SIMAZINE RATES AND MIXTURES FOR POPLAR AND WILLOW CUTTINGS

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SUMMARY

In two nursery weed control trials two poplar and two willow clones responded differently to increasing rates of simazine and to mixtures of simazine with other herbicides. The rate of simazine for maximum response of 'Tasman' hybrid black poplar was about 4 kg/ha, for 'Aokautere' Matsudana hybrid willow about 2 kg/ha, and for 'Irette' purple osier between 1.1 and 1.5 kg/ha. 'PMC 471' black cottonwood did not respond significantly to differing simazine rates. Cultivation gave better results than herbicides. For black cottonwood, simazine with chlorthal was significantly better than the unweeded control. 'Tasman' poplar responded well to simazine with oryzalin or alachlor. Amitrole-T at 3.2 kg amitrole/ha damaged all clones.

INTRODUCTION

Simazine, with or without other herbicides, is the most commonly prescribed material for post-planting chemical weed control in hardwood nurseries (Ivens 1964; Cox 1972; Gilchrist 1979; Robinson 1983). The need for mixtures with simazine is well recognised because its spectrum of activity is not sufficiently wide (Jones 1980), some hardwoods are sensitive to the rates needed for effective weed control (Corell 1979; Carter 1979; Ryan *et al* 1981), and simazine-resistant weed populations have developed (Ryan 1970; Delaney and Moon 1984; Sale and Mason 1986). Rates of simazine recommended in the UK differ from those in the USA (Robinson 1983).

Two trials were laid down at Aokautere to determine response curves of two poplar and two willow species to varying rates of simazine, and to find out what companion herbicides would be suitable to use with a low rate of simazine (1.1 kg/ha) under New Zealand conditions.

METHOD

In both trials the test plants were 'Tasman' hybrid black poplar (*Populus x euramericana* cl. Tasman), black cottonwood or western balsam poplar (*P. trichocarpa* cl. PMC 471 = S617-41), 'Aokautere' Matsudana hybrid willow (*Salix matsudana x alba* cl. Aokautere = NZ 1002) and 'Irette' purple osier (*S. purpurea* cl. Irette). Two rows of each per replicate were planted during 4-9 September 1985 as unrooted cuttings at 40 cm spacings within the row, in cultivated Manawatu fine sandy loam with 7% organic matter. The weed control treatments were applied in 2.8 m wide strips across the rows giving a split block design. Herbicide treatments were applied using an "Algen" precision sprayer with a boom carrying five nozzles 50 cm apart fitted with Teejet 8003 flat fan tips operated at 300 kPA. During assessment, trees at the edge of each strip were not measured, so the measured strip was 2.0m wide covering 5 trees in each row or 10 trees per double-row plot.

Trial 1: Effect of rates of simazine

Rows were 0.9 m apart and there were four replicates. Four rates of simazine (Simazol 4A), 1.1, 2.2, 3.4, and 4.5 kg/ha, were applied on 20 September 1985 in 255 litres/ha of water. An untreated control was unweeded. Visual tree damage and weed control assessments were rated on 17 December and dominant weeds not controlled were recorded on 5 February 1986.

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Trial 2: Effect of simazine mixtures

Rows were 1.0m apart and there were three replicates. Treatments are shown in Table 2. Propyzamide, napropamide and trifluralin were applied, and the latter two incorporated by hand "Spintiller", on 13 September. On 23-25 September the rest of the treatments given in Table 2 were applied except for the two simazine + amitrole post-emergence treatments which were applied on 29 October. All were applied in 275 litres/ha water. The cultivated treatment was hand-hoed when weeds were at the seedling stage and later hand-weeded as needed throughout the season. Weed control was rated visually on 10 February 1986.

Tree species in both trials were pruned to a single leader in February 1986. Their heights and, for 'Irette' osier, the length of the longest stem, were measured in June. At the same time the diameter at breast height, 1.4m, or at half the height for trees less than 2.8m high, was measured on trees and the number of osier wands 1.35m or more long were counted.

RESULTS AND DISCUSSION**Trial 1:**

Weed control at 2.2 kg/ha or less was "less than satisfactory" (less than 7 on a 0-10 scale). Dominant weeds not adequately controlled by simazine were barnyard grass (*Echinochloa crus-galli*), particularly in the lowest yielding replicate, and black nightshade (*Solanum nigrum*), though control was satisfactory to good at 3.4 and 4.5 kg/ha. Docks (*Rumex obtusifolius*) and willow weed (*Polygonum persicaria*) were controlled by simazine at 1.1 kg/ha and above.

