FOREST RESEARCH REPORT

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS
P. O. BOX 68, TRURO, N.S. B2N 5B8

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EFFICACY OF GLYPHOSATE IN CONTROLLING COMPETING VEGETATION IN NOVA SCOTIA

INTRODUCTION

Glyphosate (given the trade name Roundup® by Monsanto Company Ltd) is a herbicide which is presently registered in many countries of the world including the United Kingdom, Sweden, Norway and the United States. In Canada, the registration for forestry use includes both ground and aerial applications for site preparation as well as conifer release (CPPA, 1986). Ground trials were established at six locations (Figure 1) from 1978 to 1980 to determine the rates of Roundup necessary to adequately control various species of competing vegetation in Nova Scotia.

METHODS

Each experimental site (with the exception of Mt. Thom) was divided into eight, 0.04 ha (0.1 acre) plots with a 3 m (10 foot) buffer zone between plots. Three different rates of Roundup were applied with a back pack hydraulic sprayer. Each treatment, plus a control, was replicated twice and randomly allocated to the plots. The treatment rates ranged from 0.56 kg ae/ha to 3.36 kg ae/ha with a total solution of 224 litres/ha (20 gallons/acre) when mixed with water except at Mt. Thom where a total solution of 448 litres/ha (40 gallons/acre) was applied (Table 1).

1. Trade name was changed to Vision® as of 1987.

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Nova Scotia Department of Lands and Forests

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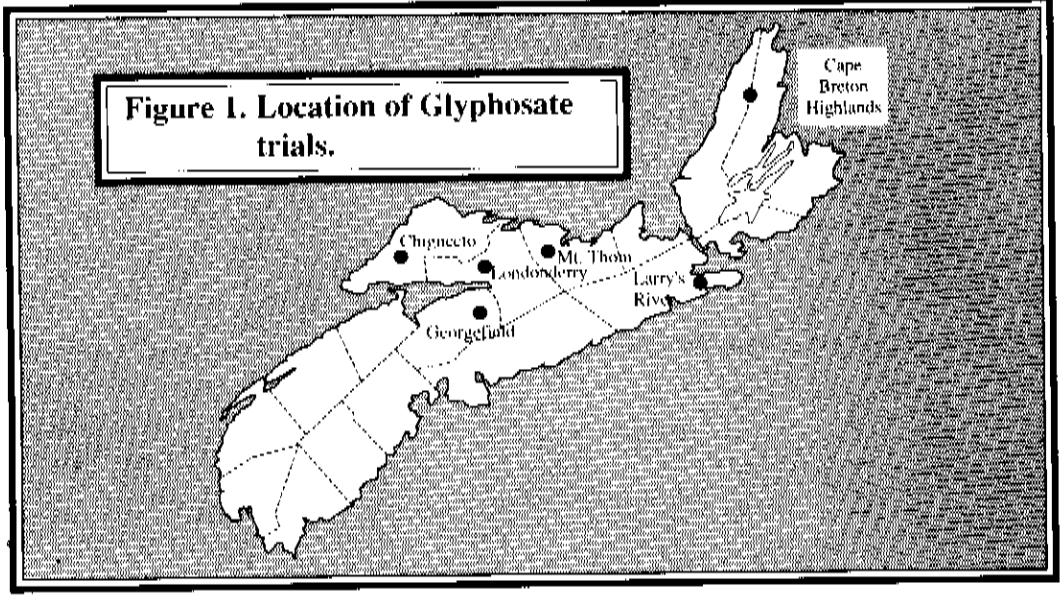


At the Mt. Thom site, Roundup was applied at two different rates with a hydraulic boom sprayer mounted on a farm tractor (Table 1). In order to minimize drift, application of the herbicide was restricted to periods of time when the wind speed was less than 8 km/hr (5 mph). To maximize efficacy, applications were

Table 1. Experimental site and treatment information.

