TOLERANCE OF CALLA LILIES TO HERBICIDES

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SUMMARY

Calla lilies (*Zantedeschia elliottiana*) tolerated the pre-emergence herbicides terbutometon/terbuthylazine (up to 3.0 kg/ha), simazine (2.0 kg/ha), diuron (2.0 kg/ha), metribuzin (0.6 kg/ha), atrazine (1.0 kg/ha), and oxadiazon (1.5 kg/ha). Bromacil, terbacil, hexazinone (all at 0.67 kg/ha and above), and oxyfluorfen at 3.0 kg/ha were very damaging. Of the post-emergence herbicides, clopyralid (up to 0.6 kg/ha) was safe but failed to control many weed species. The crop also tolerated methazole (up to 1.6 kg/ha), cyanazine (1.6 kg/ha), methabenzthiazuron (2.0 kg/ha), metribuzin (0.6 kg/ha), dicamba (at 0.3 but not at 0.6 kg/ha), and oxadiazon (at 1.5 but not at 3.0 kg/ha).

Keywords: herbicide tolerance, Calla lilies, *Zantedeschia elliottiana*

INTRODUCTION

With the expansion of exports to North America, Calla lily tuber production in New Zealand shows promise of considerable growth. Large planted areas call for cost efficient cropping systems using the best available technology, including weed control. Herbicide programmes are needed as part of an operational "blue print" both for tuber production and, to a lesser extent, for flower production.

Little research has been reported on chemical weed control in Calla lilies. The aim of this programme was to develop safe and effective weed control practices, from planting through to tuber harvest. The programme, conducted at Levin H.R.C. during 1987, consisted of one large pre-emergence residual herbicide trial, one post-emergence trial to establish tolerance to clopyralid, and one post-emergence screening trial.

METHODS

Tubers of approx. 20 mm diameter of *Z. elliottiana* cv. Amethyst (clone No 15) grown in tissue culture were supplied by the New Zealand Calla Producers Association. The tubers were stored at 8°C in dry Fibremix bark until planting.

The trial site was treated with clopyralid in early June and glyphosate in August to remove weeds, and was ploughed in mid-September. Soil tests prior to fertilizer application showed pH 6.5, Ca 1062, K 140, P 18, Mg 45, Na 7 µg/g soil. On 2 October, 1987, 700 kg/ha of 12:10:10 NPK compound fertilizer was applied and incorporated into the soil. The soil was cultivated again about 2 weeks later to remove seedling weeds and provide a suitable seedbed for planting.

On 19 October, 1987 tubers were planted 30 mm deep and 0.5 m apart, in rows 1.5 m apart. Each plot contained ten tubers, the first two and the last tuber in each plot row were small grade 5 tubers and the remaining seven were larger grade 4 tubers.

Residual herbicides (Table 1) were applied to moist soil 11 days after planting; glyphosate (1.5 kg/ha) was applied over the whole area 1 week after planting, and paraquat/diquat (0.45 kg/ha), just prior to emergence, 4 weeks after planting. All test herbicides were applied with a modified Oxford Precision Sprayer at 200 kPa in 350 litres/ha, and overall herbicides were applied with a Russell tractor sprayer at 200 kPa in 273 litres/ha. There were four replicates in the pre-emergence and the clopyralid trials, and two replicates in the post-emergence trial.

Weeds were counted in two 400 x 400 mm quadrats per plot 8 weeks after planting and weed cover on all trials was assessed 11 weeks after planting. The site was then hoed and kept weed-free until harvest. Crop injury was scored 12 weeks after planting and Calla lily leaves were counted in February 1988.

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Foliage treatments (Table 3) (were applied in mid December 1987, 7½ weeks after planting. The crop was 14 cm high with two leaves, usually not fully unfurled. Clopyralid (Versatill 30% ac), at 0, 0.15, 0.3 and 0.6 kg/ha, was also applied at this time. Weeds were counted on these trials 9 weeks after planting.

Tubers were lifted, counted and washed on 5 July 1988. After being left to dry overnight they were weighed.

RESULTS AND DISCUSSION

In the pre-emergence trial, the substituted uracils, bromacil, hexazinone and terbacil, all severely damaged the crop and reduced the number of leaves per plant (Table 1). Oxyfluorfen (all rates) and the high rate of oxadiazon (3.0 kg/ha) caused moderate crop damage. Oxadiazon 1.5 kg/ha, and all three rates of terbumeton/terbuthylazine caused some temporary injury, but the crop recovered and gave high yields. All other treatments caused only slight crop damage.

