THE USE OF HISTORY PLOTS IN THE NURSERY

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Introduction

Each mechanical inventory involves up to 32 long plot counts per nine 400-foot beds. The development of statistical inference reduced the necessary number of counts to 0.1 percent for the spring inventory and 1.0 percent for the fall inventory. The plots are selected at random, with an average of 20 counts per nine 400-foot beds. Now, with the establishment of history plots and controlled mechanical planting, only one to three counts are necessary per nine 400-foot beds.

This system can easily be adapted to any 1-0 stock planted uniformly. The pine seed at the W. W. Ashe Nursery is planted with an agricultural grain seeder with a potential of 144 settings for the distribution of seed. The gears are not changed after they are determined for a seed lot; therefore, the lots are as uniform as possible.

The use of these plots has many advantages. One asset is overall uniformity in predic - tions (table 1).

Although the overall prediction is not*. changed much with history plots, the smaller lots give predictions with more reasonable limits.

The study of the history plots was carried on in a production of approximately 30 million seedlings grown on 500 to 600 400-foot beds. Nine beds, numbered one to nine, are located between each pair of waterlines.

Establishment of Plots

The plots are randomly located prior to planting and established immediately after planting. The number of plots can be predicted by referring to table 2.

The only limitations on sampling are that the required number of plots from table 1 be located between each pair of waterlines for that lot, that the random sampling from random number tables allow the plots to fall on beds one through nine, and that the post

TABLE 1.--Difference between inventory and actual shipments[1]

Species	12-inch frame	6-inch frame	History plots
	Percent	*Percent*	*Percent*
Loblolly.....	-5.78	-5.39	+4.8
Longleaf.....	+.21	+12.51	+1.1
Slash.....	-6.61	-4.08	+4.1
Shortleaf.....	-17.83	-13.93	--
Average.....	-5.7	-4.8	+4.7

[1] Taken from 1960, 1961, and 1962 seedling crops on an average of 30 million seedlings.

TABLE 2.--Number of history plots required for an inventory[1, 2]

Square feet, thousands	400-foot beds	Sampling	Plots required	Plots per nine beds
	Number	*Percent*	*Number*	*Number*
775	500+	0.02	39	1
400	258+	.03	30	1
240	155+	.04	24	2
90	58+	.05	11	2
80	52+	.06	12	2
65	42+	.07	11	3
55	35+	.08	11	3
40	26+	.09	9	3
30	19+	.10	7	3
20	13+	.20	10	7
20	13-	1.00	50	33
14	9-	2.00	70	70

[1] The table was devised on the data gathered by Belcher from the 1961 and 1962 crops.
[2] Less than 19 beds would not be as accurate nor as economical as random sampling counts.

location be between the second and next to last post on the waterline. Any plot falling in a ditch or point of seed machine adjustment should be moved one post in either direction. A suitable media must be used to mark the boundary at the time of installation so that the 30- to 40-day germination count may be made accurately.

To install the plots, the location is spotted as soon after planting as possible. A 1- by 4-foot frame is dropped at any spot on the bed where the frame will be at right angles to the bed. The slats for the corners are installed, the frame is removed, and a cord is used to tie the slats opposite one another (1). All borderline seeds are moved in or out so there will be no discrepancy during germination counts. The seeds are counted with a pointed instrument to insure that all seeds are counted. The number is listed, and then the plot will simultaneously receive the same mulching as the rest of the bed.

Optimum plots must be representative, i.e., a plot falling in a bed sowing area should not be relocated as it will represent that type of planting. It is not wise to put a plot where seeding adjustments were made as it would represent such a small type of sample and would be apt to distort estimates derived from the sample.

When the plots are being installed, the person who is checking the accuracy of the seed distribution from the machine with the amount desired should make not less than five counts (check counts) between each pair of waterlines. These counts, being of a larger representation, will be used to check the history plots to be sure that they are representative. An adjustment percentage will be used with any set of plots for a lot that has an average differing from the check count by ±2 seedlings per foot. To insure accuracy this adjustment factor will be maintained for all inventory counts.

Particular Use of Plots

Germination

At least five counts should be made in the first 40 days after installation of plots. Germination is usually complete in 20 to 40 days --a minimum of 20 days for longleaf and 30 days for shortleaf, slash, and loblolly. The counts should be made between the 10th and 30th day, with a final close examination at the end of germination.

During counts any dead seedlings will be counted and pulled up, and the cause of death will be noted. These dead seedlings should be added to all subsequent counts so that total germination may be known.