Location	Site History	Treatment Rate kg ae/ha* (l/ha)	Application Date
Cape Breton Highlands	Softwood Clear Cut	Control 0.56 (1.57)** 1.12 (3.15)** 2.24 (6.29)**	14/09/78
Chignecto	Mixedwood Clear Cut	Control 1.12 (3.15)** 2.24 (6.29)** 3.36 (9.44)**	22/08/79
Georgefield	Hardwood Clear Cut	Control 2.24 (6.29)** 2.80 (7.86)** 3.36 (9.44)**	05/09/79
Larry's River	Fire-Barren	Control 1.12 (3.15)** 2.24 (6.29)** 3.36 (9.44)**	29/08/79
Londonderry	Old Field	Control 1.12 (3.15)** 1.68 (4.72)** 2.24 (6.29)**	23/08/79
Mt. Thom	Old Field	Control 1.12 (3.15)*** 1.68 (4.72)***	01/05/80

* acid equivalent based on 356 g/l
** - total solution of 224 l/ha (20 gal/ac) applied with a back pack sprayer
*** - total solution of 448 l/ha (40 gal/ac) applied with a spray boom attached to a tractor

avoided when rain was expected within an eight hour period. Care was taken to ensure that the water used as a carrier was free of sediment.

Prior to herbicide application, and in August of the following four years, the height and percent cover of each species of vegetation in each plot was recorded. Cover was a visual estimation of the ground area (expressed as a percentage) covered by each species.

The effect of each competing species was assessed in terms of its competition index or percent cover. The competition index was obtained by multiplying the average height (expressed in metres) of the competing species by the percent cover of the same species. The index was used to compare the effects of varying rates of Roundup on competing species which normally grow to heights greater than 1.0 metre (3 feet), e.g. raspberry, pin cherry, alder, red maple, etc. Percent cover was used to assess the competition effect of shorter species such as grass, blueberry, sheep laurel, Labrador tea and goldenrod.

RESULTS AND DISCUSSION

The results of these trials indicate that Roundup is a relatively non-selective broadleaf herbicide that is capable of satisfactorily controlling the growth of a wide variety of weed species.

TARGET SPECIES

Raspberry

Raspberry is a common competitor in many newly established plantations and cutover sites. In this study raspberry was one of two main target species at three of the six locations - Chignecto, Georgefield and the Cape Breton Highlands. At all locations, treatment with Roundup provided good control initially and, with the exception of the 0.56 kg ae/ha treatment at the Cape Breton Highlands site, this control has been maintained (Figure 2). For example, the competition index for raspberry (2.24 kg ae/ha treatment) was 83 to 98% less than the corresponding control values one year after treatment and still 55 to 85% less four years after treatment for the Chignecto, Georgefield and Cape Breton sites.

Red Maple

Red maple was the second target species at the Georgefield experimental site. The 2.24, 2.80 and 3.36 kg ae/ha treatments provided excellent control of this species (Figure 2). The higher rates provided only marginally better control than the lowest rate of 2.24 kg ae/ha. The suppression and mortality induced by the herbicide was evident the following growing season and vigorous regrowth has not occurred (Figure 2). Four years after treatment, the competition index of red maple was on average approximately 40 times greater (i.e.153 versus 4) in the control plots than in the plots treated with the 2.24 kg ae/ha of Roundup (Figure 2).

Sugar Maple

At Chignecto, sugar maple was the second target species. Vigorous resprouting occurred after treatment with the 1.12 kg ae/ha rate. In fact, this resprouting resulted in the competition index being greater for the 1.12 kg ae/ha treated plots than the control plots one year after treatment. Greater control was achieved with the 2.24 and 3.36 kg ae/ha rates (Figure 2). Observations of more recent experiments and herbicide operations indicate that even at the higher rates, Roundup does not adequately control this species.

Pin Cherry

Pin cherry was the second major competitor at the Cape Breton Highlands site. Treatment rates ranging from 0.56 to 2.24 kg ae/ha provided excellent control of this species the first year after treatment (Figure 2). The competition index for the 0.56 kg ae/ha treated plots increased dramatically in the second year after treatment, whereas, control was maintained with the higher treatment rates.

