HERBICIDE INVESTIGATIONS IN CONIFEROUS TREE NURSERIES IN SASKATCHEWAN AND ALBERTA

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In this paper I will provide a brief overview of the current research in weed control for the production of conifer seedlings and transplants in Alberta and Saskatchewan. Replicated weed control trials are being conducted at the PFRA. Tree Nursery, Indian Head, Saskatchewan; Alberta Tree Nursery (ATN) and Horticultural Centre (HC), Edmonton; and Pine Ridge Forest Nursery (PRFN), Smoky Lake, Alberta, although informal experimentation is occurring at other nurseries too. The overall objectives of the Indian Head and Edmonton trials are to reduce hand weeding to a minimum without jeopardizing crop safety or incurring phytotoxic soil residuals in subsequent crops. At Pine Ridge the major objective is similar, but more emphasis is being placed on herbicides as a standby procedure in the event of emergencies or if nonchemical methods would be too costly.

Before I review the investigations now under way, I will briefly outline what weed control practices are being used in the production of bare-root conifer seedlings.

CURRENT PRACTICES

Prior to seeding conifers, the nurseries at Indian Head and Prince Albert, Saskatchewan, fumigate the seedbeds with dazomet, which is sold as Mylone or Basamid. Seedbeds are generally treated in September for spring seeding.

At Prince Albert, diphenamid is applied after seeding and prior to hydromulching. Enide is applied at 11.2 kg/ha; no residual effects have been observed on succeeding cover crops. There is, however, a trend to using glyphosate at 1.1 kg a.i./ha for both white spruce and jack pine at any stage of growth (S. Price, personal communication). Glyphosate is also used at Indian Head for weed control in Colorado spruce seedbeds.

At the Pine Ridge Forest Nursery, neither fumigants nor herbicides are used in general production of coniferous seedlings. At the Alberta Tree Nursery, linuron and cyprazine are used in conifer transplants, but seedlings are started in the greenhouse.

HERBICIDE INVESTIGATIONS

The weeds of major concern (Table 1) are quite similar for all the nurseries in this discussion, although narrow-leafed hawk's beard appears to be confined to the two Alberta nurseries. Also, since PFRN is at a relatively new and isolated site, it does not have all the weed problems other nurseries do.

In this discussion, I will review some of the results achieved with various candidate herbicides.

Table 1. Major weed species of Alberta and Saskatchewan tree nurseries

Common name	Scientific name
Common groundsel	*Senecio vulgaris*
Purslane	*Portulaca oleracea*
Stinkweed	*Thalspi arvense*
Flixweed	*Descurainia sophia*
Lamb's-quarters	*Chenopodium album*
Redroot pigweed	*Amaranthus retroflexus*
Narrow leafed hawk's-beard	*Crepis tectorum*
Russian pigweed	*Axyris amaranthoides*
Scentless chamomile	*Matricaria maritima*
Dandelion	*Taraxacum officinale*
Perennial sow thistle	*Sonchus arvensis*
Canada thistle	*Cirsium arvense*

GLYPHOSATE-ROUNDUP

Until about 5 years ago, the only overall postemergent treatment available for conifer production was Varsol or herbicidal oil. As a result, if the soil fumigant or preemergence herbicide was not effective, there was basically no alternative but to resort to expensive hand-weeding.

Glyphosate has changed this picture, although it is not registered for use as an overall spray in conifers. Glyphosate has been widely tested on Colorado spruce, as outlined in Table 2. This species as 2-0, 2-1, 2-2, and 2-3 stock has been subjected to overall glyphosate treatments from 1.0 to 2.8 kg/ha as single and repeated treatments during May, when in full flush, to August (Carter 1978; Carter et al. 1978; Howe and Morgan 1977). In four reports, glyphosate from 1.0 to 1.7 kg/ha applied at any time during the growing season, repeated up to three times per year, did not cause any crop injury. Glyphosate at 2.2 kg/ha, however, did cause severe injury to 2-0 seedlings and at 2.8 kg/ha caused some injury to transplanted Colorado spruce in 1 year.

