January 17, 1949

Meeting of Forest Tree Nurserymen
Anderson Hall - University of Washington
Seattle, Washington
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Registration from 9 to 9:30 A.M.

Meeting was opened by Chairman L. T. Webster, who gave a few words of welcome. Stuart Moir, Forest Counsel for the Western Forestry and Conservation Association, was introduced. George Schroeder of the Crown Zellerbach Corporation, Chairman of the Nursery and Planting Committee, gave a talk on the history of the Western Forestry and Conservation Association. He stated that Thornton Munger had suggested that there was a need for coordination of this subject and the late Warren Tilton, Forester for the West Coast Lumbermen's Association, pushed the idea. Mr. Tilton was the first chairman of the Nursery and Planting Committee. Munger is still an advisor. L. T. Webster is chairman of the Nursery Practice Committee and has worked out the details of this down-to-earth meeting, where nurserymen can get together and discuss the problems of the group and gain knowledge they would not otherwise obtain.

Chairman Webster: Our first topic on the program is Nursery Equipment. The subject will be presented by Mr. Karl Lanquist of the U.S. Forest Service, R-5.

NURSERY EQUIPMENT
by
Karl B. Lanquist

My subject covers a considerable range of possibility, inasmuch as quite a number of factors are involved, namely: economic, silvicultural, topographic, climatic, and many others. You may note that I mention economic factors first and silvicultural factors second, and you may wonder why. The answer is that while silviculture is the goal in forestry practice, it can only be attained through the proper application of economic principles, since silviculture that does not pay cannot be practiced.

First I would like to tell you about a typical occurrence at a small Nursery in the Lake States about 15 years ago. Two nurserymen were trying to sow some pine seed with a home-made seeding machine. The machine sowed the seed too deep, and sometimes not deep enough. The covering device did not work very good, and something was wrong with the drive gears. Brains were performing at top speed and screws, bolts and haywire were used to repair and improve the machine, so the seeding job could be completed. Sanding machines, weeding machines and many other machines were invented and constructed. Some of the inventions were good and have been improved on, and the others are probably in the same class as Rube Goldberg's inventions.

I am sure that all nurserymen have had the same experience, probably not with a seeding machine, but with some kind of nursery job that required a special machine or device for doing a certain operation. Most equipment used in nurseries has been developed by nurserymen, and some of it improved on by commercial, mechanical engineers.

The Emergency Rubber Project at Salinas, California, was a proving ground for all kinds of nursery equipment and nursery techniques. Nurserymen and nursery

equipment from the South, West and Middle West were well represented and congregated in one place. We had all kinds of excellent opportunities to try different types of equipment. The urgency of the job was such that it soon became apparent that in order to rush production of seedlings, all jobs had to be streamlined and handwork eliminated as much as possible.

This experience proved to be of much help to the nurserymen when they came back to their own nurseries and found that labor wages had risen over 100% and that help was very scarce. The only solution to our problem was, of course, to mechanize and streamline as many nursery operations as was possible, and we did just that. The initial investment for machinery is somewhat expensive, but will pay for itself in one or two seasons, and the quality of the job is greatly improved by the use of modern equipment, in as much as the job performed is more uniform, which is very important in nursery work. Local conditions, soils, climate, etc. may require modifications of the following recommended equipment:

For Preliminary Ground Preparation:

The object of preliminary ground preparation is to loosen the soil for aeration, to break up soil packed from irrigation, and to dispose of debris left over from the initial preparation, and to plow under cover crops, etc.

On heavy soils the following equipment is recommended:
One D-2 caterpillar tractor, or equal with wide treads.
One 3-bottom offset plow.
One combination of disc and peg-tooth harrow.

On sandy soils:
Preparation on sandy soils is about the same as for heavy soils, except that instead of plowing, the ground may be disced with a heavy duty, offset, double disc with 20" blades. In case of a cover crop, the ground should be tilled with a tiller.

There are two good soil tillers on the market. The 4-ft. Rototiller and the 3-ft. Arien Tiller. The Rototiller requires a D-2 tractor for power, and the Arien tiller has its own power. I prefer the Arien tiller, because it is easier to handle, does not require a tractor for power, and is more economical to operate. The manufacturers make different tines for the tillers. For example, one can buy knife tines for cutting and tilling cover crops and round tines for pulverizing the soil.

