# REGULATING NURSERY SEEDBED DENSITIES

## **BENEFITS** AND FACTORS

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Abstract. This paper includes a discussion of the benefits of regulating nursery seedbed densities and the factors included in sowing formulas. It presents one method of calculating sowing rates and discusses how to obtain estimates of seedlot parameters and nursery factors needed to compute accurate sowing rates.

## BENEFITS OF REGULATING NURSERY BED DENSITIES

The benefits of regulating nursery seedbed densities include more uniform seedlings, better quality seedlings, more seedlings per pound of seed, and lower costs of cultural treatments. Lower costs of cultural treatments are possible because there would be less wasted production space. Blank areas in seedbeds caused by poor germination are unproductive areas and can seriously reduce the production per acre. Although these blank areas produce no trees, they still receive irrigation, fertilizers, and pesticides. A final benefit of better regulation of bed density is better control of inventories. This improvement results from lower variation in the beds which allow more accurate estimates that are more easily obtained.

## WAYS TO REGULATE BED DENSITIES

Some of the ways to regulate seedbed densities are to devleop fertile, uniform nursery soils, sow seed precisely, use seed of high viability and vigor, use appropriate presowing treatments, and apply water, fertilizer, and pesticides evenly and in a timely manner. Soil fertilizer and uniformity is a topic that has been covered by speakers earlier in the meeting and will not be covered in this workshop.

Sowing seed precisely involves three factors: seed sizing, seed drill operation and sowing rates. Seed sizing is the separation of seed into size classes using seed cleaning screens. Separations by specific gravity can also be accomplished using gravity separators. Sizing results in a uniform product which machinery can move in a more consistent way.

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Seed of different sizes often are different in their germination speed or in total germination. Sowing seed that has been sized into two or more lots requires testing each new lot and calculating different sowing rates for each lot. However, this may prove worthwhile since the slower germinators will have a better chance of surviving than before. The seed drill must be suitable to the species. A drill that works well for pine might be poor for spruce and vice versa. A seed drill must also be carefully calibrated and deliver a uniform flow of seed. An irregular flow of seed will result in clumps of seed and seedlings instead of an evenly spaced row.

SOWING RATES

Using a computed sowing rate is superior to using average figures for a species. To compute a sowing rate, each seed lot must be tested under accurate and controlled laboratory conditions. The variables determined in the laboratory are germination, seed per pound, and purity. The nursery manager must determine from experience what density and survival to consider. These variables are all combined in the following formula.

$$\text{Sowing Rate in lbs of Seed} = \frac{(\text{Sq. ft. seedbed to sow})\ (\text{Desired seedling density})}{(\text{Purity})\ (\text{Seeds per Lb.})\ (\text{Germination})\ (\text{Survival})}$$

Table 1. Illustrates how the amount of seed needed to sow 100 linear feet of nursery bed varies with different values of germination and seed per pound.

Table 1. Pounds of seed needed to sow 100 linear feet of nursery seedbed when: purity = 100, survival = 50, desired seedling density = 30, seedbed width = 4 feet.

| | Germ % | | | |
|---|---|---|---|---|
| Seed/lb | 90 | 80 | 75 | 70 |
| 40,000 | .67 | .75 | .80 | .86 |
| 50.000 | .53 | .60 | .64 | .60 |
| 60,000 | .44 | .50 | .53 | .57 |

The cost of using a fixed amount of seed each year based on a rule-of-thumb rather than the amount computed from current test and survival data can be ilustrated using data from the table above in the following example. Assume that the germination of a seedlot is 90%, purity 100X, and the required production is 4.8 million seedlings. In 100 linear feet of bed at a seedbed density of 30 seedlings per square foot, there would be 12,000 trees. To produce 4.8 million trees we would sow 400 100-foot beds. From table 1 we use the value of 0.53 pounds of seed when there are 50,000 seed per pound and 0.44 pounds of seed when there are 60,000 seed per pound. Now 400 times 0.53 pounds is 212 pounds of seed and 400 times 0.44 is 176 pounds of seed. Had our seed lot contained 60,000 seed per pound and our rule-of-thumb data was developed from seedlots which averaged 50,000 seed per pound, we would have sown 36 excess pounds of seed. At a cost of $50.00 per pound we would have experienced a direct loss of $1800 worth of seed. We would have had overly dense seedbeds which may have lowered seedling quality and increased seedling cull percent and we would have produced nearly one million excess seedlings. In addition there are many hidden costs which would include shortages of seed in the future, higher replacement cost of the seed used, increased cost for culling and possibly even the cost of thinning overly dense seedbeds.

