Herbicides for Weed Control in Tree Nurseries[1]

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Abstract.--Weed control during tree seedling production is of major importance. The Tree Nursery at Indian Head, Saskatchewan, Canada is currently using and testing herbicides to supplement the weed control program. Current uses include: chloroxuron for caragana sowings; chloroxuron or linuron for poplar and willow cuttings; trifluralin for Siberian elm sowings; linuron for choke cherry sowings, conifer transplants and all 1-0 deciduous crops. Promising treatments for future use include: EPTC for caragana sowings, chloramben for honeysuckle sowings, oxyfluorfen for poplar and willow cuttings and conifer sowings and linuron for green ash sowings.

INTRODUCTION

The PFRA Tree Nursery at Indian Head, Saskatchewan, Canada annually produces six to seven million deciduous and coniferous bare root seedlings for distribution to over ten thousand applicants. These seedlings are utilized in field, farm and roadside shelterbelts as well as wildlife and municipal plantings where they reduce wind erosion, provide snow control, food and shelter for wildlife and add aesthetic value.

Good weed control is a major part of seedling production and requires the use of herbicides in addition to the usual manual and mechanical weed control operations. Over the past 25 years the Tree Nursery at Indian Head has been involved in investigative work to establish herbicide practices which can be incorporated into production of bare root tree seedlings.

Major nursery crops at Indian Head include: caragana (Caragana arborescens), green ash (Fraxinus pennsylvanica lanceolata), willow (Salix spp.), poplar (Populus spp.), villosa lilac (Syringa villosa), Manitoba maple (Acer negundo), Siberian elm (Ulmus pumila), choke cherry (Prunus virginiana melanocarpa), buffaloberry (Shepherdia argentea), Colorado spruce (Picea pungens), white spruce (Picea lauca), and Scots pine (Pinus sylvestris).

Herbicides are used during the first year of production for all of the nursery crops listed except green ash, villosa lilac, Manitoba maple and buffaloberry. Work is ongoing for green ash, villosa lilac and honeysuckle (Lonicera tatarica) with additional work to evaluate new chemicals for caragana, poplar, willow, and conifers.

Herbicide Treatments Currently Used in Seedling Production

Immediately after sowing caragana, chloroxuron (Tenoran 50 WP) is applied at 5.6 kg/ha. Overhead irrigation provides incorporation. This treatment has generally provided satisfactory results, however, organic matter content of the soil would appear to be a limiting factor as indicated in a 1979 study in which poor control occurred where organic matter content was 5.0 percent and good control was achieved in areas where the soil contained 3.0 percent organic matter. Increased rates of chloroxuron were tested in an attempt to overcome the decreased herbicidal affect caused by adsorption to soils containing higher levels of organic matter. Weed control at 10.0 kg/ha was not significantly better than 6.0 kg/ha, therefore the 6.0 kg/ha rate was retained. Chloroxuron application has no adverse affect on caragana and, in some instances, has actually resulted in increased growth.

Chloroxuron or linuron (Lorox L 48%F or Afolan F 45%F) are used during the production of rooted poplar and willow hardwood cuttings. Investigative trials indicated that linuron at 2.2 kg/ha or chloroxuron at 5.6 kg/ha could be safely applied after planting but before bud break. Even though initial testing was conducted using clones of northwest poplar (Populus jackii 'Northwest'), Walker poplar (Populus x deltoides 'Walker'), acute willow (Salix acutifolia) and laurel willow (Salix pentandra) more recent testing has indicated Walker poplar may be adversely affected by linuron application. If these results are confirmed, chloroxuron will be substituted for linuron for Walker poplar production. It should

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be noted that application of either linuron or chloroxuron should be followed by overhead irrigation to provide soil incorporation.

