Effects of peat and silica grit mulches on the early growth of black spruce seedlings

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Both mulches increased growth significantly when the seedlings were fertilized with N+P and N+P+K.

Nurserymen have used organic mulches of various types for many years, often for different purposes. One common reason for their use is to protect seedbeds from erosion, another is to minimize frost-heaving. Damage from the latter may be particularly severe in small shallowrooting conifers such as black spruce *Picea mariana (Mill.) B.S.P.)* seedlings during the fall and spring following their first grossing season.

In Ontario (1) the application of sphagnum moss in a layer 1.2 cm 10.5 in) thick over the seedbed surface has been found to be effective in ameliorating frost heaving in 1-0 black spruce. One of us, (K.A.A.) has observed over a period of years that not only did the use of mulches minimize damage from frost-heaving but also resulted in improved growth and vigour of seedlings when compared with those which were not mulched. Causes of better growth could he from increased supply of soil moisture as a result of the mulch reducing surface evaporation and/or a more effective movement of fertilizer nutrients into the soil when applied at the surface. In order to determine experimentally what the effects of mulching might be on the growth of young black spruce, an experiment was established in December 1973 in which black spruce were grown under different mulches and fertilizer regimes.

Materials and Methods

The soil used was a medium sand, pH 5.5 (soil: water, 1:5). The containers were plastic tumblers 12 cm deep and mean diameter of 8 cm. In each container 20 black spruce seeds were planted December 20, 1973. A total of 36 tumblers were seeded. Germination was completed by January 6, 1971. Eighteen days later the seedlings were thinned to 10 per tumbler and the three mulch treatments were applied. Mulches consisted of applying coarse silica (approx. diameter 2-3 mm) to a depth of 1.5 cm, or milled sphagnum peat to the same depth or a control of no mulch. Four fertilizer treatments were used: nitrogen only, nitrogen and potassium, nitrogen and phosphorus, and nitrogen combined with phosphorus and potassium.

Potassium as potassium sulphate was applied at the rate of 179 kg/ha (160 lb/ac) K and phosphorus was applied as mono calcium phosphate at the rate of 358 kg/ha 1320 lb/ac) P. These fertilizers were given in an aqueous solution of one application 20 days following germination. Nitrogen was applied as ammonium nitrate in five equal aqueous applications of 22 kg/ha (20 lb/ac) N during the grossing period from January 21, to February 21, 1971. The experiment was terminated at the end of March,

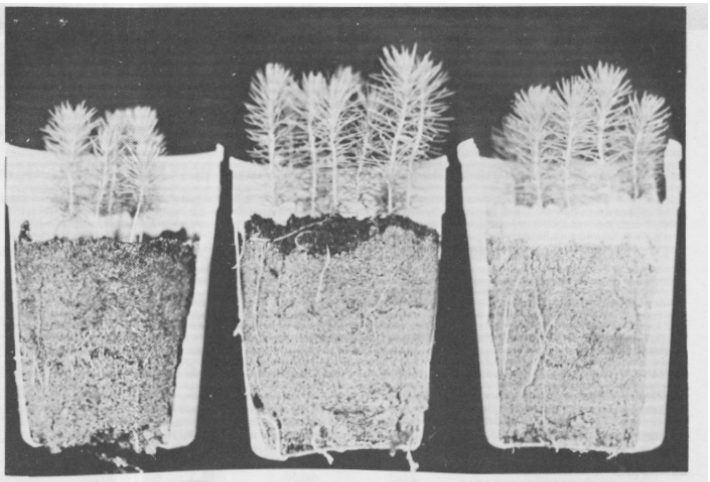

Figure 1.—View of black spruce seedlings at termination of experiment from fertility treatment N + P + K.
Left, control (no mulch); middle, peat mulch; right, silica mulch.

1971. after a period of 82 days follow ins germination.

There were three replications and the experiment took place in a heated

greenhouse using a 20-hour photoperiod. Seedling growth was measured as height (cm), root area index (cm^2) (2) and total seedling dry weight (mg).

Results

The mean seedling measurements by treatments are given in table 1. Modification of seedling size by mulch was minimal for the nitrogen only (N) treatment. Both peat and silica mulches resulted in increase in seedling size and the effect was most pronounced for those with the silica mulch. The same pattern of growth response existed for the nitrogen plus potassium (N + K) treatment but there was a consistent but non significant decrease in seedling growth for the N + K, compared to the N treatment. Both the N + P and N + P + K treatments resulted in significant increases in seedling size compared with the N and N + K treatments, but the differences between the N + P and N + P + K were non significant. The effect of the two mulches at these last two fertilizer treatments was to significantly increase seedling sizes when compared with the control (no mulch).

When the seedlings were being extracted the more extensive systems of the seedlings grown under mulched conditions was quite evident (figure 1).

Discussion and Conclusions

The beneficial effect of both peat and silica grit mulches in enhancing the growth of black spruce seedlings is clear. especially under adequate soil fertility. The improvement in growth was considered to be primarily due to improved soil moisture regimes for the following reasons: 1. All applied fertilizer solutions. whether to non-mulched or mulched containers. infiltrated into the soil equally. Thus the total supply of available nutrients may be considered similar in all treatments. 2. An organic mulch such as peat could be expected to be somewhat less effective in reducing surface evaporation than an inorganic mulch because the peat would itself absorb some of the applied water which could then subsequently be evaporated into the atmosphere. The fact that seedling weights were somewhat less for the peat than the silica mulch especially in the N + P and N + P + K fertilizer treatments lends circumstantial support to this.

It might be anticipated that over a longer growing period, in actual nursery beds the black spruce roots could develop to a significant degree in the peat mulch, a feature that they would not show in the. silica grits. Under these conditions the roots in the peat would probably have some advantage in water and nutrient absorption compared to roots in the mineral soil. In the present study there was only a minimal development of seedling roots in the peat mulch.

Literature Cited

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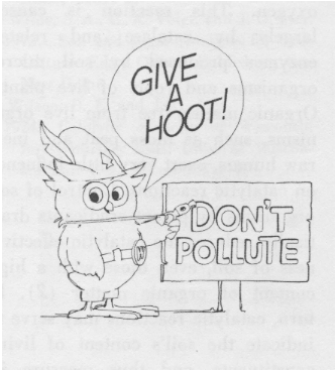

Table 1.—Mean seedling heights, root area indices (RAI) and dry weights by treatments.

Fertilizer	Mulch Type								
	Control (no mulch)			Peat			Silica		
	Ht.	RAI	D. Wt.	Ht.	RAI	D. Wt.	Ht.	RAI	D. Wt.
	(cm)	(cm²)	(mg)	(cm)	(cm²)	(mg)	(cm)	(cm²)	(mg)
N	3.0	0.6	16.0	3.5	0.7	18.3	3.7	1.0	25.4
N + K	2.6	0.6	14.6	3.2	0.6	15.6	3.2	0.9	23.7
N + P	6.0	0.9	51.8	7.7	1.5	70.8	6.9	1.6	77.9
N + P + K...	5.6	1.3	51.4	7.3	1.6	73.2	7.6	1.7	80.6