MEETING NURSERY PRODUCTION OBJECTIVES

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INTRODUCTION

Optimum management of forest nurseries requires that the actual seedling production meet the sowing objective as closely as possible. Both over and under-running a seedling lot increases costs. To over-run means nursery bed space has been tied up unnecessarily and someone must still pay for the trees even if they cannot be used. If the seedling lot is under-run, the cost per tree is increased because each tree occupies more bed space than was anticipated. In addition, if the seedling crop could be accurately predicted, planning for people, time and supplies would be simplified.

Production accuracy is not only important to a nursery, but it can have a large effect on tree planting activities. Having the correct number of trees of the right seed source at the right time is of critical importance to a reforestation program. Reforestation planning takes place at least eighteen to twenty-four months prior to field planting when the number of seedlings needed must be determined. The nursery sowing is then made based on this prediction. If too few trees are produced, the forest area must be planted with other trees often of the wrong seed source or perhaps not planted at all; while if the nursery beds are over-run, the owner may have to pay for trees he cannot use.

The purpose of this paper is to describe a system of record-keeping which provides for recording all pertinent data associated with a particular seedling lot. This data can then be used to determine how well a nursery is meeting its production objectives and to pinpoint where changes should be made

so sowing objectives can be met even more closely. This system does not use data from a special study but utilizes the same information which is required for regular nursery operations. Some other possible causes of sowing variation are also discussed.

NURSERY SOWING CALCULATIONS

The objective of sowing is to plant enough viable seeds so that the desired number of seedlings result. If each seed could be guaranteed to produce a plantable seedling, nursery sowing would be very straightforward. However, it is not quite that simple. Because it is impractical to actually count out the seeds required, sowing is done on a weight basis. In each seed lot there is a certain average number of seeds per pound of pure seed. But in actuality a pound of tree seed is not all pure seed, as there is always some trash. If the seed purity is 97% for example, each pound of seed actually contains 97;', seeds. In addition, all the seeds in that pound are not going to germinate. Therefore, the number of viable seed in that pound is a reduction from the total number of seed. The factor that determines this reduction is the seed germination, usually determined by a laboratory test. On top of this, all the seedlings resulting from germination will not survive in the nursery due to insects, disease, vigor, chance, etc. Therefore, the estimated potential of that pound of seed is reduced even more. This last adjustment is known as the Field Survival Factor and is based on past experience in a particular nursery.

One other adjustment is also necessary. Not all the seedlings from this pound of seed which survive in the nursery bed are going to make suitable trees for field planting. Some will be culled out. The number of percent of the trees which are suitable for field planting is called the Pack (10Q% - Cull% = Pack %). Sometimes the Field Survival and the Pack are multiplied together and expressed as one figure, called Nursery Survival.

The outcome of those modifications to the original pound of seed is a figure which represents the total potential number of plantable seedlings which that pound of seed will produce. If this figure is divided into the total number of seedlings desired, the pounds of seed to sow will be the result. This procedure is condensed in the following formula similar to that noted by Wakely (1954) and Eide (1962).

$$\text{Lbs. Seed to Sow} = \frac{\text{number of seedlings desired}}{(\text{seeds/lb.})\ (\text{Purity})\ (\text{Germ.})\ (\text{Field Survival})\ (\text{Pack})}$$ 1/

After the pounds of seed to sow of each lot is determined the seed is withdrawn, stratified, and sown in accordance with the best nursery techniques.

Considerable care has been taken to anticipate the hazards the resulting seedlings will encounter and to allow for a certain amount of mortality. The seedlings will stay in the seedbeds usually for five to twenty-three months. Hew closely will the sowing formula estimate the actual hazards during that time? Or is this information important?

For good nursery management it would be very helpful to know how each nursery lot sown actually performed, how much was the over or under-run and

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1/ (Field Survival) x (Pack) = Nursery Survival, an alternative way of taking nursery losses into account.

what was the actual Field Survival and cull. This information seems essential for the following reasons:

1. Is the present survival factor realistic? The survival factor may change in a nursery over a period of time due primarily to changing nursery practices.

2. To better help new people coming into a nursery understand the sowing procedures and their importance.

3. Individually, nursery seedling lots may each require a different Field Survival and Cull factor. If this is true, records of each lot will provide sowing information for subsequent crops.

