

## 13. SILVICULTURE

TO: INFORMATION SECTION  
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Summary

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Thirty-three abstracts were submitted on field trials in burns, cutover regeneration, forest nurseries, plantations, greenhouse, Bracke mounds, manual treatments and reed grass sites at 19 areas in British Columbia, Alberta (8), Saskatchewan (3) and Ontario (3).

Hexazinone liquid was used in 26 trials, singly or in combination, followed by glyphosate (6), hexazinone granular (2) with triclopyr dalapon, Herbec 20 and Spike 80W used in one trial each. These were applied aerially with microfoil or standard booms, exact-delivery spot gun, cyclone seeder, hand operated or CO<sub>2</sub> backpack sprayers, by hand or Herd 1-92 granular applicator. Timing varied, with both spring or fall showing equally good results and generally poor for summer applications.

The hosts were predominantly spruces, followed by lodgepole pine, red pine, Douglas fir, alpine fir and hemlock while the target species were generally aspen-poplars, birch, willows, alders, dogwood, salal and other shrubs. Grasses and ferns were also a major problem area.

Results varied, covering numerous soil types and depth of organic cover. Hexazinone liquid or granular gave continued excellent results on aspen-poplars, birch, willows, dogwoods, grasses, ferns and large numbers of shrubs with control levels increasing the second year. In British Columbia, a number of trials showed little to no effects due to the drought conditions existing through most of 1985. Good controls were noted on grasses, extending well into second and third year - as well the growth response on white spruce was notable. Lodgepole and jack pine are much more sensitive to hexazinone while red pine exhibits considerable tolerance. The white spruce injured during initial spot, broadcast or aerial treatments recovered rapidly depending on degree of chlorosis.

Large scale granular hexazinone applications were very effective on grasses, poplars and shrubs, but rose, willow and alder exhibited differential tolerances. Glyphosate was used singly or in combination with dalapon. Results were good on site preparations on lady fern and grassy sites into the second year in B.C., on red pine plantations in Ontario and on conifer release for Sitka spruce in B.C. In some cases glyphosate gave good controls but considerable regrowth occurred in the second year or was followed by an increase in undesirable dogwood or grasses.

Triclopyr, Herbec-20, Spike 80W (tebuthiuron), hexazinone, 2,4-D and glyphosate were evaluated for weed control in red pine plantations. Triclopyr, glyphosate and hexazinone showed the most promise. Translocation of glyphosate under forest conditions indicated that it is highly phloem mobile in alder, birch, accumulating in the leaves, stems and roots. Evaluations of a modified sprayer for herbicide applications in small field plots showed a greater degree of weed control and coverage. Further testing will follow.

CONIFER release with hexazinone and spot gun on spring application.

Drouin, J.A. The trial site is located in a burn at Slave Lake, Alberta, south of the Faust Reforestation Project at Strawberry Creek, most of which was aerially seeded to white spruce in 1969. The site supports an overstory of 16-year-old aspen, balsam poplar, birch and an understory of aspen, balsam poplar, willows, cranberry, rose and currant, as well as white spruce ranging from 32 cm to 1.8 m. Two treatments were applied: 1) 4 ml of undiluted hexazinone (240 g a.i./litre) at 2 meter grid spacing, and 2) 8 ml of hexazinone at 1.5 m grid spacing. Each treatment was replicated once, measures 20 by 50 meters and one control plot. The hexazinone was delivered with an exact delivery spot gun calibrated for both treatments. The applicator applied the spots at 1.5 and 2 m spacings and avoided where possible hitting the crop trees. Assessment of per cent defoliation on 30 overstory tagged deciduous, 28 understory trees/shrubs and 80 white spruce hosts was carried out in the fall and for 3 successive years. All tagged species were assessed for per cent control on each of twenty 5 m<sup>2</sup> assessment subplots.

TREATMENT		% DEFOLIATION						
HEXAZINONE SPOT IN ML	GRID SPACING (M)	OVERSTORY			UNDERSTORY			
		ASPEN	BIRCH	ASPEN	BIRCH	WILLOWS	*CRAN.	**CURR.
4	2.0	8	8	9	7	5	3	4
4	2.0	9	9	9	9	7	4	5
8	1.5	9	9	9	9	9	9	9
8	1.5	9	9	9	9	9	9	9

\* CRANBERRY \*\* CURRANT

Very effective defoliation of the overstory and understory including grasses noted at both rates. The 4 ml x 2.0 m spacing is clearly superior exhibiting good "window" opening of both over/understory and minimal host mortality or chlorosis. (Canadian Forestry Service, Edmonton, Alberta).

GRASSY site preparation using four herbicides, 2nd year results.

Fahlman, R. and Herring, L.J. Four herbicides were tested as a site preparation treatment for control of Scribner's reed grass and fireweed on a backlog site in the Peace River region of B.C. The experiment employed a completely randomized design consisting of 3 replicates of 4 herbicides plus controls. Treatment plots were 20 x 20 m, with twenty 5 m<sup>2</sup> assessment plots within each treatment plot. Glyphosate was applied by backpack sprayer on July 16, 1983. Other treatments were carried out on May 3, 1984. Dalapon and liquid hexazinone were applied with a knapsack sprayer and hand-held spray boom. A cyclone seeder was used to distribute granular hexazinone (10%). Post-spray planting of white spruce plugs (PSB 415) was completed on May 26, 1984. Percent control of weed species was rated on the basis of reduction in percent cover. The level of reed grass control, after one and two growing seasons is presented below. There was no significant reduction in fireweed cover for any of the treatments. Heavy frost damage to crop seedlings occurred in all treatments, precluding any meaningful response assessments.

Treatment	Rate kg/ha	Reed Grass 2 years	% Control 1 year
control	0	0 a	0 a
dalapon	6	32 ab	11 a
glyphosate	3	38 ab	69 b
granular hexazinone	3	56 bc	43 ab
liquid hexazinone	3	75 c	47 b

Means compared by Duncan's multiple range test ( $P = 0.05$ ).

After two growing seasons, the liquid and granular hexazinone treatments gave the best control of reed grass, reducing cover by 47% and 43% respectively. Glyphosate gave good control in the first growing season but considerable regrowth occurred in the second year. Dalapon did not significantly reduce reed grass cover in either year. (B.C. Ministry of Forests, Research Branch, Victoria, B.C.).

GLYPHOSATE for brown and burn site preparation. Herring, L.J. and Fahlman, R. Use of glyphosate spray followed by prescribed burning as a site preparation treatment was tested on a backlog area, near Dawson Creek, B.C. The site had been subjected to repeated wildfires over the past twenty years and at the time of treatment it supported a 2 to 3 m high cover of trembling aspen, with minor components of balsam poplar, willow and alder. Scribner's reed grass was prevalent beneath the canopy and within open areas. On June 23, 1983, glyphosate (3 kg ai/ha) was aerially applied to one half of the site, using a Simplex Model 2700 sprayer attached to a Bell 206B helicopter. Airspeed was 60 km/hr, with a spray pressure of 275 kPa and a swath width of 13 m. In April of 1984, both the sprayed and unsprayed portion of the site was burned. The fire was carried throughout the site by the dried mat of reed grass. The burn was relatively light affecting only the organic L layer. In May 1984, 3 replicates, each consisting of twenty 5 m<sup>2</sup> subplots were established in sprayed and unsprayed portions of the burns. Each subplot was centred on a planted (PSB 313) white spruce seedling. Two growing seasons after treatment the subplots were assessed for vegetative competition and crop tree response. There were no significant differences in seedling growth performances between the two treatments. Results of target vegetation assessments and analysis of variance ( $P = 0.05$ ) are given below.

Weed Species	Burned	Sprayed and Burned
reed grass % cover	26% a	63% b
trembling aspen shoots/ha	19,700 a	1800 b
balsam poplar shoots/ha	3,900 a	0 b
alder shoots/ha	2,100 a	0 b
willow shoots/ha	1,250 a	730 a

Although significant reductions in both poplar species and alder occurred in the sprayed treatment, the % cover of reed grass was greatly increased by spraying. This could have been due to a reduction in other competing vegetation, or the increased amount of dead plant material on the sprayed plots may have caused a hotter burn resulting in a more favourable seedbed for grass germination. In any event, the spray and burn technique did not result in an overall reduction in vegetative competition. (B.C. Ministry of Forests, Prince George, B.C.).

