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

JOHN R. HANNAH

Henry Field Seed and Nursery Co.
Shenandoah, Iowa 51602

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.

4. The bottom leaves would be removed from the cutting.
5. The top leaves might be cropped.
6. The cuttings are stacked in a bundle.
7. Bundles of cuttings are dipped in rooting hormone solution.
8. The cuttings are then stuck in the rooting medium.

There are many steps in this system. Any industrial engineer can tell you that every step results in a cost. Reducing the number of steps automatically reduces costs. At this point we should consider actions one might take to reduce the number of steps in the cutting making process.

Cropping leaves. Cropping leaves is a practice that dates back before the advent of mist systems. At that time it was necessary to reduce the transpiration surface of the cutting in order for it to survive at all. Today it is an unnecessary step with one exception, namely to save room in the propagating bed. If space is not a problem, then cropping is probably detrimental to the plant.

Making cuttings in the field. Rather than bringing wood into the greenhouse to make cuttings on the bench, cuttings can be made right in the field. One cut then results in one cutting. This is not a new idea. It has been done for a number of years by several large Oklahoma nurseries and I am sure many others use the same procedure. At Field's we make our cuttings in the field, bundle them with a rubber band and put the bundles in a plastic bag where they are kept wet with a hand sprayer. They arrive at the greenhouse in great shape and are usually stuck under mist within a couple of hours. This method is fast. I have had one individual make over 11,000 cuttings in one day. Daily counts of 6,000 or 7,000 per individual are not difficult to attain.

Making cuttings without a knife. Cuttings on some plants can be gathered very green before fiber forms and can be popped off the mother plant without a knife. This practice has worked extremely well on *Spiraea* × *bumalda* cultivars, *S. albiflora*, and *Kolkwitzia amabilis*. Perhaps it works on other plants; it is worth investigating. It won't work on everything, but when it does it can save money by eliminating a step.

Leaving bottom leaves. The previous two summers Henry Field's has stuck gooseberry cuttings without the removal of any bottom leaves. They root better than when the bottom leaves are removed. This same thing surely applies on other plants, so this is another step that can be eliminated on occasion.

Making cuttings mechanically. A flat top hedge will often have an abundance of cuttings sticking straight up from it. Mow

them off with electric hedging shears and stick them. It works on some plants. In practice, at Henry Field's we are using a blend of these techniques to meet our propagation goals. We pick the system with the least steps that will give the results we need. Most of our softwood shrub cuttings are made in the field. The only plants we cut on the bench are the various vines we grow. We avoid the use of the knife if we can. We also avoid cropping the leaves unless we absolutely must to give more room in the propagation bed.

SYSTEMS AFFECTING PLANTS AFTER ROOTING

Next we will look at the systems that affect a plant after rooting takes place. The first of these is the traditional liner production system as outlined below.

Traditional liner production system. This system is the one that has been used dating back several generations. The system usually consists of the following procedures:

1. A cutting is stuck in a rooting medium in early summer.
2. As rooting takes place and the cutting is removed from the rooting medium.
3. The rooted cuttings is potted by hand into a clay pot.
4. The clay pot is set into an outdoor cold frame where the plant will overwinter.
5. The following spring the clay pot is removed from the cold frame.
6. The potted liner is removed from the pot, flatted and sent to the field for transplanting.

The primary advantage of this system is its familiarity so when a problem occurs it has usually been seen previously. The disadvantage, of course, is that it has a very high labor cost.

Leafy bare-root liner production system. This is a "bare-bones" sort of system that consists of just the bare necessities. The steps are as follows:

1. The leafy cutting is stuck in a rooting medium.
2. When a considerable amount of roots are formed, the cutting is removed from the medium and sent to the field for transplanting, usually in late July.

This system is most effective when used with species that are vigorous growers and transplant easily, such as *Sambucus, Forsythia, Cornus* (shrub types), *Lonicera, Potentilla* and *Spiraea*. It is very inexpensive which, of course, makes it very attractive. The liners are transplanted to the field in early summer so there is no conflict of labor requirements with the digging and shipping season. In addition, this system can produce a saleable plant in 1½ growing seasons. Unfortunately this is a

rather high risk system. In Iowa the time of planting coincides with our period of highest plant stress from heat and drought. If the planting crew gets careless, the plants can die before they are ever transplanted. The new transplants must have water immediately after planting and repeated waterings until growth commences. The plants take a relatively long time to become established. The net result of the above is that stands from using this system are sometimes not as good as the stands from other systems.

Dormant bare-root liner production system. This is a relatively simple system requiring the following production steps:

1. The cutting is stuck in early summer. It then remains in the bed until it goes dormant in the fall.
2. The following spring, before growth resumes the cutting is moved to the field and transplanted, or the cutting is dug in late fall, roll wrapped and refrigerated through the winter. Transplanting takes place in the early spring (before April 15 if possible).

This system shares an advantage of the leafy bare root system in being relatively inexpensive, especially if the cuttings are spring-dug and winter refrigeration can be avoided. It usually gives good stands. On the negative side, this system can be subject to the vagaries of weather. A wet spring, a late thaw, or a spring drought can all delay transplanting to the fields, thus causing reduced stands. This system also conflicts directly with the shipping and digging seasons, so it adds to the labor crunch that most nurseries experience in the fall and spring.

