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Effect of weed stress on seed yield and quality of onion (*Allium cepa*)*

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Onion *(Allium cepa L.)* is a biennial crop that forms bulbs in the first year and seed in the second year under bulb to seed method. Availability of quality seeds is lower than the requirement that reduces the crop productivity and increases the cost of production. Weed infestation is the major limiting factor in the production of bold and healthy seeds of onion. Onions are very sensitive to the competition of weed because of their slow growth, sparse canopy, shallow roots, wider spacing, encourages the luxurious growth of weed flushes (broadleaf and sedges) during crop growth period, which greatly reduce yields if not controlled timely. The period during which weeds can be tolerated by the crop without reduction in the final yield depend on the period for which weeds are associated with the crop. Hence, knowledge of the critical period of weed-crop competition is important in formulating weed management strategies. Seed crop badly infested by weeds produce seeds with lower test weight and usually produce low vigour poor seedlings because of smaller size and lower food supply. Therefore, the field study was undertaken to evaluate the effect of weed competiton on seed yield and its quality.

A field experiment was conducted during the winter season of 2003–05 at IARI Regional station, Karnal.Twelve treatments comprising weed free for initial 20, 40, 60, 80, 100 days and season long as T_1, T_2, T_3, T_4, T_5, and T_6 and weedy thereafter and weedy for the first 20, 40, 60, 80, 100 days and weedy season long as T_7, T_8, T_9, T_{10}, T_{11} and T_{12} and weed free thereafter were tried in randomized block design with 4 replications. Bulbs of 'Pusa Red' onion were transplanted on 20 October 2003 and 23 October in 2004 at 45 cm × 30 cm spacing between rows and plants with a plot size of 3.60 m × 3.60 m, respectively. A uniform basal dose of 40 kg N/ha, 60 kg P and 40 kg K/ha was applied at sowing in both the years. Remaining dose of nitrogen was applied in 2 splits, 40 kg N each after first and second irrigation. Repeated hand weeding was done in weed-free plot to keep the plots weed free for whole season. Other recommended cultural practices were followed as per requirement of the crop. Two roguings were done to bring the seed plot to seed certification standard. Two quadrates of 0.25 m^2 were placed randomly in each plot at 40, 60, 80 and 100 days after planting and weeds within the quadrates were removed, counted and dried. Critical period of crop-weed competition was determined as per the procedure given by Kumar (2001). Seed quality parameters were recorded according to ISTA (1993).

The weed flora of the onion field comprised *Coronopus dydimus* L. (51%), *Anagalis arvensis* L. (9%), *Spergula arvensis* Linn. (4%), *Vicia sativa* Koch. (2%), *Convolvulus arvensis* L. (1%), *Cyperus rotundus* L. (26%), *Poa annua* Linn Desf (5.0%) and other weeds (2%). Other weeds included *Melilotus indica* (L.) AII, *Lathyrus aphaca* Linn. and *Euphorbia helioscopia* L.

Both density and weed dry matter reduced with increase in weed-free period at different growth stages (Table 1). The total weed dry matter produced at stages subsequent to the completion of initial weed-free period decreased significantly with increase in the duration of initial weed-free period. These were due to decreased weed density and further their checked growth due to regular weedings. Significantly lower weed dry matter was observed in the plots kept weed free for initial 60, 80 and 100 days after planting and in the plots, which remained weed infested for initial 20 days after planting (Table 2). Initial weed-free period up to 20 and 40 days could not reduce the weed density and weed dry weight compared to initial weed-free period of 60 and 80 days due to reemergence of weeds in these plots, which accumulated higher dry matter than initial weed-free periods of 60, and 80 days. Total weed density showed reduction with increase in growing period, whereas the corresponding dry weights showed continuous increase up to 100 days after planting. Weed density and weed dry weight showed significant increase at different growth stages when weeds were allowed to grow up to 60, 80 and 100 days after planting compared to 20 and 40 days (Table 1).

*Short Note

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Table 1 Weed density and weed dry weight as affected by different weeding treatment

Treatment	Weed density (/0.25 m^2) Days after planting				Weed dry weight (g/0.25 m^2) Days after planting			
	40	60	80	100	40	60	80	100
T_1	(43.4) 6.5	(52.9) 7.1	(41.6) 6.2	(38.1) 6.2	1.57	16.29	35.05	80.23
T_2	(35.9) 5.9	(22.9) 4.6	(26.4) 5.0	(21.7) 4.7	0.76	3.62	11.13	41.15
T_3	(39.5) 6.2	(20.0) 3.8	(17.3) 3.5	(19.2) 4.4	0.52	2.74	1.91	7.07
T_4	(45.5) 6.7	(19.5) 4.0	(2.4) 1.7	(4.4) 2.0	0.33	1.25	0.21	0.28
T_5	(32.6) 5.7	(20.3) 4.1	(3.3) 1.8	(3.3) 1.9	0.35	1.057	0.39	0.47
T_6	(34.1) 5.6	(0.00) 1.0	(0.80) 1.2	(0.0) 1.0	0.37	0.00	0.03	0.00
T_7	(52.6) 6.6	(22.4) 4.7	(0.90) 1.2	(5.0) 2.1	0.78	1.84	0.07	0.40
T_8	(133.0) 11.3	(22.8) 4.6	(1.8) 1.5	(4.7) 2.0	6.84	1.6	0.22	0.44
T_9	(137.2) 11.7	(132.8) 11.4	(3.4) 1.94	(5.0) 2.1	8.27	42.9	0.72	0.57
T_{10}	(149.4) 12.1	(135.9) 11.5	(98.5) 9.6	(3.50) 1.8	10.26	49.1	68.56	0.68
T_{11}	(152.1) 12.3	(131.8) 11.3	(90.6) 9.3	(94.6) 9.3	8.53	43.41	73.80	102.45
T_{12}	(147.4) 12.0	(141.1) 11.7	(104.1) 9.6	(104.2) 9.7	8.91	41.77	73.11	103.67
CD (*P*=0.05)	(26.5) 1.3	(21.0) 1.3	(20.7) 1.2	(16.2) 0.76	2.99	4.44	5.71	12.3