LIQUID hexazinone for grass control on Bracke mounds. Fahlman, R. and McArthur, S. The site, near Fort St. John, B.C. was winter-logged in 1983. Windrowing was followed by Bracke-mounding in October, 1984. Soils were imperfectly drained silty clay loams to silty clays and domination of the site by Scribner's reed grass was considered likely. Experimental layout was completely randomized, with 4 replicates of 4 rates of hexazinone liquid (0,2,4 and 6 kg ai/ha). Each replicate consisted of twenty, 0.5 m radius assessment plots, each centred on a Bracke mound. On April 24, 1985 herbicide was spot-applied to a 0.6 m radius over each mound. A CO<sub>2</sub> back-pack sprayer with a solid cone nozzle was used, delivering approximately 60 ml of solution per spot. Mounds were planted with PSB 313 white spruce seedlings on May 30, 1985. Vegetation assessment was done August 21.

	Hexazinone kg (ai)/ha			
	0	2	4	6
% cover of reed grass	4.6a	2.2b	1.5b	1.7b
% crop tree mortality	2.4a	19b	15ab	49c
% crop trees with necrotic or chlorotic foliage	4.3a	32b	26b	73c

ANOVA done on arc sine transformed data. Means tested by Duncan's new multiple range test (P= 0.05).

Due to a relatively dry summer, there was minor invasion of the mounds by reed grass. As results indicate, considerable mortality and crop tree injury was observed in the treated plots. Further assessments are required to better evaluate tolerance and efficacy. (B.C. Ministry of Forests, Research Branch, Victoria, B.C.).

SITE preparation with glyphosate. Herring, L.J. and Fahlman, R. In August 1983, a site preparation trial using glyphosate at 2.25 kg/ha was carried out on a site at Ames Creek, near Prince George which was logged in 1980. The site supported a dense cover of lady fern and fireweed. The experiment employed a randomized block design with 6 replicates each of glyphosate and control treatments. Treatment plots consisted of 4.5 x 40 m swaths. Ten assessment sub-plots (5 m<sup>2</sup>) were located within each treatment plot. Herbicide was applied on August 5, 1983 using a knapsack sprayer and hand-held spray boom. Planting with 2+0 BR white spruce was done in mid-May 1984. Results obtained 2 growing seasons after treatment are presented below. Three major weed species were assessed: lady fern, fireweed and red elderberry. Analysis of variance ( $P = 0.05$ ) was carried out on height data and on arc sine transformations of % cover data. Crop tree response data was not available for inclusion in this abstract. However, in the glyphosate treatment, 40% of the seedlings were classed as free to grow and only 18% were overtapped, whereas in the control treatment 0% were free to grow and 73% were overtapped.

Treatment	lady fern		fireweed		elderberry	
	% cover	avg ht (cm)	% cover	avg ht (cm)	% cover	avg ht (cm)
control	34	77.0 a	28 a	97.0 a	16 a	55.0 a
glyphosate	1	3.0 b	20 a	56.0 b	26 a	36.0 b

Means not followed by a letter in common are significantly different ( $P = 0.05$ ).

After two growing seasons, glyphosate gave excellent control of lady fern with respective reductions in cover and height of 97% and 96%. Percent cover of fireweed was not significantly different from the control, but height was reduced by 42%. Percent cover of elderberry was not reduced, although a significant height reduction of 35% was recorded. (B.C. Ministry of Forests, Prince George, B.C.).

HEXAZINONE liquid for site preparation following disk ing. Fahlman, R. and Herring, L.J. The site, near Dawson Creek, B.C., was within a backlog area which supported an aspen, mixed shrub and reed grass community. Soil was a moderately well-drained sandy loam. Site was cleared and disked in late October, 1984. The trial consisted of three 0.04 ha plots of each of two treatments, a control and a relatively heavy (7 kg ai/ha) rate of liquid hexazinone. On May 8, 1985, herbicide was broadcast using a CO<sub>2</sub> backpack sprayer. Delivery rate was 120 L/ha at a pressure of 138 kPa.<sup>2</sup> A 3 m swath width was achieved with a red polijet nozzle. Within each plot, twenty 5m<sup>2</sup> subplots were assessed. Target species were poplars (trembling aspen and balsam poplar), fireweed and Scribner's reed grass. Spruce seedlings will be planted in the spring of 1986. After one growing season, there was no evidence of herbicide control or damage within the treatment plots. A very dry summer may have reduced the mobility and uptake of the herbicide. Further assessments will be carried out. (B.C. Ministry of Forests, Research Branch, Victoria).

GRASSY site preparation with hexazinone, 2nd year results. Fahlman, R. and Herring, L.J. Spring application of 4 rates (0, 2, 4 and 6 kg/ha) of liquid hexazinone was tested in a completely randomized experiment with 3 replications of 0.04 ha plots. The site, near Dawson Creek, B.C., had been blade cleared in February, 1983 and supported a dense cover of Scribner's reed grass, fireweed, and poplar coppice and suckers. Soils were moderate to imperfectly drained fine sandy loams, with an LFH layer of 8 to 24 cm. On April 11, 1984, herbicide was applied by a knapsack sprayer with a hand-held spray boom. Delivery rate was 625 L/ha. Heavy rainfall, at the test site, was recorded during mid-May. Plots were planted with bareroot 2+1 white spruce seedlings on May 4, 1985. After two years, there was no observable effect of the herbicide on fireweed or poplars (balsam poplar and trembling aspen). Although there was a trend towards increasing control of reed grass with increasing herbicide concentration, within treatment results were highly variable, likely due to the varying depth of the soil organic layers. No significant differences ( $p= 0.05$ ) were found. Based on percent cover, average control of reed grass varied from 32% at 2 kg/ha to 59% at 6 kg/ha. For the 3 spray treatments, the overall level of control was 17% higher in the second year than the first, suggesting hexazinone was still active in the soil during the second growing season. On all treatments, planted seedlings had suffered heavy frost damage, precluding any meaningful response assessment. However, little damage attributable to herbicide was observed. (B.C. Ministry of Forests, Research Branch, Victoria, B.C.).

HEXAZINONE liquid for site preparation following a breaking-plow.

Fahlman, R. and McArthur, S. The site, near Chetwynd, B.C. was a backlog area which had supported a mixed shrub and reed grass community. Site was cleared and plowed in October, 1984. Soil was a well-drained sandy loam. Experimental design was completely randomized with 4 replicates of 4 rates of hexazinone liquid (0, 2, 4 and 6 kg ai/ha). Individual replicates consisted of a spray swath 3 m wide and 60 m long, which was centred over a furrow-slice created by the breaking-plow. Twenty, 0.5 m radius assessment subplots were located within each replicate. On May 10, 1985 herbicide was applied by a CO<sub>2</sub> backpack sprayer, with a delivery rate of 132 L/ha, at a pressure of 138 kPa. On August 20, 1985 the site was summer planted with PSB 313 white spruce stock and treatment efficacy was evaluated the same day. At the rates applied, there was no evidence of control or damage to any of the major target species ie. Scribner's reed grass, fireweed, willow or balsam poplar. A very dry summer may have adversely affected herbicide efficacy. Crop tree tolerance and a further assessment of target vegetation efficacy will be done in 1986. (B.C. Ministry of Forests, Research Branch, Victoria, B.C.).

CONIFER release with hexazinone liquid. Pollack, J.C. Three rates of 25% liquid hexazinone and a manual cutting treatment were tested in a twenty replicate trial near Burns Lake, B.C. on June 28, 1984. Liquid hexazinone was applied with spot guns at 1.68, 3.36 and 5.04 kg a.i./ha rates on a 2.25 m grid in 20-m<sup>2</sup> plots. Willow was the target species in an established two-year-old white spruce plantation originally planted with bare root stock. Soils were loamy brunisolic grey luvisols with 2 cm of surface organic material. A single crop tree and weed tree were assessed in each plot before treatment, and one and two growing seasons after treatment. Rainfall totalled 19.0 mm in the week, and 36.1 mm in the month, following treatment. First growing season results were reported in the 1984 ECW abstracts, and second growing season results are presented in the table which follows. (B.C. Ministry of Forests, Smithers, B.C.)

