Preparing planting sites with herbicides

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In old fields, increased growth and survival of planted Japanese larch and hybrid poplar can be obtained by using the proper herbicide and optimum rate to control known species of competing vegetation. The amount of vegetation removed at a given rate of applied herbicide was directly related to the seedling growth. These exploratory trials indicated that herbicide "prescriptions" can be developed for a given site with prior knowledge of its soil texture, vegetative cover, and weed-kill response.

Old fields, abandoned after cultivation, fire, and timber cutting, are often difficult to reforest. Early stages of plant succession generally consist of a profuse cover of annual and perennial weeds that rob planted trees of essential water, nutrients and light during the critical establishment period. The kind and amount of competing vegetation found on old abandoned fields depend on treatments before reforestation. Various methods of site preparation, including mechanical methods and prescribed burning, have been and are currently being investigated.

The development of effective and inexpensive herbicides of negligible toxicity, with a high degree of plant selectivity, offers the land manager a wide variety of up-to-date tools for the removal of unwanted plants. This article is an attempt to develop herbicide "prescriptions" for use on a variety of old-field sites. Recommended herbicides and rates of application depend on specific weed cover, soil hype, and kind of trees planted.

Herbicide Application

At each of four central Pennsylvania old-field test sites, eleven chemical treatments (single and combined herbicides), plus adjacent untreated controls, were replicated three times on 18.6 square meter plots (3.05 x 6.10 meters). All chemicals and chemical combinations were first prepared in the lab according to rate, then spread (granules and pellets) or sprayed with wettable powders (WP) on the test plots from May 3 to 13, 1969. (Table 1.)

TABLE 1.—These herbicides, per formulation and kilograms per hectare, were applied:

Common Name	Trade Name	Formulation	Rates in kg/ha (active ingredient) Low	Medium	High
1. Bromacil	Hyvar X	85%granule	5.6	11.2	22.4
2. Bromacil		80% WP	5.6	11.2	22.4
3. Diuron	Karmex	8% granule	11.2	22.4	33.6
4. Karbutilate	Tandex	50% granule	5.6	11.2	22.4
5. Karbutilate		80% WP	5.6	11.2	22.4
6. Fenuron	Dybar	25% pellet	11.2	22.4	33.6
7. Picloram	Tordon	10% pellet	2.2	5.6	11.2
8. Picloram plus Bromacil (1:4)		11.25% pellet plus 45% granule	7.0	14.0	28.0
9. Picloram plus Karbutilate (1:4)		10% pellet plus 45% granule	7.0	14.0	28.0
10. Picloram plus Diuron (1:8)		33.3% granule plus 8% granule	12.6	25.2	28.0
11. Diuron plus Bromacil (1:1)		5% granule plus 4% granule	6.3	12.6	25.2

(The chemical name for Hyvar X is 5-bronco-3-sec-but66-methvluracil: for Karmex it is 3(3.-1-dichlorophenvi)-l. 1-dimethvlurea; for Tandex it is tert-butvlcarbamic acid ester with 3-(mhydroxphenyl)-l. 1-dimethylurea: for Dybar it is 3-phenyl 1. 1-dimethylurea: and for Tordon it is 4-amino-3..5.6-trichloropicolinic acid.)

Tree Planting and Site Condition

To examine the prospects for survival and development of trees on herbicide-treated plots. 2-year-old Japanese larch seedlings *(Larix leptolepis* Sieb. and Zucc. Gord.), and 12inch cuttings of 1-year-old hybrid poplar *(Populus maximowi zii trichocarpa),* were hand-planted at all four test sites from April 11 to 25, 1970. Six seedlings (3 larch and 3 poplar) were planted on each plot. A total of 3,168 seedlings was planted (6 seedlingsX 11 herbicides x 4 rates X 4 sitesX3 replications). Two years after planting and again after the third growing season. tallies were made of the number of surviving trees and their height growth in relation to chemical rate, weed cover control. and soil texture.

