but it to has not been able to provide sufficient numbers. Softwood cuttings have also done reasonably well. This year we took 3-inch softwood tips in June, two-bud cuttings, and 10-inch cuttings. We found that by putting these cuttings all in a polyhouse with extra shading, keeping high humidity with as little watering or misting as possible, keeping the house closed tight with temperatures reaching 110F and higher gave a greater success than by keeping the temperature down with ventilation and more misting. We used a peat and perlite medium for the larger cuttings and a cocoa-mulch medium for the tip cuttings. Gisela® rootstocks are currently propagated in California, Oregon, Washington, Michigan, and Ontario with varying success.

Innovation in Perennial Propagation

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Propagation of perennials by seed is nothing new or innovative. Plugs and plug seeders are not new to the industry either. Many of the large annual plug growing operations around the nation seed bedding plants with highly sophisticated seeding lines. They typically contain automatic flat fillers, dibblers, high-speed drum seeders, watering tunnels, conveyors and sometimes, robots to move plug trays to the bench or the cracking chamber. This equipment is very well suited to bedding material as trays are seeded in lots of several hundred trays. These systems are very fast, very accurate, very sophisticated, and very expensive to set up. Anywhere from $30,000 for the seeder alone to a few hundred thousand for the entire set-up. Only a few perennial plug producers, that I am aware of, utilize this equipment.

If you are a smaller plug producer and typically seed in lots of 5 to 50 plug flats per taxa, the expense of such an elaborate seeding set-up can usually not be justified. Until a few years ago, the next most viable option was a plate seeder. These are very simple pieces of equipment consisting typically of a tray holder, an airtight box holding the seeding plates and a vacuum cleaner with a regulator valve. The plates have holes drilled into them corresponding with the selected plug tray size. Usually three or four plates with different hole sizes are used to cover most seed sizes. Accuracy of seeding depends significantly on the skill of the operator and the number of flats that have already been done that day. Typically the first 20 or 30 are quite good, by the time you hit number 200, your back aches, your wrists are sore, and you are ready to strangle the inventor of this contraption. Of course you conveniently forget the days when plug trays were seeded with a vibrator seeder or a salt shaker.

A decade and a half ago needle seeders made their entrance into the market. Initially rather prone to plugging and somewhat difficult to control, the concept none the less was sound. You put a vacuum across some hypodermic needles to pick up a defined number of seeds from a seed tray, move the needles over a plug tray, release the vacuum and the seed is seeded. In theory you can seed practically any type of seed from cyclamen to walnuts by this method. In practice it was found that more sophisticated controls were needed. Several companies took the initial seeders and added vacuum controls, blow-off switches, vibrating seed trays, and seed retrieval

systems to come up with the modem needle seeder. The strength of the needle seeder lies in the seed handling capabilities. It is capable of singulating most types of seeds when operated by a skilled person. It works very well for small batches of seed, say 500 to a few thousand, although I still use a plate seeder for smaller quantities.

Here is how it works. You place your seed in the vibrating seed tray and adjust the vibrator to create the effect of seed swimming in the tray. Insert the plug tray under the dibbler and watch the machine do the rest as it seeds each cell row by row. Of course it isn't quite that simple. A few things need to be done first. Picking the right needle size is important. Using a #8 needle to seed *Aquilegia* seed would create some serious plugging rather quickly, likewise using a #41 needle would not have sufficient vacuum to hold the seed. Regular observation and accurate record keeping quickly establishes which needle is appropriate for specific genera. Entering these observations in a database and utilizing it for planning a seeding session greatly decreases the number of needle changes, and increases productivity tremendously. The second variable is the amount of vacuum on the needles. Higher vacuum pressure increases the number of multiple seeds per cell (sometimes desirable), too low and the seeds fall off before they reach their destination. Blow-off pressure can also be important. Too much and the seed bounces out of its cell, too little and the seed sticks to the end of the needle enabling you to seed an entire 288 tray with 12 seeds. Once you've made those adjustments you are off to the races. Finish a seed selection and have seed left over; the seed change-over is quick and painless. Simply suck up the excess seed, put in the new plant and away you go.

Utilizing this machine and my unsophisticated setup a two-person crew is capable of processing between 500 and 800 288-plug trays in an 8-h day. That is roughly 50% faster than with a plate seeder. Adding a flat filler, conveyor, and watering tunnel could double that figure again. The biggest benefit however is reduced operator fatigue.