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The Thursday morning session convened at 8:00 a.m. with David Hensley serving as moderator.

A SYSTEMATIC APPROACH TO GROUNDCOVER PRODUCTION

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A "system," according to Webster, is "a scheme, plan or method," or "a regular method or order". If this definition were interpreted for ground cover production, it may read, "a consistent method for producing groundcovers". At Midwest Groundcovers, we have always felt the need for a system, because of the large number of units involved. We have also found that as the components within the system change in size or nature, the entire system may need to be modified to compensate for these changes. This will be the thesis for this presentation based on our experiences at the nursery. The system which will be looked at is the production of groundcovers, from the making of cuttings to the loading of the flats on the customer's trucks.

To start out, let's set some parameters on this discussion. The crops which are included are *Pachysandra terminalis* 'Green Carpet', *Euonymus fortunei 'Colorata'* and *Polygonum cuspidatum* var. *compactum*. The cuttings are direct stuck in 2 in., 3 in, or quart pots in flats. The 2 and 3 in. pots have two cuttings per pot and the quart has 3 cuttings per pot. The cutting season varies with the crop: *Polygonum* is May 15 to July 1, *Pachysandra* is June 15 to August 10, and *Euonymus* is June 15 to September 15. The yearly production of groundcover units has been increasing every year since the company began in 1969. In 1982, there were about 1,100,000 groundcover units of these species produced. By 1984, production was up to 1,500,000, a 36% increase. These rapid increases greatly stressed our propagation facilities and production system. We had to re-evaluate our current system, make changes and come up with a new system. In this presentation, we will review, the "old system" with the problems that were experienced and the decision to build the "new system," and then look at the new system that was developed for producing groundcovers.

First of all, let's take a look at the "old systems" facility. It was a 5 acre nursery located 3 miles south of the main nursery. In those 5 acres, there were about 91 beds suitable for groundcover propagation, with an average capacity of 310,000 units. The beds were 6 ×

40 ft., unheated, and of simple construction. When *Polygonum* cuttings were being rooted in the frames, they were covered with white plastic. If the crop was *Pachysandra* or *Euonymus* the frames would be covered with 55% shade cloth. The covering material was suspended on a 10 foot piece of electrical conduit bent in the shape of a hoop.

The first step in the production system was flat filling. The inserts or pots were placed into the flat and filled with soil. The flats were filled and stacked next to the soil pile. One man could fill about 100 flats in an hour.

Our groundcover cuttings came from three different sources. In 1982, 23% of our groundcover cuttings came from stockbeds in the nursery. About 64% came from plants in production. The taking of cuttings from these plants also served as their pruning. The last 13% came from what we call cooperators. These were gardens or home landscapes in the area that had a large bed of groundcover. All of the cuttings were, and still are field made; that is they are cut, counted, stripped, and bundled together with a rubber band right in the field. As soon as one bundle is finished, it is immersed in a bucket of water and placed into a plastic bag in the shade. The cutting rate per hour varied with the type of cuttings and the source of the cuttings. If the cuttings were being made at a cooperator, the rate averaged between 5,000 and 10,000 cuttings per man per day. This was dependant on the amount of driving time to and from the cooperator, and the other maintenance work that was needed at the cooperator. When cuttings were made from stockbeds, the men averaged 15,000 to 22,000 cuttings/man/day. This was always a difficult job to do for it meant bending over for the entire day. If the cuttings were taken from production plants, the flats could be elevated to waist height and the average rate increased to 20,000 to 30,000/ man/day.

Periodically throughout the day, the propagator would pick up the bags of cuttings, bring them back to the work building and dip them in a Captan-Benlate solution. After draining, they were put back in the bags and placed in the cooler at 38°F. The hormone treatment would be done by the production crews just before the cuttings were to be stuck.

Sticking of the cuttings on the old system was for the most part done at a central location. A sticking table, which was shaded and protected from the elements, was located close to where the flats were setting. The workers stood at the table, stuck the cuttings, and then wheeled the flats, eleven at a time, to the frame where they were to be set. This system worked fine if the flats did not have to be wheeled very far. After setting the flats, they were lightly watered and covered with shade cloth or white plastic. The rate at which the cuttings were stuck was dependent on several factors: the crop, the size of the pot, and the distance the flats had to be wheeled. On the average one person could stick about 15,000 cuttings a day, which is

to say 7500 units per day could be produced because there are two cuttings per 2 and 3 in. pot.

The misting of the cuttings was controlled by time clocks. There were two different kinds of mist systems used. The *Euonymus* and *Pachysandra,* which went under shade cloth, were covered by a mistline that ran on the outside in between two frames. The nozzle was a shrub head irrigation nozzle which provided a coarse mist, and had an output of 3.8 gal/minute. This line doubled as an irrigation line when necessary. The *Polygonum,* which was stuck under white plastic, was covered by a mistline that ran down the center of the frame on the inside. These nozzles provided a very fine mist. Rooting of cuttings occurred in 4 to 6 weeks, and were ready to be moved out of the propagation frames soon thereafter.

