

intervals, starting on December 6. The rooted cuttings were dug 12 weeks later.

The results were:

1. Cuttings rooted nearly 100% in the two December groups while the second two taken in January, ran 50% and 20% each.
2. Wounding seemed to have little effect on the rooting.
3. Jiffy Grow produced a slightly better root formation than Hormodin.
4. Wood from any part of the current year's growth rooted as well as the terminal wood. This included cuttings up to one-half inch in diameter.
5. Rooted cuttings placed in gallon cans kept in the heated greenhouse sustained a 30% loss, which was largely due to a weak root system.

In 1967 the same procedure was followed except that only Jiffy Grow was used. Again, the results were much the same, and pointed conclusively to the taking of cuttings as soon as the stock goes dormant. The plants this year were canned and put in a cool poly house. This resulted in a 60% loss, although most of these, again, were the ones with weak roots.

In 1968 conditions prevented putting in cuttings before mid-December. Two small batches of cuttings were put in a week apart in the same bed as before, and a third, larger group of cuttings was put in a new bed on the east side of the greenhouse in an unheated poly house. Cuttings were used from all parts of the current year's growth, and treated with Jiffy Grow. None of the cuttings were wounded.

Between Christmas and New Year's Day a storm hit. No more cuttings were taken until late January. The cable in the new bed failed during the hardest freeze, and could not be repaired. The cuttings froze in place. The cuttings taken in late January were a complete failure. From a total of nearly 2000 cuttings only 150 survived and these were from cuttings taken in mid-December.

MODERATOR KESTER: Thank you, Lee. Now Rudy Wagner will discuss some of his experiments in propagating fruit tree rootstocks by hardwood cuttings.

ROOTING HARDWOOD CUTTINGS OF FRUIT ROOTSTOCKS

GOTTLOB (RUDY) WAGNER

C & O Nursery

Wenatchee, Washington

Propagation by hardwood cuttings is known to be the least expensive and easiest way of reproducing plants vegetatively. The cuttings are easy to prepare and no special equipment is needed during the callusing and rooting period. Hardwood cuttings are made usually from one-year-old dormant wood.

However, in propagating fruit rootstocks, one should follow the method best suited for his region. Factors to consider are:

- (1) Source of the cutting material
- (2) Timing — when is best to take cuttings
- (3) Preparing the cuttings
- (4) Treatment of the cuttings
- (5) After-care of the cuttings

In 1960, Dr. Hudson Hartmann and Prof. Carl J. Hansen reported that 'Old Home' pear (*Pyrus communis*), is a valuable rootstock in combating pear decline and fire blight. Cuttings can be rooted if taken in November with the bases soaked 24 hours in 200 ppm IBA, packed in moist, *not wet*, peat moss and placed at 65° to 70°F. These root in 3-4 weeks and can then be planted immediately in the nursery, weather permitting. If stored at 40° F., only 1/3 as many survived.

In late October, 1962, we started propagating 'Old Home' pear along these recommended lines on a small scale. Although we did not have a large supply of suitable plant material, there was enough to gain the necessary experience to prove it to be commercially feasible in our operation.

1. *Source of cuttings* — The cutting material should be taken only from clean, healthy and vigorous parent trees with the shoots having completed their first year's growth. Shoots one to three feet long and 1/4 to 3/8 inch in caliber make excellent cuttings. If not fully defoliated at cutting time the leaves should be pulled off.

2. *Timing* — After experimenting in taking the cuttings at various times from September through October, and into November, October seems best in our region.

3. *Preparing the cuttings* — The cuttings are cut into 8 to 10-inch long sticks, either by a hand shears or tied in bundles of 50 or 100 and cut to length with a fine-tooth band saw to make a fairly smooth cut. We prefer the saw.

4. *Treatment of cuttings* — As soon as the cuttings are prepared, the basal ends should be soaked for 24 hours in a 200 ppm IBA solution, which is made by dissolving 1/2 teaspoon IBA in a small amount of ethyl alcohol, then diluting it to one gallon with water. After trying out various solutions and strengths, including a quick-dip of 2000 ppm IBA, the 200 ppm, 24-hour soak, seemed the most satisfactory.

