use during propagation. After fumigation we roll it back for aeration and cutting insertion. This saves on plastic.

ED MEZITT: Do you move the poles to put digging machines under the cuttings?

DON SHADOW: No, but I plan to do this because the poles can be moved easily.

RICK ALLRED: Would you elaborate on your conifer grafting?

DON SHADOW: We use a side graft, lay them on a 45° angle in the bed, and cover with a plastic tent. I am not sure about the temperature. It is between 21° and 27°C (70 and 80°F).

EFFICIENT PRODUCTION IN PROPAGATION

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Maybe some propagators have a green thumb or a white root or some other special knack of the art. But efficiency does not come from green thumbs. It comes from analyzing, organizing, developing methods and pushing your crew and facilities to yield their utmost.

What does this mean to us anyway? Making our propagation departments more efficient means that we will produce more plants at a lower cost per plant with the same effort we are already putting into it! And producing more plants at a lower unit costs means more profit. Profit is the lifeblood of business. And that is just as valid for commercial propagators as it is for General Motors. The more profit we propagators make, the more new and better facilities we build, the more propagator meetings we go to, the more plant excursions we go on, the more plants to produce for an expanding market, and the more people we put to work. So the more profit there is, the more life there is. It is high time that we commercial propagators get to look at ourselves as businessmen first and plant lovers second, and that we act accordingly.

We must take a critical look at the various segments of our operation, analyze how they function and figure out what should be done. (In parentheses I should say, that if any of us concludes that all is so well that nothing should be done, I suggest we have somebody else look at it.) A good hard look at our propagation functions (without stubbornness and prejudice)

will often reveal that some parts of the function can be scrapped all together. An example being artificial wounding of cuttings in most cases or pounding of sticking sand and pounding of soil into the pot. Another part of the function may be done unnecessarily exact, an example being the clean-cutting of the base of cuttings which is usually not necessary. Parts of the function may be altogether missing, such as disinfection of sticking boards and cutting pans. And parts of the function may be done in the wrong sequence. For example, it costs a lot less to transport soil and plants bulk before potting than to transport the same amount of plants already potted.

At this point you may be wondering where the practical details are, that will be useful and meaningful. I have picked three important parts of the propagation and growing process which we shall take a close look at:

1. Making of cuttings.
2. Sticking of cuttings.
3. Potting of plants.

MAKING OF CUTTINGS

We are going to talk about field making of cuttings versus bench making of cuttings and also piecework. Field making of cuttings means to make the cuttings ready to stick right off the plant in the field. Bench making means cutting a branch off the stockplant, bringing the branch inside and there cutting one or several cuttings from the branch.

We feel that field making of cuttings seems to be the best answer for reducing costs by eliminating or reducing many labor wasting operations. Making, stripping, counting, and bunching in the field eliminates the labor of crews gathering plant materials, storage and removal from storage of bulky materials and disposal of waste aftrer bench cutting operations. It made sense to train crews to do the entire operation in the field, since time studies showed an overall reduction of more than 50% in the cost per unit of field made cuttings compared with bench made.

Reduction in labor costs and crew size to perform the necessary operation did not result in significant changes in quality. Making the cuttings more efficiently actually increased the rooting percentage because large volumes of cuttings could be made at the most suitable timing for maximum rooting. Just the savings in storage space and storage handling is significant, and there is less danger of handling diseased material or spreading such diseases as juniper blight.

Crew size is a factor in efficiency, and field making is best adapted to individual contract workers on a piece work basis or

small crews with a good crew chief. If you have a good crew chief and a crew of 5-6 persons you can operate most efficiently as far as travel to stock blocks or production areas. If you have as many as 10 unskilled workers to train in this method you have to use more supervisory help and closer supervision to avoid damage to field production areas or container plants used for cuttings. Cost per unit of production usually goes higher with more crew members and is lowest with individual contract worker in different areas on piece work rates.

The bench making of cuttings, however, can probably not be eliminated completely. Certain plant materials, such as arborvitae and related genera do not lend themselves to efficient field making. These can be made during cold and inclement weather by hauling in, storing and bench making on days or periods when field making is not practical. In winter, if your operation requires the use of deciduous hardwood cuttings, you can bench-make and store cuttings, such as *Ligustrum* and *Lonicera* with good results.

In our nursery we implemented a piecework system several years ago. It has worked extremely well. Without it we would never have been able to achieve the production we have. We have only three cutters and they make over 3 million cuttings in the season from April to October, all field-made. Good piece work operators should earn at least double the average hourly worker's wage.