After rooting, the propagation frames have to be cleared to get ready for the next crop. This was done by loading the flats of rooted cuttings on a trailer and hauling them up to the container division at the main nursery, 3 miles down the road. Since the container division did not have a permanent area set aside to receive the groundcovers from the propagation division, one of two things could happen to the newly-rooted plants. They may be placed in a prime area where they could be shaded for a while, properly watered and fertilized, and cared for in a proper way; or they could end up between 5-gal junipers with no shade, a watering regime set for the junipers and less than ideal conditions for the newly-rooted groundcovers. This latter situation became more prevalent late in the days of the old system. Also, at this time, hauling was getting to be a real chore. A crew of 3 men would be busy hauling 4 out of 6 days a week, from July 1 to September 15.

As mentioned above, in 1982 the annual production of groundcovers was about 1,100,000 units. Also mentioned was the fact that the propagation facility could handle about 310,000 units at a time, which meant about 3.6 rotations per year through each frame, (1,100,000 ÷ 310,000 = 3.6). Since each crop took 4 to 6 weeks to produce and the propagation season was about 4 months long (May 15 to Sept. 15), the facilities were just about adequate to take care of 1982's production. But, by 1984, when our annual production of these three items increased to 1,500,000, we needed 4.8 rotations through each propagation frame per year to make the schedule. Obviously this was impossible, so propagation ended up borrowing space from the container division to do its schedule. This put added stress on the container division, which was already overflowing with material that was hauled from propagation.

The significant increases in production caused several problems in the groundcover production system. Hauling was getting to be a sizeable job and of considerable cost, which really did not add any value to the product. Secondly, there was a lack of propagation space that was set up for groundcover propagation. Thirdly, the

rooted groundcovers were taking up more and more space in the container division which was affecting the production of 2- and 5-gal material. The system had to change. So it was decided to expand the propagation department by designing and building a new facility. It was decided that this new facility should be solely for propagation of groundcovers in flats, and should also function as a growing area. The goals of this new area were to achieve: increase groundcover production, improve quality and efficiency in groundcover production, and consolidate groundcover propagation and production into one area, thus opening up production space in the container division.

In designing the new system, two criteria were used for deciding how much land was needed. First of all, there had to be enough space to accommodate a yearly production of 2 to 3 million units, which we anticipated future production to be. Secondly, there had to be enough room to have a two year rotation. Since *Euonymus* and *Pachysandra* take a cycle of over a year to produce, having two phases and propagating in each section in alternate years, this would allow us to propagate, grow and sell each crop without ever having to move it. If a section was to lay empty for an extended period of time because of this cycle, we felt we could fill in with other short term crops. Fortunately, land was available adjacent to the main nursery and we were able to purchase 30 acres.

Construction started in August, 1984, and Phase I was to be ready in May, 1985. The first job was to have the land excavated and leveled until it had a 1% slope to the north and west. The excavator also dug a pond that would function as an emergency water supply and catch whatever run off there would be from the drain lines. The drain lines were the next to go in. One 4-in. drain line was to run between each house and connect to headers that would eventually lead to the pond. Following the drainlines, all inground irrigation and wiring were put in before winter; ¾ in. crushed limestone was tailgated over the entire area before any frames were built.

When the question of frame size came up it was decided to go with a larger 13 × 96 ft house rather than 6 × 40 ft frame. The larger house gave us greater utilization of space, fewer houses to maintain and cover; it could be covered by a standard 24 × 100 ft piece of plastic, and the combination irrigation-mistline could be located within the house. By having the mistline in the house, this would enable us to irrigate with the plastic on if ever necessary. It was also important to have each end of the house accessable by a road to facilitate the use of machinery.

The primary source of water for this nursery was to be a well that could supply 300 gal/min at 60 lb pressure. The water system was designed to be a pressurized system to permit misting the cuttings. A large pressure tank of 10,000 gal was installed to reduce the number of times the well pump would have to cycle. Double main

lines were installed and each ten-house section could be fed off either line. Since this new area was to be used as a propagation facility and a growing facility we felt it was necessary to have one line with clear water for misting the cuttings; the other line would contain fertilizer-treated water for irrigation of rooted plants.

The pH of the water from the well was 7.8 and we would prefer it to be down in the range of 6.3. So an Anderson Acid Injector was installed that would inject sulfuric acid into both main lines to reduce the pH. An inline pH meter was also installed that would constantly monitor the pH and have the ability to shut down the entire water system if the pH varied out of the set limits.

The fertilizing would be done by injecting liquid fertilizer into one of the main lines with a Volmatic Electronic Fertilizer Injector. The reasons we picked an electronic fertilizer injector over other systems were that it was capable of handling a wide range of flow rates, more versatile, easier to alter the stock solutions and, believe it or not, less expensive than other systems.

A soil mixing facility that could be operated efficiently was also to be part of this new construction. The four components of our soil mixes: peat moss, mushroom compost, perlite, and sand, were to be stored close to the mixing pad. Several bins capable of holding different mixes were also built adjacent to the mixing pad. Other things that were included in the building facility were a walk-in cooler, and under-roof storage for production materials and equipment.