Rate (ha)	Weed Control <sup>1,2</sup> (0-9)	Crop Tolerance <sup>1,2</sup> (0-9)	Coppice Growth <sup>2</sup> (new stems/old stems)
Check	0.0 a	8.8 a b	0.0 a
1.68 kg	8.3 b	8.5 b	0.4 a
3.36 kg	8.6 b	9.0 a	0.1 a
5.04 kg	7.8 b	8.9 a	0.3 a
Manual Control	4.8 c	9.0 a	3.3 b

1 Based on a visual rating.

2 Means not followed by a letter in common are signif. diff. (P = 0.05).

SITE preparation with granular hexazinone. Pollack, J.C. and van Thienen, F. Three rates of 10% granular hexazinone and a manual cutting treatment were tested in a twenty replicate trial near Burns Lake, B.C. on June 17, 1985. Granular hexazinone was applied by hand at 2.0, 3.0 and 4.0 kg a.i./ha in 20-m<sup>2</sup> circular plots. The test site occupied an area burned by wildfire in 1961 in which standing snags had been windrowed and burned. Willow, the target species, occupied 45% of the area by percent cover, and averaged 107 cm in height at the time of treatment. Soils were loamy brunisolic grey luvisols with 1 - 2 cm of surface organic materials. A single weed tree was assessed in each plot before treatment, and on Sept. 3, 1985 one growing season later. Weather was hot (22° C) and windless at the time of application. In the first 15 days after application, 31.8 mm of rain were recorded. First year damage to willow, rated on the basis of percent defoliation, are shown in the table which follows (B.C. Ministry of Forests, Smithers, B.C.):

Rate (ha)	Weed Control <sup>1,2</sup> (0-9)	Coppice Growth <sup>2</sup> (new stems/old stems)
Check	0.0 a	0.0 a
2.0 kg	4.1 b	0.0 a
3.0 kg	7.4 c	0.0 a
4.0	7.8 c	0.0 a
Manual Control	4.1 b	2.6 b

1 Based upon a visual rating.

2 Means not followed by a letter in common are signif. diff. (P = 0.05).

CONIFER release with glyphosate. Pollack, J.C. Three rates of glyphosate were tested in a late summer application near Hazelton, B.C. to release a hybrid (white x Sitka) spruce plantation on a silty-loam regosolic soil situated on a floodplain of the Skeena River. The site was logged prior to being planted with bare root stock in the spring of 1982. Herbicide treatment occurred on August 26, 1983 at which time crop seedlings exhibited well-formed terminal buds. A light rain fell within four hours of treatment, but the foliage was not soaked to the drip point. Backpack sprayers were used to deliver treatments of 1.0, 1.5 and 2.0 kg a.i. glyphosate / ha in total spray mix volume of 63.5 l/ha. The experimental design used randomized complete blocks with two replications and 0.5 ha plots. Twenty 10-m<sup>2</sup> subplots were systematically located within each plot. Subplot evaluation was made before, and one and two growing seasons after treatment. The second year results, based upon reduction in percent cover of weed species, are shown below:

Rate (ha)	Weed Control (0-9)			
	Cottonwood	Red Osier Dogwood	Snowberry	Thimbleberry
Check	0.0 a	0.0 a	0.0 a	0.0 a
1.0 kg	8.8 b	0.0 a	4.3 a	5.0 a
1.5 kg	8.9 b	0.0 a	6.7 a	6.9 a
2.0 kg	9.0 b	0.0 a	6.7 a	8.4 a

Means not followed by a letter in common are significantly different (P=0.05)

The ECW weed control scale did not reflect the increased area coverage of red osier dogwood which persisted into the second year. Species which increased in percent cover in the 1.5 and 2.0 kg a.i./ha treatments included wood reed grass, fireweed, red osier dogwood and rose. All crop seedlings in the project were free from glyphosate damage at the end of the second growing season (E.C.W. tolerance 9.0). (B.C. Ministry of Forests, Smithers, B.C.)

CONIFER release with glyphosate. Pollack, J.C. and van Thienen, F. A single rate of glyphosate was used in a late summer application at Kwinitsa, B.C. on a sandy-loam regosolic soil at the base of a colluvial fan on the Skeena flood plain. The productive coastal site was logged in the summer of 1978 and planted in the spring of 1979 with 2+1 bare root Sitka spruce nursery stock. Weed species at the time of application included salmonberry, red alder, red elderberry, stink currant, red osier dogwood and Cooley's hedge nettle. The site was sprayed on August 28, 1980 using a slip-on tank unit and high pressure hose. Weather was excellent during treatment of 2.0 kg a.i./ha glyphosate at 910 l/ha spray solution; no rain fell in the 24 hours following treatment. Two replicates of 0.3 ha control and treatment plots were used. After five years, weed species and crop tree response were assessed using 10 10-m<sup>2</sup> circular subplots and 25 crop trees per plot. Results are presented in the table below:

Variable	Check Plot	2.0 kg a.i./ha
Sitka spruce		
total height (**)	1.00 m	2.15 m
1985 height increment (**)	0.09 m	0.50 m
Red alder		
percent cover (**)	97%	2%
height (**)	9.1 m	2.8 m
Salmonberry		
percent cover (n.s.)	44%	25%
height (*)	1.6 m	1.2 m
Lady fern		
percent cover (n.s.)	17%	6%
height (n.s.)	0.7 m	0.9 m
Red elderberry		
percent cover (n.s.)	9%	10%
height (*)	2.8 m	1.7 m

n.s. = not significant

\* = significant ( $P = 0.05$ )

\*\* = highly significant ( $P = 0.01$ )

Glyphosate treated plots contain dramatically larger crop trees after five years. Although understory vegetation has reoccupied the glyphosate plots, the present stature of the crop and the absence of red alder suggest; a second treatment will not be required. (B.C. Ministry of Forests, Smithers B.C.)

EVAULATION of Some Herbicides for Weed Control in Red Pine Plantations. Prasad, Raj.

Six herbicides and a hand cutting method were employed to investigate control of weeds (eastern alders, aspen and grasses) in a 5 year-old red pine plantation in Algoma district of northern Ontario (Searchmont and Thessalon). A field experiment with randomised block layout and with 3 replications (plot size - 5x5 m) was designed. Some herbicides (Garlon, Glyphosate, 2,4-D) were applied to foliage by a knapsack sprayer and some others (Velpar, Herbec-20 and Spike-80W) were applied through soil. Treatments were made in the middle of August 1982 when conifer needles were completely "hardened off". Observations on phytotoxicity and weed control were made in the following year (Aug./84). Garlon, Roundup, Herbec-20, Spike-80W were most effective against aspen while 2,4-D, Roundup, Garlon, Spike-80W were effective against eastern alder (*Alnus rugosa* Spreng.). Grasses were best controlled by Roundup, Spike-80W and Velpar. However, both Herbec-20 and Spike-80W were extremely phytotoxic to red pine and seemed more suited for possible site preparation or industrial vegetation control. Even though Herbec-20 was very efficacious against aspen, it did not completely kill the alders. Profuse coppicing of alder stumps was visible in plots cut manually; similarly aspen resprouted heavily in plots cut manually (by hand); resprouting was more frequent in plots treated with 2,4-D and Garlon than with other herbicides.

Treatment	Rate (per ha)	Method of Treatment	Weed Control (%)			Resprouts - No.		Crop Tolerance (%)
			Alder	Aspen	Grasses	Alder	Aspen	
Control	-	-	01	0	0	0	0	0
2,4-D (amine)	6L	F.S. <sup>2</sup>	74.4	81.1	0	150	18.3	100
Garlon (triclopyr)	6.5L	F.S.	81.4	96.7	0	35	25.3	100
Roundup (glyphosate)	5L	F.S.	100	98.6	63.3	0	11	100
Herbec-20 (tebuthiuron)	14kg	S.A.	0	98.5	44.4	0	12	0
Spike-80W (tebuthiuron)	8kg	S.A.	96.7	100	58.9	6.7	0	0
Velpar (hexazinone)	10L	S.A.	18.9	98.7	52.2	6.7	2.7	100
Manual Cut (by hand)	-	-	60.5	76.7	0	235	41.3	100

<sup>1</sup> 0 = no control and/or tolerance, 100 = complete control and/or tolerance

<sup>2</sup> F.S. = Foliar spray, S.A. = Soil application

Garlon, Roundup and Velpar seem quite promising for weed control in red pine plantations. Red pine seems more resistant to Velpar than jackpine and further experiments are underway to study the causes of this selectivity. (Forest Pest Management Institute, Canadian Forestry Service, Sault Ste. Marie, Ontario.)