The Rototiller will cover about 3 acres in one 8-hour day. The Arien tiller will cover about 1-3/4 acres in one day.

A tree bottom plow will cover about 7 acres a day, and a double disc will cover about 14 acres in one day.

Secondary Ground Preparation
On heavy soils

The object of secondary preparation is to level the soil and put it in proper condition for sowing.

A disc, ringroller and Portuguese harrow, pulled in tandum, will pulverize the soil and break up the clods. This operation might be followed by chiseling to a depth of about 10-12 inches, depending on the soil. The standards on the chisel should be set about 6-8 inches apart to prevent ridges. After chiseling, the area should be floated and leveled with an Eversman leveler and tilled to a depth of about 6-7 inches.

On sandy soils

The chisel and Portuguese harrow may not be necessary on sandy soils; otherwise, the procedure will be the same as for heavy soils.

The equipment should be operated in tandum, or sets, in order to avoid packing of the soil and excessive costs.

Discing should be done with an 8-ft. disc and a 10-ft. ring roller.

Floating and leveling is accomplished best by using a 12-ft. Eversman leveler.

Two sets of equipment, pulled by a D-2 tractor, or equal, will cover about 6 acres in one day.

A 4-ft. Rototiller, powered by a 35-40 H.P. tractor will cover 3 acres in one day. A 3-ft. Arien tiller and one man will cover about 1-3/4 acres in one day.

Final Ground Preparation

This phase of operations consists of putting the soil in as good condition as possible for seeding or transplanting.

It should not be necessary to use much equipment on this operation. On heavy soils, however, it might be advisable to run over the beds with a 4-ft. spike harrow, in order to break up the crust.

On sandy soils all one needs to do would be to lay out the beds and use a combination bed shaper and float. Our seedbeds are 4 ft. x 400 ft. The beds are lined out with a #22 International crawler type tractor. The tractor is so constructed that it will straddle a 4-ft. seedbed, or transplant bed. The threads on the tractor are 10 in. wide. Each bed is treated as a unit, and the combination bed float, leveler and bed shaper, attached to the tractor, form and shape the bed, and completes the bed for sowing. The tracks formed by the tractor, operating this combination, are identical to those of the seeder and thus gives the seeder a firm and uniform bed to operate on. This combination is also equipped with $2\frac{1}{2}$-in. wide and $\frac{1}{2}$-in. deep metal strips, spaced $3\frac{1}{2}$ inches apart. These strips make the initial groove in the seedbeds for receiving the seeds, and also serve as a guide for the seeding machine.

Sowing in Drills

Sowing of seed is a very important job, and must be accomplished with utmost care in order to obtain a uniform stand of seedlings and at a desired density, and last but not least, at a reasonable cost.

In order to do this, it is almost essential to use a seeding machine that is so constructed that it is adjustable to sow any size seed and at any desired density. The seeding machine must also be equipped with devices for making a suitable seed-furrow, cover the seed to a desired depth, and finally roll the seedbed,-all in one operation.

We have tried many models of seeding machines and also constructed a few. They all worked after a fashion, but we were never quite satisfied with them. We built one last winter, a year ago, that we used for sowing over one hundred

400-ft. seedbeds at the Mt. Shasta Nursery in California. This machine works very well and comes closer to desired performance than any of them.

The hopper holds enough seed of any specie to sow at least one 400-ft. seedbed. The machine is mounted on rubber-tired wheels, 18" in diameter, and all bearings are ball bearings. Each wheel pulls independent of the other, and the machine will automatically go out of gear if pulled or pushed backwards. The bottom of the hopper is built like a rectangular box with 8 openings. These openings can be adjusted to any size by a sliding panel in the bottom of the hopper. The openings are the beginnings of the seedpockets. In the seedpockets are fluted cast iron rollers, all connected to the drive shaft. The rollers are 2½" long and turn against rubber bumpers in the seedpockets. This arrangement will permit any size of seed to go through the seedpockets and without grinding or crushing the seed. The speed of the rollers determines the amount of seed sown. This again is controlled by the different size gears on the drive shaft. The machine has two rollers, one in front and one in back of the hopper. The front roller is machined in such a way that when it rolls the ground it makes eight 2½" wide depressions in the seedbed. This depression or furrow will receive the seed. The reason for the wide furrows is to scatter the seed over a larger area. Immediately behind the hopper, and in line with the furrows are 8 triangular metal flippers, with ½" metal strips on the bottom, also set at angles. These flippers work independently from each other and serve as covering devices. The back roller rolls and packs the soil. The seeding machine can be operated behind a tractor, but it is much safer to have two men pull the machine, as one has better control of the operation. Two men can sow twenty-four 400-ft. beds in one day.

