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Short communication

Weed management effect on vegetative growth and flowering parameters of chrysanthemum

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Chrysanthemum *(Chrysanthemum morifolium* Ramat.) is one of the most widely cultivated herbaceous perennial plants belonging to family Asteraceae and commonly known as 'Autumn Queen' or 'Queen of East'. Chrysanthemum produces showy flowers with different flower colour, shape and plant height, that can be used as pot plants for beautifying indoors and outdoors, as cut flowers for making bouquets and base decoration, as loose flower for making garlands, worshipping purpose and for garden decoration (Arora 2013). It contributes largely to the floriculture industry by virtue of its yield potential, colour variation and long life. In the North-Indian plains, the commercial growers propagate chrysanthemum plants through terminal stem cuttings at the end of June that can be extended up to the end of July, *i.e. Kharif* season. After transplanting in July and August, the terminal rooted cuttings have a very slow growth rate initially as they take long time to get established in the field (Singh 2006). The early emergence and faster growth of weeds causes severe competition with crops for light, moisture, space and nutrients, resulting in yield losses up to 50-100% (Rao *et al.* 2007, Mehta *et al.* 2010, Meena *et al.* 2013). Use of pre-emergence herbicide can be a viable option for controlling weeds right from the emergence of crop (Shivasankar and Subramaniam 2011). Chrysanthemum is the most appropriate crop to concentrate on the development of successful weed control strategy to encourage crop growth and flowering that would be greatest benefit to the flower industry as a whole. Chemical weed control is an effective method and an alternative to old practices of manual weeding as manual weeding is costlier and has become impracticable due to non-availability of labourers during the critical period of weed competition. Though use of pre-emergence herbicide, immediately after transplanting of very tender rooted cuttings, can give good control of weeds, but may retard growth and development of the delicate seedlings. Keeping all these in view, the present experiment was conducted to enhance the vegetative growth and flower yield with better weed control, using different combinations of herbicides.

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Field experiment was carried out during the winter season of 2014-15 at the research farm of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana. Soil of the experimental site was sandy loam in texture with a pH of 8.3. Experiment comprises of seven treatments (**Table 1**) was laid out in a randomized block design with three replications. The healthy terminal rooted cuttings (5-7 cm) of chrysanthemum cv. "*Ratlam Selection*", free from symptoms of any disease or insect pest were prepared during mid of June and then planted in propagating plug trays having burnt rice husk as rooting media. Plug trays were kept moist by sprinkling water to ensure satisfactory rooting of cuttings. New roots developed after 15-20 days. After the application of herbicides, the plots were kept undisturbed till transplanting of rooted cuttings. Terminal rooted cuttings were transplanted in field in the first week of August for further evaluation. Planting of terminal rooted cuttings was done at a spacing of 30 x 30 cm having plot size of 1.5 x 1.5 m. All the package of practices recommended by PAU, Ludhiana were followed to get good plant growth and quality flower production. Pinching operation was practiced at two stages *i.e.* first at four weeks after transplanting and second at seven weeks after transplanting to encourage the emergence of lateral shoots. Observations on weed count and weed fresh as well as dry weight (g), at 25 and 50 days after application of herbicides were recorded. Observations on vegetative and flowering parameters like plant height (cm), plant spread (cm), days to colour break stage, days to full bloom stage, number of flowers per plant, flower diameter (cm) and flowering duration (days) were recorded and statistically analysed. Species wise weed count was recorded.

Effect on weed growth

The major weed flora of the experimental field were *Cyperus rotundus* (Motha), *Dactyloctenium aegyptium* (Makra), *Eleusine indica* (Madana), *Paspalum distichum* (Nadi Ghas) and *Phyllanthus niruri* (Hazardani) (**Table 1**).