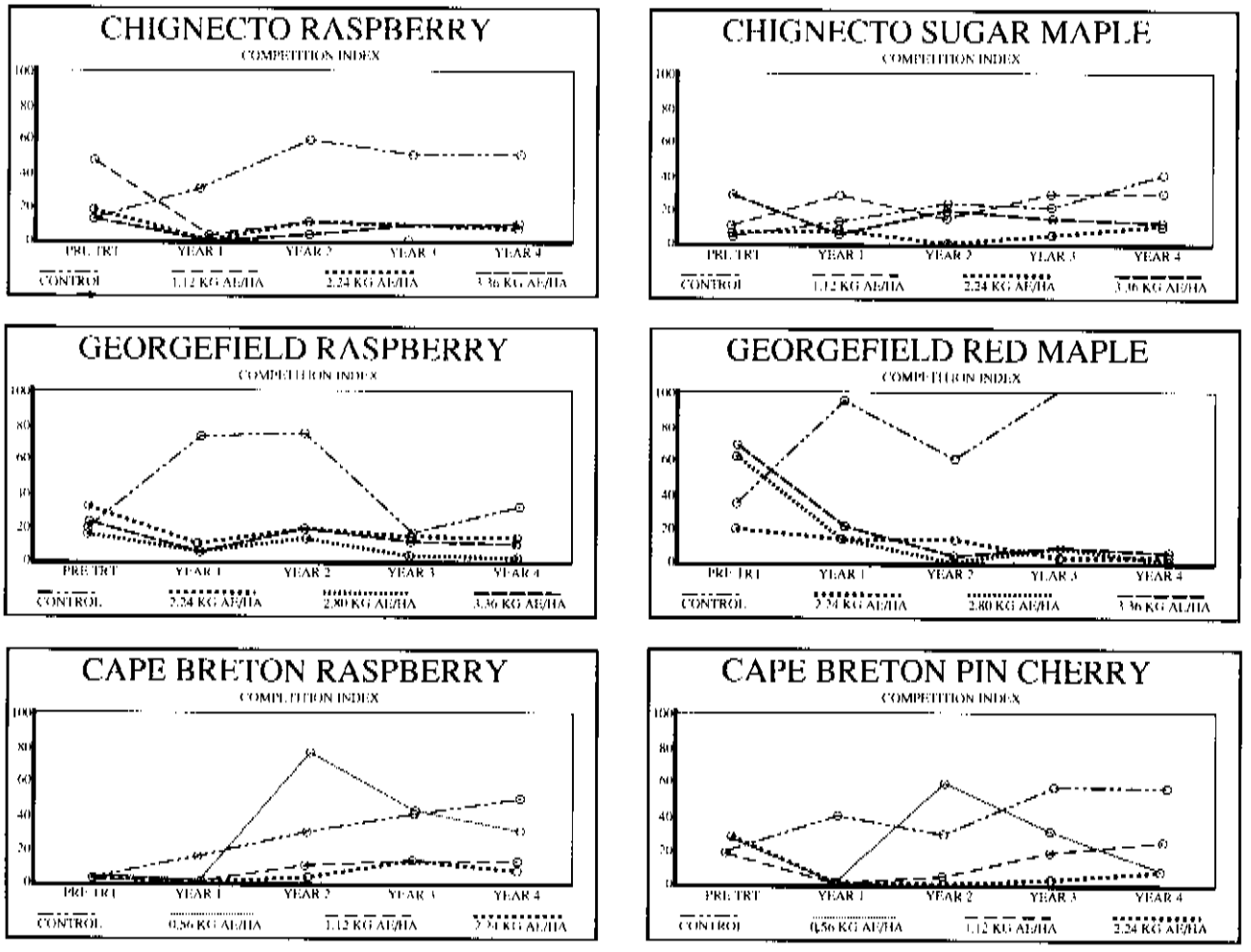
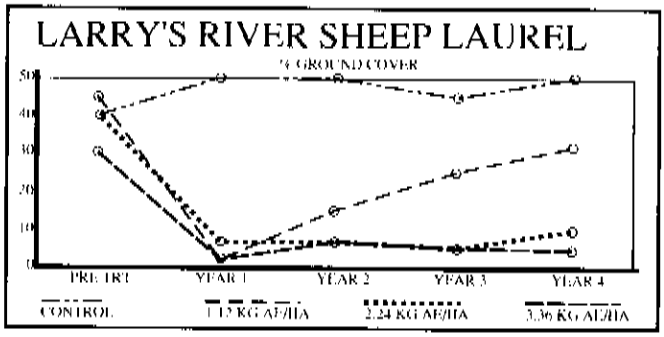
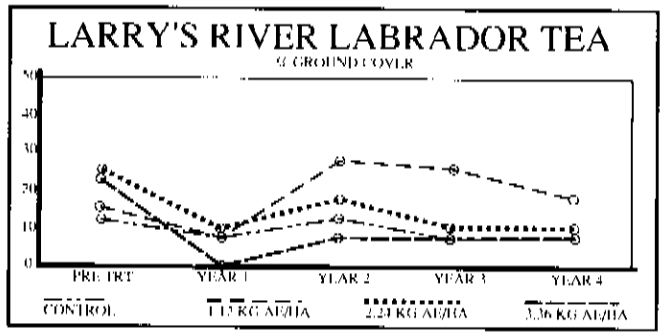


