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 the summer followed by a period of dormancy during the winter and new growth the following year.

The priciple of accelerated growth is that the tree is subjected to conditions which break this dormancy period. Instead of going into a dormancy period, the tree continues its height and root structure growth and reaches a size in 5 or 6 months that ordinarily takes 3 or 4 years under field conditions. Apparently in breaking this cycle, we make a physiological change in the tree itself. The accelerated growth tree will continue to grow at a rate which is faster than normal after it has been planted in the field to grow under normal conditions.

This is the theory of accelerated growth. Apparently this physiological change which we have developed in the tree in the juvenile stage induces it to grow at a rate that it ordinarily wouldn't attain until it was 10 or 15 years old and a large tree. Some trees planted out by Michigan State University have flowered and produced viable cones at the age of 5 years. These were White Spruce and ordinarily they would take 10 or 15 years before they flower and produce cones. On this basis we have surmised that the trees have had a physiological change when subjected to the acceleration process. Now for the system we use to accelerate our conifers. First, we are growing the trees in styrofoam blocks with each tree having its own cell which contains a plug of dirt 1 × 1 × 5-3/4 inches deep. We are using a growing mix consisting of half peat and half vermiculite.

The cells in the block are filled with the growing medium and tamped thoroughly to assure that there's ample medium packed into each cell. The blocks are vibrated and tamped and additional soil is added so that there is adequate soil in each cell and it is firmly packed in.

The block then goes to the seeder and we put at least two seeds in each cell, depending on our germination tests. We want to make sure that each cell will have at least one live plant. Then we cover the seeds firmly by putting a thin application of chicken grit over the top of all the seeds. The blocks are then set into steel racks which hold 9 blocks and are set onto benches in the greenhouse. As soon as the blocks are located on the benches, we water them thoroughly.

Our watering system is a walking sprinkler which moves down each bay. It has arms reaching out into each side over each of the benches on the sides of the bay. The amount of water can be controlled by controlling the speed that the sprinkler travels.

The seeds germinate in 1 to 2 weeks in greenhouses held at 70°F and quickly push up and put on their first needles. At this time we turn on the lights so that the plants get 24 hours of natural and artificial light. Our HVO flourescent lights give out about 250 ft-c of light at bench level.

Shortly after the plants attain their epicotyl growth, the thinning operation is performed with a little set of manicure scissors. The thinners try to leave the strongest plant that is growing the closest to the center of the cell. The plants that are cut out are shaken from the block.

The fertilizer program is begun as soon as the plants have germinated. Liquid fertilizer is included with each watering. The fertilizer program varies because we find that the different plants have different fertilizer needs.

The growing routine is followed for the next 4 months. The plants grow very rapidly and we are looking for a plant with a 6 inch stem and a completely developed root system which we feel will produce the optimum growth when it is outplanted. When the plants reach this size we begin reducing the fertilizer and water and lowering the temperature. These changes induce the plant to go dormant and develop a bud system.

The root systems develop very rapidly and will appear at the bottom of the growing block in a matter of a few weeks. The roots will extend a short distance out of the bottom of the block and then will burn off as they are exposed to the air. This system of root pruning induces the plant to develop new and more roots which follow the same pattern of going down through the growing medium, extending and being pruned off. We think this particular feature has a definite advantage in developing the root system we want.

The temperature is lowered further to thoroughly chill the plant so that it will break bud and continue growing in the field. If the plant is not subjected to this chilling, we find that when it is outplanted it will go dormant and wait until it has gone through a cold period before producing new growth.

In the process of making the plant go dormant we also induce a considerable amount of root growth. This is necessary because we do not consider the plant finished until it will do what we call "plug". This means that the plants have developed a root system so firm and solid that the roots and dirt come out of the cell in a solid plug. When the plants have reached this condition, we remove them from the cells and either ship them or put them into cold storage. Shipping the plug plant is almost like shipping a container grown plant because we have a solid root system in the plug and the roots are not disturbed during the harvesting and shipping. We feel that one of the keys to the accelerated growth program is this massive root system which arrives at the customer's site completely intact with no damage done to any of the fiber roots.

We are only growing a few varieties and continue experimenting with new varieties each year. Some of these varieties will respond immediately to the accelerated growth program and others have been complete failures. An example is the Eastern White Pine which we have not been able to accelerate. This tree follows the normal time cycle for growth and dormancy that you would find when it is growing under natural field conditions. It will grow for a short period of time and then becomes dormant and will stay dormant in the greenhouse even though the growth conditions are right for acclerating other pines and spruces.

One of the phenomenon we have noticed in our greenhouse operation is the situation where a pine will set a bud on the stem but will continue growing beneath it. It continues its growth with the bud setting on top and the needles and stem developing beneath the bud and growing as steadily as if it had not set a bud. Apparently we have triggered a condition where the trees both want to go dormant and still respond to the greenhouse atmosphere and continue to grow.

NITROGEN NUTRITION OF JUNIPERS[1]

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With the trend to faster production of saleable nursery plants in containers, the nursery industry utilizes large amounts of fertilizers in their growing procedures, especially nitrogen. The effects of NH_4^+ and NO_3^- sources of nitrogen, on growth of woody ornamentals in containers have not been studied to any great extent. Differential response of certain horticultural plants to NH_4^+ and NO_3^- has been reported (1,2,3,8) and in most cases better growth was reported when NO_3^- was the N source. However, species specificity has contributed to diversity in results obtained from two nitrogen sources (4,6,7). Experiments were conducted in the greenhouse and outdoors to evaluate the effect of N form on growth, appearance, cold hardiness and N composition of five cultivars of juniper.

Greenhouse Study

MATERIALS AND METHODS

Rooted cuttings of *Juniperus procumbens* 'Nana', *J. chinensis* 'Pfitzeriana', *J. communis* 'Repanda', *J. sabina* 'Broadmoor' and *J. horizontalis* 'Wiltonii' (blue rug juniper) were potted in a

[1] Contribution No. 1547, Department of Horticulture-Forestry, South Dakota Agricultural Experiment Station, Brookings, SD 57007.