Well trained individuals on a piece work basis tend to produce a consistent product. There is no evidence that the fast and efficient piece work operator produces significantly poorer cuttings than the slow, careful benchworker on an hourly rate. What is significant is that he produces as much as 5 times the volume.

STICKING OF CUTTINGS

When we receive the cuttings from the field, they are moistened and held in cold storage at 3° to 5°C (37° to 40°F) until we are ready to use them. When the time comes, the cuttings are submersed in a fungicide solution and quick-dipped in a hormone, if necessary. Whether the stickers stick groundcovers in cellpacks, junipers in open flats or deciduous in ground beds, they always do it as piece work.

Close supervision is necessary to keep track of 5 to 6 stickers going at the same time. If a man is not doing a quality job, he must correct his mistake. The second time, though, he would not receive any piece-work or hourly rate. In a 10 hour day, a good sticker can stick 10,000 to 15,000 cuttings. The actual amount would depend on the type and condition of the cut-

tings, whether the cuttings are being stuck in cell packs, open flats, or ground beds, and the sticker's other responsibilities. Some of these other responsibilities may include filling flats with sticking soil, preparing ground beds, watering in the newly stuck cuttings and covering them with saran cloth, and misting the cuttings.

We feel that when an employee is sticking cuttings on an hourly rate, he has little or no personal incentive to push. His wage for one day will be the same whether he sticks 1,000 or 15,000 cuttings. On the other hand, the paycheck of an employee that is in the piece work system is directly proportional to how hard he has worked.

POTTING OF PLANTS

On-site potting is done at Midwest Groundcovers. On-site potting is potting by hand a few feet away from the final growing place. Two men make a potting crew. They have one soil wagon and each a flatbed cart to haul the potted plants to their place. Soil, pots and some plant materials will be supplied by another man who is servicing 3 potting crews and also mixing soil.

On-site potting is more efficient than centralized potting. There are no breakdowns of expensive machines and very little maintenance. Only greasing the tractor loaders and the carts. It is easy to switch from one size container to another. It is not important whether the soil is dry or wet, hands don't get plugged up or stuck. Most motorized equipment used to haul the potted plants is eliminated. On an average we have found that one man in a 10-hour day can pot 2,200 half-gallon or 1,000 2-gallon plants. At this rate our men can usually double their hourly wage.

Before anyone is put on potting piece work, he will have worked with an experienced potter. He has to prove for several weeks that he can work at a constant speed and produce good quality work under all conditions.

We would not want to go back to potting by the hour because we get more done faster by piece work. Our men also absolutely do not want to go back to hourly pay because they like the extra earnings.

BEN DAVIS: How did you establish a piece rate that was equitable for you and your employees?

PETER ORUM: It is very difficult to do and takes time to work out. We started out just potting ourselves and seeing what we could do. Some rates we found out were set too high while others were set too low. We adjusted those in future years.

DWIGHT HUGHES: How are your workers paid when not on piece work?

PETER ORUM: By the hour and this rate depends on the individual.

PETER VERMEULEN: How do you decide who gets the piece work?

PETER ORUM: It is somewhat a seniority question. New people rarely go on piece work. They must prove themselves first.

JOHN SPARMANN: Do you separate cutting preparation, cutting sticking, and potting, in your piece work?

PETER ORUM: Yes.

A SYSTEMATIC APPROACH TO PROPAGATION OF SHRUBS BY SOFTWOOD CUTTINGS

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Any person growing and propagating plants on a large scale uses a system or a pattern of work flow to accomplish his goal. It has been my observation that many propagators select one system and depend solely on that system to produce their entire output. It seems to me that this leads to the same mistake the army makes when it dresses everybody in olive drab, and then concludes because they all look the same, they are the same. Logically, using one single system of production for a variable input would force a propagator to be inefficient. Therefore, I would like to discuss some of the various systems and techniques of summer softwood shrub propagation and also the way systems can be fitted to the plant rather than fitting the plants to the system as is usually done. The first thing I would like to discuss is the cutting making system. I am going to describe the traditional system and then I am going to suggest some avenues that one might use to simplify a production system.

SYSTEMS FOR MAKING CUTTINGS

Traditional cutting system. A traditional cutting-making system would have at least the following steps:

1. Cutting wood would be removed from a mother plant.
2. The wood would be transported to a holding area.
3. Cuttings would be made to a certain length by a worker sitting at a bench.