HERBICIDE EVALUATION IN CHINA ASTER GROWN FOR SEED

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SUMMARY

Alachlor, chlorpropham, oryzalin, simazine and trifluralin were evaluated for weed control in direct sown and transplanted China aster (*Callistephus chinensis* L. Nees) grown for seed. China aster plants could not tolerate simazine (0.25 kg/ha) while alachlor (1.125 kg/ha) stunted growth. A single application of oryzalin (3.75 kg/ha at 4 days after transplanting) provided excellent weed control and a tenfold increase in seed yield (to 568 kg/ha). Only trifluralin (2 kg/ha) applied pre-sowing did not significantly reduce aster emergence while oryzalin (4.5 kg/ha applied 10 days after sowing) provided the best aster seedling survival. However, weed control from both treatments was only partial and further work is required on herbicide use in direct sown aster.

Keywords: China aster, herbicide, weed control, phytotoxicity, seed yield

INTRODUCTION

China aster (*Callistephus chinensis* L. Nees) is a popular flower with excellent keeping qualities, and a number of cultivars are available for use as cut flowers, potted plants or bedding plants. Demand for seed is therefore high, but because of the highly competitive nature of commercial production, published information on factors affecting seed production is limited.

Weeds are always present and often a major cost factor in flower seed production, and weed control must be highly efficient. Herbicides are particularly effective in the establishment of direct sown crops (Kinsella 1978) and can provide good weed control in transplanted annual flowers (Fretz 1976). However, specific recommendations for aster were not available and the purpose of this study was to evaluate weed control and the phytotoxicity of some herbicides on either transplanted or direct sown asters grown for seed.

METHOD AND MATERIALS

Experiment 1

Glasshouse trial: Alachlor (Lasso, 50% e.c.) at 1.125 kg/ha, chlorpropham (Yates Chloro-IPC, 40% e.c.) at 1 kg/ha, simazine (Gesatop 500FW, 50% s.n.) at 0.25 kg/ha, and oryzalin (Surflan, 75% w.p.) at 3 kg/ha were sprayed via a portable 5 litre pressure sprayer onto 24-day-old seedlings of aster cv. Powderpuff and 44-day-old seedlings of cv. Kurenai growing in a glasshouse at $25 \pm 5^\circ\text{C}$. There was one seedling per eight cm pot, and pots were spaced at 25 x 25 cm. Treatments were allocated at random and replicated six times. Herbicide phytotoxicity was assessed 1, 2, 4 and 6 weeks after application.

Field trial: Thirty eight-day-old glasshouse grown plants of both cultivars were transplanted into a Tokomaru silt loam soil at Massey University (40°S, 175°E). Plots were 1.0 m x 2.5 m, and plants were placed at 25 x 25 cm spacings. The same four herbicides at the same application rates as used in the glasshouse experiment were applied by the same sprayer in 0.5 litre water/plot on 22.12.87 to cv. Powderpuff 5 days after transplanting, and to cv. Kurenai 25 days after transplanting.

A completely randomized design with three replicates of each treatment (including an untreated control) was used for each cultivar. Seedling damage was assessed at 2 and 4 weeks after herbicide application. Weed numbers were assessed 1 month after

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transplanting by counting all weed plants within two 0.1 m² quadrats placed at random within each plot. Data were square root transformed before analysis to overcome marked variance heterogeneity (Snedecor and Cochran 1980).

Experiment 2

Forty-day-old seedlings of cv. Powderpuff were transplanted into the field on 23.11.88 at 25 x 25 cm plant spacings (=transplanted aster). On the same day, seeds of aster cv. Powderpuff were hand sown at 50 seeds/2 m row, with 25 cm row spacing, into 1 m x 2 m plots (=direct sown aster). Treatments as shown in Table 1 were replicated three times in a randomized complete block design. All plots were sprinkler irrigated immediately after completion of the transplanting and sowing, after herbicide application, and weekly thereafter. The sprinkler delivered 6 litres water/m²/h. Weed numbers and aster emergence were assessed once at 1 month after transplanting or sowing. Weed counts and analysis were as described in Experiment 1. Aster seed heads from 0.75 m² of each plot were hand harvested on 7.4.89, air dried for 2 weeks, then threshed and cleaned. Seed yield is expressed at 7% seed moisture content, and data were log transformed before analysis.

Experiment 3

Seeds of aster cv. Powderpuff were hand sown on 30.12.88 using the same method and design as Experiment 2: direct sown aster. Oryzalin was applied at three rates (3.0, 3.75 and 4.5 kg/ha) at sowing and at the highest rate at 4 and 10 days after sowing (Table 2). Aster seedling emergence was recorded on 24.1.89 and weed counts were made on 26.1.89. Aster seedling survival was recorded on 22.2.89, and then four plants per plot were removed at random, washed, dried to a constant weight for 3 days at 65 °C, and leaf number, length and width, root and shoot length, and dry weight were recorded. Data were transformed (square root or log) prior to analysis.

RESULTS

Experiment 1

Glasshouse trial: Powderpuff seedlings treated with simazine began dying 1 week after herbicide application, and both Powderpuff and Kurenai seedlings were dead after 2 weeks. Alachlor caused leaf necrosis in seedlings of both cultivars, and by 4 weeks after application, leaves present at the time of spraying were distorted. However, there were no effects on new shoot growth or the flower head. No phytotoxicity was recorded following chlorpropham and oryzalin applications.