5. *Care of cuttings after treatment* — After the cuttings are removed from the solution, they are packed horizontally in moist, *but not wet*, peat moss. To maintain an even moisture around the cuttings we line our boxes with 4-mil poly and also tie a sheet of poly over the box. This usually holds the moisture during the callusing and rooting period. Do not allow roots to elongate during the callusing period. This is when our problems started; we were able to get good strikes, but to carry them through the winter until spring and line them out was another thing. Several attempts in storing the cuttings in

moist peat at 35° to 37°F. until the following spring gave complete failure. We then tried repacking the cuttings in a mixture of ½ sand and ½ peat. The bundles were cut open and the cuttings were then put vertically and singly in boxes with the 2 top buds showing. Approximately 500 cuttings per box were used. The boxes were then buried right in the field, covered with sawdust, straw, or a similar material. This seems to be the answer in keeping the frost out of the boxes. This extra effort is well worthwhile when you see a fine batch of rooted 'Old Home' pear cuttings coming safely through the winter.

Clonal apple rootstocks are mainly propagated by stooling, but when a certain clone needs to be on its own root, we may resort to hardwood cuttings. The cuttings are made in the same manner as all other hardwood cuttings except no heat treatment is needed as is the case with pears. The bundles of cuttings are packed in moist peat moss and stored in temperatures of 40° to 60°F. until planting time. The tops should be kept somewhat cooler than the base to hold back top growth until rooting is completed.

Quince rootstocks are propagated either by stooling or by hardwood cuttings. When multiplied from hardwood cuttings, shoots that failed to root in the stooling beds furnish the cutting wood, or mother plants are grown for the purpose of providing one-year-old wood to be made into cuttings. Such cuttings seem best for quince, with the cuttings being stored like apples at cool temperatures until spring. Under good growing conditions the cuttings can even be directly lined out in the field in seasons with ample moisture. Often 80% rooting can be obtained.

MODERATOR KESTER: We will now open up this session for questions.

BRIAN GAGE: Are there any differences in vigor — now I am asking a general question — in plants from rooted cuttings as compared with those grown from seed and then grafted or budded, which is, of course, the usual method of propagating trees?

MODERATOR KESTER: I might make a comment. It seems to me it is going to depend upon the rootstock; there may be an inherent vigor because it is a seedling. I am not aware that this has been shown, however, as opposed to hardwood cuttings from the same plant. Now somebody else might comment on this.

DR. HARTMANN: I might mention a specific case of 'Bartlett' pear trees started from hardwood cuttings versus those that were grafted on *Pyrus communis* seedlings. Dr. Griggs, in our department at Davis has several pear rootstock plantings where he has various stock-scion combinations, as well as 'Bartlett' pears on their own roots. The latter has been a somewhat dwarfed tree in comparison with 'Bartlett' grafted on seedling roots. With the present interest in dwarf trees and close planting, this could be an advantage.

MODERATOR KESTER: It would be difficult to make a gen-

eral statement that all plants on seedling roots would be better than those on clonal rootstocks with the same scion material, or vice-versa. Probably each combination is going to have to be checked-out.

DAN GIBBIE: I would like to ask Dr. Hackett a question. I think it might be interesting to know, concerning heat treatment for elimination of some diseases, approximately what the heat treatment is, how high a temperature is used, and for how long.

DR. HACKETT: In general, I think we can say that for actively growing plants — plants not in a dormant state — not many of them will stand much more than 100°F. for any length of time. The general experience has been that the heat treatments used are approximately 100°F., with the length of time varying according to what the plant will stand. A standard practice for carnations has been three weeks at 100°F. Some other plants will stand this temperature for longer periods. Perhaps there are differences, too, in what different species will stand.

JOHN TRAAS: Dr. Hartmann, for a month, approximately from mid-September to mid-October there is a period that the shoots in the stool beds form roots abundantly. Is this a question of temperature in night and daytime, or a different physiological structure of the plant — or is it a matter of high humidity or of reduced light? Thank you.

DR. HARTMANN: This is a difficult question to answer since it would take quite a bit of study to determine which of those, or other, factors is responsible. It may be a complex of things that could be tied in with rooting promoters or inhibitors which are involved with bud activity, or it could be some other of the points you mentioned. In order to come up with a real answer, it would take a good bit of study to eliminate the various factors one by one. I can't give you a meaningful answer without a study of the problem.

MODERATOR KESTER: It seems like timing is certainly involved in this. This has been experienced in our peach/almond material. We feel that the earlier in the fall hardwood cuttings are taken the better the rooting. I would suspect it is related to timing.

HARRY LAGERSTEDT: Is it correct that the pear initiates roots from the callus, rather than from the stem tissue. It seems to me that I heard this somewhere and I thought that if this is true it might have a relationship to timing and the forming of callus first.

DR. HARTMANN: I am not aware of studies showing that roots originate from callus in pear. I believe they arise in the stem tissue itself.

HARRY LAGERSTEDT: It seemed to me that Dr. Westwood thought they originate from the callus rather than from the stem tissue. I may be incorrect, so this is why I asked the question.