Figure 2. The competition index for target species at the Chignecto, Georgefield and Cape Breton sites versus time since treatment, resulting from various Roundup application rates. Each point represents the mean of two plots.

Ericaceous Vegetation

Ericaceous species such as blueberry, sheep laurel, Labrador tea, crowberry, etc. are found throughout Nova Scotia and are common on barren lands created by fire. Members of this family were the major competing species at only one of the six experimental sites - Larry's River. Remeasurements of the plots one year after treatment indicated that all treatment rates (1.12, 2.24 and 3.36 kg ae/ha) had provided effective control of sheep laurel and blueberry (Figure 3). However, by the beginning of the fourth year, the degree of control provided by the 1.12 kg ae/ha treatment had decreased markedly for these species. Labrador tea, on the other hand, was effectively controlled for three years at the 3.36 kg ae/ha rate only.





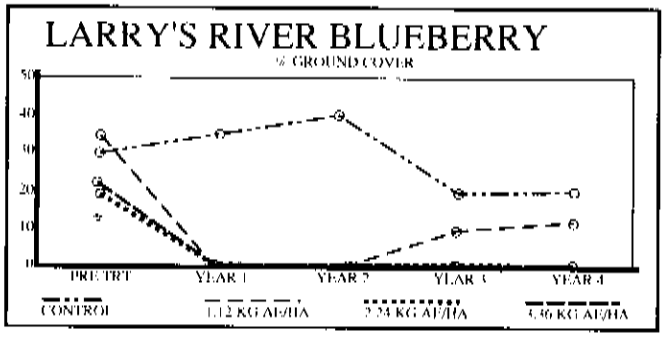


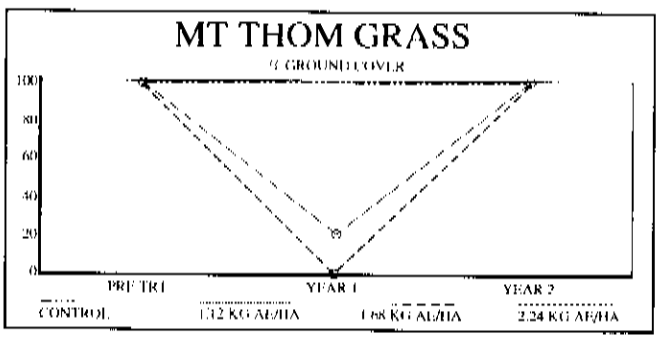
Figure 3. Percent ground cover for Ericaceous species at the Larry's River site versus time since treatment, resulting from various Roundup application rates. Each point represents the mean of two plots.

Grass

Various species of wild grasses were the main competition on the abandoned field at the Mt. Thom experimental site. Treatment was confined to alternate strips approximately one meter (three feet) wide. Excellent control of grasses was provided by both the 1.12 and 1.68 kg ae/ha treatments during the first year, however, by the end of the second year, vetch and grass had established themselves with the vetch being especially prominent on the site treated with the 1.12 kg ae/ha of Roundup (Figure 4).