4. The Field Survival may vary throughout a nursery due to such things as soil type.

TI NURSERY PRODUCTION CARD

In order to come to some conclusions as to the accuracy of the sowing, it is necessary to have available all sowing and production data. Inventory data is also very useful as a check on production figures and if a check on inventory accuracy is also desired.

Figure 1 illustrates a form which has been developed for recording all data pertinent to an individual seed lot. Figure 2 is a continuation of Figure 1. In practice, Figures 1 and 2 would be printed back to back on 8'1' x 11 inch card stock. One card would be filled out for each seed lot and kept in a three ring notebook. As sewing inventory and production data for each year becomes available, it is entered on the card. With the final disposition of a lot, calculations can proceed to determine the accuracy of the inventory and the sowing and what sowing factors should have been used in the sowing formula and should be used in the future considering the same conditions.

If needed, instructions are available from the author (Route 4, Box 490, Olympia, Washington 98501) for completion of all parts of Figures 1 and 2 including the calculations.

USEFULNESS OF DATA

For each lot:

1. A complete permanent record of each lot will be available in one place.

2. The accuracy of the inventory can be calculated.

3. The accuracy of the sowing can be calculated.

4. The actual Nursery Survival can be calculated and also actual Field Survival if cull is known.

5. The individual seed lots can be graphed as in Figure 3 to better illustrate their development.

6. The above sowing data will be available for future sowings of the same lot(s).

For all nursery lots collectively:

1. Actual production can be compared to predicted as in Figure 4. Plotting individual lots here will illustrate the variation present.

2. The results of individual lot sowing and production information can be combined to provide an average Nursery or Field Survival for a particular nursery.

3. It would be possible to correlate the actual Nursery or Field Survival with such things as seedbed density, seed collection year, seed weight etc. This would provide information for calculating the sowing of lots never before sown.

OTHER VARIABLES

Up to this point the assumption has been made that most seed lot variation is due to the nursery. This seems reasonable because of the great variety of conditions which affect the quantity and quality of each seedling lot. There are, however, three other factors which depend on sampling variation and which directly influence the sowing for each lot. These are seeds/lb., purity and germination. Each of those factors is determined for each lot by a single sample and a standard test.

If the sampling variation is large and if a particular sample is not representative of the whole seed lot, a sowing error will result. However, if the sampling variation is small, even a sample at the extreme end of the curve may have little effect on the nursery sowing.

The following example illustrates how sampling and testing variation could influence the sowing. Assume that the sowing is for 200.000 trees:

$$\frac{\text{Desired trees}}{(\text{seeds/lb.}) \times (\text{Purity}) \times (\text{Germination}) \times (\text{Nursery Survival})} = \text{lbs. of seed}$$

$$\frac{200,000}{42,000 \times 97 \times 95 \times 75} = \frac{200,000}{29,027} = 6.89 \text{ lbs. of seed}$$

Now if the sowing components for the seed actually sown were lower than this by about:

½% in seeds/lb.
1% in purity
5% in germination

the actual number of seedlings which should result is:

$$41,790 \times 96 \times 90 \times 75 \times 6.89 = 186,589$$

Figure 1

NURSERY PRODUCTION CARD

_____ 19_____ 2-0 Crop
Ownership

_____ _____ _____ 19
Species Nursery Code Date Sown

SEED SOURCE: _____ Lot No.: _____

Locale: _____ Elev.: _____

SOWING:
Sowing For: _____ 2-0 Seedlings
Seeds/Lb.: _____ Purity _____ Est. Field Survival _____%
Germ. Test: _____% Est. Pack _____%
Quantity of Seed Sown: _____ Pounds _____ Ounces. Est. Nursery Survival _____%
No. Seeds Sown _____
Expected Germinants _____

YEAR									
SEEDLING AGE	1-0	1-1			2-0	2-1			TOTAL
INVENTORY:									
Spring									
Fall									
Est. Cull									
Net									
HELD OR TRANSPLANTED									
DISPOSITION:									
Destroyed									
Public Sale									
Other									
District									
1)									
2)									
3)									
TOTAL									
O/U RUN OF INVENTORY:									
Trees									
%									

Figure 2

TOTAL over/under runs:

Sowing by _____ trees _____%

ACTUAL:

Nursery Survival = $\frac{\text{TOTAL}}{\text{Germinants}}$ x 100% = _____ = _____%

Pack = 100 - _____ (cull) = _____%

Field Survival = $\frac{\text{Nursery Survival}}{\text{Pack}}$ = _____ = _____%

SHOULD HAVE SOWN:

Seeds: _____ Lbs. of Seed: _____

SEED BEDS:

Total Bed Feet _____ Density _____ Sdlgs./ft.^{2}

Sown in:

Block	Bed	Feet

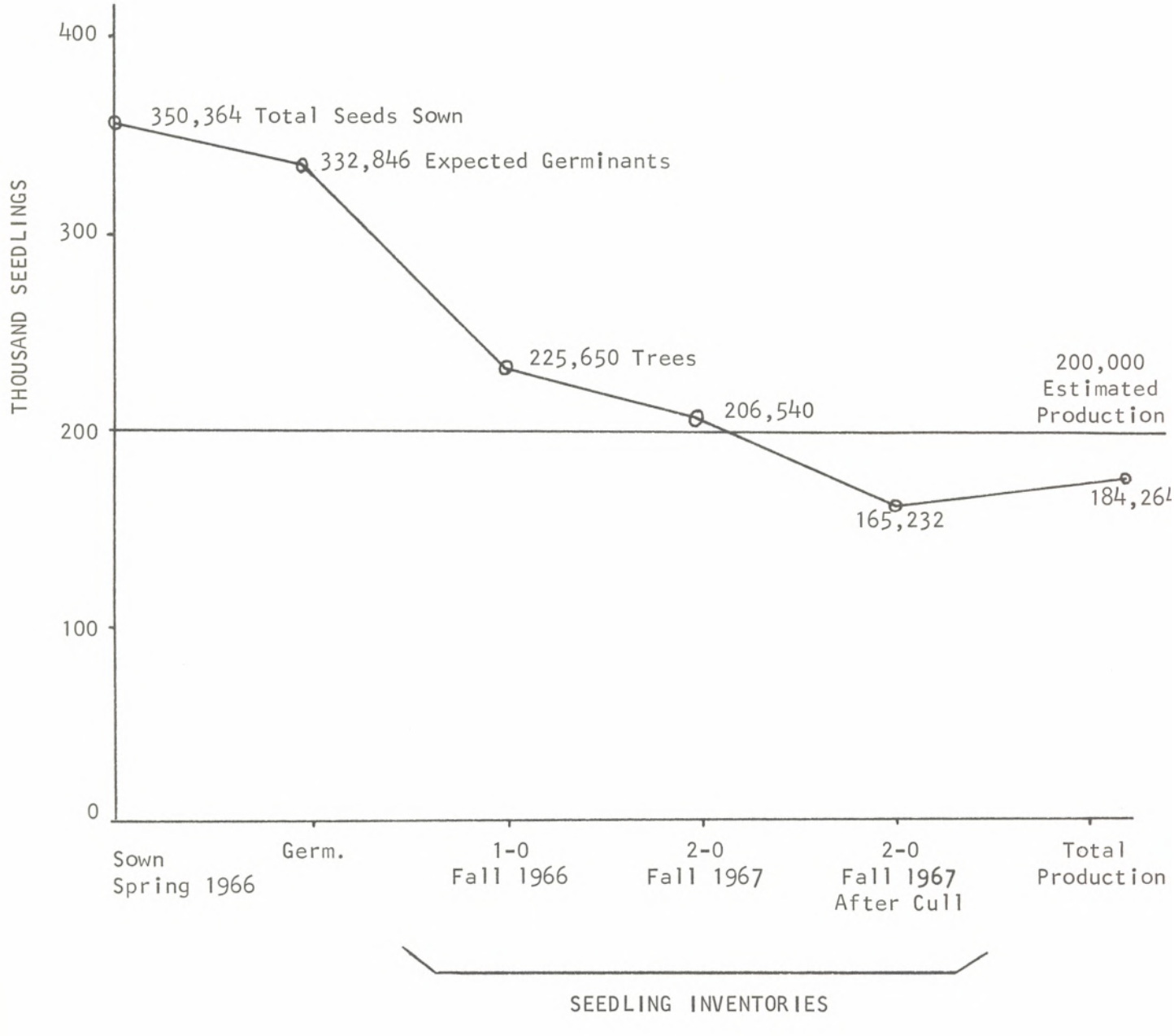
REMARKS: _____

_____

_____

_____

Figure 3 An example of the development of a 2-0 Douglas-fir seedling lot.