TABLE 1: Leaf growth, crop injury scores and yield in *Calla* lily after application of residual herbicides on 30.10.87.

Chemical	Rate (kg ai/ha)	Leaves/plant Feb 1988	Crop injury score ¹ 12/1/88	Tuber yield (kg/ha)
bromacil (Hyvar X 80% wp)	0.67	2.7	8	236
bromacil	1.0	1.0	8	0
bromacil	2.0	0.2	9	0
hexazinone (Velpar 90% wsp)	0.67	7.5	6	862
hexazinone	1.0	3.2	7	0
hexazinone	2.0	0.6	8	0
terbacil (Sinbar 80% wp)	0.67	4.8	7	431
terbacil	1.0	1.4	8	70
terbacil	2.0	0.5	9	0
oxyfluorfen (Goal 24% ec)	1.0	10.7	6	986
oxyfluorfen	1.5	10.1	6	1007
oxyfluorfen	3.0	10.5	6	846
terbumeton/terbuthylazine (Caragard 50% sn)	1.0	9.6	3	1134
terbumeton/terbuthylazine	1.5	10.9	3	1409
terbumeton/terbuthylazine	3.0	11.1	4	1351
atrazine (Gesaprim 80% wp)	1.0	9.6	3	1193
atrazine	2.0	9.4	3	1002
simazine (Gesatop 80% wp)	1.0	10.1	3	1307
simazine	2.0	13.0	3	1526
diuron (Karmex 80% wp)	1.0	10.5	2	1310
diuron	2.0	11.0	3	1377
metribuzin (Sencor 70% wp)	0.3	9.7	2	1158
metribuzin	0.6	11.3	3	1299
oxadiazon (Foresite 40% sn)	1.5	12.9	4	1280
oxadiazon	3.0	10.4	6	948
control — untreated		7.9	1	871
LSD 5%		2.4		295

¹Key for crop injury: 0 No injury 7-8 Severe injury or very stunted
2 Slight injury 10 Mortality
4-5 Moderate injury

Weeds were controlled well by the high rates of all chemicals used, and by the low rates of oxadiazon and simazine and the middle rate of terbumeton/terbuthylazine (Table 2). The major weed on the site was summer grass (*Digitaria sanguinalis*); previous experience has shown that this can be controlled in the crop by specific grass herbicides, e.g. sethoxydim or fluazifop-butyl. Scrambling speedwell (*Veronica persica*) was not controlled by the low rate of diuron, and the low rate of metribuzin gave poor weed control.

TABLE 2: Weed counts recorded on 16.12.87 and weed scores on 11.1.88, after application of residual herbicides on 30.10.87. Only herbicides tolerated by the crop are included.

Chemical	Rate (kg ai/ha)	Weeds/m ²		Weed score ¹
		Summergrass	Broadleaf	
terbumeton/terbuthylazine	1.0	60	8	7
terbumeton/terbuthylazine	1.5	23	4	7
terbumeton/terbuthylazine	3.0	3	6	6
atrazine	1.0	103	1	7
atrazine	2.0	41	2	7
simazine	1.0	56	4	7
simazine	2.0	2	0	7
diuron	1.0	45	29	8
diuron	2.0	12	16	7
metribuzin	0.3	139	25	8
metribuzin	0.6	30	6	7
oxadiazon	1.5	2	1	6
control — untreated	-	166	78	9

¹Key for weed score: 0 No weeds 5 Moderate weediness, 30% ground cover
2 Few small weeds 10 Some large weeds, 60-70% ground cover

TABLE 3: Crop injury scores, leaf numbers, and tuber yield at harvest in Calla lily after application of post-emergence herbicides on 11.12.87.

