

## NURSERY SEEDING AND SEEDLING HISTORY PLOTS

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I won't go into nursery seeding because, as we all know, there is a lot of machinery needed for planting many species yet. However, the essentials of good nursery planting are a well mixed seed lot, uniform mechanical planting, and reliable germination data. Hand planting is necessary with small lots and hardwood seed but more uniform density can be obtained with pine seed by using an agricultural grain planter. The Hazard seeder often used for longleaf pine seed has been used successfully for seed as large as baldcypress when they are dusted.

If you had some money invested in stocks, bonds, or what have you, you'd be quite interested in knowing how they were doing. Well, so it should be with your seedling crop. Your crop represents a substantial investment and the best way to keep up with it is with History Plots.

### What are History Plots?

They are randomly located permanent plots in the nursery beds. They are generally 1 x 4 foot in size. The History Plots should be chosen randomly prior to planting and listed on tentative data sheets. The number of plots is determined by tentative planting schedules to minimize biasing choice of plot locations.

### How do you prepare History Plots?

We can not go into the nursery after planting is over or at some other convenient time and set up plots to check with any accurate use of results. Also, we do not get representative data if we skip a spot in the bed and sow it later by hand. The only true representation of our operation is to sample from it. That is, to sample by the normal planting methods. If you sow by machinery, the History Plots should be installed directly behind the planter. Because accuracy depends on large samples and uniform representation, it is necessary to set our plots accordingly.

The plots are established by dropping a 1 x 4-foot frame at the previously chosen random spot. Flexible corners are placed in the soil (venetian blinds are good) and opposite pairs are tied with string. The seed are then counted with borderline seed being moved as either in or out to avoid confusion later. The count is then tallied by its location. This can be done by the same person who is keeping a check on the seed density. The seed density counts are also recorded and can be used to check the representation of the History Plots because the density counts are a larger percent sample.

### What is the possible use of History Plots?

One is germination. At least 5 counts should be made between the 10th and 40th day after planting for most of the southern species. During these counts, dead seedlings are pulled up and the probable reason for death noted. Those pulled up will be added to all future counts to obtain the total germination. We can gain germination percents as well as mortality figures attributable to various causes in the nursery.

A second item is survival factor. Throughout the summer and the fall 3 counts should be made, probably June, August, and October. This will give a survival factor, by species, which over a 5-year period would give an accurate representation of any one nursery. This is a figure which we all guess at and yet it only varies by two important factors: location and nursery practice. This means that each nursery could work out the survival factor for each species at their location. If the nursery practice was varied within a species, the value of a particular nursery practice could be assessed by the use of the survival factor.

Grading is a third. With History Plots we can grade in the field to arrive at a sample to be applied to shipping by weight. On a large nursery only one plot per nine 400-foot beds would be necessary. The seedlings could be graded with wooden wedges, thus eliminating the human factor of error and only borderline cases upgraded.

And fourth, the most advanced use of History plots is for inventorying. 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 be normally acceptable. Studies on a crop of approximately 30 million at the Ashe Nursery indicated that History Plots were reasonable and accurate on lots of 19 beds or more (table 1).

Therefore, if the seedling crop is large enough to have 30,000 square feet of bed space, a History Plot inventory can be made economically and with reasonable accuracy.

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 at least 5 counts (check counts) per 9 beds, and preferably more. 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 seeds per foot. To insure accuracy, this adjustment factor will be maintained for all inventory counts.

Inventory counts amount to the same 3 counts taken for the survival factor. As the string will be almost deteriorated by August, the last two counts can be made by use of two 4-foot metal rods. The rods are pushed across the bed from one corner slat to the other.

Table 1.--Number of plots required for an inventory

Square feet (thousands)	beds	Sampling	Plots required	Plots per 9 beds
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>
775	500+	0.02	39	1
400	258+	0.03	30	1
240	155+	0.04	24	2
90	58+	0.05	11	2
80	52+	0.06	12	2
65	42+	0.07	11	3
55	35+	0.08	11	3
40	26+	0.09	9	3
30	19+	0.10	7	3
20	13+	0.20	10	7
20	13-	1.00	50	33
14	9-	2.00	70	70

On the crop studied, 2.3 man-hours were required per plot. This includes everything from planning the plot to analyzing it. When compared with other methods, the History Plots were by far the most economical and were just as accurate (table 2).