Pre-planting application of pendimethalin 1.0 kg/ ha *fb* hand weeding 30 and 60 DAP controlled the maximum weed population effectively and recorded the lowest population of *C. rotundus* (8.8), *D. aegyptium* (4.1), *E. indica* (3.6), *P. distichum* (3.0) and *P. niruri* (3.5) per unit area at 50 days after transplanting as compared with weedy check. The pre- planting application of pendimethalin 1.0 kg/ha followed by *(fb)* hand weeding 30 and 60 DAP and post-emergence application of isoproturon 0.75 kg/ha 20 DAP *fb* hand-weeding 60 DAP, however, were statistically at par regarding the reduction in total weed count, weed fresh weight (g) and weed dry weight (g) per unit area 50 days after transplanting (**Table 2**). Reduction in weed population in these treatments can be attributed to relatively better management practices which shifted the competition in favour of chrysanthemum. Similar results were also reported by Kaur *et al.* (2014).

Effect on vegetative growth and flowering parameters

All the weed management treatments significantly influenced vegetative and flowering parameters like flowers/plant, diameter, flowering duration in chrysanthemum (**Table 3**). Weed free treatment exhibited maximum plant spread, number of branches, followed by pre-planting application of pendimethalin 1.0 kg/ha *fb* hand weeding 30 and 60 DAP which may be due to better availability of nutrients, moisture, sunlight and space for crop growth in weed free treatment. This is in conformity with the findings of Kaur and Bala (2016). The lowest plant height was recorded in weedy check which may be due to more weed pressure, resulting in severe competition with the crop for resources. All the treatments didn't show any significant results with regard to days to bud appearance, days to colour shown and number of days to flowering. Similar results were reported in gladiolus (Kumar 2001), with respect to number of flowers, flower diameter and flowering duration, treatment comprising pre-planting application of pendimethalin 1.0 kg/ha *fb* hand weeding 30 and 60 DAP and weed-free check were comparable with each other that resulted in greater values of floral traits than other treatments. The highest number of flowers per plant (71.9), maximum flower diameter (9.5 cm) and flowering duration (24.8 days) was observed with weed free check, followed by with pendimethalin 1.0 kg/ha *fb* hand weeding 30 and 60 DAP with flowers per plant (65.4), flower diameter (8.3 cm) and flowering duration (20.9 days). This was due to the fact that the crop plants in these treatments experienced good vegetative growth right from the early stages of growth period to the end of cropping period because of less competition of weeds for nutrients, water, space, sunlight and nutrients which might have resulted in higher photosynthetic activity and higher number of flowers per plant. Similar results were also reported in chrysanthemum by Kaur *et al.* (2014).

Table 1. Effect of herbicides on population of different weed species in chrysanthemum

Treatment	Weed density (no./m^2)									
	C. rotundus		*D. aegyptium*		*E.indica*		*P.distichum*		*P.niruri*	
	25 DAT	50 DAT	25 DAT	50 DAT	25 DAT	50 DAT	25 DAT	50 DAT	25 DAT	50 DAT
Atrazine 0.75 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	87.3 (9.3)	108.7 (10.4)	8.0 (2.3)	20.0 (4.6)	8.3 (3.0)	16.0 (4.1)	4.7 (2.3)	13.3 (3.8)	5.3 (2.5)	16.0 (4.1)
Pendimethalin 1.0 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	68.7 (8.31)	76.7 (8.8)	6.0 (2.6)	16.0 (4.1)	7.0 (2.8)	12.0 (3.6)	2.7 (1.8)	8.0 (3.0)	4.0 (2.1)	11.7 (3.5)
Isoproturon 0.75 kg/ha 20 DAP (PoE) *fb* hand weeding 60 DAP	97.3 (9.9)	106.7 (10.3)	11.0 (3.5)	25.3 (5.1)	12.0 (3.6)	20.0 (4.6)	8.7 (3.0)	19.3 (4.5)	10.7 (3.4)	20.0 (4.5)
Three hand weedings at 30, 60 and 90 DAP	101.3 (10.1)	110.7 (10.5)	12.0 (3.6)	22.0 (4.8)	13.0 (3.7)	18.0 (4.3)	10.7 (3.4)	26.7 (5.2)	9.3 (3.1)	22.0 (4.8)
Oxyflurofen 0.2 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	80.0 (9.0)	100.0 (10.0)	7.0 (2.8)	17.3 (4.2)	8.0 (3.0)	12.0 (3.6)	6.0 (2.6)	10.7 (3.4)	6.7 (2.7)	12.7 (3.7)
Weedy check	132.7 (11.5)	166.0 (12.9)	15.0 (4.0)	28.0 (5.4)	16.0 (4.1)	24.0 (5.0)	12.7 (3.7)	40.7 (6.4)	13.3 (3.7)	39.3 (6.3)
Weed free check	0 (1.0)	0 (1.0)	0 (1.0)	0 (1.0)	0 (1.0)	0 (1.0)	0 (1. 0)	0 (1.0)	0 (1.0)	0 (1.0)
LSD (p=0.05)	1.93	1.98	0.11	0.41	0.33	0.43	0.99	1.02	0.99	0.94

