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PLASTIC AND PEAT SEED SHELTERS IMPROVE STOCKING

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CATEGORY: Silviculture
KEY WORDS: Direct seeding, microsite, microclimate, seed shelters, jack pine

INTRODUCTION

Seed shelters provide an improved microclimate for seed germination and physically protect seeds against predation and burial by wind and rain. In northern Ontario, Wood and Jeglum (1984) and Baker (1990) reported that shelters produced up to 32% better black spruce (*Picea mariana* [Mill.] B.S.P.) stocking than bare seed. Buse (1992) measured the heights of 2-year-old sheltered jack pine (*Pinus banksiana* Lamb.) and black spruce seedlings and found them to be almost twice those of unsheltered seedlings and with stockings up to 55% greater. Dominy and Wood (1986) found significantly improved stocking for sheltered jack pine, black spruce and white spruce (*Picea glauca* [Moench] Voss) seedlings, although seedling heights did not improve consistently.

The shelters most often used have been Scandinavian-made photodegradable open-ended plastic cones that anchor to the ground and are seeded manually or by using hand-operated mechanical seeders. The cost of these shelters (about 8¢ each) and their slow decomposition rates under shade have prompted a search for alternatives.

Peat pots, manufactured in Canada by Jiffy Products Ltd. (Shippagan, N.B.), show promise due to their low cost (2¢ each), and their similarity to cones in terms of weight, size, handling, and method of seeding (Fig.1).

A 1991 trial by Forestry Canada, Ontario Region (FCOR), produced 96% stocking and 85% germination in peat shelters versus 94 and 68%, respectively, in plastic cones 3 weeks after sowing. This Note reports on a subsequent trial that compared temperature variations and jack pine stocking levels in peat shelters, plastic shelters, and bare ground.

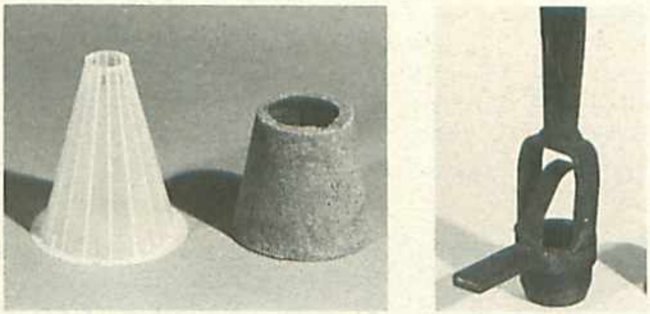

Figure 1. (left) Cerbo Cerkon photodegradable plastic seed shelter, (middle) Jiffy Products Ltd. peat pot shelter, and (right) prototype tool used to remove a soil plug for insertion of the peat pot.

METHODS

Seed-spot trial

This study began 15 May 1992 in FCOR's outplanting compound, as part of a larger spot-seeding trial. The treatments included: (1) bare seed (control), (2) Cerbo Cerkon plastic shelter cones, and (3) Jiffy peat pot seed shelters. Each treatment comprised five replicates of 10 seed spots, each with three seeds. The pretrial germination analysis, using International Seed Testing Association methods,

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showed the seedlot to be 94% viable. Germination and establishment assessments occurred 4, 6, and 16 weeks after sowing.

Seed spots were lightly scalped and compressed to form a level surface. In the control, bare seed was deposited directly into a shallow depression on the soil surface. Plastic shelters were anchored by hand-mounding loose soil to a height of 2 cm around the shelter's base. A prototype tool developed by Jiffy Products, created a 2.5 cm deep hole in which peat shelters fit snugly with little need for mounding around the shelter's base. Seeds were then sown through the shelter's top using a laboratory funnel.

To protect the seed spots from predation by ravens, conical wire mesh screens were placed over groups of seed spots. The site was not irrigated during the trial. The area around the protective screens was periodically hand-weeded as required.

Temperature measurements

Temperatures of sheltered and bare seed spots were measured with fine wired thermocouple sensors and recorded with a Campbell Scientific Inc. data logger. In the control, thermocouples were placed directly onto the unsheltered soil surface; in the other treatments, they were placed at the soil surface near the shelter's center and 3.5 cm above the surface in the shelter's center. The data logger also collected on-site weather data (air temperature, relative humidity, precipitation, and solar radiation).

RESULTS

Stocking

Four and 6 weeks after seeding, both sheltered treatments had stocking greater than 80%, versus less then 10% in the control (Fig. 3). Stocking was not significantly different (P = .05) between the two shelter types.

Figure 2. Photograph of the experimental seed spot trial showing conical protective wire mesh screening over seed spot groups.