Table 2.--Analysis of various inventories

Type of inventory	Counts per year	Man-hours per plot	Plots per million seedlings	Man-hours per million seedlings	Inventory to actual ship (+30 million crop)
	<u>Number</u>		<u>Number</u>		
Frame 12" x 4'	2	0.8	70	56.0	-5.7
Frame 6" x 4'	2	0.5	30	15.0	-4.8
History Plot	8	2.3	5	11.5	+4.7

What does all of this inventorying mean to you?

It means fewer counts--The average large nursery having 400-foot beds and using a mechanical or random plot sample, now make a minimum of 20 counts per 9 beds. With History Plots this can be reduced to from 1 to 3 plots.

It means less time and cost in inventorying--A comparison of methods at the Ashe Nursery on a crop of approximately 30 million was made. The usual method of inventorying a 0.1 percent sample in the spring and a 1.0 percent sample in the fall required 70 plots per million trees which took 56 man-hours per million trees, and what did they have? -- Two general estimates of the number of seedlings in the nursery. The History Plots on the same crop averaged 5 plots per million trees and required only 11.5 man-hours per million trees; yet, 8 counts were made.

It means a more intimate knowledge of your crop. You can obtain:

- actual field germination
- reasons for mortalities during germination
- check on moisture conditions during germination
- check on seedling development
- spring and fall inventory
- survival factor
- knowledge of the cull percent in the field
- weed counts
- knowledge of insect attacks
- knowledge of disease outbreaks
- knowledge of seedling density
- and other various items from your History Plots

Although all of these uses can not be applied to every nursery, I'm sure every nursery can benefit from the use of some of these.

Suggestions for possible data sheets

Chart 1.--Random location prior to planting and planting data

Location				Species and lot number	Number of seed planted	Date planted	Soil and weather conditions
Comp.	Line	Bed	Post				

Chart 2.--Check count comparison to make History Plots representative

Species and lot number	Number plots desired	Number plots obtained	Desired seed per foot	Average seed per foot on plots	Average seed per foot on check

Chart 3.--Germination checks

Species and lot number	Location				Number of seed planted	Date planted	Germination checks by days after planting				Remarks
	Comp.	Line	Bed	Post							

Chart 4.--Inventory and grading counts

Species and lot number	Location				Inventory checks			Grading				Dis-eased	Ave. height
	Comp.	Line	Bed	Post	June	Aug.	Oct.	#1	#2	#3	Total		

Chart 5.--Inventory estimate

Species and lot number	Number plots	Total plot count	Average per foot on plots	M seedlings per bed	Number beds	M seedlings total	Ad-just-ments	Less culls

Reference

Belcher, Earl W.

1964. The use of history plots in the nursery. Tree Planters' Notes 64:27. U.S. Dept. Agr., Forest Serv.

Lanquist, Karl B.

1961. Venetian blind slats as nursery bed markers. Tree Planters' Notes 48:23. U.S. Dept. Agr., Forest Serv.

DISCUSSION TO: Earl Belcher and Eugene Turner

- Q. What's the difference between Turner's regular and permanent plots?  
Is Turner's regular or permanent plots the same as Belcher's history plots?
- A. (Turner) We cut down on the regular plots by having the permanent plots in there. That's a statistician's deal in there for more accurate sampling and to reduce the number of counts we have to make. The regular plots are made at inventory time and are never the same each time.
- A. (Belcher) A statistician may argue with my idea of history plots because he would say you can't plant that uniformly. I'm taking such a small sample that I'm saying these seedlings are planted as uniformly as possible which is rather doubtful in most people's minds. However, I think the accuracy of our count as far as the inventory is concerned bears out the fact that using a mechanical planter and with accurate checking that once the dials are set on a mechanical planter and the seed are thoroughly mixed that it is going to put the same amount of seed out during the planting period. The only variation will be from one end of your bed to the other as the seed level drops in the planter. Now, this is a natural thing you have to take into account so that our planting with a mechanical planter with accurate checks is about as uniform as anyone could possibly obtain; and, under these circumstances, there is no need for taking these counts to check on it. We take ours at the beginning when we set up our history plots to give us the check and the plots are adjusted by this count so they are representative. Our history plots would be equal to Mr. Turner's permanent plots.
- Q. When do you take your fall inventory?
- A. (Turner) We take it in November (late) so it will be ready the first week in December.