The sites chosen for the experiment were uncultivated old fields, differing in soil types and years of abandonment. All vegetation was classified by genera and species: a total of 180 species. including woody plants was identified. The soil type and percentage of total dominant ground cover by species for each site were as follows:

Silty clay loam: 31 percent Kentucky bluegrass *(Poa pratensis L.); 22* percent timothy *(Phleum pratense L.):* and 14 percent poverty grass *(Danthonia spicata (L.)* Beauv.)

Silty clay loam: 17 percent poverty grass; *16* percent goldenrod *(Solidago sp.);* and 13 percent Kentucky bluegrass.

Loamy sand: *26* percent little bluestem *(Andropogon scoparius Michx.); 22* percent poverty grass: and *20* percent scrub oak *(Quercus ilicifolia Wangenh.).*

Silt loam: 41 percent quackgrass *(Agropvron repens (L.)* Beav.); and 40 percent timothy.

Results and Discussion

An analysis of variance of the main effects: i.e. herbicide, rate of application and site (soil). on seedling height growth and survival revealed significant differences. As shown in table *2.* site and herbicide showed highly significant differences for both species. The effects of herbicide rate of application for Japanese larch were nonsignificant. Conversely, the rate of herbicide applied to hybrid poplar resulted in significant differences in height growth and survival. Highly significant first order interactions were also found between site herbicide for Japanese larch, and between site herbicide and site X rate for hybrid poplar. The results indicated lack of independence between and among the main effects and, therefore, one is justified in ranking the herbicides according to rate of application and soil type.

The eleven herbicides were then ranked in descending order of maximum height growth obtained, according to the "best" site and rate of application under a given weed cover condition. Based on this method, herbicide prescriptions applicable to Japanese larch and hybrid poplar, after three growing seasons, were developed (tables 3 and 4).

A species comparison of the mean height and survival clearly indicated the superiority of hybrid poplar. As shown in figure 1. although seedling survival, weed cover, and soil type were identical on a diuron-treated plot. hybrid poplar height growth was more than double that of Japanese larch. The remaining herbicides exhibited similar growth differences between species.

The influence of soil texture on height growth for each species was clearly evident. For Japanese larch. the mean height growth on silt loam soil, compared with a silty clay loam. was 431 and 294 centimeters respectively: for hybrid poplar. the silt loam produced 849 centimeters of growth whereas the silty clay loam produced only *342* centimeters.

As expected, dominant weed cover control increased directly with increased rate of herbicide, high > medium > low > control. The percentage of weeds killed, and rate of

TABLE 2.—Analysis of variance summary table

Japanese larch

Factor	df	Height growth F-ratio	Height growth Probability	Seedling survival F-ratio	Seedling survival Probability	Weed kill F-ratio	Weed kill Probability
Site (soil)	3	38.08	***	49.12	***	6.33	***
Herbicide	10	4.94	***	4.32	***	73.33	***
Rate	3	0.62	NS	0.99	NS	610.14	***
Site X herbicide	30	2.69	***	2.04	***	5.10	***
Site X rate	9	0.61	NS	0.42	NS	1.24	NS
Herbicide X rate	30	0.88	NS	0.78	NS	10.07	***
Total	90						

Hybrid poplar

Factor	df	Height growth F-ratio	Height growth Probability	Seedling survival F-ratio	Seedling survival Probability	Weed kill F-ratio	Weed kill Probability
Site (soil)	3	16.30	***	28.21	***	6.34	***
Herbicide	10	2.82	***	1.94	**	73.33	***
Rate	3	2.18	*	2.84	**	610.14	***
Site X herbicide	30	2.97	***	2.00	***	5.10	***
Site X rate	9	2.08	**	2.21	**	1.24	NS
Herbicide X rate	30	1.01	NS	1.03	NS	10.07	***
Total	90						

***1% level of probability; **5% level; *10% level; NS = nonsignificant.

herbicide applied, were then reflected directly in terms of growth for each species. For Japanese larch, the mean height growth for high, medium, and low rates was 532. 224. and 313 centimeters respectively. The mean growth obtained for hybrid poplar, based on high, medium, low, and control was 678, 660. 588, and 277 centimeters respectively. The removal of competing weeds, using a prescribed rate of herbicide. and the resulting early growth of hybrid poplar is shown in figure 2.