Many undesirable characteristics of Siberian elm have caused the Tree Nursery to drastically reduce production of this species. In fields used to produce this crop, trifluralin is applied at 1.1 kg/ha and incorporated to a depth of 7 to 10 cm seven days before sowing. Occasionally this trifluralin treatment has been observed to cause some reduction in Siberian elm top growth. This reduction is not of concern as it improves the top to root ratio and the elm are still of sufficient size at harvest time.

The Tree Nursery produces approximately 200,000 choke cherry per year. Linuron is applied at 1.7 kg/ha in late fall after the choke cherry are sown. Precipitation during the fall and winter provide incorporation of the herbicide. This linuron treatment progressed through the Tree Nursery's testing program without complication and after three years, refinement of rate and application timing were established. The treatment has been included in Nursery production practices for a number of years and has not caused any adverse affects on choke cherry sowings.

Bare root conifer production at Indian Head involves a two year period of seedbed growth followed by two years growth in the transplant area: three years for Colorado spruce. Considerable work has been conducted in an attempt to find an acceptable herbicide that can be applied preemergence for weed control in seedbeds of Colorado spruce, white spruce and Scots pine. The most promising herbicide tested, which is unfortunately no longer available, was fluorodifen (Preforan) a Ciba-Geigy product. Other promising herbicides tested included: napropamide (Devrinol), bifenox (Modown) and oxyfluorfen (Goal). The one which is currently of interest and still being tested is oxyfluorfen. Its application has resulted in some injury to conifer seedlings, however a reduction in rates of herbicide application may provide the desired margin of safety. A rate of 0.5 kg/ha is currently being tested.

In the conifer transplant area weed control is provided by linuron application at 2.2 kg/ha after transplanting and at 1.5 kg/ha applied each fall thereafter. Linuron application has not resulted in a residual buildup nor has it been found to have moved beyond a depth of 5.0 cm in the clay loam soil.

All deciduous species which require more than one growing season to produce receive a linuron application at 1.7 kg/ha in the fall of the first year, once the abscission layer has formed. This treatment is particularly effective for control of winter annuals such as flixweed (Descurainia sophia), stinkweed (Thlaspi arvense) and shepherd's-purse (Capsella bursa-pastoris).

Herbicide Treatments Currently Being Tested for Use in Seedling Production

Several herbicides are presently being tested. Alternate treatments for weed control in caragana sowings include: EPTC (Eptam 80% EC), applied and incorporated prior to sowing, and 2,4-DB (Cobutox 40% EC), applied overall when caragana are in the first to fourth trifoliate leaf stage.

Results for the EPTC treatments have been very promising with no significant reduction in the stand or growth of caragana (table 1). At a rate of 4.0 kg/ha, EPTC has consistently provided excellent weed control.

Unfortunately, 2,4-DB has not provided the same kind of consistently promising results that EPTC has (table 2). A greenhouse trial in 1984 and a field study in 1985 resulted in 2,4-DB injury to caragana seedlings even though seedlings in 1982 and 1984 field studies did not show any such injury symptoms. Based on these results further evaluation is needed.

Linuron is currently being tested for use in green ash production. It has been tested in 1982 and 1983 and is scheduled for further testing in 1985. Test results to date indicate the most promising treatment is a fall application of 2.0-2.5 kg/ha applied after sowing (table 2).

Even though tatarian honeysuckle is a minor crop at the Tree Nursery some herbicide work has been conducted on this species Chloramben is the herbicide of interest and has shown considerable promise for preemergence use in honeysuckle sowings. In 1982, chloramben was applied preemergence to plots which had been sown to honeysuckle the previous fall and at 4.0 kg/ha provided fair weed control with no adverse affects on the honeysuckle (table 3). To further pursue this use of chloramben, rates of 4.0 to 6.0 kg/ha were applied in the fall of 1982, after sowing, and in the spring of 1983, before crop and weed emergence. All of the treatments except the 4.0 kg/ha rate, spring applied, provided good to excellent weed control, again without adverse affects on the honeysuckle. An additional study was conducted in 1984, testing rates of 4.0 to 7.0 kg/ha fall applied after sowing or spring applied prior to crop and weed emergence. All of the treatments provided good to excellent weed control with no adverse affects on stand or growth of honeysuckle.