Goldenrod

Prior to treatment, goldenrod covered approximately 30 to 50% of the ground area at the Londonderry experimental site (Figure 4). One year after application of 1.12 to 2.24 kg ae/ha of Roundup, the cover of goldenrod was reduced to approximately 10% or less. This level of control remained evident in the second, third and fourth years but only in the plots treated with 1.68 to 2.24 kg ae/ha. The percent cover of goldenrod in the plots treated with 1.12 kg ae/ha gradually increased with time and by year two was the same as the control plots.



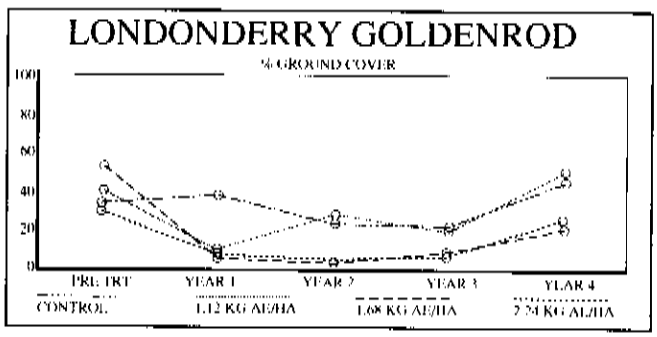


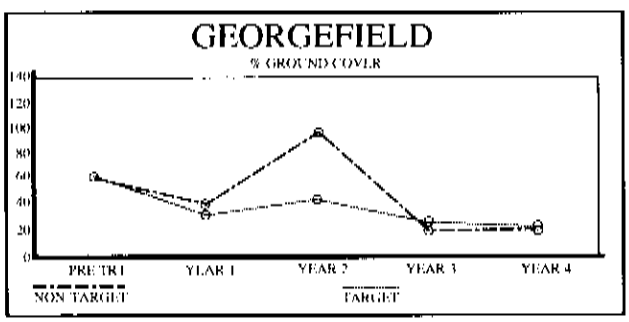
Figure 4. Percent ground cover for grass at the Mt. Thom site and goldenrod at the Londonderry site versus time since treatment, resulting from various Roundup application rates. Each point represents the mean of two plots.

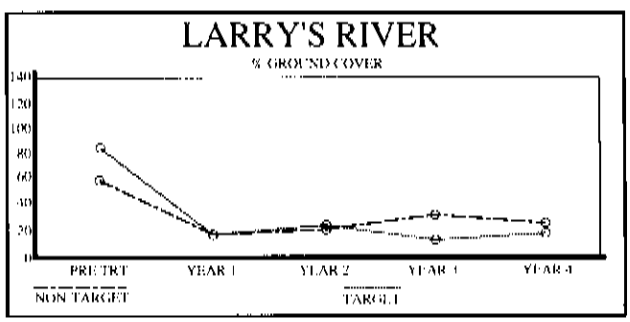
NON-TARGET SPECIES

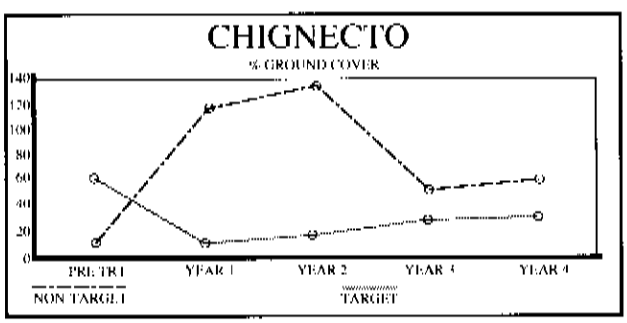
On sites where the non-target species are in the understory, the degree of control provided by Roundup is variable depending on the volume of spray intercepted by the overtopping vegetation. Moreover, extra light reaches the ground when the overstory (target species) has been defoliated, permitting the surviving understory to rapidly colonize the site as well as allowing other species to invade the site.