Chemical	Rate (kg ai/ha)	Crop injury score ¹	Leaves/plant Feb 1988	Yield (kg/ha)
cyanazine (Bladex 50% wp)	0.8	3	8.2	870
cyanazine	1.6	3	9.8	1100
dicamba (Dicamba 20% liq)	0.3	3	9.5	1070
dicamba	0.6	3	7.9	740
glufosinate ammonium (Buster 20% ac)	0.75	7	6.7	580
glufosinate ammonium	1.5	8	5.0	350
glyphosate (Roundup 36% ac)	1.0	6	7.4	490
glyphosate	2.0	6	4.9	420
ioxynil (Totril 22.5% ec)	0.8	5	9.4	950
ioxynil	1.6	5	8.5	820
linuron (Linuron 50% wp)	0.8	5	8.4	750
linuron	1.6	6	7.7	770
methabenzthiazuron (Tribunil 70% wp)	1.0	4	8.8	1110
methabenzthiazuron	2.0	4	10.2	1150
methazole (Probe 75% wdg)	0.8	4	10.9	1340
methazole	1.6	5	11.0	1160
metribuzin (Sencor 70% wp)	0.3	4	10.3	1090
metribuzin	0.6	4	9.1	1080
oxadiazon (Foresite 40% sn)	1.5	1	10.1	1090
oxadiazon	3.0	7	6.6	510
paraquat (Gramoxone 20% ac)	0.5	8	5.8	420
paraquat	1.0	9	5.3	190
phenmedipham/desmedipham (Betanal 16.5% ec)	0.8	5	8.7	870
phenmedipham/desmedipham	1.6	5	7.5	820
prometryn (Gesagard 50% wp)	0.8	4	9.2	960
prometryn	1.6	5	8.9	890
terbutryn (Igran 80% wp)	0.4	3	9.1	870
terbutryn	0.8	5	7.8	870
control — untreated		1	8.6	900
LDS 5%			4.9	680

¹See Table 1 for crop injury index key.

TABLE 4: Weed counts recorded on 23.12.87 and weed scores on 5.1.88, after post-emergence herbicide application on 11.12.87. Only herbicides tolerated by the crop are included.

Chemical	Rate (kg ai/ha)	Weeds/m ²		Weed score ¹
		Summergrass	Broadleaf	
cyanazine	0.8	59	10	6
cyanazine	1.6	48	5	5
dicamba	0.3	86	75	7
dicamba	0.6	117	39	7
methabenzthiazuron	1.0	50	9	4
methabenzthiazuron	2.0	11	2	3
methazole	0.8	72	103	6
methazole	1.6	27	9	3
metribuzin	0.3	14	13	4
metribuzin	0.6	17	4	3
oxadiazon	1.5	100	97	7
phenmedipham/ desmedipham	0.8	62	5	4
phenmedipham/desmedipham	1.6	48	24	3
prometryn	0.8	119	22	4
prometryn	1.6	12	2	2
terbutryn	0.4	111	5	5
terbutryn	0.8	31	13	4
control-untreated	—	87	171	10

¹See Table 2 for weed score key

Several of the safer herbicide treatments resulted in significantly higher tuber yields than the untreated control (Table 1) indicating that some weed competition had occurred before the crop was hoed.

In the post-emergence screening trial, the low rates of oxadiazon, terbutryn and dicamba caused little or no damage (Table 3). Severe injury symptoms were noted shortly after treatment with glufosinate-ammonium or paraquat. Glyphosate and the high rate of oxadiazon also caused severe injury but symptoms took much longer to develop. Ioxynil and linuron quickly caused moderate injury, but methazole, cyanazine, phenmedipham/desmedipham, methabenzthiazuron and the high rates of prometryn and terbutryn developed light to moderate injury symptoms about a month after spraying.

Tuber yield did not differ significantly from the control in any treatment, except with paraquat at 1.0 kg/ha. Broadleaf weeds were controlled well by both rates of cyanazine, phenmedipham/desmedipham, ioxynil, linuron, methabenzthiazuron and terbutryn, and with the high rates of methazole, metribuzin, oxadiazon and prometryn (Table 4). Metribuzin and the high rates of methabenzthiazuron and prometryn gave good control of summer grass (Table 4).

In the clopyralid trial, no treatment injured the crop significantly, but few weeds were controlled. Most weeds controlled by clopyralid were killed in the overall pre-planting application. The only other weeds controlled were in the Compositae family e.g. Californian thistle, dandelion, and in the Leguminosae family e.g. clover.

CONCLUSIONS

Clopyralid may not harm the crop, but it only effectively controls a narrow spectrum of weeds so should be used only when these weeds become a problem.

The safest and most effective pre-emergence herbicides for Calla lilies are terbutocton/terbuthylazine at 1.5 and 3.0 kg/ha, simazine at 2.0 or oxadiazon at 1.5 kg/ha.

The high rates of methabenzthiazuron, metribuzin and prometryn are tentatively suggested as the best post-emergence herbicides. Further work should be done to confirm all of these results.

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