Two factors have been taken into consideration during the planning of the current herbicide studies for poplar and willow cuttings. Firstly, inconsistent weed control with chloroxuron resulting from herbicide adsorption to soil organic matter and secondly, the possible negative effect of linuron application on the rooting and development of Walker poplar cuttings.

In a 1985 field study, the treatments of most interest involved oxyfluorfen at 0.5 and 1.0 kg/ha. Both rates provided satisfactory results for use in production of rooted poplar cuttings. For willow production, it appears rates exceeding

0.5 kg/ha may result in significantly reduced growth.

During grounds maintenance operations, at Indian Head, glyphosate (Roundup 36% SN) was applied to control unwanted brush of which lilac was a component. The lilac was not controlled indicating that the morphology of the lilac leaves and/or physiology of the lilac plants provided some degree of tolerance to glyphosate. In light of this it was decided to conduct a greenhouse screening study using low rates of glyphosate, applied at various leaf-stages. Initial rates tested were 1.0, 1.5 and 2.0 kg/ha applied when the villosa lilac seedlings were in the cotyledon, two and four leaf-stages. Results were very encouraging for all treatments except the 2.0 kg/ha rate, applied at the cotyledon stage, which reduced the stand and resulted in seedling injury.

Since the greenhouse screening in 1982 glyphosate has been tested on three occasions for villosa lilac sowings. The first time, rates of 1.0-2.5 kg/ha applied at the four to eight leafstage proved unsatisfactory. In 1983, rates of 0.50 and 0.75 kg/ha showed marginal acceptability: the seedlings recovered and achieved near normal growth in 1984.

In a study conducted in 1985, glyphosate at 0.25, 0.50 and 0.75 kg/ha alone and with the addition of concentrated sulfuric acid at 0.25% volume per volume was applied when villosa lilac were in the six to eight leaf-stage. Results indicate that a rate of 0.50 kg/ha with H_2SO_4 added will provide adequate weed control with some yellowing and stunting of villosa lilac seedlings (table 4). It is expected that these seedlings will recover and achieve normal growth in 1986.

CONCLUSION

As can be seen from the information reported herein, it takes at least three years, even if everything goes well, before a treatment can be considered for inclusion in a nursery's herbicide program. With the development and inclusion of each new herbicide treatment a nursery is able to increase the weed control options available, decrease labor requirements and reduce costs.

Table 1.--Stand, growth and weed control in caragana sowings as affected by EPTC application[1]

Treatment	Rate 1983	Rate 1984	Type of application	Stand 1983	Stand 1984	Growth[2] 1983	Growth[2] 1984	Weed[3] control 1983	Weed[3] control 1984
	(kg/ha)			(#/0.5m)	(#/2m)	(g)			
Check weeded	-	-		57	88	1.16	0.65	-	-
Check not weeded	-	-		100	72	1.89	0.52	0.0**	0.0**
EPTC	2.5	-		71	-	1.27	-	6.0	-
EPTC	3.0	3.0	Pre-sow	96	48	1.27	0.61	7.3	7.0
EPTC	3.5	3.5	incorporated	138	57	1.24	0.50	8.7	6.7
EPTC	4.0	4.0		82	69	1.28	0.48	8.8	8.6
EPTC	-	4.5		-	81	-	0.60	-	7.8

[1]Data based on means of three and four replications in 1983 and 1984, respectively.
[2]Growth: top dry weight per ten seedlings.
[3]Weed control: 0-no control, 9-complete control.
**Significantly less than for best weed control (P=0.01).

