STOOL BED PRODUCTION OF CLONAL APPLE UNDERSTOCKS

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The production of clonal apple understocks in stool beds is dependent on the process known as mound layering, hence the terms, "stool beds" and "layer beds", are frequently used interchangeably. In layering, the exclusion of light and provision of a suitable environment favors root initiation and development on a developing shoot while it is still dependent on the mother plant for nutrition. In stool beds this is accomplished by surrounding the bases of growing shoots with moist sawdust, inducing the process of blanching.

The reasons for propagating apple understocks through this process are: 1) difficulty of other means of production (hardwood or softwood cuttings); 2) its adaptability to mechanization; 3) high quality of the liner produced; 4) relative low cost of production; and 5) ease of maintenance and inclusion into the work calendar.

Understocks currently in production at Carlton Nursery include Malling-Merton 106 and 111 (MM106 and MM111) and East Malling 7A and 26 (EM 7A and EM 26). The words Malling, Merton, and East Malling refer to the locations of research stations in England that have worked together to develop the understocks. In recent years clonal understocks bearing the designation, EMLA (**E**ast **M**alling-**L**ong **A**shton), have become available, indicating selections which have undergone heat treatment and virus indexing and can be sold or used as virus-certified when grown according to the requirements of the certification program governed by the state in which they are grown. Virus-certified clonal apple understock are also being developed through other programs, such as the USDA IR-2, in the United States.

Briefly, MM 111 can be described as a semi-vigorous rootstock, MM 106 and EM 7A as semi-dwarfing, and EM 26 as a dwarfing apple rootstock. For more detailed information on these and other rootstocks, consult references 1, 5, and 7.

Planting and Establishment. A well drained soil of good fertility is a requirement for longevity of the stool bed. It should be as level as possible and rock free. The site should be prepared and fumigated in accordance with state requirements if it is to be used for production of virus certified understock. The chief purpose of fumigation is to reduce (hopefully to

eliminate) the presence of viruliferous nematodes which are capable of transmitting viruses from a host plant to an uninfected plant.

In the spring, understocks are planted in rows 4 to 6 ft. apart (at Carlton Nursery the rows are spaced 6 ft.) and 6 in. apart in the row. The rows should be oriented north-south; east-west-oriented rows have a tendency for the sawdust to dry out on the south side (2). It is very important to use high quality, large caliper liners, as it has been shown that yield is affected by the quality and size of the original plant (8).

The understocks are allowed to grow for one year, whereupon early in the spring and the following year they are cut back to 1 in. above the soil level and the mounding process is begun.

An alternative means of establishment is to plant the understocks 9 in. apart on a 30 to 45° slant, then grown for 1 year. They are then pinned down using twine and hop clips pressed into the soil, and then the mounding process is begun.

The first year's production is very light; full production is not realized until the 4th to 6th year. The life of a well maintained stool can easily exceed 20 years (4,7).

Table 1 gives graded harvest specifications for the Carlton Nursery stool beds in their 4th year of production.

Table 1. Graded rootstock production in the fourth year's production.

Rootstock clone	Yield of No. 1 Quality Rootstocks	Acreage	Yield liners/acre
MM 111	73,560	2.35	31,302
EM 7A	70,350	1.86	37,822
MM 106	21,900	1.45	15,103
EM 26	16,100	1.86	8,656

From this table some patterns are evident, although they must not be taken as exact characteristics. MM 111 and EM 7A both produce very prolifically in the stool beds. MM 106 is not as productive, yet it should provide a much higher yield than we have received. EM 26 is the poorest producer, a noted characteristics of this clone (5); it also yields a greater proportion of shoots with bent stems, which are discarded. However, it also should be considerably more prolific than is seen here. Both EM 106 and EM 26 have suffered due to areas of poor drainage, resulting in poor establishment in our stool beds.

Production Procedures. For the sake of simplicity we will consider the work schedule through one calendar year.

January: Harvest of layers from the stool beds is generally accomplished in January, but may be done any time from leaf drop to early March. Cool, cloudy weather is ideal; sub-freezing weather should be avoided.

The rootstocks are first undercut by means of a tractor-drawn sickle mower which is adjusted to cut just above the mother plants. It is important to cut as low as possible so that the mother plant does not become too tall or uneven in time. However, by cutting too low it is possible to destroy the mother plants; hence it is necessary to frequently check the cutting depth.

The layers are shaken to remove excess sawdust, stacked, and tied then moved to cold storage to await grading.

The sawdust is left in place over the mother plants for protection from sunburn and cold temperatures until March.

February: No work required.

March: The stool beds are swept with a converted street sweeping brush mounted on a tractor. Following this they are hand raked to remove residual sawdust and any remaining shoots are cut off and discarded. At this time the only fertilizer application of the season is done, consisting of 300 lbs/A of ammonium nitrate (34-0-0).

April: In the latter part of the month frequent checks for leafroller and leaf-tier damage are begun. Damage to the terminals from these pests can easily ruin an understock at this young age. Sprays of Guthion, Orthene, or Diazinon have provided effective control. By the first of the month growth should be in the range of 4 to 6 in.

May: Leafroller sprays as necessary. Growth should be 12 in. by the first of the month.

