3 days after which time you can remove the grafts from the tent or you can remove the plastic covering the grafts; either way the grafts must now be spaced out slightly. The grafts are now given the normal care that you would give any other plant growing in your greenhouse.

CHARLES McCLOUD: What are your temperature ranges during the various grafting operations?

LENNY SAVELLA: The understocks are brought in from a holding house which usually ranges from 45 to 50°F and when they are grafted they go into the grafting house at a temperature of 76°F and we try to hold this temperature.

CHARLES McCLOUD: What about the temperatures in your tent, on a bright sunny day does the temperature go way up?

LENNY SAVELLA: Yes it may. I forgot to mention this in my talk, but on a bright sunny day it is very important that you put some kind of shading over the top of your tent.

JOE CESARINI: Can you graft lower and cover the union with the peatmoss in the poly tent?

LENNY SAVELLA: No, you can't do that Joe. What I'm trying to do is design a system which requires the least amount of labor, care and attention possible. This method is 100% foolproof. I make the union, stand it up in the tent, the union doesn't have to be covered or waxed and this considerably reduces labor.

## DWARF ROOTSTOCKS — PROPAGATION AND USAGE

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Rootstocks, especially for fruit crops, is an old subject with renewed interest. For example, 25 years ago there was very little interest in dwarf apple trees compared to current use of up to 90 percent in commercial orchards. There are practical reasons for this, such as: smaller trees are easier to manage, production per unit of land is higher than the old system, fruit quality is improved and management costs are less. This report is an update on rootstocks and their application for controlling tree size and for increased yields.

## ROOTSTOCKS FOR *MALUS* SPECIES

For the sake of clarity, only the apple rootstocks which are currently used in the U.S.A. will be discussed in order from the most dwarfing to the most vigorous.

**Malling 27.** Being the most recent introduction, M.27 has not been extensively tested for growth and yield characteristics with American apple cultivars. It is very dwarfing and produces a bush-like tree. The propagation rights of M.27 have been granted to the Oregon Rootstock Company, and rooted cuttings of it should be available in 1979.

M.27 may in the future be useful in dwarfing ornamental *Malus* species of which there are hundreds of cultivars. For example, there is a need for a range of sizes of crab apples from small bush-like to larger trees. This rootstock could also fit into greenhouse pot culture for testing compatibility characteristics of both fruit and ornamental *Malus* species and cultivars. Thus, only a small test area would be needed compared to field testing.

**Malling 9.** This rootstock is well known because it has been in use for about a century. It will dwarf apple cultivars to 30% of the standard size trees. M.9 used to dwarf apple trees will give small trees which fit into the home landscape. Another ideal place for such trees is for the small orchardist (5 to 10 acres) for "pick your own" fruit. These trees can be held to a maximum height of 8 ft or less. M.9 is very precocious, starting to bear fruit the first and second year with some cultivars.

M.9 also is good for dwarfing of ornamental crab apple trees; however, bud take is usually poor. The cause of this may be due to latent viruses in both this stock and the *Malus* species. The new EMLA 9 no doubt will take the bud better. Trees on M.9 are not free standing and require support.

**Malling 26.** This rootstock gained rapidly in popularity among commercial fruit growers because it has excellent dwarfing and early fruiting qualities. When budded correctly, M.26 will give a well anchored, free standing tree.

The following rootstocks should be budded about 30 cm high in the nursery: M.27, M.9, M.26 and M.7. In so doing, such trees can be planted 25 cm deeper than they were in the nursery. This will provide more stable trees and eliminate crown suckering.

**Malling 7.** Without doubt M.7 is the most tested and most reliable semi-dwarf apple rootstock. It is compatible with all cultivars tested, precocious and productive, and it is well anchored. M.7 is prone to some crown suckering, but this is kept to a minimum when trees are budded high and planted deeper in the orchard. This method also improves tree anchorage.