Tube liner production system. This combines aspects of both bare root systems and the traditional potted liner system. The production steps are as follows:

1. The cutting is stuck in early summer in a tube type container.
2. In 4 to 6 weeks the cuttings are well rooted and are removed from the container for field planting.

This relatively new system offers the following advantages: (1) Planting is done in summer when labor is usually readily available. (2) Cuttings planted in the field become established in a matter of a week. (3) Root penetration into surrounding soil begins in about 4 days. (4) Transplant shock is practically nonexistent. (5) Plants are less subject to drying out in the transplanting process. (6) The whole process seems less influenced by weather than other systems. (7) Cutting sticking and the process of removal from tubes can be done at a work bench in a cool part of the greenhouse. (8) The work itself is much easier on the laborer than sticking cuttings while bent over a bench in a hot greenhouse. (9) Stands and growth seem much

more even than with other systems. (10) Transplanting success of over 97% is common. (11) Saleable plants are produced in 1½ growing seasons.

This system does have some disadvantages: (1) The capital cost is a little bit more than a bare root system, probably about 1.5¢ per plant more. (2) Some plants root so slowly that they are not ready to plant until late summer. The system should not be used to hold plants. When plants are well rooted they should be planted. If not planted, the tube-rooted cutting may not grow properly when it is finally transplanted to the field. (3) Some wide-leaved plants do not tolerate the crowding usually present in tube growing. (4) The system may not produce a large enough plant for sales at the end of two growing seasons for some nurseries. It works great for us since we are mail order and want the $^{12}/_{18}$" and $^{18}/_{24}$" size. If 2/2½' sizes are necessary at the end of two growing seasons, then the system is not satisfactory. There are some adjustments that have to be made in watering schedules, fertilizing and so on; if personnel cannot make the adjustment then problems will result.

Three years ago at Henry Field's a modified traditional system was being used. At that point Field's began to experiment with tubes for growing. Field's experience with tube growing has been extremely successful with the result that slightly over ½ of our softwood shrub production this year was in tubes. We have not gone completely to tubes and will not for the following two reasons:

1. It is a new system and we don't feel we know everything about it yet.
2. We want to diversify our production systems to reduce the risk of a system-induced failure.

Next summer we plan on changing our alignment further. We plan on slightly over half of our production being in tubes, about a fourth by a dormant bare root system, and about a fifth by the traditional system. Up to this point I have treated the cutting making systems and the postrooting handling systems separately. Table 1 illustrates how we fit the systems together and shows the route through the systems that we would prefer to follow in producing a softwood shrub liner from the making of the cutting to the transplanting stage.

In conclusion, I have outlined some systems of production that are presently economically and technically feasible. The propagator must, of economic necessity, continually reexamine all underlying assumptions relating to his or her propagation systems and eliminate any unnecessary steps from the systems.

Table 1. Preference for systems of summer softwood shrub propagation.

Genus or species	Preference for type of cutting system[1]			Preference for type of rooting system[1,2]			
	Make in field	Cut at bench	Use no knife	Traditional	Leafy bare root	Dormant bare root	Tube rooted
Berberis	1	2	No	3	No	2	1
Buddleia	1	2	No	2	No	No	1
Celastrus	No	1	No	4	3	2	1
Chaenomeles	1	2	X	2	No	3	1
Cornus (shrub types)	1	2	X	4	2	3	1
Cotinus	1	2	No	No	No	2	1
Deutzia	1	2	X	2	No	X	1
Euonymus alatus cultivars	1	2	No	3	No	1	2
Forsythia	1	2	X	4	3	2	1
Hydrangea	X	1	X	1	X	X	X
Kolkwitzia	1	2	1	3	No	2	1
Ligustrum	1	2	X	3	No	2	1
Lonicera (shrub types)	1	2	X	4	3	2	1
Lonicera (vine types)	No	1	X	4	2	3	1
Philadelphus	1	2	X	No	No	2	1
Physocarpus	1	2	X	4	2	3	1
Potentilla	1	2	X	No	2	3	1
Prunus	1	2	X	No	No	2	1
Ribes	1	2	X	2	X	3	1
Salix	1	2	X	4	1	2	3
Sambucus	1	2	X	4	1	2	3
Spiraea albiflora	1	2	1	3	2	No	1
Spiraea × *bumalda* cultivars	1	2	1	3	2	X	1
Spiraea × *vanhouttei*	1	2	No	3	2	X	1
Symphoricarpos	1	2	X	2	No	No	1
Syringa (French Hybrids)	1	2	X	3	X	2	1
Syringa persica	1	2	X	4	2	3	1
Syringa patula (Syn.: *S. palibiniana*)	1	2	X	4	2	3	1
Viburnum	1	2	X	1	No	2	No
Weigela	1	2	X	3	No	2	1

[1] Systems marked "No" should be used with caution because problems have appeared with a similar approach in the past. X indicates limited information

[2] 1 is most preferred.

Editor's Note: Joseph Cesarini moderated a group of short presentations on tricks and ideas in propagation and growing. The papers by J.B. Fletcher and J. Peter Vermeulen were part of that session.