EVALUATION of a Modified Sprayer for Application of Herbicides to Small Field Plots.  
Prasad, Raj and Dal Travnick. Herbicides are one of the most economical tools for forest management (site preparation and conifer release) and yet there is a great dearth of herbicides registered for forestry uses in Canada. Therefore, a new program of screening of newer compounds and/or their formulations was initiated at the Forest Pest Management Institute. This involves two steps: (i) a comprehensive laboratory and greenhouse screening trial is carried out to discover the potential activity of several promising compounds against a wide spectrum of forest weeds and (ii) when some of the selected candidates show good promise, they are evaluated under field conditions using a small field plot-technique so as to determine the effects of dosage rates, droplet size, volume rates, formulation characteristics and weather parameters on the efficacy. A modified sprayer system for delivering uniform application rate to small field plots was developed and tested under forestry conditions near Thessalon, Ont. The target species was predominantly aspen, 2-3 m high and two types of plots, (a) rectangular or square (5 m x 5 m) and (b) circular (2.5 m in diameter) were used. Accordingly, the sprayer was designed to suit both types of plots and consisted of a boom with nozzles, upright handles and a pressurised handpump sprayer; the boom being made of two pieces of 1" aluminum pipes (each 3 m long) connected in the middle with a 3/4" straight coupling together with 10 flat spray, vari-spacing nozzles located on nine double-hose connectors + 1 single-hose connector, all with sliding clamps; a Tygon tubing (3/8") cut to length between nozzles was led from the boom to the sprayer; the boom attachment system was then mounted on two pieces of 1" aluminum pipes (3 m long) with a 3/4" single socket Tee, attached to each pipe to give an H-like appearance. These two upright handle pipes carried the boom (with nozzles) over the plots to be sprayed and depending upon the size of the brush, the height of the boom was adjusted accordingly. A garden sprayer (3 gallons, 30 psi) was connected to the boom and was carried by the operator on one side of the plot while the other side was supported by an assistant on the opposite side of the plot. In the circular plot design, the spraying system used only half of the boom and was mounted on only one handle, thus up to a 2.5-m radius could be sprayed in a circular manner.

The sprayer was locally assembled and was used to spray Velpar (10 L/ha) in 150 L of water to a stand of aspen; the delivery speed was ca. 4 mph and the boom was held at 40 cm above the canopy; application was made early in August 84 and the response (weed control) was monitored 3-4 weeks later.

Plot type	Weed control (%) <sup>2</sup>		
	Damage	Defoliation	Stem dieback
Rectangular <sup>1</sup>	80.1	53.2	5.1
Circular	91.8	95.0	13.3

<sup>1</sup> Average of three plots.

<sup>2</sup> 0% = no control, 100% = complete kill.

Results obtained from a preliminary trial suggest that the sprayer system functions properly and that the degree of weed control is slightly greater in circular than in the rectangular plots probably because of better coverage resulting from a slower speed. Further work is in progress (Forest Pest Management Institute, Canadian Forestry Service, Sault Ste. Marie, Ontario).

TRANSLOCATION of Glyphosate in Forest Weeds. Prasad, Raj. Glyphosate (Roundup) was recently registered for forestry uses (site preparation and conifer release) in Canada and is very effective in controlling many perennial weeds such as aspen, alder and birches, etc. However, re-sprouting is a serious problem with many of these perennial forest weeds and therefore a translocatable (phloem-mobile) herbicide that can move to underground parts following foliar applications and can thus produce systemic effects, would be rated as an efficient compound. Even though considerable research has been done with agricultural weeds, very little information is available on the penetration, distribution and accumulation of glyphosate in forest weeds. With this objective in mind, a greenhouse study was carried out to study the translocation profiles of glyphosate-C<sup>14</sup> in two forest weeds (eastern alder and white birch). Plants were grown in the greenhouse under controlled conditions of light intensity, temperature, relative humidity and nutrition for four months and a single and fully developed leaf of each species was fed with glyphosate-C<sup>14</sup> (1200 ppm) and glyphosate-C<sup>14</sup> (1200 ppm) plus an adjuvant (G3780A, 0.05%). There were three replications and after 2 weeks of feeding, plants were harvested, separated into leaf, stem and roots and counted for the radioactivity. While the radioactivity was extracted from these plant parts by a standard procedure, a gross autoradiographic study was also carried out to monitor the path of translocation in different plant parts.

Wood Species	Treatment	Content of radioactivity (cpm/g)			Total (cpm/g)
		Leaves	Stem	Roots	
Alder	a) Glyphosate alone	601	817	225	1643
	b) Glyphosate + adjuvant	883	1367	330	2580
White birch	a) Glyphosate alone	1617	10	375	2002
	b) Glyphosate + adjuvant	2008	167	450	2625

Results obtained from both qualitative and quantitative techniques demonstrated that glyphosate is highly phloem-mobile in alder and white birch and that accumulation takes place in leaves, stems and roots. The adjuvant was very effective in enhancing the penetration and as a result greater amounts of glyphosate moved into the underground parts (roots). These results, thus, suggest that glyphosate is an efficacious herbicide for perennial weeds because of its capacity to translocate and accumulate into underground parts (roots) of forest weeds. (Forest Pest Management Institute, Canadian Forestry Service, Sault Ste. Marie, Ont.).

HEXAZINONE Liquid for Conifer Release with Spot and Broadcast Methods  
Teskey, K.K. and Masterson, S.O.M. Location: Eastern slopes of the Cascade Mountains in the Babine Lake Valley, 34 km North of Burns Lake, B.C. The area was logged in 1976 during the winter with no site preparation. Planting of 1-0 plugs of lodgepole pine was done June 1980 (1600 plants/ha). The plants, including white spruce and alpine fir natural regeneration, range from one to three meters in height. Brush species of primary importance to be controlled are: alder, birch, douglas maple, rose and thimbleberry and the herbaceous component of fireweed. The soil texture is sandy loam. Four treatments of undiluted hexazinone liquid were applied using a spot gun at two grid spacings (1.5 m and 2 m) and two rates of delivery (4 and 8 ml per spot). The broadcast method using a solo backpack was put out using three rates of hexazinone liquid (240 g ai/l). The spray volume was 360 l/ha with a pressure of 200 kPa. The randomized trial design of 15 m by 15 m plots was replicated three times. The date of application was May 7, 1984, during cool and wet conditions. Assessments were done on September 17, 1984 and August 1, 1985.

ASSESSMENT: AUGUST 1, 1985  
UNDILUTED LIQUID SPOT

ML/SPOT	TREATMENT SPACING	PERCENT INJURY						PERCENT KILL				
		M	SW	PL	AL	B	M	AS	R	TB	CB	C
4	2.0	0	0	18	62	32	*	73	28	15	13	25
4	1.5	0	0	30	87	52	*	80	40	23	18	50
8	2.0	0	5	25	65	32	*	62	40	32	10	50
8	1.5	3	7	55	90	47	98	93	50	38	25	58

KG AI/HA

1.1	0	0	0	2	0	0	8	0	0	0	0	2
2.2	0	3	3	47	3	45	25	12	2	0	0	12
4.3	0	3	7	95	28	55	65	28	10	8	0	37
Control	0	0	0	0	0	0	0	0	0	0	0	0

\* no individuals in treatment

SW = White Spruce; PL = Lodgepole Pine; AL = Alder; B = Birch;  
M = Maple; AS = Ash; R = Rose; TB = Thimbleberry; CB = Cranberry;  
C = Currant; FW= Fireweed

Results: Very little injury occurred to conifers, with the white spruce exhibiting slightly greater tolerance than lodgepole pine. Brush and herbaceous species were suppressed during the second year after application with only birch being well controlled at the 1.5 m spacings and the high broadcast rate (4.3 kg ai/ha). (Du Pont Canada Inc. Calgary, Alberta).

HEXAZINONE Liquid for Conifer Release with Spot and Broadcast Methods.  
Teskey K.K. and Masterson, S.O.M. Location: Eastern slopes of the Cascade mountains, 14 km Southeast of New Hazelton, B.C. Logging of commercial timber was completed in 1979 with a residual felling in 1983. Lodgepole pine, white spruce, alpine fir and western hemlock exist presently as natural regeneration ranging from .5 m to 3 m in height. The major brush species are: aspen and birch. The soil texture is silt loam. Two rates of undiluted hexazinone liquid (4 ml and 8 ml per spot) were applied with a spot gun at two grid spacings (1.5 m and 2 m). The broadcast method using a solo backpack was put out using three rates of hexazinone liquid (240 grams ai/litre) at a spray volume of 360 litres per hectare at a constant pressure of 200 kPa. The randomized trial design of 15 m by 15 m plots was replicated three times. The date of application was May 8, 1984. At the time of application weather conditions were cool and wet. Assessments were made August 14, 1984 and August 1, 1985.

