bi-monthly research notes

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SILVICULTURE

The Effect of Defoliation on Conifer Seedling Root Initiation.—A positive relationship between conifer seedling root growth and photosynthetic activity has been suggested by several workers (Keller, Forstwiss. Centralb. 85:65-79, 1966; Etter and Carlson, Can. J. Plant Sci. 53:395-399, 1973). Since root initiation in lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) and white spruce (*Picea glauca* [Moench] Voss) seedlings was stimulated by light (Carlson, Bi-Mon. Res. Notes, 32:21-22), it was suggested that the light affects the hormonal composition and/or chemical balance, which directly affects root initiation. The extent to which the light-intercepting area of a seedling affects root initiation is the subject of this report.

Dormant 2-0 lodgepole pine and 3-0 white spruce seedlings were partially defoliated to test the effect of needle loss on root initiation. Three defoliation treatments were used for pine (0, 50, and 100% foliage removed) and four for spruce (0, 25, 50, and 75% foliage removed). In lodgepole pine the needles were removed starting at the top until the desired percentage of defoliation was attained. Attempts to remove needles from the spruce resulted only in extensive injury to the seedlings; therefore, defoliation was attained by cutting the tops to the desired sizes. The seedlings were potted in sand and grown for 30 days in the greenhouse. Greenhouse conditions were the same for all treatments, i.e. minimum light intensity was 10 500 lux, day length was 18 h, air temperature ranged from 15 to 30°C, and sand temperature was maintained at 18.5 ± 1°C. The seedlings were excavated after 30 days and new root tips counted. The data are expressed as means of 80 seedlings per treatment. The means were compared using a modified range test (Snedecor, Statistical methods, Iowa State Coll. Press, 1959, pp. 251-253).

Lodgepole pine seedling that had 50% or 100% of their needles removed produced (significantly) fewer new roots than the nondefoliated control (Table 1). Those that had 100% of the needles removed produced fewer new roots than those with 50% defoliation. However, only when 100% of the needles were removed did the number of seedlings with new roots decrease. These data are similar to those shown for reduction in light intensity for lodgepole pine (Carlson, *op. cit.*). A 50% reduction in light intensity or in needles did not result in fewer plants with new roots, but the number of roots per plant was less. A 100% reduction in light intensity or needles resulted in fewer plants with roots and fewer roots per plant.

In white spruce, 25% reduction in foliage (tops) significantly increased root initiation. However, the total number of plants with new roots remained unchanged. In fact, none of the defoliation treatments on white spruce appreciably affected the number of plants with new roots. Only the 75% top reduction resulted in significantly fewer roots per plant.

In general, reduction of the photosynthetic area significantly reduced root production for both species. However, it took a greater amount of defoliation to initialy reduce root production in white spruce than it did for pine. The difference in the white spruce response could possibly be due to the method of defoliation. Increased root initiation by partial defoliation (25% and 50%) could be related to removal of the terminal bud and needles rather than needles only (as in pine) and its effect on the hormonal balance. The hormonal effect of bud removal stimulating root production may have obscured the effect of reducing the photosynthetic needle area.

TABLE 1

The effect of defoliation on conifer root initiation

Species	Amount of defoliation	Roots per living plant	Plants with new roots -%
Pine	None	49.1a*	93.8
	50%	40.8b	93.8
	100%	8.9c	68.8
Spruce	None	41.3b	100.0
	25%	48.8a	100.0
	50%	45.2ab	100.0
	75%	33.6c	96.3

* The letters indicate multiple range groupings of treatments which do not differ significantly at the 5% level.

The data presented here on defoliation and those on the effect of light regimes (Carlson, *op. cit.*) show that root initiation of conifers is directly related to activity in the shoots. That activity may be photosynthetic and/or hormonal in nature depending on the conifer species. The extent to which either photosynthesis or hormones affect root initiation will need further investigation.—Lester W. Carlson, Northern Forest Research Centre, Edmonton, Alta.

Germination of Black Spruce and Jack Pine Seed on Soil and Germination Paper Media Following Paraquat Herbicide Spraying.—Several herbicides have been found to have an inhibitory effect on the germination of tree seed, and a toxic effect on young seedlings (Kozlowski, Growth and development of trees. Vol. 1, Acad. Press, 1971). To date, no studies have been reported on the effects of paraquat (1,1′-dimethyl-4,4′-bipyridilium), which is reported to lose its effectiveness upon contact with soil (Costen, Ont. Prof. For. Assoc., Herbic. Semin., Toronto, Ont. 11 p, 1968; Winston and Haavisto, Bi-mon. Res. Notes 30(6):37-38, 1974). The following note summarizes the results of three tests on the effects of paraquat on the germination of black spruce (*Picea mariana* [Mill.] B.S.P.) and jack pine (*Pinus banksiana* Lamb.) seed.

In the first study, paraquat, at rates equivalent to 0.00, 0.56, 1.12 and 2.24 kg/ha dissloved in 336 l/ha of water, was applied by mist blower to 0.01 ha field plots in peatland conditions. Four petri dishes (two covered to act as controls), each containing 100 pre-imbibed black spruce seeds on moistened germination paper, were located in each plot. Spray was applied uniformly to drip point. Each treatment was replicated four times. Immediately after spraying, all seeds were subjected to a 28-day laboratory germination test at 25°C.

Significantly more seeds germinated in the controls than in the paraquat treatments at any concentration (Table 1). Germination of the fully imbibed black spruce seeds on germination paper in petri dishes decreased with increasing concentrations of herbicides.

In the second study, we attempted to determine whether a low concentration of paraquat might affect germination of dry seeds, i.e., seeds not pre-imbibed. Black spruce (seed from a different source than that used in the first study) and jack pine seed were set out on pre-moistened germination paper in petri dishes (2 species × 4 replicates × 100 seeds per replicate) in the laboratory. Paraquat was sprayed by hand-held mist sprayer at a rate equivalent to 0.56 kg/ha dissolved in 336 l/ha of water on each container. These containers were then covered and placed in a germinator at 25°C. Untreated controls were maintained throughout the 28-day test.

All seeds started to germinate normally and it appeared that the low concentration of herbicide did not affect germination. The seeds, once germinated (radical length ⩾ 3 mm), were not removed from the containers, but were allowed to continue growing. It soon became apparent that radicles in the treated petri dishes were not continuing to

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