A SLIDE RULE FOR COMPUTING SEED NEEDS AND SOWING RATES IN FOREST NURSERIES

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Every forest nursery, to produce a certain quantity of seedlings, must determine the amount of seed of each lot needed or/and the pounds of seed to sow per bed. Usually this is done in longhand or on a desk calculator, methods which are accurate but time consuming.

A multiple slide rule (fig. 1) described here can be used to calculate the pounds of seed needed or sowing rates rapidly, accurately, and simply. For clarity, this rule will be referred to as the Wilson slide rule. It is used much the same as a conventional engineer's slide rule; numbers can be multiplied or divided by adding or subtracting their logarithms. It consists of six scales, four of them sliding.

This slide rule can be used to solve the following formula by Wakeley (1).

Forumla 1

$$\text{Pounds of seed needed} = \frac{\text{M seedlings desired}}{(\text{M seeds/pound})\ (\text{survival \%})\ (\text{purity \%})\ (\text{germination \%})}$$

The numerator, M seedlings desired, is at the top of the rule, which is its normal position in formula 1. The four denominators occupy the four sliding scales, progressing down the rule in the same order as in formula 1. To solve a sample problem, assume the following, using Douglas-fir seed.

$$\text{Pounds of seed needed} = \frac{\text{30 M seedlings desired}}{(\text{40 M seeds/pound})\ (\text{85\% survival})\ (\text{90\% purity})\ (\text{80\% germination})}$$

1. Aline 30 M seedlings on the upper stationary scale with 40 M seeds/pound.

2. Aline estimated survival (85 percent) with the right index of the above M seeds/pound scale.

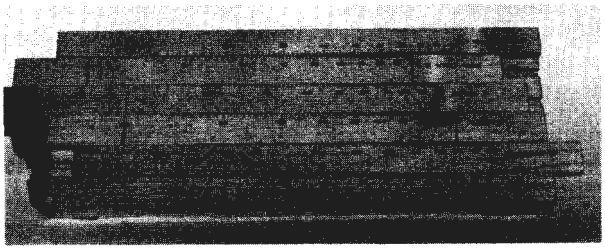

Figure 1.--Multiple slide rule for computing seed needs and sowing rates in forest nurseries.

3. Aline purity (90 percent) with the right index of the above survival scale.

4. Aline germination (80 percent) with the right index of the above purity scale.

5. The left index of the germination scale will indicate the pounds of seed needed; that amount is shown on the bottom stationary scale. Care should be taken to assure correct placement of the decimal point. In this case, 1.23 pounds of seed are needed. If 3 M, 300 M, or 3 MM seedlings are desired, 0.123, 12.3, or 123 pounds of seed, respectively, are needed.

A similar slide rule has been designed by Mugford (2). His rule is designed to find the pounds of seed needed for 400 square feet of seedbed for any desired seedling density. The slide rule is constructed of hardboard, and the sliding rules are held in place by an acetate cover.

Swofford [1] developed a cardboard circular slide rule for computing the sowing rate of slash and loblolly pine seed. His rule solves formula 1 by substituting "desired seedlings per square foot" in the numerator and by

1 Personal examination of a circular rule developed by Toni Swofford, Eastern Tree, Seed Laboratory, Macon, Ga.

having a specially constructed scale giving the needed amount of seed directly in pounds per 100 linear feet of a 4-foot-wide nursery bed.

The "Mugford" and "Swofford" rules can only be used to determine the pounds of seed needed for 100 linear feet of the standard 4-foot-wide nursery bed. However, the "Wilson" slide rule can be used to compute the pounds of seed needed for various situations. As shown in formula 1, it can be used to compute the amount of seed which should be stratified to give a desired number of seedlings. This may be 5 M, 50 M, or 5 MM seedlings. This rule can also solve the same problem that Mugford and Swofford solve, i.e., the pounds of seed needed for 100 feet of nursery bed. The problem is shown in formula 2.

Formula 2

$$\text{Pounds of seed needed per 100 bedfeet} = \frac{\text{M seedlings desired/100 bedfeet}}{\text{(M seeds/pound) (survival \%) (purity \%) (germination \%)}}$$

The pounds of seed needed per 100 feet of nursery bed can be expanded to give the pounds of seed needed for the entire bed. This, of course, is done by simple multiplication; the two upper scales of this rule can be used as an engineer's slide rule. However, the amount of seed needed to sow the entire bed can be determined directly when the number of seedlings desired in that bed is known. This is done by solving formula 3.