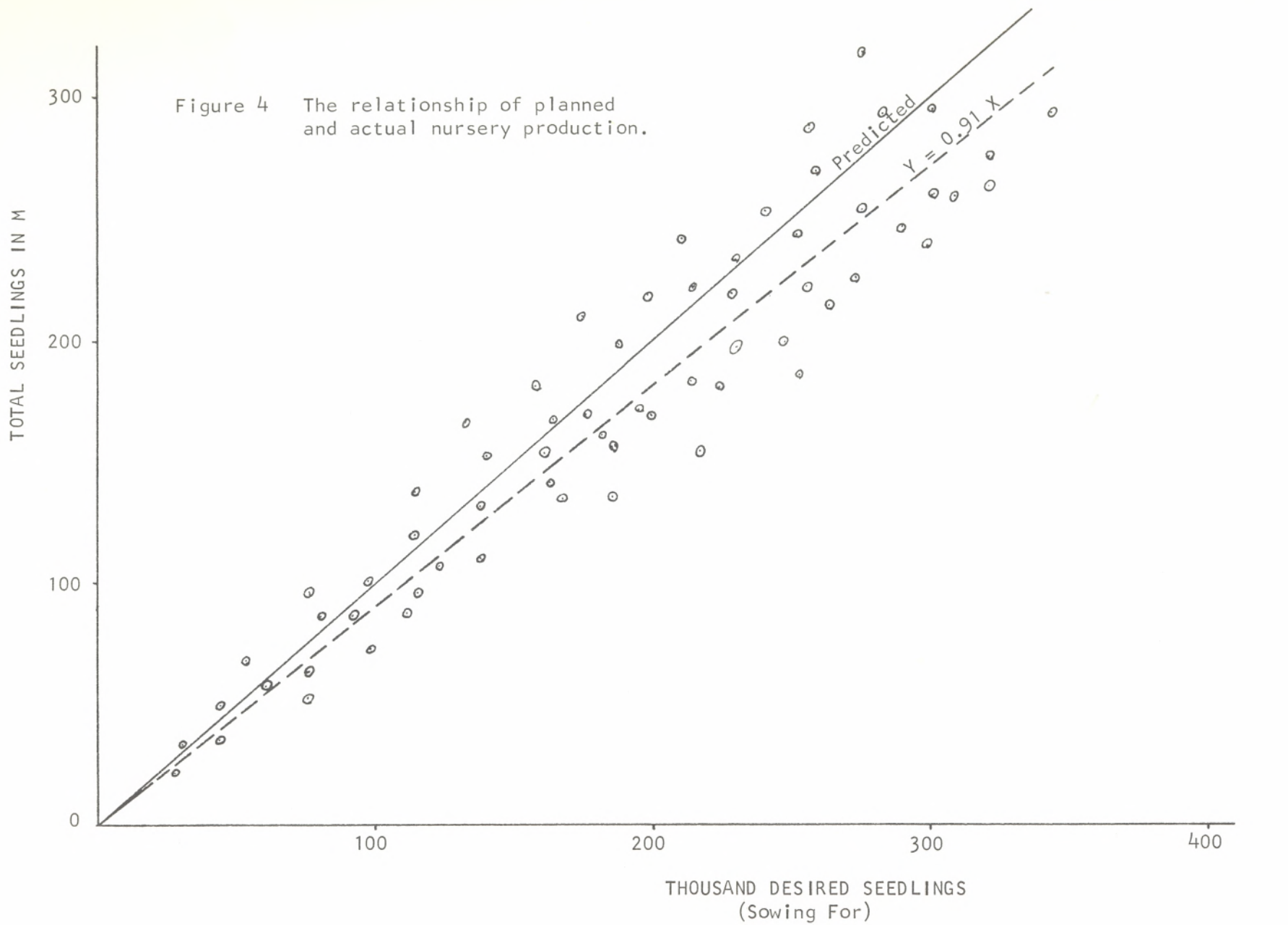


Figure 4 The relationship of planned and actual nursery production.

rather than 200,000. This is an under-run of:

$$100 \times \frac{200{,}000 - 186{,}580}{200{,}000} = 100 \times \frac{13{,}420}{200{,}000} = -6.7\%$$

before the seed is even sown. The same chance exists that this would be an over-run of +6.7%.

It is very unlikely that the sampling extremes in the same direction will occur at any one time in any one seed lot. The sampling should tend to average out. This does illustrate, however, that this could be an important source of error when meeting nursery sowing objectives are concerned.

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