for 10 years. There are no signs of decrease in vigor to date.

Continuous or Row Layering: Somewhat different from stooling or mound layering, continuous layering has the advantage of distributing the shoot growth over a larger area and thus giving more uniform layers of the desired, medium sizes. It requires more labor and care in establishment and the initial cost is higher. But once established the layers are easily managed and the results are better with some plant materials.

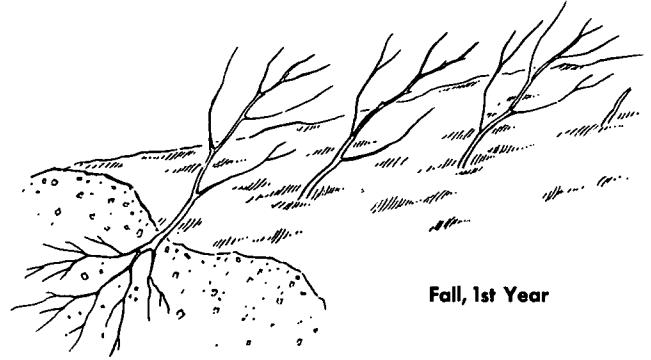
The original plants are usually set farther apart in the row in this method, usually 18 to 30 inches and at a 45° angle. Rows are best planted north and south for good light exposure down the rows. The plantings are usually made in the spring, and after a full year of growth and root

*As used in this circular, etiolation refers to the process whereby the stem is blanched and its tissues so modified to encourage adventitious root development.

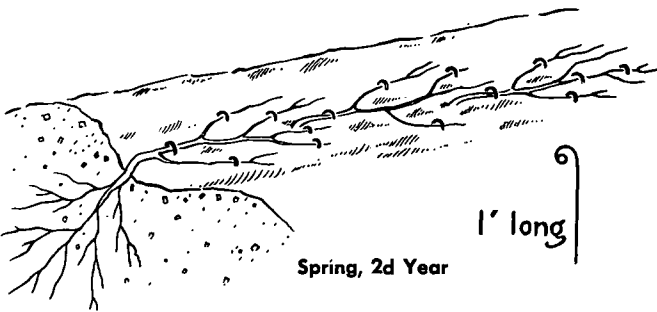
Continuous Layering



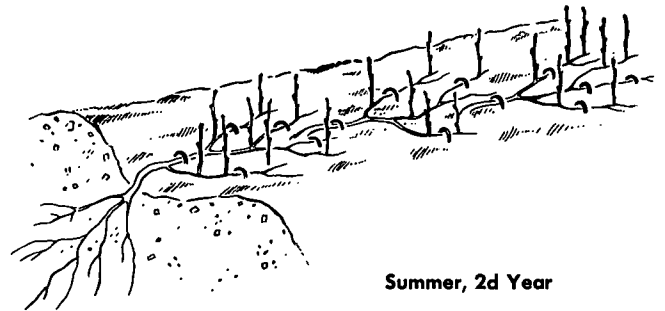
Spring, 1st Year



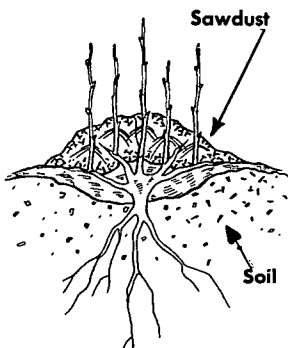
Fall, 1st Year



Spring, 2d Year



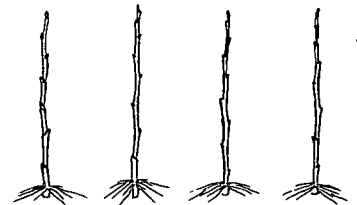
Summer, 2d Year



Late Fall, 2d Year



Spring, 3d Year-- Parent Stock



Spring, 3d Year
Harvested Layers

development, the tops are pegged down on the soil in a horizontal position. If the row is planted in a slight depression or furrow (2 inches), it will help make this operation easier. A little soil should be removed near the shoot base to help bending and upward bowing of the stock. If the tops are branched, the several shoots can be trimmed back slightly and laid out for good distribution of the subsequent layers produced. Branches can be held in place with wooden pegs or preferably wire pins made out of No. 10 galvanized wire. This layering should be done in early spring before buds start to break into growth.

As the buds break and new growth starts, new shoots are kept covered, except for the tip, with sawdust as they continue to elongate. Two or three moundings of sawdust will be required to bring the final mound to 10 to 12 inches in height without smothering the shoots or allowing them to become hard and woody instead of etiolated. The latter is necessary for early and extensive rooting of the shoot bases.

This method is often used with rootstocks that do not root readily on stools and can often be used to fill in gaps forming in old established beds. The age of these layered tops will vary and some need to be renewed from new shoots or reverted to stools. It has been our experience that some can be rather long lived--with beds of continuous layers that have been producing regularly for 10 to 12 years without dying out.

