

WEED CONTROL IN CALLA SEEDLINGS

T.J. MACKAY¹ and K.C. HARRINGTON*Plant Science Department, Massey University, Palmerston North.*

SUMMARY

In order to widen our knowledge of weed control recommendations that can be made for calla lily crops, 39 herbicide treatments were applied to seedlings of *Zantedeschia albomaculata* cv. 'Chromatella' in a field trial. Weed competition reduced tuber yields by up to 50%. The highest yields of tubers were obtained from post-emergence herbicides with residual activity, particularly terbutryn (0.5 kg/ha) and methazole (1.1 kg/ha). Bentazone (1.0 kg/ha), methabenzthiazuron (1.6 kg/ha) and a phenmedipham/desmedipham (0.66 + 0.66 kg/ha) mixture also gave high yields of tubers. Pre-emergence herbicide treatments which appeared useful included oryzalin (3.5 kg/ha), terbuthylazine (1.0 kg/ha), simazine (1.5 kg/ha) and propazine (1.0 kg/ha).

Keywords: herbicide tolerance, calla lilies, *Zantedeschia albomaculata*, *Polygonum persicaria*, *Epilobium ciliatum*.

INTRODUCTION

Callas are currently the second largest cut flower export earner for New Zealand, worth \$4.03 million in 1992/93, and these exports are continuing to increase (Muller 1993). Much of the weed control information available for this crop was obtained from one trial conducted by Ingle and Bussell (1991) on *Zantedeschia elliottiana* cv. 'Amethyst' grown from tubers. Pre-emergence herbicides tolerated in their trial were terbutryn/terbuthylazine, simazine, diuron, metribuzin, atrazine and oxadiazon. Post-emergence treatments considered safe were clopyralid, methazole, cyanazine, methabenzthiazuron, metribuzin, dicamba and oxadiazon. They concluded their report by stating that all results needed confirming by further research.

Although most growers produce calla lilies by planting tubers, there is also some production from seeds (Funnell 1993). This paper presents results from a field trial which tested the tolerance of a wide range of herbicides on a species and cultivar of calla lily different to that used by Ingle and Bussell (1991), and on seedlings rather than plants grown from tubers. Presumably herbicides tolerated by seedlings could be considered safe for use in calla lilies grown from tubers.

MATERIALS AND METHODS

The field trial was conducted on 1.0 m wide raised beds of Koputaroa sandy loam (pH 5.8) at a commercial cut flower property near Levin. After a series of cultivations over several weeks, seeds of *Zantedeschia albomaculata* cv. 'Chromatella' were hand-sown on 29 November 1991 to a depth of 2 cm at 2.5 cm intervals in three rows 40 cm apart in plots 2.1 m long.

Four days after sowing, the herbicide treatments listed in Table 1 were applied to some of the plots using a randomised block design, with each treatment replicated four times. Two of the herbicide treatments, trifluralin and EPTC, were applied to plots 2 days prior to sowing and were incorporated into the soil because of their volatile nature. All herbicide treatments were applied with a gas-powered precision plot sprayer in 250 litres/ha at 200 kPa. There was 84 mm of rain 2 days prior to sowing, and a further 14 mm fell during the 5 days after herbicide application. Seedlings emerged on 30 December 1991, though poor seed quality resulted in field emergence

¹Present address: National Pig Breeding Co NZ Ltd, PO Box 1535, Palmerston North.

varying from 34% to 78%. Three days prior to emergence, all plots were sprayed with 0.7 kg/ha glyphosate in 270 litres/ha to remove weed seedlings, a technique commonly used by commercial calla lily growers. The post-emergence treatments listed in Table 2 were applied to the remaining untreated plots on 12 February 1992, 6 weeks after emergence of the calla lily seedlings. The hand-weeding treatment involved hand-hoeing on three occasions: late January, early March and early April.

The density of weeds in each plot and the severity of herbicide damage suffered by calla seedlings were both assessed by a scoring technique 4 and 14 weeks after application of the post-emergence and pre-emergence treatments respectively. Tubers were harvested from each plot on 14 May 1992, dried at 80°C and weighed.

An analysis of variance was performed on all results, with a probit transformation being used on the scores to provide a normal distribution of data. Means were separated using the Student-Newman-Keuls multiple range test.

TABLE 1: The effects of pre-emergence herbicide treatments on weed density and crop damage 14 weeks after application, and yield, number and size of tubers 23 weeks after application, to germinating *Zantedeschia albomaculata* cv. 'Chromatella' seedlings.