White spruce transplants were tolerant to glyphosate at 1.5 to 1.7 kg/ha when treated in August, but treatment in May or June occasionally caused damage (Table 3). New sowings showed poor tolerance in one trial at Pine Ridge Forest Nursery, but 2-0 were tolerant to single applications. When the rate of glyphosate was increased to 2.2 or 2.8 kg/ha, white spruce tolerance was reduced in 2-2 stock and particularly so in 2-0 stock.

Scots pine was considerably more sensitive to glyphosate than Colorado spruce and white spruce when treated in May (Table 4). Since only a few reports are available for applications in July and August, further testing of low rates at these later stages appears worthwhile.

From other studies, pine appears to be more tolerant to glyphosate when treated at the mature growth stage. This is supported in basic research work by Lund-

Table 2. Effects of glyphosate applied on Colorado spruce seedlings and transplants at various growth stages

	Age of Colorado spruce	Time of application	Effect on Colorado spruce
A. Glyphosate at 1.0 to 1.7 kg/ha			
PFRA-77	2-2	May, June, July single, double, triple (s, d, t)	Neither survival nor growth affected
PFRA-78	2-2 2-3	May, June, July s, d, t	No injury
PFRA-79 Prod. scale	2-1	June, July, August	No injury
PFRA-79 Prod. scale	2-2	July, August	No injury
ATN and HC[1]	2-1	August	No injury
PFRA-78	2-0	May, June, July s, d, t	No injury
PFRA-79 Prod. Scale	2-0	May, June, August August	No injury
B. Glyphosate at 2.2 to 2.8 kg/ha			
PFRA-77	2-2	May, June, July s, d, t	No injury
PFRA-78	2-2	May, June, July s, d, t	Slight tip burn, growth not affected
PFRA-78	2-0	May, June, July s, d, t	Severe injury, significant growth reduction

[1] From Grainger (1980).

Table 3. Effects of glyphosate applied on white spruce seedlings and transplants at various growth stages

	Age of white spruce	Time of application	Effect on white spruce
A. Glyphosate at 1.0 to 1.7 kg/ha			
PFRA-77	2-2	May, June, July	June application caused reduced growth
PFRA-78	2-2	May, June, July	May application--slight tip burn, growth not affected
ATN and HC[1]	2-2	August	No injury
PFRN-80	1-0	July	Poor tolerance
PFRN-80	2-0	July	Good tolerance
PFRA-78	2-0	May, June, July	Good tolerance to single application, double and triple application caused injury
B. Glyphoste at 2.2 to 2.8 kg/ha			
PFRA-77	2-2	May, June, July single, double, triple, (s, d, t)	Poor tolerance, reduced growth
PFRA-78	2-2	May, June, July s, d, t	May and June--tip burn, growth not affected
PFRA-78	2-0	May, June, July	May--marginal tolerance, severe injury from double and triple applications

[1] From Grainger (1980).

Table 4. Effects of glyphosate on pine seedlings and transplants

	Age	Species	Rate and time of application	Effects on pine
PFRA-77	2-2	Scots pine	1.7 kg/ha, May	Injury, plants recovered
PFRA-77	2-2	Scots pine	2.8 kg/ha, May	Significant growth reduction
PFRA-78	2-0	Scots pine	1.1 kg/ha May	Injury, survival not affected
PFRA-78	2-0	Scots pine	2.2 kg/ha, May	Significant growth reduction, survival not affected
PFRN-80	1-0	Lodgepole pine	0.6, 1.1 kg/ha, July	Severe injury
PFRN-80	2-0	Lodgepole pine	0.6, 1.1 kg/ha, July	Good tolerance

Hoie in Norway (Lund-Hoie 1976). He found that Norway spruce absorbed four to five times more of the glyphosate in plants at the shoot growth stage than in plants that had ceased growth. Norway spruce had the capacity to rapidly detoxify the absorbed glyphosate.

A third factor was that glyphosate when absorbed was translocated only over short distances.

