number of pinches per plant, percentage of grade one plants and grade index, resulted from 65° F. night minimum plus 24 hours light (supplementary illumination dusk to dawn). Gro-Lux fluorescent and incandescent were equally effective.

Final independent gradings by a nurseryman and the author in September, 139 days following termination of lighting with grade based on size and appearance only, revealed no improvement as a result of supplementary illumination.

On the other hand, dusk-to-dawn illumination with either Gro-Lux fluorescent or incandescent plus a minimum temperature of 65° F. resulted in over 60 percent of the plants initiating flower buds compared to 30 percent for the higher yielding check (natural days and 45° F. night minimum). Light for 16 hours, where Gro-Lux is supplementary, is equal to dusk-to-dawn lighting with lighting with Gro-Lux, but less than equal to dusk-to-dawn with incandescent.

Light quality from mercury vapour and four kinds of fluorescent used in this experiment, is not considered critical for dusk-to-dawn supplementary illumination where growth stimulation of *R. molle* is the objective.

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MODERATOR LEISER: Our next speaker is Gottlob "Rudy" Wagner from C. and O. Nursery at Wenatchee, Washington. Rudy!

PROPAGATING APPLE ROOTSTOCKS BY THE METHOD OF CONTINUOUS LAYERING

GOTTLOB (RUDY) WAGNER
C. & O. Nursery Co.
Wenatchee, Washington

The increasing use of vegetatively propagated rootstocks in our fruit tree nursery, in search for better rooted liners and for a constant source of supplies, made us decide in 1962 to grow

some of our own rootstocks. As clonal rootstocks cannot be reproduced true-to-type from seed, we must therefore resort to asexual methods of propagating. The methods used for propagating clonal rootstocks commercially is either by mound layering or by continuous layering, but mound layering seems to have the preference by many propagators. I think the reason for this is the lower cost in establishing the stool beds. But we must not count out other methods such as hardwood cuttings, root cuttings and softwood cuttings. All these will eventually be as important commercially as the layering methods. In either case a fertile, well-drained, soil should be used in establishing the stooling or layering beds. Before planting we apply the following fertilizers: (actual per acre) 320 lbs. nitrogen, 320 lbs. phosphate and 160 lbs. potash as early in spring as possible.

We use the continuous layering method in our operation. It requires more labor and care in establishing the beds and the initial cost is much higher, but continuous layering has the advantage of distributing the shoot growth over a larger area much faster than the mound layers and produces more uniform layers of the desired medium sizes. But once the layering beds are established, the layers are easily managed and the results are superior to other methods.

Spring planting is the most suitable in our region. We plant our rows 8 feet apart, 16 inches in the row, and the mother plants are set at a 45° angle for easy layering and preferably pointed to the south for good light exposure down the rows. To get the sawdust into the layering beds has always been a big chore. We now haul the sawdust directly from the mill right into the rows and unload the truck from both sides. This of course must be done early and soon after planting while we still can straddle the rows. The 8′ rows give us plenty of room to pile enough sawdust between the rows for several years of covering. Having the sawdust in rows between the mother plants is also a good weed control. After a full year's growth and root development of the mother plants, the shoots are then pruned and prepared for the actual layering. Any branches that cannot be held flat against the soil should be pruned off. The whole top and the lateral shoots are then pegged down on the ground and spread in alternating directions for a good distribution of the shoots. We prefer wire over wooden pegs because wire is easier to pin with. We use No. 10 galvanized wire cut in 24″ lengths and bent in a "U" form; near the end of the prong we put an extra little bend which helps in holding the shoot to the soil. This operation is very important; the shoots must fit and be held very firmly to the soil. otherwise the mother plants cannot establish a good root system if left dangling between the sawdust and the soil. If the plants are planted in a slight depression or furrow 2 to 3 inches deep it will make this operation much easier. A wedge of soil should be removed from the base of the plant to help bend the stock. It will also relieve pressure on the shoot and less popping up will occur. For the base we