## LABORATORY SEED TEST DATA

Laboratory test data includes germination, seed per pound, and purity. It is important that proper procedures and conditions are provided when doing laboratory tests. Repeatability and accuracy are the key words in performing lab tests, with repeatability being most important because we wish to predict the field performance as closely as possible. The more variation in our test data the poorer the predictions become.

Germination is the factor which requires the most control to produce repeatable results. Therefore, germination tests should not be attempted unless proper conditions are available. Rather than attempting to perform germination tests under less than optimum conditions, the seed samples should be sent to a qualified laboratory. All states maintain a seed testing laboratory that can be contacted for assistance. If the state laboratory cannot help, the National Tree Seed Laboratory can offer assistance in getting the tests conducted or it can provide contacts with commercial testing laboratories.

### A. Germination Tests

Germination tests consist of 4 subsamples of 100 seeds. The number of normal seedlings is counted weekly for four weeks. The result is a percent computed according to this formula:

$$\text{Germination} = \frac{\text{Number of Normal Seedlings}}{\text{400 Seeds}}$$

### B. Purity Tests

The purity test tells how much of the seedlot is pure seed. This could be done at a nursery if personnel are properly trained. The purity percent is computed using the following formula:

$$\text{Purity \%} = \frac{\text{Weight of Pure Seed}}{\text{Weight of Impurity + Weight of Pure Seed}}$$

### C. Seed Per Pound Tests

The seed per pound test tells how many seed there are in a pound of seed. The seed per pound is computed by sampling the seedlot using appropriate sampling techniques. Five subsamples of 100 seeds each are then counted out of the sample and weighed. The weights should be checked to assure that the difference between the heaviest weight and the lightest weight is not more than 10% of the average weight of the five subsamples. If it is, the process should be repeated. If the accuracy of the subsamples are okay, the following formula can be used to determine the weight of 1000 seed.

Weight of 1000 seeds =

+ Weight of Rep 1
+ Weight of Rep 2
+ Weight of Rep 3
+ Weight of Rep 4
+ Weight of Rep 5
________ Weight of 500 seed x 2

This data is then entered into the following forumula to determine the number of seed per pound.

$$\text{Number of Seed per Pound} = \frac{453{,}600}{\text{Weight of 1000 Seed}}$$

GUIDELINES FOR SAMPLING AND FREQUENCY OF TESTING

A representative sample must be drawn in from each seedlot to be planted. If the lot is in several containers, each container must be sampled. Some seed should be taken from top, middle and bottom levels within in the container. This can be done by pouring the seed out of the container or by using a seed sampling probe. This seed should now be mixed thoroughly if it was taken

from several containers or if it is a large amount. A smaller sample termed a "working sample" can then be drawn and the remaining seed returned to the container(s). Seed per pound and purity estimates will not change from year to year so a one time estimate of these two factors will be sufficient. Germination can and often does change from year to year. For sowing purposes, a test should be run on the seed six months prior to planting. For storage purposes, germination should be tested at the time seed is placed in storage and again every three years. Moisture content must be tested every year to ensure that the desired moisture content is being maintained. This is at or below 9% for most conifers and hardwoods. The seed of oaks and walnuts present a different problem since these must not be dried or death will result.

ESTIMATING SURVIVAL

Survival is the percentage of the germinable seed that will germinate in the field. A formula for survival % is:

$$\text{Survival \%} = \frac{\text{Field Germination}}{\text{Laboratory Germination}} \times 100$$

The survival estimate must be developed from nursery experience over several years. A predictable relationship can be developed that gives some indication of how well a seed lot with a specified laboratory germination will germinate in the field.

History plots are a good way to develop the survival factor. These are permanent sample plots. They are established at the time of sowing. The Number of seeds sown on each plot is counted immediately after the seed is sown. The germination on these plots is recorded at least weekly until germination is complete. Counts can be made later through the season to estimate losses beyond the germination period. These plots can also be very useful for monitoring growth, diseases, weeds, and insects. They can represent a very small area that will take only a brief amount of time each day to monitor and they will provide valuable information the nursery manager needs to be more effective.