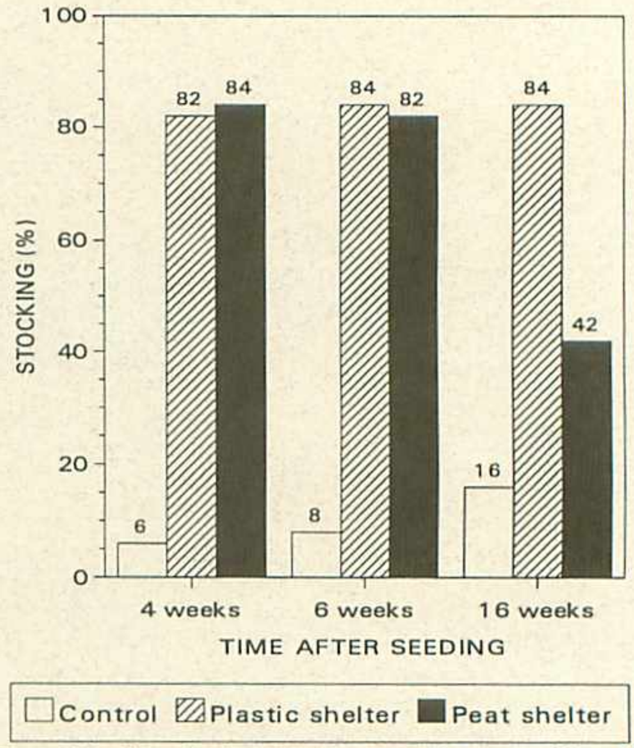

Figure 3. Stocking of jack pine seed spots over the course of the seed spot trial.

Temperature effects

Both shelter types reduced the temperature around the seedlings (Fig. 4). Surface temperatures exceeded those at the 1.5 m height in all cases, but the difference was less in shelters. Daily fluctuations were also less within shelters than on bare ground, resulting in a longer daily period of seed exposure to optimum cardinal temperatures (OCT) for germination of jack pine seed, which range from 18°C to 35°C (Fraser 1970). On 10 June for example, seeds within shelters were exposed to 5 hours more of OCT when compared to unsheltered seeds. Outside shelters, surface temperature fluctuations were greater than inside shelters on both cloudy and sunny days, but were greatest on sunny days.

Inside peat shelters, shade is provided by the opaque walls, and varies with the traversing sun. This provides some relief to seeds and seedlings from direct sunlight. Soil surface temperatures inside peat shelters were up to 3°C cooler than in plastic shelters during the hottest hours, though this difference was probably insufficient to benefit seedlings. Plastic shelters showed condensation build-up on inside walls, indicating that the dew point of the air inside the shelter was greater than the wall temperature. On cloudy days, there was little difference between shelters in terms of soil surface temperature.

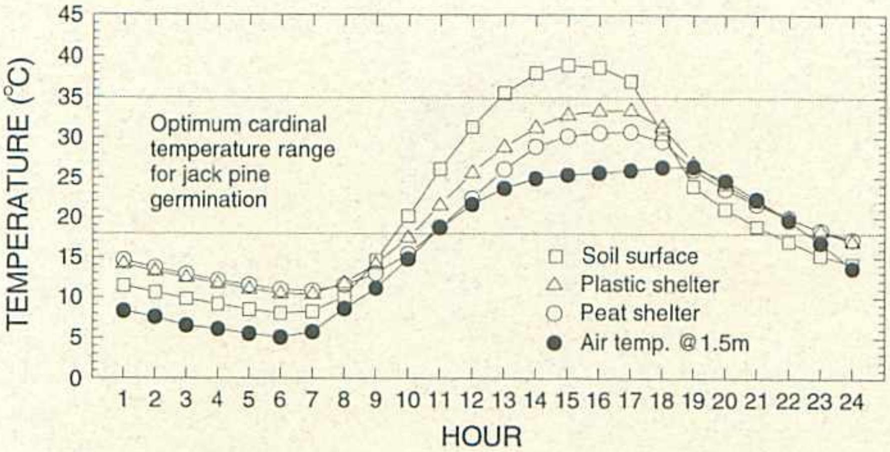

Figure 4. Mean hourly unscreened soil surface temperatures inside and outside seed shelters as recorded on a warm sunny day (10 June 1992).

STOCKING

Four months after seeding, stocking was 84% in plastic shelters, significantly greater than in peat shelters (42%) and with bare seed (16%) (Fig. 3).

The decreased peat shelter stocking, from over 80% at 6 weeks to 42% after 4 months is believed to have been caused by predation by European earwigs (*Forficula auricularia* L.), observed nesting inside the shelters. Earwigs are a common pest in urban areas, but have not been reported in forests (P.D. Syme, FCOR, personal communication). In two other northern Ontario peat shelter trials conducted simultaneously, jack pine stocking was 85% or greater (J. Oleynek, Dubreuil Bros.; and B. Nicks, E.B. Eddy, personal communication), with no evidence of predation. The low final stocking in peat shelters is therefore likely to be a consequence of the urban study site.

Stocking on bare soil started to increase about 7 weeks after seeding because of increased rainfall but remained relatively low (16%) at the final assessment.

DISCUSSION

Soil Moisture

Insufficient soil moisture is recognized as a cause of poor emergence of conifers (Arnott 1973). Laboratory studies have shown that jack pine germination decreases rapidly at water potentials below -12 bars. When constant water availability is < 20 bars, germination ceases (Thomas and Wein 1983).

