Phytotoxicity and Weed Control of Oxyfluorfen and Napropamide on Container-grown Conifer Seedlings — FRDA Project 1.47

INTRODUCTION

Weeds are a significant problem in conifer nurseries competing with crop plants for space, sunlight, water, and nutrients. In addition, weeds may interfere with seedling extraction during harvest. Also, there are few herbicides registered in Canada for use on container seedlings and none are effective against established weeds.

British Columbia forest seedling nurseries allocate significant sums of money to handweeding since approved chemical weed control products are inadequate. These costs are estimated at $1000 per million seedlings.

FRDA Project 1.47 is part of a Canada-wide series of trials designed by the Canadian Forestry Nursery Weed Management Association. The information from this project will aid in the evaluation of a promising broad spectrum herbicide called oxyfluorfen to be registered for use in conifer seedling nurseries.

Oxyfluorfen is a pre- and post-emergence herbicide that has been registered for use in United States conifer nursery nurseries since 1979 (Jaeger 1986). The chemical kills weeds by causing oxidation of plant proteins and pigments which results in cell damage or death (Kunert and Boger 1981, Kunert et al. 1985). Oxyfluorfen requires light for activation and is most effective when weeds are small. In addition to weed control potential, oxyfluorfen has several characteristics that make it desirable for use in nurseries: 1) it has a very low mammalian toxicity (acute oral LD50 of > 5000 mg/kg) (Thompson 1983), 2) it is not corrosive, 3) it is compatible with most other pesticides, 4) it has a very low solubility in water, and 5) it is strongly adsorbed by soils (Jaeger 1986), making runoff or groundwater contamination unlikely.

The herbicide napropamide was also included in the trials to determine its usefulness for B.C. conifer nurseries. Napropamide is currently registered in Canada for use on conifer seedlings. This study included Douglas-fir, white spruce, and lodgepole pine.

CONCLUSIONS

Oxyfluorfen, when used according to label instructions at rates of 0.25 and 0.50 kg/ha, appears to be harmless to the conifer species tested and offers good weed control when applied before weeds become too large (beyond six-leaf stage). Napropamide does not damage seedlings, but does not appear to provide effective weed control as tested.

OBJECTIVES

The objectives of the study were to assess the effects of oxyfluorfen and napropamide applications on the designated crop plants, and evaluate how well the herbicides controlled typical weed species.

METHODS

The trials were established at the B.C. Ministry of Forests Surrey Nursery near Langley, B.C. All seedlings were grown in styroblock containers (size 313a) in a peatvermiculite (3:1) medium. The study used recently seeded (1+0) Douglas-fir, white spruce and lodgepole pine, and one-year-old (2+0) Douglas-fir and white spruce. All seedlings were grown using standard commercial cultural conditions. The oxyfluorfen formulation used in the trials was Galant® (TM, Rohm and Hass Canada), 19% emulsifiable concentrate. The napropamide formulation was Devrinol® (TM, Stauffer Chemical Co. of Canada) 50 wettable powder.

Oxyfluorfen was applied at rates of 0.25, 0.50, and 1.00 kg a.i./ha, and napropamide was applied at a rate of 0.50 kg a.i./ha. Oxyfluorfen was applied three days after seeding (pre-emergence) on 1+0 seedlings, and both oxyfluorfen and napropamide were applied at three and six weeks post-emergence. Both herbicides were applied before bud-break, and three and six weeks after bud-break on 2+0 seedlings. In addition to the herbicide treatments, each trial included a weeded and unweeded control treatment.

Seedlings were examined at weekly intervals for signs of phytotoxicity. Ten to eleven weeks after treatment, all weeds were removed from each styroblock and identified. The number of monocotyledon and dicotyledon weeds, weed fresh weight, liverwort fresh weight and moss fresh weight were recorded. In October/November, ten seedlings were randomly sampled from each styroblock (80 seedlings/treatment) and individual caliper, shoot height, dry root, and shoot weight were measured. In early December 2+0 seedlings were harvested and the number of culls/styroblock was recorded, using B.C. Ministry of Forests guidelines and personnel.