Treatment	Rate (kg ai/ha)	Weed density score ¹	Crop damage score ²	Total dry weight of tubers (g/plot)	Average no. of tubers per plot	Average dry weight per tuber (mg)
alachlor	1.9	3.0	1.5	9.8	63.0	156
atrazine	1.0	0.2* ³	2.0*	13.5	78.5	171
aziprotryne	2.0	2.3*	1.8	6.7	60.9	110
chlorpropham	3.4	3.5	1.3	15.8	82.7	191
diuron	1.6	1.3*	2.0*	11.0	88.2	125
EPTC	5.0	2.5	3.3*	1.1	14.7*	74
methabenzthiazuron	1.4	2.0*	2.0*	11.3	49.1	229
methazole	1.1	2.0*	1.5	16.5	68.0	241
metribuzin	0.35	2.3*	1.8	15.9	97.4	163
oryzalin	3.5	1.1*	1.3	23.2	99.5	233
oxadiazon	1.6	1.6*	2.0*	6.7	51.2	130
oxyfluorfen	0.6	1.8*	1.8	11.0	72.2	152
pendimethalin	1.3	2.1*	1.8	13.9	86.9	159
propachlor	5.8	3.3	1.3	8.8	47.0	186
propazine	1.0	1.1*	1.8	17.6	91.1	193
simazine	1.5	0.6*	1.5	16.6	70.1	236
terbuthylazine	1.0	1.3*	1.8	21.4	86.9	245
terbuthylazine + terbumeton	2.5 + 2.5	0.0*	2.2*	1.2	23.9	49*
trifluralin	1.0	4.7	0.8	6.3	42.0	150
hand-weeded	-	0.0*	1.0	27.0	97.4	276
untreated	-	4.0	0.5	14.2	65.1	217

¹ 0 = no weeds 5 = very weedy

² 0 = no damage 5 = severe damage

³ Means marked with asterisks are significantly different to the untreated control at P=0.05.

RESULTS AND DISCUSSION

High densities of weeds had developed in plots with no herbicide treatments by the time tubers were harvested in May. By comparing the untreated plots with those that were hand-weeded, weeds apparently reduced the weight of tubers produced by 48%

(Table 1), though variability in results meant this reduction was not statistically significant ($P=0.05$). As some weeds did grow in the hand-weeded plots prior to each hoeing, and as hoeing may have caused some crop damage, this calculation may underestimate the effect of weeds on tuber production.

The apparent effectiveness of herbicide treatments was influenced by the weed species, as herbicides unable to control one of the main species present in the plots scored poorly. The two most troublesome species present were willow weed (*Polygonum persicaria*) and tall willow herb (*Epilobium ciliatum*). Other species present included creeping buttercup (*Ranunculus repens*), sow thistle (*Sonchus oleraceus*), groundsel (*Senecio vulgaris*), white clover (*Trifolium repens*), twin cress (*Coronopus didymus*), summer grass (*Digitaria sanguinalis*), narrow-leaved plantain (*Plantago lanceolata*), toad rush (*Juncus bufonius*), black nightshade (*Solanum nigrum*), spurrey (*Spergula arvensis*) and hydrocotyle (*Hydrocotyle heteromeria*).

TABLE 2: The effects of post-emergence herbicide treatments on weed density and crop damage 4 weeks after application, and yield, number and size of tubers 13 weeks after application, to 6 week-old *Zantedeschia albomaculata* cv. 'Chromatella' seedlings.

Treatment	Rate (kg ai/ha)	Weed density score ¹	Crop damage score ²	Total dry weight of tubers (g/plot)	Average no. of tubers per plot	Average dry weight per tuber (mg)
asulam	1.2	3.0	1.8	8.9	63.0	140
bentazone	1.0	1.8* ³	1.3	27.7	116.3	237
bromofenoxim	1.0	1.8*	1.3	5.9	54.6	107
chloroxuron	5.0	1.8*	1.7	17.2	90.3	190
clopyralid	0.3	3.3	0.8	16.1	79.8	201
cyanazine	1.5	1.6*	1.5	14.9	72.2	206
dalapon	7.4	2.8	1.5	6.7	59.6	111
dicamba	0.2	2.6*	1.5	16.7	84.8	197
fluazifop	0.37	4.0	1.3	10.0	54.6	183
glyphosate	0.36	2.6*	2.2*	4.7	31.5	149
haloxyfop	0.25	4.7	0.5	10.0	63.8	156
ioxynil	0.67	1.2*	2.0*	5.0	48.3	102
MCPA	1.1	2.8	3.0*	0.4	2.9*	136
mecoprop	2.4	2.8	3.0*	0.5	5.0	85
methabenzthiazuron	1.4	1.6*	1.3	26.4	102.9	256
methazole	1.1	1.7*	1.0	34.8*	75.6	460
metribuzin	0.35	1.1*	1.7	5.6	54.6	105
oxadiazon	1.6	2.8	2.7*	2.9	48.3	59
phenmedipham + desmedipham	0.66 + 0.66	2.3*	1.7	21.6	80.6	267
terbutryn	0.5	2.1*	1.3	40.8*	107.1	381
hand-weeded	-	0.0*	1.0	27.0	97.4	276
untreated	-	4.0	0.5	14.2	65.1	217