For example, at Georgefield, the cover of the non-target species (i.e. ferns, grass, goldenrod, cinquefoil and pearly everlasting) was slightly reduced following the 2.24 kg ae/ha treatment, but, by the end of year two the combined cover of these species had increased to 98% from 60% at the time of treatment (Figure 5). Similarly at Chignecto, the non-target species (i.e. ferns, grass, bunchberry, goldenrod, strawberry, hemp nettle and buckwheat) responded quickly to the release from the overtopping vegetation, increasing from 15% cover in the year of application to 130% two years after treatment (Figure 5).

At Larry's River, the non-target species (i.e. bunchberry, cranberry, broom crowberry, wintergreen, honeysuckle and goldenrod) occupied the same vegetation strata as the target species, i.e. both groups of vegetation were approximately the same height. Therefore during the treatment both the target and non-target species intercepted approximately the same amount of Roundup per unit leaf area. As a result, similar control was obtained for both target and non-target vegetation (Figure 5). Observations indicate that in most instances, the ingrowth of non-target species on sites where the overhead competition has been controlled does not seriously affect the growth of planted or natural conifers. Also, because the height of these species is generally less than 15cm (6 in), they do not provide a habitat for rabbits. From an ecological point of view, the rapid coloniza-







Competing Vegetation

Target		Non-Target
Red Maple Sugar Maple Raspberry	Georgefield	Ferns, Grass Goldenrod, Cinquefoil, Pearly Everlasting
Raspberry Sugar Maple	Chignecto	Ferns, Grass, Bunchberry Goldenrod, Strawberry Hemp Nettle, Buckwheat
Sheep Laurel Labrador Tea Blueberry	Larry's River	Bunchberry, Cranberry Wintergreen, Broom Crowberry, Honeysuckle, Goldenrod

Figure 5. Percent ground cover of target and non-target species at the Georgefield, Chignecto and Larry's River sites versus time since treatment, resulting from the 2.24 kg ae/ha Roundup application rate. Each point represents the mean of two plots.

tion of the site with non-target species is desirable for a number of reasons (Thompson and Troeh, 1978), including:

1) They aid in the maintenance of site productivity by reducing the loss of nutrients from the site due to leaching.
2) They impede soil erosion by the stabilizing effects of their root systems.
3) They add organic matter to the soil through leaf-fall and root sloughing thereby improving the soil moisture holding and cation exchange capacity of the soil.
4) They help to protect the upper soil layer from temperature extremes.

SUMMARY

In newly established plantations, Roundup satisfactorily controlled a variety of competing vegetation species. The rate of application required to achieve effective control was found to vary with the particular species involved.

1) Raspberry was effectively controlled with all rates equal to or greater than 1.12 kg ae/ha (3.15 l/ha).
2) Red maple was fully controlled with rates of 2.24 kg ae/ha (6.29 l/ha) and greater.
3) Sugar maple was slightly controlled with rates of 2.24 kg ae/ha (6.29 l/ha) or greater.
4) Pin cherry was controlled with treatments of 1.12 to 2.24 kg ae/ha (3.15 to 6.29 l/ha).
5) Ericaceous species were effectively controlled with 1.12 (3.15 l/ha), 2.24 (6.29 l/ha) and 3.36 kg ae/ha (9.44 l/ha). By the third year, species treated with 1.12 kg ae/ha (3.15 l/ha) showed a marked increase in growth. To provide temporary control of Labrador tea, a treatment rate of 3.36 kg ae/ha (9.44 l/ha) was required.
6) There was excellent initial control of grass by the 1.12 and 1.68 kg ae/ha rates (3.15 and 4.72 l/ha) but for only one year after treatment.
7) Goldenrod was effectively controlled with applications of 1.68 and 2.24 kg ae/ha (4.72 to 6.29 l/ha).
8) The growth of non-target species in most cases increased due to the release from overtopping vegetation. However, since this vegetation was usually shorter than the planted seedlings and did not have a dense root mat, it is not considered a problem in relation to tree seedling survival and development.

More recent Nova Scotia Lands and Forests aerial and ground studies have tested the efficacy of Roundup when applied as finer droplets and over a wider range of treatment rates. These tests indicate that Roundup application rates for certain species, e.g. red maple, can be reduced below those specified above. These results will be published at a later date.

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