Height (H), diameter at breast height or half height (D), survival (n), and volume index (D²H) at the end of the growing season are shown in Table 1. For 'Irette', number of 1.35m wands per plant is given instead of diameter and volume measurements.

TABLE 1: Height (H), diameter (D), volume index, (D²H), number surviving out of 40, (n), and number of well grown stems (No.) of poplars and willows in response to weed control with differing rates of simazine.

RATE (kg ai/ ha)	'Tasman'				'PMC 471'			
	H (m)	D (mm)	D ² H (cm ³)	n	H (m)	D (mm)	D ² H (cm ³)	n
0	2.15	9.8	234	39	1.79	7.8	137	27
1.1	2.76	12.6	551	40	2.07	8.7	217	29
2.2	2.90	13.8	640	39	1.79	7.9	146	27
3.4	3.12	14.7	776	40	1.94	8.2	195	27
4.5	3.16	15.3	817	39	2.12	8.9	207	16
SEM	0.17	1.0	108		0.18	0.6	40	
RATE (kg ai/ ha)	'Aokautere'				'Irette'			
	H (m)	D (mm)	D ² H (cm ³)	n	H (m)	No. of wands	n	Weed control (0-10)*
0	2.62	9.2	240	40	1.90	2.22	40	0
1.1	3.11	12.0	489	40	2.11	2.65	40	5
2.2	2.88	11.5	431	40	1.87	1.98	40	7
3.4	2.88	11.7	474	39	2.01	2.00	39	8
4.5	2.43	9.2	285	38	1.42	1.10	36	8
SEM	0.14	0.7	57		0.16	0.27		

*0 = none 1-3 = slight 4-6 = moderate 7-9 = good 10 = complete

The 4.5 kg/ha treatment significantly affected survival — 81% over all species compared with over 90% for the other treatments. To weight the growth data for survival, dead trees' measurements (mostly zero) were included in means used in the analyses of variance and regression analyses.

Over all species the rate of simazine had only just significant effects on height, diameter, and volume. Highly significant species x rate interactions ($P < 0.001$) were

also found. Response curves for individual species rather than for all species combined were therefore derived where the regressions were significant.

The effects of herbicide rate on height, diameter, and volume index of 'PMC 471' were not significant. The effects on 'Tasman', 'Aokautere' and 'Irette' were significant and quadratic equations best fitted the responses.

The resulting parabola of volume response for 'Tasman' gives the following equation: $V = 252 + 251R - 29R^2$ where R = rate of simazine ($r^2 = 0.968$). The peak of the curve corresponds to a simazine rate of 4.3 kg/ha. Similar curves of height and diameter response in this clone peak at 3.8 and 4.2 kg/ha respectively. 'Tasman' is remarkably tolerant of simazine and responds to the good weed control that high rates give. For overall growth 4 kg/ha is recommended where simazine is used alone.

The volume response curve for 'Aokautere' is described by the equation: $V = 260 + 202R - 44R^2$ ($r^2 = 0.842$) giving a peak at 2.3 kg/ha. The height and diameter response curves peak at 1.9 and 2.1 kg/ha respectively.

With purple osier the effect of rate on height was not significant, but because this species provides wands for streambank erosion control, the number of wands meeting minimum specifications is the best measure of productivity. Here the effect of rate on number reaching breast height was significant. A quadratic model was significant at the 10% level and is represented by the equation $N = 2.3 + 0.24R - 0.11R^2$ where N is the number of wands and R the rate of simazine, ($r^2 = 0.871$). From the response curve the estimated optimum rate for overall growth is 1.1 kg/ha

Trial 2:

Best weed control lasting into February was given by the simazine and oxadiazon mixture (Table 2). Other companion chemicals which controlled barnyard grass, the dominant species not controlled by simazine alone, were alachlor, napropamide, oryzalin, and diphenamid. Though barnyard grass was not fully controlled, general weed control by diuron was as good as with these four.

Mortality of all clones was unacceptably high (>70%) with the amitrole-T (3.2 kg/ha) mixture and only 'PMC 471' tolerated the lower rate of amitrole in SDA. Diuron significantly increased mortality of 'Tasman' to 40% in this trial.

A notable result in Table 2 is the poor response of 'Tasman' to diuron at 2.8 kg/ha. Even allowing for poor survival, growth was not significantly better than the unweeded control, although weed control was as good as with simazine and alachlor. This is contrary to results obtained for another *P. x euramericana* clone 'Flevo' (Gilchrist 1986). It is evident that there are site, seasonal, or clonal differences in response to weed control using diuron within the *P. nigra* (European) x *P. deltoides* (American) hybrid.

Where simazine alone is unable to control the weeds present suitable companion herbicides for 'Tasman' would be alachlor, oryzalin, napropamide, chlorthal, or oxadiazon.