Cultivation and Weeding

A very handy tool for hand cultivation and weeding is the "stirrup weeder." This tool cuts off the weeds between the rows and at the same time loosens the soil. Cultivation and weeding can be done very close to the seedlings with this type of hand tool. It is handy for small spot weedings.

Mechanical Weeders

There are two models of weeding machines that have been used with some success in forest nurseries - the Salinas weeder and the Ashe cultivator. The Salinas weeder, mounted on a Model "A" Farmall tractor, is so constructed that the cultivator operator may shift or guide the toolbar from 4 to 8 inches to either side of the center position. This cultivator covers a 4-ft. bed.

The "Ashe" type cultivator has also been used successfully. One advantage of this cultivator is that it is a small pull type rather than being mounted on the tractor. When not cultivating, the tractor is available for other use. The tool bar on this cultivator is stationary, but it is guided by the operator by means of foot pedals. Various types of cultivator tools can be attached to this machine. In machine cultivating, one tractor operator and one cultivator operator can cultivate and weed about 175 400-ft. beds in one day. Chemical weed control will probably eliminate these machines.

Maintenance of Soil Fertility

When fertilizer is applied before sowing, it should be distributed with either a fertilizer spreader or a graindrill with fertilizer attachment. The ground should be tilled or disced to a depth of about 6-7 in. This might vary some depending on several factors. The only disadvantage of this type of machine is that it is much slower than others designed to apply liquid fertilizer.

When liquid fertilizers are applied, the operation can be speeded by mounting a large tank (500-1000 gals.) on the frame of a 1½-ton truck, from which the outside dual wheels have been removed. An agitator must be installed in the lower end of the tank and powered by a small gasoline engine. The solution is piped through a 3" pipe at the rear to three different lengths of 2" pipe, which are fitted with ¼" nipples and short lengths of rubber hose which drag on or just above the ground between each row. The center section of the 2" pipe covers one bed, and the other two lengths, which are hinged to either end of the center, are long enough to reach two more beds on either side. This machine will cover a strip 5 beds wide and will average not less than one bed per minute, including reloading time.

Another device similar to this may be constructed by mounting a 50 or 100 gallon tank or barrel on a two-wheel cart or on a small Farmall. A 2" pipe hung below is the outlet for the liquid.

A 500-gallon tank on a small tractor or truck will cover 450 beds per day.

A 100-gallon tank on a tractor, truck or two-wheel cart will cover 210 beds per day.

Fertilizer drill with tractor will cover about 225 beds per day.

Stock Distribution

Equipment for this operation will probably be discussed by Mr. McDermitt.

Transplanting

One of the most expensive and time-consuming operations in a nursery is transplanting of seedlings. Numerous machines and devices have been built by nurserymen in order to simplify and reduce the cost of this operation. Many of these attempts were steps in the right direction, and by combining several ideas we now have a workable transplant machine.

This transplant machine is an adaptation of the Holland Celery Planter. The machine is powered by a 2 H.P. motor, and is geared down considerably in order to correlate the speed of the machine with that of the planters. The machine is self-steering by means of a cast iron shoe that follows a "V" shaped trench, made by hand. This trench is made in the middle of two beds. The steering shoe is attached to a flanged wheel, mounted in front of the machine. Two heavy duty, 8.25x20 tires support the machine on the sides. The machine is built like a triangle. In back of the machine is a draw bar, fitted with 14 slotted, vertical steel spacers. The planters operate the machine from little wagons attached to the draw bar and the spacers.

These wagons are fitted with a plow and a 24" steel disc. Rubber clips, spaced 2" apart, are mounted on this disc. Two steel wheels are set on angles on each side of the disc. A seat for the planters completes the wagon. Operation of this machine is very simple.

A series of V-belts and drive chains provides the transplant machine with a creeping forward motion and sufficient power to cut the furrow. A coulter is mounted immediately ahead of the furrowing device. This coulter will cut any small obstructions, such as weeds and roots and small sticks. As the machine advances, the coulter cuts the soil, and the shoe or plow opens a narrow trench. The plant-holding discs are powered by sprockets and chains from the packing wheels. As the

discs revolve, the seedlings are uniformly inserted with the tops inside and the roots outside of the rubber clips. When a seedling reaches an upright position, it is released as the rubber clip moves past the guide and springs open. The trench is closed and the packing wheels firm the soil on each side of the seedling.

A shallow V-trench is made between two 4-ft. beds, and the steering shoe is started in the trench. The two transplant wagons are attached in the proper slots and the operators take their place on the wagons. A supply of seedlings, enough to last for two trips, is placed in front of the operators and the machine is started across the field. Two beds are planted simultaneously, with one row in each bed each trip across the field. We plant seven rows to each bed. The plants are spaced 7 inches between the rows and 2 inches between the plants. The planting wagons are adjustable, and the last row planted is where the wheels made the tracks. One machine and two operators will plant between 30 to 35 M seedlings in one day. In order to do this, one must change operators for each 4-hour shift. The work is not very hard, but somewhat tedious, and production falls off considerably after 4 hours work.

The quality of machine planting compares favorably with hand planting, and is in many cases superior, in as much as survival of machine-planted seedlings is somewhat better than that of hand-planted. Costs of planting are reduced by about 60% and consequently the 12-man transplant crew can be reduced to about 5 men.

Seed Extraction

Cone drying by solar heat is a satisfactory means of opening cones, providing the weather is clear and the sun is shining. This method is, however, very cumbersome and time-consuming and, at its best, expensive. When several hundred sacks or bushels of cones are to be dried before winter sets in, drying of cones is a real problem. Seed recovery is low, in as much as it is difficult to dry the cones uniformly. The only solution to cone drying is drying in special kilns, using artificial heat, circulated by forced draft around the cones.

The Forest Products Laboratory in Madison, Wisconsin, has designed a very efficient cone kiln. Several of these kilns are in use in the Lake States. The kilns are somewhat expensive to install, and material for the kilns is also rather expensive.

These cone kilns are compartment kilns arranged for batch operation using the tray system of cone handling. They are of the forced-circulation type, adaptable to drying of any size of seed cones at any drying conditions that may be required. In designing the kiln, control of both temperature and relative humidity is provided and, through the use of internal fans, large volumes of air are circulated horizontally across the trays of cones. The kilns have short transverse-shaft fans mounted overhead. Steam is used for heating and humidification. The kiln walls and ceiling, in the form of panels, are attached to a steel frame. This frame also supports the overhead fan equipment and heating coils. Two 24" disc fans are used, operating at 550 r.p.m. and driven through "V" belts by two 1/3 H.P. reversible electric motors. The heating coils are so located as to give efficient heat transfer. They are capable of being used singly or in multiple units, so that the radiation can be varied to suit the heating demands and thus provide better temperature control.

The temperature and relative humidity of the kiln are controlled with an electric recorder-controller. The same instrument automatically controls the amount of air vented when dehumidification is required. This system conserves

heat in that only as much air is vented as is necessary to remove the moisture from the cones. The plants use extracted cones for fuel, however, and as 25% of the cones obtained provide the required fuel, conservation of heat is not so much of a factor when fuel is purchased. Humidification is provided to condition case-hardened cones, as well as to control the moisture content of the dried seed.

The wall and ceiling panels are made of "expanded transite," an asbestos-cement material made by the Johns-Manville Company. It is a moisture proof, fire-proof material and has a fair degree of insulation. It provides hard interior and exterior surfaces and should withstand the changing temperatures and relative humidities of the cone kilns without deterioration.

The cone kilns are located on the second floor of the extractory, the skid loads of cones being trucked on trams from the cone storage sheds. The cone-shaking equipment is also on the second floor, the steam boiler and seed cleaning rooms being in the basement or ground floor.

The seed cones are handled in and out of the kilns with lift trucks, the cone trays being nested one on top of the other and piled on a skid. In order to take care of variation in size of cones, the trays have been equipped with spacing lugs which also provide the nesting features, giving rigidity to the pile of trays. The trays can be spaced 2, 3 and 4 inches apart to suit the size of cones. Each tray holds about ½-bushel of ponderosa pine cones, and each skid holds 16 bushels of cones.

Dry-Kiln at a Moderate Cost

A packing shed or building, properly designed for combination storage and packing and kiln, will serve very well. The building should have at least the following dimensions: 25'x45' with an 8' concrete basement, main floor, and a storage loft. A large brick flue should be constructed from the basement through the ridge. The loft provides storage space for a great quantity of cones.

A 6½'x7½'x8' wooden kiln can be constructed in one end of the loft. The kiln can be built of 1"x6" sheeting and lined with 28-ga. sheet steel throughout, with 2"x2" strips between the sheeting and the steel to form a dead air space. An 18" hot air furnace can be installed in the basement and the heat conducted to the kiln by a 15" sheet iron pipe made in sections so as to be readily removable. This arrangement clears the main floor space for location of extraction machinery.

Cones are placed in 3'x6' trays made of 1"x4" lumber with the bottom covered with ¼" hardware cloth. About 1½ bushels of Ponderosa pine cones are put in each tray. The trays slide into the kiln on 2"x2" cleats fastened to the side walls. The kiln holds two tiers of 9 trays with a space of 18" from the floor to the bottom of the first tray, 3½" between trays, and 10" between the top tray and ceiling of the kiln. A space of about 6" is provided at the front and back of the kiln and between the two tiers of trays. A "V"-shaped hood is placed over the heat register to force the circulation towards the outer edges of the kiln. A system of vents in the top of the kiln also aids in controlling the circulation.

The temperature is regulated entirely by furnace controls and kiln vents. The temperature varies about 2-3 degrees.

The output is small, but it is surprising how many cones can be dried a day in this type of kiln.

Other equipment used for seed extraction, such as cone shakers, dewinging machines and fanning mills, are standard equipment. I would like to mention that the common hammer mill is a very handy piece of equipment in a nursery and it can be used for seed extraction very successfully.

Very recent investigations reveal that drying of cones can be accomplished in a matter of minutes by using infra-red rays as heat units, and if this method is practical on a large scale, it will revolutionize our methods of seed extraction and seed treatments.

Chairman Webster: Do you root prune your stock?

Lanquist: We have not done any root pruning.

Question: Do you transplant everything? Answer: Yes.

Question: How many nurseries do you have? Answer: One and one-half.

Question: What Capacity? Answer: 5 million seedlings. Forty acres.

Engstrom: I have a problem with rock and stones and I am interested in root pruning. I am not going to be able to use a pruner.

McDaniel: We have a blade 5 or 5½ inches wide. Run deep enough so that the rocks and stones will not be thrown out of the ground.

Augenstein: We have done considerable root pruning. We use a graderblade built on an "A" frame. Blade is 6 inches wide with a tapering edge. We have no trouble keeping it down. We run it deep and the rock will go down instead of coming up. One big fault of lifting is getting the blade down.

Lanquist: Is the lifting done in front of the machine?

Augenstein: Yes.

McDermitt: Do you use all hydraulic controls?

Augenstein: Yes, International T-6 Cat, also Jeepsters are used and Allis-Chalmers, small farm tractor, a 20.

Question: Have you ever used a pruner under the ground?

Engstrom: We used one in Minnesota and did not find it satisfactory.

Augenstein: In too much rototilling in the nursery, other than in sandy soil, do you not get too much caking of soil?

Lanquist: The soil in California is very heavy. A rototiller worked very well there. At Mt. Shasta Nursery the soil is more sandy. If you do rototill your soil, you have to let the soil lay a few days to settle down before seeding.

Schroeder: I read an article in the Soil Science that unless you used it with care you will ruin your beds. A tiller should be used only once a year.

Chairman Webster: If you do till the soil, it doesn't pack. It has a tendency to break it up.

McDaniel: Plow the cover crop first, till the ground, and then let it lay.

Chairman Webster: How much do you till and how deep? Some advocates think we are overdoing it.

Engstrom: I think we are doing too much to our soil. I would not use a rototiller which will bring up the soil a good 8 inches and it is too loose and should be packed down. I prefer to use our offset disc.

McDaniel: We would not be interested in rototilling in our type of soil. It hardens the soil. The plow for regular farm work is preferred.

Engstrom: I think the use of the tiller helps in grub worm control.

Augenstein: In our nursery we have heavy soil. We tried at first on slow speed, but could see no difference. It still beats the soil.

Lanquist: Don't you think that by using the tiller deep you also thoroughly mix the cover crop, and fertilizers that are used. If we plow 7 to 8 inches deep, most of the fertilizer lays at that level and is not always available to the plants. It seems to me to be a good implement, if its use is not overdone.

Chairman Webster: I have not heard any discussion on wheel tractors vs. crawler tractors.

Augenstein: I think we need both. We need bed pruning equipment which works best on wheel tractors rather than the crawler. Also the lifting is better done with wheel tractor.

Chairman Webster: Can we get along with one machine? What is the capacity of your nursery?

Augenstein: 12 million. The big fault is getting the work done on time. The first thing is to get enough equipment so we can do the work when it should be done. If the work is done by hand, the season is over before the required work is completed. One tractor is not sufficient.

McDermitt: I think a track layer and smaller wheel machine are necessary. The larger the nursery, the more machinery is needed.

Dill: If you have transplants of 20 to 30 acres, where would you make the division?

McDermitt: A lot depends on soil conditions. If you have one Cat in the nursery, I would be for keeping one tractor in the nursery if it could be made to do all the work.

Hagenstein: We are speaking in general terms. Topographic conditions also enter in. We have one tractor and can do all the work with it.

Rindt: In all types of soil we could not operate with one tractor.

Augenstein: Soil conditions and climate enter in. In Savenac we have snow. With the seasons so short, seeding and lifting are done at once. We need both types of tractors.

Chairman Webster: What about the use of shade frames?

Dill: I thought they were out long ago.

Lanquist: What about birds?

Augenstein: We have shaded Savenac and we have birds too. Years ago we built a frame for shading which passed out of the picture 8 or 10 years ago. We now have a saw horse on either end of the bed and snow fence over this. They did sag when they had to be moved back and forth. Roll of fence over seed beds can be removed for weeding and inventory. We shaded smaller trees and used a gun on the birds. We recommend feeding the birds something else. Put canary seed on the footpaths between the seed beds. The birds do not bother the seed, but they pick the seedlings off as soon as they germinate.

Chairman Webster: We have the same problem of birds pulling out the seedlings.

Lanquist: We are troubled with quail. When we were sowing some seed in the fall, I saw as many as 450 quail in seed beds. It was in hunting season, too.

Augenstein: Carbide popping machine is not satisfactory to keep birds away.

Lanquist: A shotgun is plenty good.

Rindt: I have known nursery men a long time. Many types of machines were mentioned. I think that as nurserymen we all agree that there are many good types of machines. I wonder if there could be a clearing house for different types of machines developed. Could we get pictures of different machines?

Chairman Webster: We are building up a collection of pictures. I believe the U.S. Forest Service has some. Also Oregon State. I will be glad to receive pictures of nursery equipment from all of you, preferably two prints of each subject.

Adams: Are there any other types of seed extractors used other than mentioned by Lanquist?

Chairman Webster: We built one in Olympia. We have a kiln in which we put a big charge of cones. It is not too efficient, but it handles a large volume satisfactorily.

Cronemiller: We use a heat kiln in Oregon.

Chairman Webster: What is the highest temperature you allow?

Lanquist: Depends on the type.

Augenstein: We use 123° F. as an average and consider 133° F. a safe margin. We have a kiln with a small closet room 7' in diameter with steam heat, and with a turn table in the middle. 1½ to 2-inch trays are pushed in on a cart. Each cone is turned as it becomes dry. Eight hours are required for opening. For mass production, this would not be enough capacity.

Lanquist: Suggested using infra-red lamps for cone drying.

Chairman Webster: Our next topic, which is vital to the operation of all nurseries, is "Weed Control." It will be presented by James W. Augenstein, Nurseryman from Savenac Nursery, Region 1.