Field trials: Major weed species present in the field were redroot (*Amaranthus powellii*), prostrate amaranth (*A. deflexus*), black nightshade (*Solanum nigrum*), willow weed (*Polygonum persicaria*), nettle (*Urtica urens*), sow thistle (*Sonchus oleraceus*), dock (*Rumex spp.*), field speedwell (*Veronica arvensis*), white clover (*Trifolium repens*), shepherd's purse (*Capsella bursa-pastoris*), groundsel (*Senecio vulgaris*), dandelion (*Taraxacum officinale*), spurrey (*Spergula arvensis*), wireweed (*Polygonum aviculare*), and pelty spurze (*Euphorbia peplus*). Untreated plots contained 277 weeds/m², and although oryzalin and simazine halved these numbers, no treatment provided effective weed control when applied either 5 or 25 days after transplanting. Alachlor and simazine produced leaf necrosis when applied 5 days after transplanting, and although plants recovered, their growth was checked. Only simazine caused leaf necrosis to cv. Kurenai when applied 25 days after transplanting.

Experiment 2

Transplanted aster: All treatments except chlorpropham significantly decreased weed numbers (Table 1) and no treatment injured aster seedlings. Oryzalin was the most effective herbicide, but a double application did not increase weed control. Trifluralin plus oryzalin provided better weed control than trifluralin alone. Oryzalin controlled all weeds present with the exception of docks while trifluralin did not control black nightshade, docks, shepherd's purse and white clover.

Seed yield was related to the degree of weed control in that oryzalin and trifluralin plus oryzalin significantly increased seed yield because more seed heads were present (Table 1).

TABLE 1: Effect of herbicide application on weed control and seed yield in transplanted aster, and weed control and seedling emergence in direct sown aster, cv. Powderpuff (Experiment 2).

Treatment	Rate (kg ai/ha)	Transplanted			Direct sown	
		Weeds /m ²	Aster seed heads /m ²	Aster seed yield (g/m ²)	Weeds /m ²	Aster seedlings (%)
nil		1560 a	63 c	5.1 c	840 ab	40 ab
trifluralin ¹	2.0	597 b	20 d	1.8 c	390 c	32 bc
chlorpropham ¹	2.0	1540 a	34 d	2.8 c	650 b	25 cd
oryzalin ²	3.75	23 d	329 a	56.8 a	950 a	49 a
oryzalin ²	3.75	23 d	317 a	44.5 a	880 a	44 ab
+ oryzalin ³	3.75					
trifluralin ¹	7.0	137 c	153 b	22.0 b	110 d	16 d
+ oryzalin ³	3.75					

Values with the same letter(s) indicate no significant difference ($P > 0.05$) based on analysis after transformation — applied to both tables. Actual data given.

¹ applied 1 day before planting or sowing and washed into the soil via sprinkler irrigation

² applied 4 days after planting or 30 days after sowing

³ applied 30 days after planting or 60 days after sowing

Direct sown aster: Trifluralin at 2 kg/ha provided 54% weed control and was not phytotoxic to aster emergence and early establishment. Although the higher rate of trifluralin (7 kg/ha) gave better weed control (87%), aster seedling emergence was significantly reduced (Table 1). Oryzalin applied 30 or 60 days after sowing was too late to control established or escaped weeds. Chlorpropham provided little weed control and significantly reduced seedling numbers.

Experiment 3

Oryzalin at 4.5 kg/ha applied 4 days after sowing gave the best weed control but significantly reduced seedling emergence and aster plant survival (Table 2). Oryzalin at the same rate applied 10 days after sowing provided moderate weed control, with no negative effect on aster seedling emergence and survival (Table 2) and allowed the production of larger and more vigorous aster plants (data not presented). Oryzalin applied at sowing significantly reduced weed numbers and aster seedling emergence, irrespective of application rate. However more aster seedlings which did emerge survived (Table 2).

TABLE 2: Effect of oryzalin application rate and time on weed control, field emergence and seedling survival of direct sown aster cv. Powderpuff (Experiment 3).

Treatment	Rate (kg ai/ha)	Weeds/m ²	Aster	
			emergence ⁴	survival ⁵
nil		843 a	100.0	56.5
oryzalin ¹	3.0	133 c	43.8	81.9
oryzalin ¹	3.75	150 c	39.0	74.8
oryzalin ¹	4.5	80 cd	35.6	74.1
oryzalin ²	4.5	33 d	63.5	40.0
oryzalin ³	4.5	577 b	94.6	83.2

¹ applied at sowing

² applied 4 days after sowing

³ applied 10 days after sowing

⁴ percentage of control

⁵ percentage of emerged seedlings

DISCUSSION

The lack of control of later germinating weed seed in the field trial of Experiment 1 indicated the need for either a higher rate or a second residual herbicide application to provide season-long weed control. Frequent irrigations which are necessary for vigorous plant growth stimulate weed seed germination, and reduce herbicide residual activity due to excessive leaching (Whitcomb and Butler 1975) and herbicide degradation (Elam-Wenzel 1988).

For transplanted aster, oryzalin at 3.75 kg/ha applied 4 days after planting provided acceptable weed control and as a consequence increased seed yield from 5.1 to 56.8 g/m². The second application of a residual herbicide failed to further reduce the weed population. Depending on the weed species present, spot spraying by a non residual post-emergence herbicide may be needed for the removal of weeds not killed by the initial oryzalin application.

No treatment used with direct sown aster provided effective weed control without reducing aster emergence or establishment. Oryzalin, which produced no adverse effects on transplanted aster, significantly inhibited aster germination, a result similar to that reported in other direct sown flower species (Lamont and O'Connell 1986). However, in a further unreplicated investigation, trifluralin at 2.0 kg/ha applied pre-sowing followed up by oryzalin at 4.5 kg/ha 10 days after sowing provided good weed control without aster seedling damage. This herbicide combination still requires experimental confirmation.

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