Completion of this new propagation facility was on schedule and propagation of *Polygonum* started in May, 1985. With this new facility a new production system had to be developed that would accomplish the goals set forth before.

The flat-filling procedure was now to be a mechanized process instead of by hand. We hoped to increase the rate of flat filling, but also this was the first step toward mechanization. The machine would need a three-man crew to operate it, and a skid steer loader to load the soil into the hopper. As the flats come off the conveyor belt, they are stacked directly on a 5 × 10 ft self-tracking trailer. Once there are three trailers completed they would be hauled out by tractor to the site where the cuttings are to be stuck. The three-man crew would put the inserts in the flats and fill the flats with soil at a rate of 350 per hour, which is slightly faster than before.

The making of cuttings was basically the same system as before. We are still field-making all of the cuttings but the cutting rate increased because we are now taking more of our cuttings from production plants, and less from the cooperators. This is because we have a larger inventory of groundcover in production. The cutting rate on production plants averaged 20,000 to 30,000 cuttings per person per day while, at the cooperators it averaged only 5,000 to 10,000 per person per day.

The dipping of cuttings in the fungicide solution and hormone

treatment was about the same process as before, except that the new facilities are better able to handle the larger number of cuttings we are now dealing with.

All cuttings are to be stuck on site, now that it is possible to haul the flats to the sites by tractor and trailer. The flats are lightly watered to settle the soil and loaded onto hand carts. They are pulled into the houses and the cuttings are stuck in the flats right off the carts. Then the flats are set on the ground, and the operators work their way down the house setting the flats behind them. One house holds approximately 16,000 3 in. units, or 32,000 cuttings, and two persons can complete 1½ houses in one day.

Misting of the cuttings was basically the same procedure as before. Each house is controlled by a station on a time clock.

As mentioned before, growing-on of the groundcovers under the old system, was not always done by the book. But under the new system, proper attention could be given to this part of the production. As the crop is rooting the mist is gradually decreased until it is shut off altogether. The shade cloth or plastic is removed from the *Euonymus* and *Polygonum* while the *Pachysandra* remains under the shade at all times. Fertilization is begun when the first white roots consistantly appear on all of the cuttings checked. The first shot of fertilizer is given at the low rate of 150 ppm N. The second application of fertilizer comes about a week later and this would be at the higher rate of 300 ppm N. Pruning is not done until the second year when cuttings are taken to make the following year's crop. Weed control is generally not a problem, but we have done some tests with Devrinol and oxadiazon with good results. The use of insecticides is usually geared around the control of *Euonymus* scale on the *Euonymus* and oyster shell scale on the *Pachysandra*. We have found that preventative sprays of insecticide, especially during peak scale season, is the best way of controlling the pests.

This is really the last step in producing groundcovers. After two years of using this new system (1985 and 1986), we have looked back and evaluated whether we have achieved the goals we set out to. In 1984, the old system struggled and borrowed space to produce crops of 1,500,000 groundcover units. In 1986, the yearly production was 2,500,000 units, which is a 66% increase.

Another goal, which was achieved was to consolidate production of these three crops into one area. This opened up significant space in the container division for increases in the 2- and 5-gal production.

The third goal was to increase the efficiency of production and quality of these three crops. The flat filling rate under the old system was about 100 per person per hour; under the new system it was increased by 16%. There was an increase in the cutting rate because a higher percentage of the cuttings came from production plants which are faster to cut than from the cooperators or stockbeds.

Also, by having all the material in one area, the workers did not have to travel all over the nursery to get the cuttings. There was an increase in the sticking rate. Under the old system of sticking cuttings at a central point, on person could barely do 15,000 cuttings per day. With the new system of on-site sticking, one could consistantly stick 20,000 to 25,000 cuttings per day. We feel that the better growing procedures of slowly hardening off the cuttings, and giving them priority attention during the growing process will produce a higher quality plant.

In general, we feel we have achieved all the goals we set out to do when designing this new system but there is one more measurement that is needed. The cost accounting figures need to be compared between a crop produced on the old system with one on the new system; this will be the true test as to the success of the new system.

UPDATE OF GRO-PLUG® SYSTEM

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Abstract. Most evergreen and deciduous plant material, whether seedling or cutting propagated, is being successfully integrated into our GRO-PLUG system. It has become a basic "Hub" and feeds directly into our second "Hub"—the SIX-PAC.

We reported on the practical application of GRO-PLUG systems for conifer ornamentals at the 1980 IPPS meeting (1). At the 1982 meeting, we reported on direct sticking of deciduous cuttings into the GRO-PLUG system (2). We have been asked to update our experience with GRO-PLUGS. Following are the major changes, expansions, and system philosophy that have taken place since the original two reports.

CHANGES

Conifer seedlings. We now find that all conifer seedlings we work with can be grown successfully as GRO-PLUGS. Fine tuning the system has made this possible. The system has become more and more complex—but more predictable. Complete scheduling is imperative.

Direct seeding. We have shifted from no direct seeding to almost 100% direct seeding. This required the development of our