OXYFLUORFEN--GOAL

Oxyfluorfen or Goal 2E has registration in the U.S. for preemergence and postemergence weed control in conifer seedbeds, transplants, and container stock. In Canada, Goal is available for experimental testing only. This chemical has been tested at the Alberta Tree Nursery and Horticultural Centre in Edmonton, Pine Ridge Forest Nursery at Smoky Lake, and at the PFRA Tree Nursery, Indian Head, Saskatchewan.

At Smoky Lake, Goal at 1 and 1.9 kg a.i./ha caused some injury to white spruce when applied in May, but no injury was noticed when treated in July. Goal provided excellent weed control at these rates (D. Altmann, personal communication).

At the federal agricultural research station at Morden, Manitoba, oxyfluorfen at 1.5, 3, and 6 kg/ha was applied to Colorado spruce about 25 cm in height on April 22, prior to weed growth and bud break. In this replicated trial no injury to spruce was noted and weed control was good.

At Indian Head (Alspach and Neill 1980a, b), oxyfluorfen was applied pre- and postemergence to sowings of Colorado spruce and Scots pine. Postemergence applications of oxyfluorfen caused significant injury to both species, but the preemergence treatment appeared safe. Alspach and Neill reported excellent weed control from these treatments.

The effectiveness of oxyfluorfen for weed control has also been confirmed in trials with woody ornamentals at two locations in Alberta.

Although this chemical is not commercially available in Canada, Goal has considerable potential as a preemergence treatment in spruce and pine seedlings.

BIFENOX-MODOW N

Bifenox, commercially known as Modown, was applied at 2.2 and 3.4 kg/ha for both pre- and postemergence in Colorado spruce and Scots pine sowings at Indian Head (Alspach and Neill 1980a, b; Carter 1978). As a preemergence, bifenox caused stem twisting in both species. Both pre- and postemergence applications of bifenox provided excellent weed control (mainly shepherd's-purse and purslane).

Bifenox is a herbicide in the substituted diphenyl ether class, and its activity is not significantly affected by soil organic matter content and soil types. Like other preemergence herbicides it requires some moisture after application for activation. Bifenox has low water solubility and relatively short persistence (half-life in soil of 7-14 days). Oxyfluorfen is a more active herbicide than bifenox and is more persistent.

CONTROL OF GRASSY WEEDS

This year we are testing two experimental herbicides for postemergence control of grassy weeds at ATN and HC, Edmonton. These chemicals are sethoxydim (formerly BAS 9052), commercially known as Poast, and fluazifop methyl (formerly TF 1169), commercially known as Fusilade. Both were combined with a surfactant. Poast and Fusilade were both applied at 0.2, 0.4, and 0.8 kg/ha on June 1 to white spruce and lodgepole pine. Neither species showed any injury as a result of these treatments. In this trial, grassy weeds were not present for evaluation, but in vegetable trials at Brooks we have shown that these chemicals will control volunteer cereals, wild oats, barnyard grass, and green foxtail at 0.4 kg a.i./ha.

Another postemergent herbicide, diclofop methyl, commercially known as Hoe Grass, has also been evaluated at several locations. Hoe Grass appears safe to use on conifer seedlings; however, its control spectrum is more limited than those previously mentioned.

Fusilade and Poast should be tested again to confirm their safety to coniferous species at several growth stages and also to evaluate their efficacy in controlling perennial grasses such as quack grass and brome grass.

In similar work, we are also evaluating bromoxynil and bentazon as directed sprays for control of common groundsel and weeds of the mustard family. Crop tolerance is not a problem as a directed spray, and work from P.E.I. indicates that bromoxynil can be applied overtop of white spruce seedlings without detrimental effect.

SUMMARY

Herbicidal treatments are being developed at several nurseries in Alberta and Saskatchewan for the production of conifer seedlings. Of these treatments, glyphosate as an overall application has probably the greatest potential, but further investigations are still required for pine seedlings. Two diphenyl ether herbicides, bifenox and oxyfluorfen, have shown encouraging results and have the advantage that their activity is not significantly affected by soil organic matter content. However, neither Goal nor Modown is currently commercially available.

New herbicides are also being developed for special weed problems such as grassy weeds. This research effort should result in more alternatives for controlling a wide spectrum of weeds and for special situation problems in conifer nurseries.

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