Table 2.--Stand, growth, seedling injury and weed control in fall sown green ash during 1983 as affected by linuron application[1]

Treatment	Rate	Time of application	Stand	Growth[2]	Seedling[3] injury	Weed[4] control
	(kg/ha)		(%)	(g)		
Check weeded	-		14	2.2	1.4	-
Check not weeded	-		17	2.2	2.7	0.0++
Linuron	1.5	Fall	16	2.5	3.1	6.1
Linuron	2.0	Fall	14	2.1	22.6	7.5
Linuron	2.5	Fall	16	2.1	19.2	7.8
Linuron	3.0	Fall	19	1.4	19.1	7.0
Linuron	1.5	Spring	19	1.8	13.4	2.3++
Linuron	2.0	Spring	12	1.9	26.8*	8.7
Linuron	2.5	Spring	13	1.7	26.6*	8.4
Linuron	3.0	Spring	14	1.4	53.9**	8.4

[1]Data based on means of four replications.
[2]Growth: top dry weight per seedling.
[3]Seedling injury: percent of seedlings with necrotic leaves.
[4]Weed control: 0-no control, 9-complete control.
*,**Significantly greater than for check weeded (P=0.05) and (P=0.01).
++Significantly less than for best weed control (P=0.01).

Table 3.--Stand, growth and weed control in honeysuckle sowings as affected by preemergence chloramben application[1]

Treatment	Rate 1982	Rate 1983	Rate 1984	Time of application	Stand 1982	Stand 1983	Stand 1984	Growth[2] 1982	Growth[2] 1983	Growth[2] 1984	Weed control[3] 1982	Weed control[3] 1983	Weed control[3] 1984
	(kg/ha)				(#/.3m)	(#/.5m)	(#/.5m)		(g)				
Check weeded	-	-	-		47	83	19	1.7	1.0	10.8	-	-	-
Check not weeded	-	-	-		46	78	21	1.6	1.9	10.2	0.0**	0.0**	0.0**
Chloramben	-	4.0	4.0	Fall after sowing	-	70	19	-	1.6	9.8	-	7.7	6.8
Chloramben	-	5.0	5.0		-	85	24	-	1.4	8.9	-	7.5	7.5
Chloramben	-	6.0	6.0		-	58	26	-	1.6	9.7	-	8.4	7.2
Chloramben	-	-	7.0		-	-	27	-	-	10.1	-	-	7.8
Chloramben	2.0	-	-	Spring prior to crop and weed emergence	45	-	-	1.9	-	-	2.5**	-	-
Chloramben	3.0	-	-		44	-	-	1.7	-	-	4.7*	-	-
Chloramben	4.0	4.0	4.0		53	71	17	1.5	1.6	12.6	6.1	5.0*	6.7
Chloramben	-	5.0	5.0		-	87	23	-	1.5	13.2	-	6.7	7.6
Chloramben	-	6.0	6.0		-	73	21	-	1.6	9.4	-	7.5	8.1
Chloramben	-	-	7.0		-	-	24	-	-	10.9	-	-	7.9

[1]Data based on means of four replications.
[2]Growth: top fresh weight per seedling.
[3]Weed control: 0-no control, 9-complete control.
*,**Significantly less than for best weed control (P=0.05) and (P=0.01).

Table 4.--Preliminary results for seedling injury and weed control in villosa lilac sowings as affected by glyphosate application at the six to eight leaf stage[1]

Treatment	Rate	Seedling[2] injury	Weed[3] control
	(kg/ha)		
Check weeded	-	0.0	-
Check not weeded	-	0.0	0.0
Glyphosate	0.25	0.4	0.4
Glyphosate	0.50	3.3**	2.5
Glyphosate	0.75	3.9**	8.4
Glyphosate plus H_2SO_4	0.25 0.25% v/v	1.4**	0.7
Glyphosate plus H_2SO_4	0.50 0.25% v/v	3.2**	6.9
Glyphosate plus H_2SO_4	0.75 0.25% v/v	4.2**	8.1

[1]Data based on means of four replications.
[2]Seedling injury: 0-no yellowing, 9-severe yellowing.
[3]Weed control: 0-no control, 9-complete control.
**Significantly more than for check weeded (P=0.01).