The layers are harvested and cared for in the same manner as outlined under stooling. Layered stems can be treated roughly, and if pegs are pulled loose or the old rooted stem broken, the stem can be laid down and pegged in place for further cropping. Shoots can be left to fill in gaps that are sure to develop if the foundation layer is accidentally cut loose.

Yields

Yields from such stooling or layering beds will vary greatly depending on variety, location, site, and soil. Variations will also occur with season and management practice. Ordinarily the beds will not reach full production until 4 or 5 years after planting. Production in old, well-established layering beds of types which root readily is equivalent to 60,000 rooted layers per acre of all grades per year. More than half are usually ideal lining-out stock for budding. The East Malling stocks I, IV, VII, IX, and XVI are in general prolific in root formation with layers. English workers, who selected many of the clonal rootstocks for apple, quince, and certain plums and cherries, state that in full production an average crop of 50,000 stocks per acre is satisfactory--30,000 of sufficient size for budding and 20,000 to line out for another season.

Plants from layering beds are lined out in the nursery row for budding or grafting the same as one-year seedlings of the same species. It has been our experience that well-graded layers are as easy to handle and may require less trimming and preparation than seedlings. In most cases, layers are usually easier to bud than seedlings.

Cuttings

Some clonal stocks of apple, quince, cherry, and plum can be grown easily from root cuttings and a few can be grown from stem cuttings. Softwood stem cuttings of some of these taken during the summer have been rooted with considerable success under intermittent mist at Experiment Station greenhouses at Corvallis.

Root Cuttings: Although material for root cuttings is not often available in quantity, some can be obtained at digging time from stooling beds and nursery trees propagated on clonal roots. Shortening the roots does not damage these trees for sale. One- or two-year-old roots of near pencil diameter and cut 3 to 5 inches in length make suitable cutting material. These cuttings are lined out in the open ground in early spring with the upper end of the root piece at or near the

soil surface. With good growing conditions, they may be large enough to bud the same year. However, it is often necessary to carry the stock over for budding the next year.

Hardwood Stem Cuttings: Research results obtained recently at the East Malling Experiment Station in England indicate that hardwood cuttings may be used to supplement stock available from layering beds. Hardwood cuttings have definite advantages, since unskilled labor can handle them, and production can adjust more rapidly with demand.

English workers have found that source of cutting wood, growth substance, treatment and control of environment during the rooting period, all affect the success of the method. Cuttings obtained from hedges of the fruit tree rootstocks have given the best rooting percentage. R. J. Garner of the East Malling Experiment Station, describes the method: "All factors must be considered. First, the cutting must come from a good source, such as an established hedge or layer bed. The cutting must be taken in good time (October-November) to permit time for root initiation before spring. All leaves are removed. The cuttings are dipped 1 inch in an appropriate growth substance (indole-butyric acid 1/2 to 2 1/2 mg. per cc. of 50 per cent ethyl alcohol, depending on species and variety). The cuttings are plunged 8 inches deep in a sand-peat mixture and protected from cold. A temperature of 45° F. maintained at the base of the cuttings during November and December is adequate for more ready rooting subjects. Others may need heating longer, but the top of the cuttings should be kept cool, particularly after Christmas, to prevent bud development. The cuttings should be examined from time to time and when they show root initiation, they should be planted out before top growth commences."

Grafting

Nurse-root grafting has been employed in rooting stem pieces of clonal stocks. Cions of one-year wood from the desired stock are whip grafted on short pieces of seedling root and planted out in the open ground like ordinary root grafts. Top of the cion is placed near the surface of the ground. When new growth on the cion reaches 4 to 6 inches in length, soil or preferably sawdust is mounded up around the base for 6 to 8 inches to favor cion rooting. Roots will be produced during the summer and early fall if the grafts are kept well watered and fertilized. Fresh, fir sawdust is as good and in some cases better than partially decomposed sawdust. This moist, porous media is ideal for encouraging adventitious root development on the cion. When the grafts are dug in late fall or early spring, make sure that the seedling root piece is cut off. Otherwise, the root system may not have the true character of the clon desired. Rooted cions thus produced are used in the same manner as seedlings or layers as lining-out stock for budding the next year. Take care to insure that the seedling nurse-root is free of virus diseases.

Budding Precautions

Since cion rooting of varieties budded or grafted on selected, growth-controlling stocks will ultimately result in the tree taking on the size and growth habit of the cion rather than the stock, care must be taken to bud the stocks higher than on common seedlings and to see that the union is well above the soil line in the orchard. Budding the layers 4 to 6 inches above the ground in the nursery row is recommended. It has been demonstrated that high budded trees grow as well as low budded trees and possibly better. The problem of winter hardiness cannot be overlooked, however, and the exposure of rootstocks of questionable hardiness must be considered.