ASSESSMENT AUGUST 1, 1985  
UNDILUTED LIQUID SPOT

ML/SPOT	TREATMENT SPACING M	PERCENT INJURY				PERCENT KILL			
		WHITE SPRUCE	LODGEPOLE PINE	ALPINE FIR	WESTERN HEMLOCK	ASPEN	BIRCH	THIMBLE BERRY	FIREWEED
4	2.0	0	5	0	0	87	43	42	60
4	1.5	2	3	0	0	96	67	63	73
8	2.0	*	2	0	*	95	47	58	76
8	1.5	0	10	0	33	98	67	75	90
KG AI/HA									
1.1		0	0	0	0	2	0	0	0
2.2		0	0	0	0	65	30	10	8
4.3		0	0	0	0	93	77	50	40
Control		0	0	0	0	0	0	0	0

\* No individuals in treatment

Results: Injury to conifers in all broadcast treatments was 0%. Some lodgepole pine trees exhibited injury to spot gun treatments when the spots were applied closer than 1 metre to the stem. The spot gun treatment was more effective in controlling brush and weeds than the broadcast method. Aspen was well controlled at all spot treatment rates and the high rate (4.3 kg ai/ha) of the broadcast application. the narrower grid spacing (1.5 m) was more effective in controlling the 1-3 meter high birch. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Fall Application With Spot Gun for Conifer Release.

Teskey, K.K. and Masterson, S.O. M. The trial site is located at a longitude of 113° and a latitude of 55° or 10 km East of Calling Lake, Alberta. Following a wildfire in 1968 the area was left to self regenerate and was supplemented in 1980 by hand seeding white spruce. The site supports an overstory of 17 year old aspen and balsam poplar and an understory of aspen, balsam poplar and willow as well as white spruce ranging from a few cm to 1 meter. The soil texture is a clay loam sloped to the south. Four treatments were applied: 1) 4 ml of undiluted hexazinone (240 g ai/litre) at 1.5 meter grid spacing; 2) 4 ml of hexazinone at 2 m grid spacing; 3) 8 ml of hexazinone at 1.5 meter grid spacing and 4) 8 ml of hexazinone at 2 m grid spacing. Each treatment, unreplicated, is 20 by 50 meters. A control plot is also included. The hexazinone spots were delivered by a spot gun calibrated for either 4 or 8 ml squirts. The applicator purposely avoided crop trees by 1 meter. The date of application was October 27, 1983 under humid, cold conditions. Assessment of percent defoliation on 20 tagged overstory deciduous trees and 10 understory deciduous trees was carried out on August 3, 1984. In addition, 10 white spruce were tagged, evaluated for percent injury and measured (heights and diameters) in 1985 and will be assessed in subsequent years. Assessment of percent kill of deciduous brush was made June 26, 1985.

TREATMENT		UNDILUTED SPOT - FALL					
SPOT OF HEXAZINONE (ML)	GRID SPACING (M)	% INJURY		% DEFOLIATION '84			
		WHITE SPRUCE '85	ASPEN '84	BALSAM POPLAR '84	ASPEN '85	BALSAM POPLAR '85	
4	2.0	1	75	100	96	100	
4	1.5	1	80	100	*	*	
8	2.0	5	89	100	*	*	
8	1.5	0	80	99	90	100	
Control	0	0	0	0	0	0	

SPOT OF HEXAZINONE (ML)	PERCENT KILL '85					
	UNDERSTORY					
	ASPEN		BALSAM POPLAR		WILLOW	
	'84	'85	'84	'85	'84	'85
4	82	100	*	*	21	100
4	86	97	95	100	90	100
8	96	100	*	*	95	100
8	77	100	93	95	60	75
Control	0	0	0	0	0	0

\* no individuals in treatment.

Results: In two years following application the spot gun treatment has effectively killed close to 100% of all stems, both understory and overstory, with the exception of willow. Percent injury of white spruce was evaluated in 1985 and showed over 95% safety. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Spring Application with Spot Gun for Conifer Release.

Teskey, K.K. and Masterson, S.O.M. Location: longitude of 113° and a latitude of 55°, 10 km East of Calling Lake, Alberta. Following a wildfire in 1968 the area was left to self regenerate and was supplemented in 1980 by hand seeding white spruce. The site supports an overstory of 17 year old aspen, balsam poplar and a few stems of birch. The understory of aspen, balsam poplar and willow ranges from 1 to 2 m and the white spruce range from a few cm to one m. The soil texture is a clay loam sloped to the South. Four treatments were applied: 1) 4 ml of undiluted hexazinone liquid (240 g ai/l) at 1.5 meter grid spacing; 2) 4 ml of hexazinone at 2 meter grid spacing; 3) 8 ml at 1.5 meter spacing and 4) 8 ml at 2 m spacing. Each treatment, unreplicated, is 20 meters by 45 meters separated by a 10 meter check strip. The applicator purposely avoided crop trees with a spot by 1 meter. The date of application was May 16, 1984 under wet, cool conditions. Assessment of percent defoliation on 20 overstory deciduous trees and 10 understory deciduous trees was carried out on August 3, 1984. In addition, 10 white spruce were tagged, evaluated as percent injury and measured (heights and diameters) in 1985 and will be assessed in subsequent years. Assessment of percent kill was made June 26, 1985.

UNDILUTED SPOT - SPRING

TREATMENT ML/SPOT	% INJURY							
	GRID SPACING (M)	WHITE		OVERSTORY				
		SPRUCE '85	ASPEN '84	ASPEN '85	BALSAM '84	POPLAR '85	BIRCH '84	BIRCH '85
4	2	0	85	98	*	*	*	*
4	1.5	0	91	99	78	100	80	100
8	2	0	*	*	86	100	*	*
8	1.5	0	86	100	83	100	*	*
Control		0	0	0	0	0	0	0

% CONTROL

ML/SPOT	UNDERSTORY					
	BALSAM			WILLOW		
	ASPEN '84	POPLAR '85	WILLOW '84	'85	'84	'85
4	50	100	73	73	100	70
4	85	100	71	100	73	68
8	88	100	93	100	100	100
8	98	100	74	100	90	100
Control	0	0	0	0	0	0

\* no individuals in treatment.

Results: Of the 10 white spruce tagged in each treatment none incurred any damage. All overstory trees were controlled in the year following application (98%). Balsam poplar and willow understory species were completely controlled at all rates (100%). (Du Pont Canada Inc., Calgary, Alberta)

HEXAZINONE Summer Application With Spot Gun for Conifer Release.

Teskey, K.K. and Masterson, S.O.M. Location: longitude of  $113^{\circ}$  and a latitude of  $55^{\circ}$ , 10 km East of Calling Lake, Alberta. Following a wildfire in 1968 the area was left to self regenerate and was supplemented in 1980 by hand seeding white spruce. The site supports an overstory of 17 year old aspen, balsam poplar and a few stems of birch. The understory of aspen, balsam poplar and willow ranges from 1 to 2 m and the white spruce range from a few cm to one m. The soil texture is a clay loam sloped to the South. Four treatments were applied: 1) 4 ml of undiluted hexazinone liquid (240 g ai/l) at 1.5 meter grid spacing; 2) 4 ml of hexazinone at 2 meter grid spacing; 3) 8 ml at 1.5 meter spacing and 4) 8 ml at 2 m spacing. Each treatment, unreplicated, is 20 meters by 45 meters separated by a 10 meter check strip. The applicator purposely avoided crop trees with a spot by 1 meter. The date of application was August 13, 1984 under warm, dry conditions. Twenty overstory deciduous trees and 10 understory deciduous trees were tagged and assessed as percent kill June 26, 1985. In addition, 10 white spruce were tagged, evaluated as percent injury and measured (heights and diameters) at the same time.