June: Fresh sawdust is applied using a specially constructed tractor-drawn spreader which deposits sawdust on both sides of each row. This sawdust is packed into and against the layers by hand, taking care to see that the new shoots are as straight as possible. The sawdust should be applied no higher than 8 to 10 in. above the base of the shoots; if applied too high burr knots may form which will be very unsightly if exposed on a finished tree.

Irrigation commences soon after sawdust application, the first irrigation being very heavy to insure that the sawdust is thoroughly wetted. High moisture levels are necessary for good rooting and must be maintained through the growing season.

Leafroller sprays are applied as necessary. Growth should be 18 in. by the first of June.

July: Irrigate to maintain good moisture levels in sawdust. Sprays for mites may be necessary. Growth should be 24 to 28 in. by the first of the month.

August: Irrigate to maintain moisture levels. Most cultivars will begin to show roots this month. Mites and aphids may require spraying. Plants should be checked frequently for woolly aphid, especially toward the base of the shoots. This pest causes serious deformation of the shoots and is difficult to control as it thrives in the environment within the sawdust. Temik or Di-Syston have both shown promise as effective controls. Care should be exercised in their use as they are extremely toxic. Growth should be 32 to 36 in. by the first of August.

September: Irrigate to maintain sawdust moisture levels. This month through the end of October is the period of greatest root development.

Growth should be 36 to 38 in. by the first of the month.

October: Irrigate as needed. Growth should be 38 to 40 in. by the first of the month and hardening off begins.

November: As leaf drop begins spray with Kocide 101 (6 to 8 lbs/A) as a general fungicide.

December: Harvesting may commence following leaf drop.

Grading. The bundles of recently harvested understocks are brought into the processing room where they are sorted according to caliper and the culls discarded. Layers with crooked stems, lacking good root development, or being too large or small are considered culls. At this time any spurs or side branches are removed, and the roots are trimmed to approximately ½ in., and the rootstocks are topped to a uniform height: 18 in. for MM 111, MM 106, EM 26, and 20 in. for EM 7A. This height is regulated by the desired budding height. They are then tied in bundles of 50 or 100 and again placed in cold storage until planting time.

For further information on stool bed production of clonal apple understocks see references 2,3,5,6 and 7.

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VOICE: Doug Sabin, what is the age of your stock plants when they are discarded as a source of hardwood cuttings?

DOUG SABIN: We have some old as 20 years. But the age at the beginning is more important. Cuttings do not root well until the stock plants are at least 3 years old.

VOICE: Why is *Prunus bessyii* not used more as a dwarfing *Prunus* rootstock?

DOUG SABIN: There is a considerable incompatibility problem with many *Prunus* cultivars worked on *P. besseyii* roots. But I don't know the reason for the incompatibility.

ALAN ELLIOTT: We have used *P. besseyii* as a rootstock. It is grown from seed and there is pronounced seedling variation in regard to its incompatibility reaction. For example, in a block of a peach cultivar worked on *P. besseyii* seedling roots you can see the great variation in tree growth due to the incompatibility encountered with some roots, but not others.

ED SCHULTZ: In storing your hardwood cuttings through the winter — are they upright or horizontal?

DOUG SABIN: The 10-inch cuttings are packed upright in peat moss in 14-inch high poly-lined boxes with air space at the top.

BEVERLY GREENWELL: How does the growth of *Acer palmatum* started from softwood cuttings compare with that from grafted plants.

LANCE LYONS: The rate of growth is better than the grafted plants.

VOICE: Is there a special procedure you use to overwinter your liners from softwood cuttings?

LANCE LYONS: After rooting, they go out into a poly house for the winter without heat, then brought out in the spring for planting in the field.

VOICE: Would you define Myro 29C?

DOUG SABIN: It is a selected seedling of Myrobalan plum — *Prunus cerasifera* — which has been maintained as a clone and used as a clonal, vegetatively propagated, rootstock. It was probably originally selected for its vigor and ease of propagation by hardwood cuttings.

VOICE: What is a good control for mildew on sugar maple seedlings?

DON POND: We use Captan-Benlate sprays.

MICROPROPAGATION OF DECIDUOUS TREES

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Microplant Nurseries was established in 1980, with our first crop going to the field in the spring of 1981. We have specialized in the micropropagation of new and improved fruit tree rootstocks of apple, pear, plum, and cherry, as well as self-rooted ornamental and shade trees such as flowering plum, flowering crabapple, birch, and Norway maples. We presently have 26 cultivars in production. These are produced in quantities of 5,000 or more per year. An additional 42 subjects are in various stages of research. Such items as red maple, sugar maple, ornamental pear, filbert, apple, and cherry cultivars are all part of our research program.

Our facility consists of a 1600 sq. ft. building divided into 4 separate areas: an outer office and storage area; a media preparation room complete with an autoclave, water purification system, pH meter, weighing machines and dishwasher; a transfer room with three laminar flow hoods, where all sterile sub-culturing takes place; and a culture room with 1,024 sq. ft. of shelf area. The culture room is maintained at 25°C with a 16-hour photoperiod.

There are three *in vitro* stages of growth in the micropropagation process: culture initiation, multiplication, and rooting. Each stage requires a different medium formulation. We have found that there are differences in nutrient requirements almost on a cultivar by cultivar basis, so that we now start with Murashige and Skoog's (MS) basic formula (1) and make systematic changes as needed. While much work has been done in the past on changing the type and concentration of plant growth regulators, we have found that the inorganic salts also play an extremely important role in promoting or inhibiting