Figures in parentheses are the means of square root transformation; PPA - Pre-planting application, PoE - Post-emergence

Table 2. Effect of different herbicides on total weed density and dry weight in chrysanthemum

Treatment	Weed count/m^2		Fresh weight (g/m^2)		Dry weight (g/m^2)	
	25 DAT	50 DAT	25 DAT	50 DAT	25 DAT	50 DAT
Atrazine 0.75 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	109.3(10)	126.3(11.2)	50.4(7.2)	62.5(80)	38.5(6.3)	49.1(7.1)
Pendimethalin 1.0 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	70.7(8.4)	87.8(9.4)	44.7(6.7)	55.2(7.5)	33.5(5.8)	44.3(6.7)
Isoproturon 0.75 kg/ha 20 DAP (PoE) *fb* hand weeding 60 DAP	79.3(8.9)	102.0(10.1)	54.8(7.5)	65.6(8.2)	43.1(6.6)	53.4(7.4)
Three hand weedings at 30, 60 and 90 DAP	81.3(9.0)	100.0(10.0)	53.2(7.3)	63.4(8.0)	46.8(6.9)	57.1(7.6)
Oxyflurofen 0.2 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	102.0(10.1)	124.7(11.2)	30.7(4.9)	53.3(7.4)	37.7(6.2)	47.5(7.0)
Weedy check	184.7(13.6)	236.0(15.4)	60.3(7.8)	79.7(9.0)	51.1(7.2)	71.5(8.5)
Weed free check	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
LSD (p=0.05)	1.89	6.78	2.51	0.56	0.64	0.46

Figures in parentheses are the means of square root transformation; PPA - Pre-planting application, PoE - Post-emergence

Table 3. Effect of pre and post-emergence herbicide on growth parameters in chrysanthemum

Treatment	Plant height (cm)	No. of branches/ plant	Plant spread (cm)	Days to first bud appearance	Days to colour break	Days to full bloom	No. of flowers/ plant	Flower diameter (cm)	Flowering duration (days)
Atrazine 0.75 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	43.40	4.27	28.34	85.92	98.67	116.87	63.20	7.95	20.61
Pendimethalin 1.0 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	45.50	5.15	30.95	83.06	98.60	115.80	67.32	8.51	21.78
Isoproturon 0.75 kg/ha 20 DAP (PoE) *fb* hand weeding 60 DAP	42.48	4.23	30.06	86.15	99.60	117.09	58.77	6.85	19.89
Three hand weedings at 30, 60 and 90 DAP	40.67	4.03	28.85	83.77	101.49	117.54	60.02	6.57	19.87
Oxyflurofen 0.2 kg/ha (PPA) *fb* hand weeding 30 and 60 DAP	44.41	4.58	30.30	84.52	99.99	116.20	65.97	8.43	20.97
Weedy check	38.96	3.82	26.96	86.78	103.37	117.06	45.02	5.68	16.25
Weed free check	47.26	6.37	33.67	82.43	95.89	113.52	73.80	10.57	25.60
LSD (p=0.05)	4.26	0.64	2.16	NS	NS	NS	7.44	0.51	3.96

Weedy check resulted in the lowest number of flowers per plant (43.1), flower diameter (5.5 cm) and flowering duration (14.2 day).

It was concluded that pre-plant application of pendimethalin 1.0 kg/ha *fb* hand weeding at 30 and 60 DAP was effective in controlling weeds and improving growth and flower productivity of chrysanthemum.

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