UNDILUTED SPOT - SUMMER

TREATMENT SPOT OF HEXAZINONE (ML)	GRID SPACING (M)	% INJURY		OVERSTORY		% KILL		
		WHITE SPRUCE	ASPEN	BALSAM POPLAR	ASPEN	UNDERSTORY BALSAM POPLAR	WILLOW	
		_____	_____	_____	_____	_____	_____	_____
4	2.0	0	94	94	*	99	53	
4	1.5	10	95	98	100	100	99	
8	2.0	0	90	100	88	90	20	
8	1.5	0	99	100	98	100	100	
Control		0	0	0	0	0	0	

\* no individuals in treatment.

Results: Ten percent of the white spruce in treatment (4 ml x 1.5 m) or 1 of the 10 trees was dead. Excellent control of all overstory stems is evident. Understory species including willow were well controlled with the narrow (1.5 m) grid spacing. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Spring Application with Spot Gun for Conifer Release.

Teskey, K.K. and Masterson, S.O.M. Location: 53 km Northeast of Prince Albert, Saskatchewan. The area was logged in 1981, scarified in 1982 with barrels and chains and planted with 3-0 white spruce bareroot in June of 1983 at a stocking density of 1600 plants per hectare. Vegetation includes a variety of broadleaved herbaceous species such as fireweed and aster and brush species of aspen and willow not exceeding one meter in height. The soil texture is a sandy loam supporting a thin organic matter of 5 cm. Four treatments of the spot gun method were applied with undiluted hexazinone liquid (240 grams ai/l). Each treatment, unreplicated, is 20 meters by 50 meters separated by a 10 meter check strip. A control or check plot is also included. The hexazinone spots were delivered by a spot gun calibrated for either 4 or 8 ml squirts at 1.5 or 2 meter grid spacing. The applicator purposely avoided crop trees with a spot by 1 meter. The date of application was May 4, 1984 under clear, warm conditions. Assessment of percent defoliation for aspen and willow was done by visually assessing the plot in three separate areas on August 23, 1984. Assessment of percent kill of aspen and willow was done August 29, 1985.

UNDILUTED SPOT - SPRING

PERCENT DEFOLIATION - '84  
PERCENT KILL - '85

SPOT OF HEXAZINONE (ML)	GRID SPACING (M)	ASPEN		WILLOW	
		'84	'85	'84	'85
4	2.0	95	98	95	98
4	1.5	98	100	95	100
8	2.0	98	100	90	100
8	1.5	100	100	100	100
Control		0	25*	0	25*

Excellent control of aspen and willow occurred at all rates.

\* Insects and disease accounted for the 25% mortality in the untreated plots in 1985. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Fall Application With Spot Gun for Conifer Release.

Teskey, K.K. and Masterson, S.O.M. The trial site is located 53 km Northeast of Prince Albert, Saskatchewan. The area was logged in 1981, scarified in 1982 with barrels and chains and planted with 3-0 white spruce bareroot in June of 1983 at a stocking density of 1600 plants per hectare. Vegetation includes a variety of broadleafed herbaceous species such as fireweed and brush species such as aspen, none exceeding one meter in height. The soil texture is a sandy loam supporting a thin organic matter of 5 cm. Four treatments of the spot gun method were applied: 1) 4 ml of undiluted hexazinone liquid (240 g/l) at 1.5 meter grid spacing; 2) 4 ml of hexazinone at 2 m grid spacing; 3) 8 ml at 1.5 m grid spacing and 4) 8 ml at 2 m grid spacing. Each treatment, unreplicated, is 20 m by 50 m. A control plot is also included. The hexazinone spots were delivered by a spot gun calibrated for either 4 or 8 ml squirts. The applicator purposely avoided crop trees by 1 meter. The date of application was October 24, 1983. Assessment of percent defoliation for aspen was done by visually assessing each plot in three separate areas on August 23, 1984. Percent kill assessment for aspen was done August 29, 1985.

UNDILUTED SPOT - FALL

SPOT OF HEXAZINONE (ML)	GRID SPACING (M)	PERCENT KILL - '85	
		'84	'85
4	2.0	95	98
4	1.5	95	100
8	2.0	98	100
8	1.5	98	100
Untreated Control		0	25*

Excellent control of aspen occurred with the four rates of hexazinone tested.

\* Insects and disease accounted for the 25% mortality of aspen in the untreated plots in 1985.

HEXAZINONE Liquid for Conifer Release with Spot and Broadcast Methods  
Teskey, K.K. and Masterson, S.O.M. Location: 75 km North of Blueridge, Alberta in the Judy Creek operating unit of Blueridge Lumber Ltd. Area was harvested August and September, 1979 followed by a ripper scarification, winter 1980 and planted, spring 1980 with 2-0 container white spruce. Soil texture is loam with a 6 cm organic layer. Species composition is dominantly aspen with balsam poplar and willow in wetter areas. Heights range from 1 to 2 meters. Understory composition is rose, raspberry and grass. Hexazinone liquid (240 g ai/l) was applied undiluted at 4 rates (grid spacing: 1 and 2 meters; delivery rates: 4 and 8 ml per spot) with a spot gun and at 3 rates as a broadcast using a pressurized CO<sub>2</sub> backpack sprayer (volume: 333 l/ha; pressure: 200 kPa) on July 27, 1984. Plot size is 10 by 10 meters replicated 3 times. Vegetation assessments were completed on September 17, 1984 and September 25, 1985.

UNDILUTED LIQUID SPOT

ML/SPOT	TREATMENT SPACING M	% INJURY				% DEFOLIATION '84				% KILL '85			
		WHITE SPRUCE		ASPEN		BALSAM POPLAR		WILLOW		ROSE		RASPBERRY	
		'84	'85	'84	'85	'84	'85	'84	'85	'84	'85	'84	'85
4	2.0	5	0	83	90	83	85	43	83	80	85	48	83
4	1.5	5	0	98	95	95	93	68	77	92	100	70	85
8	2.0	2	0	90	97	90	97	78	82	90	100	53	87
8	1.5	7	0	92	98	95	98	80	90	100	100	80	90

  

KG AI/HA	LIQUID BROADCAST													
2.2	0	0	63	65	73	72	50	50	90	80	75	80	97	95
3.2	3	0	95	85	92	82	58	68	100	90	95	80	97	100
4.3	7	0	88	86	88	90	78	83	97	100	95	93	100	100
Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Results: White spruce recovered from any injuries incurred in 1984. Percent kill in 1985 exceeded 80% in all spot gun treatments on all target weed species. Control was relatively the same in 1984 as in 1985 for the broadcast treatments. Acceptable percent kill (>80%) was evident for rose, raspberry and grass at all broadcast rates and brush control (aspen and balsam poplar) was acceptable at 3.2 and 4.3 kg ai/ha. Willow was adequately controlled at 4.3 kg ai/ha. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid for Aerial Site Preparation and Conifer Release

Teskey, K.K. and Masterson, S.O.M. Location: longitude 113°, latitude 55°, 75 km North of Athabasca, Alberta and 10 km East of Calling Lake. History: wildfire in 1968; cut and piled in 1979 and 1980; burned in 1980; Bracke scarified in 1981; planted in 1982 with 2-0 container white spruce. The soil texture is a clay loam with an organic matter layer measuring from 5-8 cm. The hexazinone liquid (240 g ai/l) was applied from a Bell T4A helicopter flying at a speed of 50 kmph, 12 to 13 m above the ground with a spray volume of 250 l/ha; pressure at 172 kPa using a 028 airfoil nozzle attached to a microfoil boom with a 14 m swath width. Three rates of hexazinone liquid were used: 2.2, 3.2 and 4.3 kg ai/ha. Each treatment including a check plot is one hectare in size and is replicated 3 times. The third replication however, was omitted from analysis due to the standing water which was present during the months of May and June. The date of application was May 15, 1984 under rainy, cool conditions. A post spray assessment on June 4 and June 5, 1984 was designed to determine the vegetation existing before spraying.

Assessments of herbicidal effects were done August 1-3, 1984 and July 18, 1985. Each one hectare plot contains nine 4 m<sup>2</sup> subplots in which assessments were made. To assess both site preparation and conifer release treatments, existing conifers (within the 4 m<sup>2</sup> subplots) were assessed as well as one lodgepole pine and one white spruce that were planted into each subplot on June 6, 1984. The lodgepole pine was a 2-0 container stock while the white spruce was from 2-0 bareroot stock.