In addition to determining the amount of seed needed to produce a desired number of seedlings, the

Formula 3

$$\text{Pounds of seed needed for one bed} = \frac{\text{M seedlings desired/bed}}{\text{(M seeds/pound) (survival \%) (purity \%) (germination \%)}}$$

reverse can be calculated; i.e., it may be desirous to know the number of trees which would result from a given amount of seed. In this case the slide rule solves formula 1 for M seedlings desired, starting at the bottom of the rule and working up.

Because all the scales on the Wilson rule are identical to each other and to the C or D scale on an engineer's slide rule, any number of seedlings desired, seed size, survival, purity, or germination can be used. There are no specially calibrated scales. In summary, it can be used to calculate the values of the other variables of all species.

One disadvantage of the rule is that the decimal point must be found by inspection. This appears difficult at first, but it is easier to do in a surprisingly short time.

Construction

The slide rule is slightly less than 15 inches long and 6 inches wide. It is constructed of light colored, straight grained spruce.

A 3/4-inch-thick board is ripped into 12 identical pieces, each 15 inches long and 1 inch wide. The 1-inch face is the approximate finished width of the four sliding portions of the rule. A groove five-sixteenths inch deep is ripped on each side of each of the pieces with one pass on a table saw. A blade producing a one-eighth-inch kerf is excellent. This groove is about one-eighth inch from the bottom of the board. Slightly more than one-eighth inch must be trimmed from the resulting runner so the boards will interlock (fig. 2).

The best 6 of the 12 strips are selected to be the front of the rule. The pieces should be assembled without glueing, and the best track for each of the four sliding rules should be selected by trial and error. Each slide must be sanded to an optimum fit. It is much easier to do the major part of the sanding and fitting

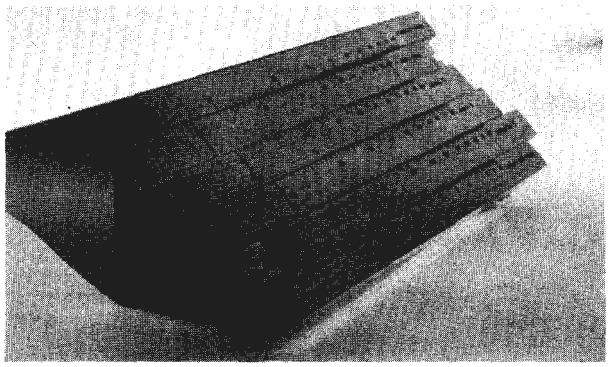

Figure 2.--End view of slide rule showing the interlocking of the individual slides and the laminated back.

before the rule is assembled and glued. Care in setting the table saw will result in a runner width equal to the groove width; thus, minimum sanding will be required.

After fitting, about one-eighth inch of the face of the six face strips is removed on the table saw to reduce bulk and assure a smooth surface for lettering. Five of the remaining strips are laminated for the back of the rule. The two stationary frontpieces can be attached and glued at the same time. The remaining strip should be ripped in two and used as a 'molding at the top and bottom edges. This molding will make a rough top and bottom edge, but the whole rule must be squared up on the saw after the glue has set. After sanding, the whole rule should be given a coat of wood sealer.

The logarithmic scales and other printing are applied directly to the sealed wood. The scales are transferred from logarithmic paper and are 10 inches long. The two fixed scales must be exactly aligned. To assure that all scales are identical, the logarithmic scale is transferred to the top and bottom fixed scales in pencil, and with the movable scales fixed in place, the various points are connected in pencil, thus transferring the scale to each of the four sliding rules. The lettering, ruling, and numbering are done in black drafting ink, and all pencil marks can be erased after the ink has dried.

Before finishing, two stands are glued near each end of the back of the rule, supporting it at a 45^0 angle. These stands are attached across the laminated strips and assure that the back of the rule will not warp. In this case the slide rule was finished with a clear liquid plastic, but varnish, lacquer, or other suitable clear material could be used. The portion of the rule in contact during sliding was sealed, but no finish coat was applied.

Literature Cited

(1) Wakeley, P. C. 1954. Planting the Southern pines. U.S. Dept. Agr. Monog. 18, p. 74.

(2) Mugford, D. G. 1962. Slide rule computer for sowing rates in nursery seedbeds. Tree Planters' Notes 51:21-22.