Weed control and phytotoxicity data were analyzed with analysis of variance (ANOVA) followed by Duncan’s Multiple Range test. A 95% confidence limit was used when designating significance for all statistical analyses.
RESULTS AND DISCUSSION

Neither oxyfluorfen nor napropamide treatments on 1+0 seedlings caused significant seedling damage or growth reduction with the one exception of a reduction of lodgepole pine root weight in the 1.0 kg a.i./ha oxyfluorfen three-week post-emergence treatment. Jaeger (1985) found oxyfluorfen had no measurable effect on roots, suggesting that the effect seen in this treatment may have been due to another cause.

No herbicide application on 2+0 Douglas-fir stock produced significant reduction in seedling quality or quantity. The 0.50 and 1.0 kg a.i./ha oxyfluorfen three-week post-flush treatments on 2+0 white spruce caused needle flecking. Measurements of seedling caliper, height, root weight, and shoot weight, however, indicated that the necrotic flecks had a negligible affect on seedling growth. In the three-week post-flush 1.0 kg a.i./ha oxyfluorfen treatment on 2+0 spruce, the mean height was significantly shorter than that for the weeded control, but was not significantly shorter than the unweeded control. In the six-week post-flush trial at 1.0 kg a.i./ha of oxyfluorfen, white spruce had a root weight mean significantly lower than the other treatments.

The three week post-emergence napropamide treatment significantly reduced 1+0 lodgepole pine root weight relative to the weeded but not the unweeded control. However, in no other circumstance did napropamide appear to affect, adversely, seedling growth.

The major weed species found in the 1+0 and 2+0 trials are listed in order of their frequency in Table 1. The value of the weed control data from the trials using 1+0 seedlings was compromised by the low number of weeds present. Low numbers were partially due to the storage of the seedlings in the greenhouse between spray applications. Only the pre-emergent treatments on 1+0 Douglas-fir seedlings had enough weeds for statistical analysis of weed number, weed weight, and moss weight. Treatment significantly affected moss weight only. Moss weights in the weeded and unweeded control treatments were significantly greater than those of the 0.5 kg a.i./ha and 1.0 kg a.i./ha oxyfluorfen treatments. Despite the lack of data, a survey of total weed fresh weights for the 1+0 trials indicates that in all cases herbicide applications were associated with weed weights lower than the control weed weights. Consequently, some weed control can be assumed.

All trials using 2+0 seedlings produced enough weeds to allow statistical analysis. Pre-flush and three-week post-flush oxyfluorfen treatments on 2+0 seedlings provided some dicot and monocot weed control, with a reduction in the number and/or weight of weeds in most cases. The six-week post-flush oxyfluorfen treatments did not provide weed control, probably because the weeds were too large to be killed. In addition, no treatment in any trial significantly reduced either liverworts or moss fresh weight.

Napropamide did not reduce the amount of weeds or moss in any trial. In the six-week post-flush treatments this was probably due to the inability of the spray to penetrate the conifer canopy and reach the sites of weed seed germination. In addition, the label on this herbicide suggests it is most effective in soils containing 10% or less organic material. The planting mix used in these trials was 75% organic, possibly reducing the herbicide's effectiveness.

TABLE 1. Major weed and moss species found in 1+0 and 2+0 trials in order of frequency

<table>
<thead>
<tr>
<th>Weeds</th>
<th>Occasional weeds</th>
<th>Moss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireweed</td>
<td>Dandelion (Taraxacum officinale Weber)</td>
<td></td>
</tr>
<tr>
<td>Liverwort</td>
<td>Field Horsetail (Equisetum arvense L.)</td>
<td></td>
</tr>
<tr>
<td>Western Bittergrass</td>
<td>Spotted Cat’s Ear (Hypochoeris radicata L.)</td>
<td></td>
</tr>
<tr>
<td>Pearly Everlasting</td>
<td>Sedge (Carex lenticularis Michx.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Black Cottonwood (Populus trichocarpa Torr. and Grey)</td>
<td></td>
</tr>
<tr>
<td>(Epilobium angustifolium L.)</td>
<td></td>
<td>(Funaria hygrometrica Hedw. (Schofield 1969))</td>
</tr>
</tbody>
</table>

LITERATURE CITED


For further information on this project, contact:
Gwen Shrimpton
or Dave Trotter
Surrey Nursery
3605-192nd Street
Surrey, B.C. V3S 4N8
(604) 576-9161