Inventory

The larger the amount to be sampled, the smaller is the percentage to be sampled. Therefore, since we are making an intensive check on a uniform lot we can use a much smaller sample than would normally be acceptable. Table 3 lists the necessary number of plots for the number of beds in that lot acceptable for inventory purposes. Although it would not' be practical to use less than the listed number for the 19+ beds, it would be wise to have one or two plots in a small lot for germination; although their use is limited, they can be used for spring inventory where culls are not recorded and where there is less precision. After germination counts are furnished, inventory counts should be made, in June (spring inventory), on August first or September first (summer inventory), and in October (fall inventory).

As the string for the boundary will be practically disintegrated, small-gage metal rods may be used to find the boundaries; the rods should be pushed across the bed from one slat to the other. Two rods will be required to count a plot.

Instruments for conducting various inventories are analyzed in table 2.

Dug Samples

The cull factor must be determined in the fall inventory. One plot per waterline will be dug and graded with a wedge cut according to the specifications of Wakeley (2). In grading, only borderline cases are upgraded. This will give a slight margin for error as more growth is possible.

These samples will be computed by species and not by seed lot as only general knowledge is needed and it would not be practical to tie the grading into the density on this small basis. All slats or stakes can best be collected during the fall inventory. The samples should be dug so that they may be used again and so that trash may be kept out of the field.

As well as germination and inventory checks, there is a benefit through the knowledge of the condition of the soil, insect attacks (when to spray), disease outbreaks, and seedling density. The greatest advantage is making a minimum of eight counts where usually only two inventories a year are made.

Work Involved

	Number of men needed	Man-hours per plot
Planning and installation of plots.....	1	0.6
Germination counts.....	2	.4
Inventory counts.....	2	.2
Computing and analysis of data on all counts	1	.7
Dug samples (digging, grading, and recording)...	3	.4
Total.....	--	2.3

TABLE 3.--Analysis of various inventories

Type of inventory	Number of counts per year	Man-hours per plot	Number of plots per million seedlings	Man-hours per million trees
Twelve-inch frame	2	0.8	70	56.0
Six-inch frame...	2	.5	30	15.0
History plots....	8 or 9	2.3	5	11.5

Summary

After the initial random placement of the plots, the germination counts could be omitted or/and only two inventory counts made. The time and expense would be much laps than that needed when conventional methods are used.

Also, to keep these plots representative for all uses, they should only be fertilized, weeded, etc., when the rest of the seedlings are.

Explanation of Sample Charts

1. Two weeks prior to planting, randomly locate plots on chart 1 (using table 1).
2. One to 2 weeks prior to planting, prepare adequate stakes and boundary string.
3. At time of planting, one person should complete chart 1 as plots are installed. Another person should make check counts and adjust the planter.
4. Within 1 week after planting, chart 2 should be completed.
5. During the 10th to the 30th days after planting, germination checks will be taken on chart 4.
6. Immediately following the 40th day after planting, chart 3 should be completed. Also, use of chart 5 should begin (summer checks for survival).
7. Chart 6 could be used for spring inventory and fall inventory for lots meeting the requirements for inventory on table 1.
8. During the fall inventory would be a good time to remove the plot corners. The data on dug samples could be listed on chart 5.

Chart 1

Location				Species and lot No.	No. seed planted	Date planted	Soil and weather conditions
Comp.	Line	Bed	Post				

Chart 2

Species and lot No.	No. plots desired	No. plots obtained	Desired seed/ft.	Av. seed/ft. on plots	Av. seed/ft. on check	Adjust-ments

Chart 3

Species and lot No.	Lab. germ.	Field germ.	No. days	Diff. from lab. germ.	Remarks

Chart 4

Species and lot No.	Location				No. seed planted	Date planted	Germ. checks by days after planted				Remarks
	Comp.	Line	Bed	Post							

Chart 5

Species and lot No.	Location				Inventory checks				Grading				Diseased	Av. height
	Comp.	Line	Bed	Post	June	Aug.	Sept.	Oct.	Total	#1	#2	#3		

Chart 6

Species and lot No.	No. plots	Total plot count	Av./foot on plots	M seedlings per bed	No. beds	M seedlings total	Adjustments	Less cull

Literature Cited

(1) Landquist, Karl B.
1961. Venetian blind slats as nursery bed markers. Tree Planters' Notes 48:23.

(2) Wakeley, Philip C.
1954. Planting the southern pines. Agr. Monog. 18:103, illus.