EXISTING 1985	WHITE SPRUCE PLANTED			WHITE SPRUCE PLANTED			LODGEPOLE PINE		
	RATE OF HEXAZINONE KG AI/HA	AVERAGE HEIGHT GROWTH (CM) '83	'84	'85	% SURVIVAL '85	AVERAGE HEIGHT GROWTH (CM) '85	% SURVIVAL '85	AVERAGE HEIGHT GROWTH (CM) '85	% SURVIVAL '85
2.2	8	9	15	77	7	89	4	89	
3.2	5	8	18	82	12	72	6	83	
4.3	6	6	7	39	6	67	5	44	
Untreated	7	6	8	100	3	100	3	94	

RATE OF HEXAZINONE KG AI/HA	DECIDUOUS					
	% GRASS COVER		% KILL			
	PRE- SPRAY	'84	'85	BALSAM ASPEN	POPLAR	WILLOW
2.2	34	3	2	71	100	90
3.2	56	2	2	80	80	89
4.3	50	0	0	100	100	100
Untreated	59	59	54	0	0	0

Results: Excellent control of grass was achieved at each rate tested. Over 80% of the total brush component was killed at the 2.2 and 3.2 kg ai/ha rates. The stems that were not killed lack in vigour and growth. Total kill of the brush and grass component is evident with the 4.3 kg/ha rate in the second season. Some mortality of the crop trees was evident, however, there is a significant growth response with white spruce at the 2.2 and 3.2 kg/ha rates. The existing white spruce located in scarified holes, experienced some mortality in the treated plots, due to the compounding effects of flooding and chemical stress. (Du Pont Canada Inc. Calgary, Alberta).

HEXAZINONE Liquid, Aerially Applied, For Conifer Release. Teskey, R. and Masterson, S.O.M. Location: longitude  $106^{\circ}$ , latitude  $53^{\circ}$ , 150 km Northeast of Prince Albert, Saskatchewan; 30 km East of Little Bear Lake. History: wildfire in 1977; planted in June 1978 with 2-0 balsam jack pine. Naturally regenerated jack pine and white spruce are also present. The soil texture is sandy loam with an organic matter layer less than 5 cm in thickness. The hexazinone liquid (240 grams ai/liter) was applied from a Bell T4A helicopter; speed of 50 kmph; 12 to 13 m above ground; spray volume of 250 liters/hectare; pressure at 172 kPa using 028 airfoil nozzle attached to a microfoil boom. The three rates of hexazinone liquid applied were 2.2, 3.2, 4.3 kg ai/ha. Each treatment, including a check plot, is one hectare in size and is replicated 3 times. The date of application was May 19, 1984. A post spray assessment on May 4 and 5, 1984 was designed to determine the vegetation existing before spraying. First and second year assessments were August 20, 1984 and August 6, 1985 respectively.

CONIFERS

RATE OF HEXAZINONE KG AI/HA	HEIGHT GROWTH (CM)				HEIGHT GROWTH (CM)			
	WHITE SPRUCE		%	SURVIVAL	JACK PINE		%	SURVIVAL
	'83	'84	'85		'83	'84	'85	
2.2	8	8	12	98	26	55	33	89
3.2	10	-1	13	71	20	-28	25	6
4.3	9	4	14	79	17	6	8	33
Control	10	7	11	0	23	27	37	90

DECIDUOUS BRUSH - % KILL

RATE OF HEXAZINONE KG AI/HA	DECIDUOUS BRUSH - % KILL				% GRASS COVER		
	ASPEN	BALSAM POPLAR	WILLOW	ALDER	PRE SPRAY	'84	'85
2.2	88	100	94	25	32	2	6
3.2	100	100	91	100	22	0	0
4.3	100	100	100	71	29	0	0
Untreated	0	0	0	0	40	41	38

Results: No significant injury or mortality occurred to the spruce or pine at the 2.2 kg/ha rate. At the two higher rates, injury from hexazinone resulted, with lodgepole pine being much more sensitive than white spruce. Excellent control of aspen, balsam poplar and willow was obtained with the three rates of hexazinone (2.2, 3.2, 4.3) tested. Grass was also well controlled. Control of alder was inconsistent. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Spot Gun with Cone Nozzle, for Site Preparation.

Teskey, K.K. and Masterson, S.O.M. Co-operator, Crestbrook Forest Industries Ltd. Location: 19 km West of Fernie, B.C. History: logged 1976; blade scarified, 1979; planted, 1981 with blister rust resistant white pine. No survival because of severe grass competition. Will be planted spring, 1986 with lodgepole pine. Grass, Calamagrostis spp is < 1 meter. Other species include snowberry, raspberry, thimbleberry, and Canada thistle. Application: June 12, 1985 with spot guns attached with cone nozzles that treated 1.5 meter diameter circles; a 2.5 meter grid spacing was used. Three rates of hexazinone liquid (240 g ai/l) were applied to 50 x 30 meter plots. A 16.7% solution of hexazinone was used (water the diluent) applying 1, 1.5 and 2. ml of product per spot. Assessment on August 14, 1985 evaluated percent grass cover for 20 pre-marked planting sites.

HEXAZINONE ML/SPOT	GRID SPACING (M)	% GRASS COVER	
		PRE-SPRAY	1985
1	2.5	44	2
1.5	2.5	68	1
2	2.5	73	2
Control		76	76

Results: Grass was almost completely controlled at all rates in year of application. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Spot Gun Applied, For Conifer Release. Teskey, K.K. and Masterson, S.O.M. Co-operator: Crestbrook Forest Industries Ltd. Location: 20 km West of Fernie, B.C. History: Selectively logged 1977; planted, 1984 engelmann spruce (1-0, 313 PSB plugs). Species composition: 40 year old birch (90%) and aspen (10%); height, 16 m; diameter 11-20 cm; crown closure 50%; stems/ha, 200. Application: June 12, 1985 with spot guns applying 2 rates of hexazinone (undiluted) (240 g ai/l), 1.8 kg ai/ha and 3.6 kg ai/ha. Six spots were applied immediately around the birch clumps with 4 and 8 ml/spot. Plots are 50 x 50 meters unreplicated. Weather was hot and dry at application. Assessment was done August 14, 1985 by measuring heights of 20 pretagged spruce and percent defoliation of 20 pretagged birch.

RATE OF HEXAZINONE KG AI/HA	NUMBER OF SPOTS/CLUMP	ML/SPOT	HEIGHT GROWTH (CM)		% DEFOLIATION	
			ENGELMANN SPRUCE 1985	% INJURY	BIRCH	
1.8	6	4	8	7	39	
3.6	6	8	8	20	92	
Control	-	-	7	10	0	

Results: Height growth was consistent for all conifers. Natural mortality accounted for 10% of the injuries. Spot treatment adequately controlled the birch at 3.6 kg ai/ha. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid for Aerial Site Preparation and Conifer Release.

Teskey, K.K. and Masterson, S.O.M. Location: longitude 120°, latitude 55°; 78 km East of Dawson Creek, B.C.; 16 km South of Stewart Lake.

History: wildfire 1971; cleared and windrowed in winters of 1982 and 1983. Planted June 1983 with 2-0 bareroot white spruce, survival rate at time of spraying was 60 percent with many plants suffering from planting shock and stress from competing vegetation; primarily marsh reed grass (Calmogrostis canadensis). Soil texture is a silty loam supporting a thick organic layer. Application from a Bell T4A helicopter; speed 50 kmph; 12 to 13 meters above ground; spray volume, 250 litres per hectare; pressure at 172 kPa; using a 028 airfoil nozzle attached to a microfoil boom; 14 meter swath width. Four rates of hexazinone liquid (240 g ai/l) were used: 1.1, 2.2, 4.3 and 6.5 kg ai/ha. Each treatment, including check plots are one hectare in size and replicated 3 times. The date of application was May 14, 1984 under calm, cool and overcast conditions. Year one assessments were made August 16 and 17, 1984. To assess both site preparation and conifer release treatments, existing conifers were assessed as well as one lodgepole pine and one white spruce that were planted into each subplot on June 11, 1984. The lodgepole pine was from 2-0 container stock while the white spruce was from 2-0 bareroot stock. Year two assessments were made August 1, 1985.