In greenhouse and field experiments, Thomas and Wein (1985) observed that jack pine was better able to emerge from infrequently watered seedbeds than white pine, black spruce, or balsam fir. It was postulated that jack pine owes its success in coping with fluctuating water availability to rapid radicle elongation; the root evades drought conditions by quickly penetrating moister subsoil.

Moisture conditions were not measured in the present trial, partly because of the difficulty inherent in detecting fine differences in surface and subsurface soil moisture potentials. However, conditions in May and June were exceptionally dry, with precipitation at only 52% of the 30-year average (Environment Canada 1992 Statistics).

Despite jack pine's ability to cope with dry surface conditions, stocking in the control was low. Dry soil, desiccating winds, and wide ground temperature fluctuations may have been more than the germinants could bear.

The soil surface within peat shelters remained moist to the touch even during prolonged dry periods. This, in part, is a function of the method of peat shelter insertion and the microsite created by the seeding tool whereby the actual depth of the seedbed surface is 2 to 3 cm below the ground surface, where subsurface moisture is more available. Water is also wicked up by the pot walls, expanding the moisture supply. Condensation in the plastic shelters also enhanced humidity levels favorable to seed germination.

Germination conditions were only suitable outside shelters from about 7 weeks after seeding into July, when the rains came; this was too late for most seeds to survive the effects of partial germination, predation by birds, and removal or burial by wind. Germination in mid- to late-summer also provides little time for seedlings to develop root systems to withstand frost heaving or build up carbohydrate stores for overwintering.

Temperature

Both shelter types moderated temperature fluctuations to provide longer periods of optimal germination temperatures. The slight differences between the two shelter types had no effect on initial stocking. Peat and plastic shelters promote cooling by creating shade—a possible advantage on exposed warm sites such as prescribed burns.

CONCLUSIONS AND RECOMMENDATIONS

Both plastic and peat shelters created conditions more conducive to jack pine germination than the harsh outside-shelter environment. Moisture retention and maintenance of favorable germination temperatures produced initial stockings >80%. Peat shelters had slightly cooler inside temperatures than plastic shelters during hot periods. However, stocking in peat shelters dropped to 42% after 4 months because of earwig damage, a consequence of the urban locale of the trial. Earwigs have not been reported in plantations nor in any other recent peat pot shelter trials.

Direct seeding with peat and plastic shelters fits well with Ontario's recent emphasis on lower-cost regeneration methods. Regeneration with peat shelters is 'low cost' (Jeglum 1990), at costs of $250 to $580/ha @2,200 pots/ha, depending on site preparation, whereas plastic shelters are 'low to medium cost' ($400 to $700/ha), in comparison, while intensive regeneration with artificially produced stock typically exceeds $1,000/ha.

The short advance notice required to use shelters, their easy handling, and low delivery costs suggest that peat and plastic shelters are appropriate for fill-in planting, strip cuts, areas managed by the shelterwood system, and isolated locations such as wildfire areas where the cost of transporting seedlings is prohibitive and logistically difficult. Shelter seeding may also be applied in natural regeneration programs to increase the stocking levels of desired species.

REFERENCES

Arnott, J.T. 1973. Germination and seedling establishment. p. 55–66 *in* J.H. Cayford, ed. Direct seeding symposium. Dep. Environ., Can. For. Serv., Ottawa, Ont. Publ. No. 1339.

Baker, W.D. 1990. Lower cost regeneration options for upland black spruce in Northwestern Ontario. Proc. Low Cost Regeneration Workshop, 10-11 Oct. 1989, Ont. Min. Nat. Resour., Hearst, Ont.

Buse, L.J. 1992. Effect of cold stratification on the germination and growth of jack pine and black spruce. Ont. Min. Nat. Resour., Thunder Bay, Ont. Tech. Rep. 67. 35 p.

Dominy, S.W.; Wood, J.E. 1986. Shelter spot seeding trials with jack pine, black spruce and white spruce in northern Ontario. For. Chron. 62(5):446–450.

Fraser, J.W. 1970. Cardinal temperatures for germination of two provenances of white, red and jack pine seed. Can. Dep. Fish. and For., Can. For. Serv., Chalk River, Ont. Inf. Rep. PS–X–15.

Jeglum, J.K. 1990. Low-cost regeneration in Ontario: what are the needs? Proc. Low Cost Regeneration Workshop, 10-11 Oct. 1989, Ont. Min. Nat. Resour., Hearst, Ont.

Thomas, P.A.; Wein, W. 1983. Post fire establishment of jack pine and black spruce from seed on organic soil seedbeds. p. 281–295 *in* R.W. Wein, R.R. Riewe and I.R. Methven, eds. Dynamics of the Boreal Zone, Proc. Conf. at Thunder Bay, Ont. Aug. 1982. Assoc. Can. Univ. for North. Stud., Ottawa.

Thomas, P.A.; Wien, R.W. 1985. Water availability and the comparative emergence of four conifer species. Can. J. Bot. 63:1740–1746.

Wood, J.E.; Jeglum, J.K. 1984. Black spruce regeneration trials near Nipigon, Ontario: planting versus seeding, lowlands versus uplands, clearcut versus strip cut. Dep. Environ., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O–X–361. 19 p.

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