¹ 0 = no weeds 5 = very weedy

² 0 = no damage 5 = severe damage

³ Means marked with asterisks are significantly different to the untreated control at $P=0.05$.

Significant levels of weed control were observed 14 weeks after application for 14 of the pre-emergence herbicides (Table 1). However five of these treatments also caused significant damage to the crop seedlings 10 weeks after seedling emergence.

The highest production of tubers occurred in plots treated with oryzalin, terbuthylazine, propazine, simazine and methazole. Variability in results meant that tuber production from none of the pre-emergence herbicide plots was significantly above that from untreated plots, though the average increase in tuber yield resulting from use of these herbicides ranged from 12 to 64%. High tuber yields resulted from both an increase in number of tubers produced and an increase in average size of tubers (Table 1).

Twelve of the post-emergence herbicide treatments gave significant levels of weed control 4 weeks after application (Table 2). Many of the herbicides scored poorly for weed control because they did not control a sufficiently wide range of weed species, but appeared very safe for the crop. These herbicides, which included clopyralid and haloxyfop, may be very useful in calla lilies if used in conjunction with other herbicides. Of the post-emergence herbicides which scored well for weed control and appeared safe for the crop 4 weeks after application, it was generally those with residual activity which resulted in the highest production of tubers. Tuber production was particularly high from plots treated with terbutryn and methazole, and the increases in production from these plots (2.9 and 2.5 times that produced in untreated plots respectively) were significant despite the variability in results. Bentazone was the only herbicide that does not have residual activity (Ross and Lembi 1985) from which high tuber production was recorded. High tuber production was also recorded from plots treated with methabenzthiazuron, the phenmedipham/desmedipham mixture, and chloroxuron.

An interesting result was the two-fold increase in tuber production from plots treated with methazole and methabenzthiazuron post-emergence rather than pre-emergence. As these herbicides have only moderate persistence, application 4 weeks prior to emergence of the crop seedlings meant their activity was dissipating too early in the season to protect the crop from weed invasion in late summer. Ideally the residual herbicides should have been applied closer to the time of emergence. However some of the pre-emergence herbicides considered safe in this trial may have become damaging if applied closer to crop germination.

Results obtained in this trial confirmed many of the findings made by Ingle and Bussell (1991). Not surprisingly, some treatments such as diuron and oxadiazon appeared more damaging to seedlings than plants grown from tubers. The damage caused by the terbuthylazine/terbumeton treatment in this trial was due to the excessive application rate used.

Note that both this work and that conducted by Ingle and Bussell (1991) concentrated on the effects of herbicides on tuber production. Some of the herbicides identified as safe for this purpose may cause unacceptable damage to blooms being produced for export.

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APPENDIX OF HERBICIDES USED

Alachlor (Lasso), asulam (Asulox), atrazine (Actazine Flowable), aziprotryne (Brasoran), bentazone (Basagran), bromofenoxim (Faneron), chloroxuron (Tenoran), chlorpropham (Chloro-IPC), clopyralid (Versatill), cyanazine (Bladex 50 WP), dalapon (Icipon), dicamba (Banvel 200), diuron (Karmex), EPTC (Eradicane Super), fluzafop (Fusilade), glyphosate (Roundup), haloxyfop (Gallant), ioxynil (Totril), MCPA (IWD MCPA), mecoprop (Shell Mecoprop), methabenzthiazuron (Tribunil), methazole (Probe 75 WDG), metribuzin (Sencor), oryzalin (Surflan Flo), oxadiazon (Foresite),

oxyfluorfen (Goal), pendimethalin (Stomp 330-E), phenmedipham + desmedipham (Betanal AM 11), propachlor (Ramrod Flowable), propazine (Gesamil), simazine (Gesatop 500 FW), terbutylazine (Gardoprim), terbutylazine + terbumeton (Caragard), terbutryn (Igran 500 FW), trifluralin (Treflan).