**Malling Merton 106 and 111.** These rootstocks are semi-vigorous to be used where wider tree spacings are needed. MM.106 is a precocious stock with all cultivars. However, due to its susceptibility to *Phytophthora cactorum*, "collar rot", it should only be used on well-drained, sandy loam soils. MM.111 is not as precocious, but well anchored and dependable on a range of soils. Apple cultivars budded on MM.106 and MM.111 should be spaced about 14 ft apart in the row and the rows 20 ft apart.

**New *Malus* Rootstocks.** Since most of the apple clone rootstocks to date have been imported, programs are now in progress to develop new rootstocks in the U.S.A. and Canada. Since these will not be available for commercial use for 2 or more years, they are only briefly mentioned here. The Michigan Apple Clone (1) series was initiated in 1948 with the purpose of developing dwarfing precocious, hardy and well-rooted clones. The most promising are now indexed and propagated in Oregon. Other clones are being developed at Geneva, New York and Ottawa, Canada.

## CLONAL ROOTSTOCKS FOR STONE FRUITS

Most of the stone fruits (peaches, cherries, apricots, and plums) are propagated on seedling rootstocks. However, few are propagated on clones. For example, peach, plum and apricot can be propagated on St. Julien A or St. Julien X on MC-20-3 plum clones. Recently, the East Malling Station has introduced a dwarfing cherry clone 'Colt'. Both sweet and tart cherries can be propagated on this clone. 'Colt' cherry can be increased by the stoolbed method or by soft and hardwood cuttings.

There exists a great need for the breeding, testing and developing reliable clonal, hardy and scion-compatible, rootstock material for all the stone fruit crops and perhaps also for the ornamental stone fruit cultivars.

## DWARFING CHARACTERISTICS

Of the dwarfing clones used, each imparts a degree of dwarfing different from the rest. Hence, the dwarfing clone serves only as a part of the tree size reduction process. Other factors such as the soil condition and tree management play important roles in obtaining and maintaining compact smaller trees.

In the case of fruit trees, each scion/cultivar combination requires a certain tree spacing depending on vigor of the cultivar and the rootstock, the type of soil and system or orchard management (Table 1).

**Table 1.** Guidelines for tree spacing, as influenced by the rootstock, tree training system and tree numbers.

| Apple Rootstocks Small to Large | Training System[1] | Spacing (feet)[2] | Trees/Acre |
|---|---|---|---|
| M.9 | St. or Trel. | 6 × 14 | 518 |
| M.26 | St. or Trel. | 8 × 16 | 339 |
| M.7 | St. or Free | 8 × 18 | 302 |
| MM.106 | Free Standing | 12 × 20 | 181 |
| MM.111 | Free Standing | 12 × 22 | 165 |

[1] St. or Trel. = Staked or trellised tree training system. Free standing training system.

[2] Vigorous cultivars will need 2 ft more each direction.

In the future, both fruit and ornamental trees will be propagated on clonal rootstocks for controlled tree size to fit orchard production systems and planned landscape designs. To accomplish this, much plant breeding and testing is yet required.

## LITERATURE CITED

1. Carlson, Robert F. (1977) New Apple Rootstock Series. *Compact Fruit Tree.* International Dwarf Fruit Tree Association. Vol. 10:7-8.

## Monday Afternoon, December 5, 1977

The afternoon sessions convened at 1:15 p.m. with Dr. Steven Still serving as moderator.

## ACCELERATED GROWTH OF CONIFERS

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The normal growth pattern of a conifer, after the seed germinates, is a series of active growth cycles followed by periods of dormancy. When a seed is planted in the nursery, it germinates and begins its growth by developing a root. Shortly afterwards, the epicotyl needles develop and in a period of 4 to 6 weeks there will be a continuing growth of both the root system and the stem and needles.

Some time later, the stem growth will stop and the tree will develop a bud. The root growth will continue for a period of time and then the tree will become dormant and remain so during the winter until the soil warms the following spring.

After the new growth begins, the same cycle will follow wherein the tree will develop both root and top growth during