WEEDS AND TREE PLANTING

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In many regions a heavy cover of weeds is by far the most frequent and critical factor responsible for depressed growth of forest plantations. On short rotations, the evapotranspiration of competing vegetation and its immobilization of nutrients may deprive a plantation owner of as much as two-thirds of the potential volume of timber. Usually, a reduction in growth of trees is closely related to biomass of weeds, the ovendry weight of their tops and roots. Neglecting to appraise quantitatively the weed biomass of planting sites leaves the prospective tree planter unable to predict the yield of the plantation to be established, the most desirable tree spacing, and the possible return on either chemical or mechanical eradication of weeds. This note describes a simplified method for estimating biomass of competing plants and outlines relationships between density of weeds, tree spacing, and expected yield of plantations.

The average weight of tops and roots of weeds is *determined* by excavating entire plants on several 1 / 10,000-acre plots (2.1- by 2.1-foot squares) . Sampling is done at random; the number of samples required for obtaining an acceptable standard deviation depends on type of soil and nature of ground cover. Often a half dozen sampled quadrads are sufficient for an area as large as 40 acres. The excavated tissues are carefully washed in water, dried in an oven at 105°C., and weighed. Because weed biomass on different soils has a very high constancy, a man with some analytical experience can closely determine the weight of plants on the basis of ocular estimate.

Next, the tree planter must establish the approximate age of the plantation (n) at which the biomass of weeds (b) will be *reduced* to the harmless level of less than 2 tons per acre. The total weight of the biomass of weeds (G), present in the plantation through the years, is then determined from the formula:

$$G = 2/3\ b \cdot n$$

For trees with heavy crowns, such as red pine, growing on fertile soils at a spacing of 4 by 4 feet, the n period is about 12 years. However, at 6- by 6-foot spacing, this period is extended to nearly 30 years.

With weed cover of blueberries, sweet fern, and other heath plants weighing 10 metric tons per acre, total biomass of 4- by 4-foot red pine plantation would be:

$$G = 2/3 \times 10{,}000 \times 12 = 80{,}000 \text{ kg/a}$$

Similar calculation for a red pine plantation established at a spacing of 6 by 6 feet gives the active weed biomass of about 200,000 kg/a.

Evapotranspiration of weeds diverts from the actual available supply of water 85 kg. per kilogram of ovendry biomass (Wilde et al., 1968). On the other hand, production of 1 kilogram of merchantable wood having specific gravity of about 0.35 requires close to 1,200 kg. of transpiration water (Wilde 1967; Shaw et al. 1968). Therefore, the loss of timber on a weight basis (L) is expressed by the formula:

$$L = \frac{85\ G}{1200} = 0.07\ G$$

Assuming active weed biomass of a 6- by 6-foot red pine plantation to be equal to 200 metric tons per acre, the loss of timber would be:

$$L = 0.07 \times 200{,}000 = 14{,}000 \text{ kg/a}$$

This weight of ovendry wood of specific gravity 0.35 approaches 16 cords, the volume which must be subtracted from the yield promised by the regression equation or the established soil productivity rating. If the potential site index of the proposed red pine plantation is 60 and the expected yield of the fully-stocked stand at the end of a 40-year rotation is 40 cords per acre, the actual volume is likely to be 40 minus 16, or 24 cords.

With present stumpage prices, this loss of 16 cords amounts to about $70. This suggests that a reasonable expenditure for weed eradication should not be much greater than $15 per acre, a sum well within the possibility of tractor cultivation.

Let us assume now that trees on this site were planted at 4- by 4-foot spacing. The greater number of trees does not increase the volume of the stand, but with greater density, ground vegetation is suppressed at the plantation age of about 12 years. Cumulative weight of the weed biomass is reduced to 80 metric tons per acre, with subsequent increased yield of about 8 cords per acre. This relatively modest gain indicates that the use of 4- by 4-foot spacing may be justified by motives not directly related to financial considerations (Wilde 1964; Wilde et al. 1968).

The given calculations, featuring the maximum 40-percent loss of merchantable timber, are largely based on observations in Wisconsin. In this State, tree planting on weed-invaded soils was usually accomplished by plowing deep, wide furrows, which greatly reduce adverse effects of weed competition. On the other hand, losses of timber well exceeding 50 percent were recorded in our study in plantations established without adequate ground preparation.

Competing vegetation not only deprives trees of water but also of nutrients. However, this loss is temporary; in time, suppression of weeds by tree crowns returns nutrients to the plantation cycle via mineralization of plant remains. By this fertilizing effect, weed cover partially alleviates damage caused during the early years of stand growth.

Conclusion

Under Wisconsin conditions pine plantations require about 1,200 kg. of water to produce 1 kg. of ovendry merchantable wood of approximate specific gravity 0.35, whereas evapotranspiration of ground vegetation diverts from the available moisture supply 85 kg. of water per kg. of ovendry top and root tissues. In turn, each kg. of weed biomass present in the plantation through the years reduces the volume of merchantable wood by 0.07 kg., or about 8×10^{-5} of a cord. At this rate, plantations established on soils with a heavy cover of heath plants may have within a 40-year rotation a loss of timber approaching 16 cords per acre, a volume justifying an expenditure for tractor cultivation.

On the other hand, control of weeds on light sandy soils promises no financial return; eradication of weed biomass below 4,000 kg/a will not render a gain over 6 cords per acre regardess of the length of the rotation.

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"HAVE YOU SEEN THESE?"

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