use double prong hooks and for the top and lateral shoots a single hook will hold. After the shoots are firmly pegged down, the entire layer is then covered with an inch of soil or sawdust before bud activity starts; this is to bring about etiolation and better rooting of the new shoots. The layering must be done in early spring before the buds break into growth and care must be taken that the soil or sawdust is in a good moist condition when the hilling-up operations are carried out. The root formation on the new shoot is influenced by hilling-up early in the growing season before the shoots become hard and woody. The hilling-up is done usually in four stages and the last one should bring the mound up to at least 12 inches if sawdust is used as the medium. Soil requires only 6 to 8 inches. With every hilling-up, the sawdust must be thoroughly worked in around each shoot. After the hilling operation is completed often prolonged periods of dry and hot weather occur, in our region, which sometimes creates a serious problem for us through overheating of the stool block medium. If not corrected at once it will hinder the root formation and the base of the shoots can easily become hard and woody. To lower the temperatures in the beds, we have changed our method of watering; instead of one heavy watering every few days, we now water several times daily. With our cold Columbia River water this drops the temperature from 10° to 15° degrees very quickly. This has or seems to have a very satisfactory effect on root formation.

The layering beds are by now in full operation and a close watch must be kept on the performance of the layers. If sawdust is used it can create a problem in available nitrogen and phosphorus. To overcome this we make two applications of ammonium phosphate (16-20), 50 lbs. actual nitrogen per acre; the first application is made just before the first covering of the shoots and the time of the second application depends on the vigor and color of the leaf. Neither very vigorous nor weak plants make good layering material; medium sized shoots are the most likely to have a high percentage of rooting and produce the most desirable medium size plants.

Insects can be troublesome in the layering beds, but can be controlled without much difficulty. If the terminal shoots are attacked by leaf hoppers or aphids and damaged, the results will be short lateral shoots and spurs instead of a clean slim stem of a rooted layer. Such short lateral shoots and spurs must be trimmed off before the shoots can be used as lining out stock. But much more serious damage can be caused by the woolly apple aphid. The aphid colonies can become established on the root of the mother plant, as well as in the rooting zone of the young shoot growth, therefore it is very important to keep this insect out of the layering beds. We are able to control them with two applications of Lindane, 2 quarts per 100 gallons of water. The first application is applied by drenching the plants thoroughly just before the first cover goes on the new shoots and a second application is applied after the hilling-up operation

is completed, which is usually about the middle of July. We sometimes encounter slight attacks of powdery mildew; usually a few sprays of Karathane, ½ to 1 lb. per 100 gallons clears it up pretty fast.

Harvesting the rooted layers can be done anytime after leaf fall if the roots are sufficiently hardened off. We prefer fall to spring cutting of the rooted layers as it gives us the exact count of stock on hand for spring planting; harvesting in the fall involves some extra work, however, as the crown of the mother-stock must be protected in winter and the winter protection must again be taken off in spring to expose the crown to the all-important sun rays. When cutting the rooted layers from the original layered stock (as close to the base as possible), we leave some of the unrooted shoots stand. Such shoots serve to maintain the layering beds; if all the shoots are rooted we leave some of the most vigorous rooted shoots stand in the beds to fill in the gaps if so needed. Eventually older plants of the layers will die out or break out through harvesting, so care must be taken each year that some new shoots remain to replace those that have been lost.

Yields of the layering beds depend on many circumstances, like any other crops, such as variety, location, fertility of the soil, variation of the season and, above all, the management practices used. The layering beds usually come in full production during the 4th and 5th years. Well-established and well-kept layering beds will produce with EM VII and EM IX approximately 50,000 per acre; EM II, if good, 25,000 per acre. Our MM 104, 106, and 111 rooted exceptionally well this year and indications are of a 60 to 65,000 yield of rooted layers per acre.

Clonal rootstocks are with us to stay from which the industry will not turn back, but will move steadily towards an even greater exactness in predictable control of orchard performance.

ROUND TABLE DISCUSSION ON PROPAGATION OF DIFFICULT PLANTS

WILLIAM J. CURTIS, *Moderator*
Wil-Chris Acres
Sherwood, Oregon

MODERATOR CURTIS: I would like to have Mrs. Whalley come forward as the first member of our program. Mrs. Whalley has a wholesale nursery in Oregon and does custom propagation; there is no one that does a better job of this than Mrs. Whalley. In fact, when we have trouble with some items, we take them over to Mrs. Whalley. Jean: