COUNTING TREES BY WEIGHT

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Grading tables as described and illustrated by Tourney and Korstian[2] are one of the postwar mechanical innovations used in the tree nurseries of New York State's Conservation Department. Such tables with moving belts permit indoor grading, culling, and counting during the shipping season, when the weather can be most uncomfortable. With additional equipment and personnel at the ends of these tables, trees can be tied and packaged for shipping.

The first tables used were similar to those described and illustrated by Robbins.[3] To facilitate tree counting the table belt was divided into sections numbered from 1 to 5 inclusive. Each of the ten counters, five on a side, was assigned a number; when a counter's number appeared in front of him he placed trees upon it. At first two trees were placed on each number; later five. Belt speed was adjusted so that each counter could consistently place the proper number of trees on his assigned number. The two collectors who picked up the trees at the end of the belts could then gather the correct count of 50 to 100 trees as desired for a single bundle. These bundles were placed untied on another moving belt which carried them to electric tiers. The tied bundles were further conveyed to the packing area where, at first, they were packed into wooden crates for storage or shipping.

At later dates, modifications eliminated by successive steps the numbers on the belts, the electric tiers, and the wooden crates. The counting was then being accomplished by the placement of an exact count on the belt, and the trees were gathered and rolled in paper bundles of 500 or 1,000. The bundles were then conveyed to the packing area for storage and shipping.

Later refinements at Saratoga eliminated the actual counts and substituted a system of "counting by weight" and bundling the seedlings in paper rolls of 500 each. The individual bunches of bed-run stock were first string-tied in the field into convenient sizes and were left tied during the weighing and bundling process, except to break some bunches to gain the exact weight. Thus these field-tied bunches did not contain any fixed number, but the whole wrapped and tied bundle contained, by weight, 500 trees. Since the minimum order accepted is 1,000 trees, such an order would contain two bundles of "500" each.

The basic count-by-weight crew consists of only two persons. The first takes a continuous sampling of the trees and weighs them. In this way the weight is calculated for the number of trees desired. This weight is then used by the second person to weigh up the seedlings to be bundled. Thus the trees are "counted by weight" by the simple conversion of count to weight.

The equipment and methods used to accomplish the above basic principle have varied. In the conversion an accumulated average was always used regardless of the exact method, since the weight of a single bunch of 50 or 100 trees varied, and the calculations could not be used for conversion immediately. Rather the average of several

counts and weighings, usually ten, were used. At first this was done by counting out the required total number to start with, and then as each new bunch was counted its weight was added and at the same time the weight of the oldest bunch on the record was subtracted.

This paper calculation took considerable time, so a unique method was devised to accomplish this mechanically. This consisted in the use of two scales with platforms and dials. On one scale platform eleven cans were fastened on their sides. The cans were opened at one end. In each of 10 cans 50 trees were placed. The weight of 500 trees showed on the dial. The weigher on the second scale would only have to match the same weight in trees as on the dial of the first scale. Each new count of 50 trees was placed in the empty can on the first scale, and the oldest 50 trees were removed. This method provided the desirable moving average, at the same time reflecting the variation in the stock coming in from the nursery.

The basic crew of two weighers is supported by seven additional workers. The first supplies trees from the storage shed. The second checks the count by taking whole bundles at random and making an accurate count. With a double weighing table, four persons pack trees in paper bundles, and the seventh person ties the bundles. Production by using the double weighing table reached as high as 577,000 trees per 8-hour day, or about 64,000 trees per day per person, in the spring of 1960 at the Saratoga State Tree Nursery. Some crews work better than others, and the different tree species made for variations. The average production for 7 working days was 404,000 trees per crew, or 45,000 per person per day. This production compares with only 10,000 per person using the original counting tables, where procedure included separation of trees and removal of culls as well as counting.

The degree of success of this weighing method over any other depends on several factors:

(1) Rapid pickup of trees in the field, including efficient pulling crews and good tree lifters.

(2) Tied bunches in the field being relatively small.

(3) More or less uniform size of the stock.

(4) Ability to tolerate some variation in tree bundle count. The trees counted by the checker can be used for filling exact count orders.

Table 1 shows the variation in number of trees counted in 1,500 check bundles taken in 1959 from a total of 17,756,000 trees bundled by weight for 6 species. Significantly, 49 percent of the counts fall within the range of 450-549 trees, and 76 percent of the counts fall within the range of 400-599 trees. The chances for inaccuracy are greatest with one bundle, but with an increase in number of bundles, the accuracy will likewise increase. Orders made up of 10 or more weighed bundles would probably be as accurate as those prepared by hand counting. Our experience in 1959 with the weight method of counting revealed an overrun of 4.7 percent. This is not unlike our experience with hand counting, which has showed by test to have a 5 percent overrun. We can conclude, therefore, that there is a tendency for a small overrun.

To evaluate the weight method of tree counting one should compare it with other related methods. One common method is to field count the trees into definite numbers per bunch and tie with string; the bunches are then rolled into bundles indoors. A second common method is to place them untied in metal tubs, and carry them indoors where they are hand culled and placed on a conveyor belt in exact numbers to be carried forward where they are further combined for a bundle count before packing.

TABLE 1.--Distribution of counted sample bundles, by number of trees and species, taken by weight method[1]

Trees per bundle (number)	Scotch pine	Norway spruce	Red pine	White pine	White spruce	Austrian pine	Total	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Percent*
200-249......................	1	--	--	--	1	--	2	([2])
250-299......................	1	--	--	--	4	--	5	([2])
300-349......................	12	5	1	--	14	--	32	2
350-399......................	26	11	5	--	30	--	72	5
400-449......................	69	22	20	2	49	11	173	11
450-499......................	103	38	30	9	138	5	323	22
500-549......................	115	43	33	7	194	15	407	27
550-599......................	70	26	24	8	98	12	238	16
600-649......................	45	12	14	7	43	7	128	9
650-699......................	28	5	14	2	26	10	85	6
700-749......................	17	1	2	--	7	--	27	2
750-799......................	5	--	2	--	1	--	8	([2])
Total bundles.......	492	163	145	35	605	60	1,500	100
Trees per bundle: Average..............	521	510	540	543	522	549		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		
Overrun..............	4.2	2.0	8.0	8.6	4.4	9.8		

[1] The 1,500 sample bundles totaled 750,000 trees by the weight method and were used in counting 17,756,000 trees in 1959. The sample was 4.2 percent of the whole.
[2] Less than 1 percent.

Further comments on the count-by-weight method are as follows:

1. The method can be employed when advance observation or inventory of the bed area indicates that the percentage of cull stock is not high enough to be objectionable. Then the trees can be pulled and tied into bunches in the field. The bunched stock is then moved to a weighing and packing operation, where it is weighed in quantities of 500 plants and packed ready for shipment.

2. If the field inventory shows that the cull percentage is high enough to be objectionable, the culling and counting operations should be moved indoors. Experience has shown that it is very difficult to train and supervise crews to satisfactorily perform the culling operation in the field. It is better to bring the stock inside and actually count it as it is run over the grading table.

3. The count-by-weight method can be used on stock that contains a high cull percentage if the presence of culls is not objectionable. The procedure is to weigh samples of stock containing cull trees, sort out the culls, and count and weigh the usable trees. Employing these counts and weights of stock, it is possible to determine the average number of usable trees per pound, bundle, or package of stock.