Of the 11 herbicides tested, the maximum height produced for both species occurred with diuron granules and picloram-diuron granular formulations. These herbicides were most effective on silt-loam soil types. On the average, hybrid poplar growth was nearly three times that of Japanese larch.

Fu;t *sF. 1.-Growth of planted Japanese larch and hybrid poplar follow mg the application of 22.4* kilogram/hectare of diuron granular herbicide. Dominant weed cover is quackgrass and timothy established on a silt loam soil.

PESTICIDE PRECAUTIONARY STATEMENT

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State or Federal agencies before they can be recommended.

Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife-if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus, pesticides and pesticide containers.

FIGURE 2.—Hybrid poplar seedling 1 year after planting. Weeds have been killed with a low rate application of picloram-diuron granular herbicide.

TABLE 3.—*Herbicide "prescriptions" based on maximum height growth and survival by soil texture, weed cover, weed kill, and herbicide rate*

Japanese larch (larix leptolepis Sieb. and Zucc. Gord.)						
Herbicide[1]	Herbicide rate	Soil Texture	Dominant weed cover[2]	Weed kill	Surviving seedlings	Seedling height[3]
	Kg/ha			Pct	Pct	Cm
Diuron (G)	11.2	silt loam	4	14	56	660.4
Picloram-diuron (G)	28.0	silt loam	4	81	33	594.4
Karbutilate (WP)	22.4	silt loam	4	66	33	548.6
Karbutilate (G)	22.4	silty clay loam	1	74	40	541.0
Picloram (P)	11.2	silty clay loam	1	18	40	444.5
Bromacil (G)	5.6	silt loam	4	33	33	279.4
Fenuron (P)	22.4	silt loam	4	22	33	279.4
Bromacil (WP)	11.2	silty clay loam	1	71	33	269.2
Diuron-bromacil (G)	6.3	silt loam	4	9	22	223.5
Picloram-karbutilate (P,G)	14.0	silty clay loam	1	11	22	124.5
Picloram-bromacil (P,G)	7.0	silty clay loam	1	17	11	88.9

[1] G = granule; P = pellet; WP = wettable powder.
[2] Quackgrass, timothy; 1 = Kentucky bluegrass, timothy, poverty grass.
[3] Sum of surviving seedlings for three replications (after 3 growing seasons).

TABLE 4. —*Herbicide "prescriptions" based on maximum height growth and survival by soil texture, weed cover, weed kill, and herbicide rate*

Hybrid poplar (Populus maximowiczii X trichocarpa)						
Herbicide[1]	Herbicide rate	Soil Texture	Dominant weed cover[2]	Weed kill	Surviving seedlings	Seedling height[3]
	Kg/ha			Pct	Pct	Cm
Picloram-diuron (G)	12.6	silt loam	4	24	56	1783.1
Diuron (G)	22.4	silt loam	4	63	56	1711.9
Fenuron (P)	33.6	silt loam	4	37	67	908.0
Karbutilate (G)	22.4	silty clay loam	2	87	38	267.4
Picloram (P)	5.6	silty clay loam	1	12	40	444.5
Diuron-bromacil (G)	6.3	silt loam	4	9	33	337.8
Bromacil (WP)	0	silty clay loam	2	0	56	276.9
Bromacil (G)	11.2	silty clay loam	2	57	40	26.16
Karbutilate (WP)	11.2	silt loam	4	49	22	221.0
Picloram-karbutilate (P,G)	7.0	silt loam	4	0	11	132.1
Picloram-bromacil (P,G)	7.0	silty clay loam	2	17	20	99.1

[1] G = granule; P = pellet; WP = wettable powder.
[2] 4 = quackgrass, timothy; 2 = poverty grass, goldenrod, Kentucky bluegrass; 1 = Kentucky bluegrass, timothy, poverty grass.
[3] Sum of surviving seedlings for three replications (after 3 growing seasons).

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