Personal observation has shown that the clone 'PMC 471' is difficult to strike from cuttings, and survival rates are usually poor compared with other species. In Trial 2 there were no significant differences in volume index of 'PMC 471' when dead-tree measurements were incorporated. Only cultivation produced significantly better diameter than the unweeded control, and the chlorthal mixture and cultivation produced significantly taller plants. When only survivors were considered, diameter responses to weed control using simazine with alachlor or oxadiazon became significant. However, both of these significantly reduced survival (Table 2).

For 'Aokautere'/' simazine with a companion herbicide such as oryzalin, or cultivation or diuron, gave the best results. Gilchrist (1986) predicted best height growth of this clone with diuron at 2.1-2.6 kg/ha.

Weed control by the addition of other herbicides to simazine did not significantly enhance growth of 'Irette'.

TABLE 2: Most significant responses in mean indices of volume computed from height and diameter measurements, mean number of well-grown stems per shrub willow plant, or mean survival, of four poplar and willow clones to simazine, mixtures with simazine, and three standard treatments.

TREATMENT (kg ai/ha)	'Tasman' D ² H (cm ³)	'Aokautere' D ² H	'Irette' No. of wands	'PMC 471' Survival (%)	Estimated * weed control
cultivation	1060a	1703a	2.43a	91.5a	10
simazine 1.1 + oryzalin 2.25	958ab	1322b	2.13a	58.1abcd	6
simazine 1.1 + alachlor 3.0	998ab	1159bc	2.10a	57.3bcd	7
simazine 1.1 + chlorthal 7.5	727abc	1105bc	1.90a	75.0abcd	5
simazine 1.1 + napropamide 2.25	750abc	1037bcd	2.43a	46.6cd	6
simazine 1.1 + oxadiazon 1.6	721abc	948cde	2.27a	43.2d	9
simazine 1.1 + diphenamid 4.5	670bcd	957cde	2.13a	56.8bcd	6
diuron 2.8	259efg	1369b	2.03a	72.0abcd	7
simazine 1.1 + trifluralin 0.8	564cde	853cdef	2.17a	70.0abcd	5
simazine 2.2	696bc	543fg	2.10a	76.8abcd	5
simazine 1.1 + propyzamide 0.85	598cde	744def	1.87a	83.6abc	4
simazine 1.1	353def	649efg	1.97a	66.7abcd	3
unweeded	348def	539fg	1.90a	55.7bcd	0
SDA 2.2 C1.1 + 0.35 + 0.72)	121fg	376g	0.93b	86.0ab	5
simazine 1.1 + amitrole-T 3.2	6g	13h	0.03c	1.1e	5
CV	33.7%	33.7	%	17.9%	10.4%

In any one column, treatment means with a letter in common are not significantly different at the 5% level. Analysis on transformed survival data (arcsine).

* Weed control 0-10 scale — 0 nil, 1-3 slight, 4-6 moderate, 7-9 good, 10 complete.

Products used:
 oryzalin, Surflan WP;
 chlorthal-dimethyl, Dacthal 75 WP;
 oxadiazon, Foresite Sn;
 trifluralin, Treflan EC;
 amitrole-T, Weedazol 4 L;
 SDA (simazine + 2.2-DPA + amitrole), Yates DAS;
 simazine, Simazol 4A Sn;
 alachlor, Yates Alachlor 50 EC;
 napropamide, Devrinol 50 WP;
 diphenamid, Enide 50 WP;
 propyzamide, Kerb 50 WP;
 diuron, Dyron 80 WP;

CONCLUSIONS

Species or hybrids of poplars and willows, and probably clones within the same species or hybrids, differ in their responses to simazine and simazine mixtures sprayed over newly-planted cuttings. Optimum rates vary from 1.1 kg simazine/ha for maximum number of wands in the first growing season of 'Irette' purple osier to 4.3 kg simazine/ha for maximum stem volume in 'Tasman' hybrid black poplar. That 'Tasman' is more tolerant of simazine than 'PMC 471' supports the conclusion of

Akinyemiju and Dickmann (1982) that clones in section Aigeiros (black poplars) are generally more tolerant of simazine (and diuron) than clones in section Tacamahaca (balsam poplars, which include black cottonwood).

Lower rates of simazine mixed with herbicides such as oryzalin, alachlor, chlorthal or, for willows and black poplars, napropamide gave a wide spectrum of weed control. For osier willows and black poplars, oxadiazon may be used with simazine and in Trial 2 gave the best weed control. Alachlor may not be safe to use on some balsam poplars, and amitrole-T at 3.2 kg/ha should not be used over any clone in its first growing season.

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