RATE OF HEXAZINONE KG AI/HA	EXISTING				PLANTED-IN				CONIFERS			
	WHITE SPRUCE			%	WHITE SPRUCE			%	LODGEPOLE PINE			%
	HEIGHT	GROWTH	'83		'84	'85	SURVIVAL		HEIGHT	GROWTH (CM)	'85	SURVIVAL
1.1	5	4	5	74				-4	81		3	96
2.2	5	4	7	85				1	92		0	88
4.3	5	4	7	80				2	79		6	92
6.5	4	8	5	81				1	44		4	58
Control	4	9	6	83				4	36		2	83

	DECIDUOUS BRUSH - % KILL			GRASS - % COVER		
	BALSAM			PRE-SPRAY		
	ASPEN	POPLAR	WILLOW	'84	'84	'85
1.1	10	40	11	74	17	13
2.2	50	80	38	55	7	13
4.3	55	50	71	65	2	3
6.5	73	100	90	69	2	2
Control	0	0	0	66	45	41

Results: Percent grass cover was considerably reduced in treated areas and is still being adequately controlled in 1985, following two growing seasons. With the 2.2 kg/ha rate, approximately 50% of total brush stems were killed. No resprouting was observed. Control of brush increased significantly as the thickness of the organic layer decreased. No significant mortality occurred to the existing spruce as a result of the hexazinone treatments. Significantly less mortality occurred to the planted-in spruce to 1.1, 2.2 and 4.3 kg/ha hexazinone treatments. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Ground Application for Site Preparation. Teskey, K.K. and Masterson, S.O.M. Location: 65 km North of Wandering River, Alberta. History: wildfire 1982; windrowed and burned, 1984; bracke scarified in conjunction with hexazinone application on May 23 & 24, 1985; planted June 1985 with 2-0 white spruce container stock. Species composition: heavy grass (Calamagrostis spp & Bromus spp) with aspen, balsam poplar and willow stems (< 1 meter high). Application: 3 methods of applying hexazinone, broadcast, volume 195 l/ha (1.4, 2.2 and 2.9 kg ai/ha); banding over the row, volume 500 l/ha (1.4, 2.2 and 2.9 kg ai/treated ha); concentrated straight stream application between the scarified patch rows (1.4, 2.2 and 2.9 kg ai/ha). Plots are 50 meters by 9 meters (4 rows) replicated 3 times. Assessment was made September 11, 1985 by evaluating percent grass cover and percent injury to white spruce in 60 subplots per treatment.

TREATMENT

<u>HEXAZINONE KG AI/HA</u>	<u>METHOD OF APPLICATION</u>	<u>% INJURY WHITE SPRUCE</u>	<u>% GRASS CONTROL</u>
1.4	Broadcast	0	68
2.2	Broadcast	0	90
2.9	Broadcast	3	93
Control		0	0
1.4 / 2.2 / 2.9 / Treated Hectare	Banding over Patch Row	0 0 4	62 79 87
1.4 2.2	Concentrated Straight Stream	0 0	16 19

Results: As one would expect, the broadcast and band applications are most effective in controlling the grass cover. Second year and subsequent evaluations will also compare the effectiveness of the three application techniques in controlling the brush component that is invading the site. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Broadcast Application, For Conifer Release.

Teskey, K.K. and Masterson, S.O.M. Location: 30 km Southeast of Chilliwack, B.C. History: logged, 1973; no site preparation; planted 1975 with 2-0 bareroot Douglas Fir. Species composition: ground cover - salal with scattered brush, 10 year old planted Douglas Fir as well as naturally regenerated Douglas Fir. Soil texture is a sandy loam. Application: hexazinone liquid (240 g ai/l) was applied from a CO<sub>2</sub> pressurized back pack sprayer (volume - 230 l/ha) April 18, 1985 at 2 kg ai/ha. Weather was cool and wet at application.

Assessment on September 7, 1985 showed no injury to the Douglas Fir and no control of the salal ground cover with 2 kg ai/ha of hexazinone. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Spot Gun Applied, for Conifer Release. Teskey, K.K. and Masterson S.O.M. Co-operator: Crestbrook Forest Industries Ltd. Location: 18 km West of Fernie, B.C. History: logged 1967, burned and planted 1982 with Engelmann spruce (good survival). Species composition: 25 year old aspen (80%), black cottonwood (10%), alder (10%); height 10 m; diameter 10-12 cm; crown closure 90%; stems/ha, 10,000. Understory species: raspberry, thimbleberry, honeysuckle, Saskatoon. Application: June 13, 1985 hexazinone liquid (240 g ai/l) (diluted 50%) applied with hand spot guns at 2 and 4 ml (product) rates on a 1 meter x 2 meter grid pattern. Plots are 50 x 50 meters, unreplicated. Weather was hot and dry at application. Follow-up assessment of 20 pretagged aspen (% defoliation) and 10 Engelmann spruce (heights and diameters) was done on August 14, 1985.

<u>HEXAZINONE LIQUID</u> <u>ML/SPOT</u>	<u>GRID</u> <u>SPACING (M)</u>	<u>% INJURY</u>	<u>% DEFOLIATION - ASPEN</u>
2	1 X 2	8	92
4	1 X 2	0	97
Control		0	10*

\* Aspen leaf miner defoliation

Results: A very high level of defoliation of aspen was accomplished with both rates of hexazinone. Injury occurred on spruce only where a spot had been applied at its base. Aspen leaf miner accounted for 10% of the defoliation. (Du Pont Canada Inc. Calgary, Alberta)

HEXAZINONE Liquid, Spot Gun Applied, for Conifer Release. Teskey, K.K. and Masterson, S.O.M. Co-operators: Crown Forest. Location: 10 km West of Kelowna, B.C. History: logged, 1973, v-plough scarified, 1977; planted with 1-0, 211 PSB plugs, 1978. Species composition: 10 year old aspen; understory, dogwood and thimbleberry. Soil texture: sandy loam. Application: hexazinone (240 g ai/l) was applied undiluted at 4 rates: 2 rates of delivery, 8 ml and 4 ml/spot at 2 grid spacings 1.5 and 2 meters. Application dates: fall, November 10, 1983; spring, May 28, 1984 and summer, July 12, 1984. Plots are 80 x 50 meters. Assessment was made September 3, 1985.

<u>RATE OF</u> <u>HEXAZINONE</u> <u>(ML/SPOT)</u>	<u>GRID</u> <u>SPACING</u> <u>(M)</u>	<u>TIME OF APPLICATION - % KILL</u>		
		<u>FALL '83</u>	<u>SPRING '84</u>	<u>SUMMER '84</u>
4	2	80	90	60
4	1.5	99	95	50
8	2	50	95	85
8	1.5	99	95	85
Control		0	0	0

Results: The spring and fall applications of hexazinone prove to be more effective than mid summer treatments. The spring applications were a little more consistent than the treatments applied in the fall. All treatments significantly opened up the aspen canopy. (Du Pont Canada Inc. Calgary, Alberta)

Pronone (Granular hexazinone) use in Conifer Release: Wellman, R.W.; MacDonald J.;

LOCATION: A trial was conducted at longitude 115° and latitude 55° which is 10° Km east of Calling Lake, Alberta. EQUIPMENT: Ground application mounted Herd-I-92 Granular applicator was used to evenly distribute the granules. SOIL TEXTURE: Clay-loam with 5-8 cm of organic matter. HISTORY: Site was burnt by wild fire in 1968, remaining timber was cut, piled and burnt in 1979-80. SITE PREPARATION: Using a brack scarifier was done 1981. Area was planted to 2-0 bare root stage white spruce at a density of 1600 plants per hectare in 1982. SIZE: Plot was 2 ha. REPLICATES: 3; RATES: 1,2,4 Kg ai/ha. WEATHER CONDITIONS: Cool and raining. ASSESSMENT: July 20.

HEIGHT:

Brush species 1 to 3 metres.

Treatment	Rate	TOLERANCE	% DEFOLIATION								
			(SW)	ASPEN	BALSAM	WILLOW	ROSE	CRANBERRY	BUFFALO GRASS	FIREWEED	CURRENT ALDER BERRY
Hexazinone	1	9	8	8	5	3	1	1	8	7	4
10% Granule	2	9	9	9	7	5	3	1	9	9	9
(Pronone)	4	8	9	9	9	7	9	5	9	9	9
	0	9	0	0	0	0	0	0	0	0	3

Very effective defoliation of grass species and poplar was observed at all rates. However, Rose, Willow and Alder exhibited differential tolerance. The crop exhibited strong tolerance at 1 and 2 Kg rates with some chlorosis at 4 Kg rate. There was no evidence of off-site movement by compound or uneven distribution by area of unaffected vegetation. In all cases a definite border was observed in all treated plots which would indicate a direct placement of granule and no subsequent movement from that placement area. (PFIZER C. & G. INC., LONDON, ONTARIO).