Table 2 Seed yield, quality and economics of onion seed production as affected by different weed control treatment

Treatment	Seed yield (kg/ha)	Weed index* (%)	Test weight (g)	Germination (%)	Seedling		Vigour index I*	Vigour index II**	Returns over control (Rs/ha)	Treatment cost (Rs/ha)	B: C ratio
					Dry wt. (mg)	Length (cm)					
T_1	90.62	53.8	2.23	55.8	1.4	8.4	465.4	79.8	7 248	3 000	2.41
T_2	129.3	34.1	2.51	57.1	1.6	8.6	491.7	94.7	22 992	6 000	3.83
T_3	154.1	21.46	2.87	70.6	1.7	9.8	683.0	119.8	32 888	9 000	3.65
T_4	173.1	11.8	2.93	70.2	1.7	9.9	697.5	120.9	40 888	12 000	3.40
T_5	169.4	13.6	2.91	68.5	1.7	10.9	737.2	110.9	39 024	12 000	2.60
T_6	196.2	0.0	3.23	74.5	1.9	11.0	822.9	141.5	49 740	18 000	2.76
T_7	191.3	2.5	3.18	74.0	1.8	11.1	825.9	133.2	47 792	18 000	2.65
T_8	165.9	15.4	3.08	68.0	1.8	10.0	683. 1	122.4	37 694	15 000	2.51
T_9	134.3	31.5	3.04	68.3	1.7	9.8	667.4	116.1	24 968	12 000	2.08
T_{10}	128.6	34.4	2.68	62.3	1, 6	9.6	597.0	101.6	22 716	9 000	2.524
T_{11}	98.2	49.9	2.68	63.4	1.5	9.4	585.8	95.1	10 512	6 000	1.75
T_{12}	71.9	63.4	2.01	50.0	1.2	8.1	403.4	63.7			
CD (*P*=0.05)	45.64		0.22	10.08	0.19	0.72	109.66	18.7			

Cost of seed Rs400/kg: Manual Weeding cost Rs 3000/ha
*WI: Weed Index

Keeping the weedy conditions from 20 to 40 days did not reduce the seed yield significantly over weed-free season long treatment. Further increasing the weedy period to 60 days onwards reduced the seed yield significantly over weed-free season long. There was 31.55, 34.42, 49.97 and 63.36% seed yield reduction when weeds were allowed to grow with onion seed crop for 60, 80, 100 and season long. Seed yield reduction to the extent of 53.8 and 34.1% was observed in initial weed-free periods of 20 and 40 days after planting compared to weed-free season long due to competition offered by late emerging weeds. Keeping the crop weed-free up to 60 days and onwards recorded seed yield at par with season long weed free (Table 2). It appeared that the crop required an initial weed-free period of 60 days and weeds emerging after 60 days were low in density and biomass production and had no adverse effect on the crop. This proved that a weed-free period of more than 60 days was required to obtain good yield of onion seed. The results are in close conformity with those of Rameshwar *et al*. (2001).

Keeping the crop weed-free for initial 60 days recorded 21.4% seed yield reduction compared to season long weed free. The critical difference for seed yield was 45.6 kg that was 23.25% of the yield of weed-free check. By using the LSD as 23.25 it was observed that when weedy period lasted up to 49 days and thereafter weed-free period up to 59 days and more caused non-significant reduction in seed yield, hence the critical period of weed competition ranged from 49 to 59 days after planting.

Weed stress to the mother plants significantly affected the seed quality parameters of onion seed crop. Significantly lower 1 000-seed mass was recorded in season long weedy, weedy for 100 days, weed free 20 and 40 days due to weed competition compared to season long weed free, weedy for 20 days. Chopra *et al*. (2002) also recorded lower 1 000-seed weight under weed check conditions compared to weed-free conditions. Seed germination was maximum in weed-free conditions, season long and minimum germination was observed in weedy check season long. Weedy 100 days and weed free 20 and 40 days recorded significantly lower germination than weed-free season long which may be due to higher weed dry matter accumulations in these treatments, poor development of seed resulting into lower test weights. Shaikh *et al*. (2002) also reported increased germination and seed ling vigour index because of higher 1 000-seed weight.

Seedling length and seedling dry weight were significantly lower in weed free 20, 40 and weedy 100 and weedy check season long compared to weed-free conditions for 100, season long and weedy for 20 days which is due to lower 1 000-seed weight owing to the higher weed stress in these treatments. Seedling vigour I and II were significantly lower in weedy 100 days and weedy season long compared to weed-free season long and weedy 20 and 40 days after planting. (Table 2). The results are in confirmatory to Chopra *et al*. (2006).

The results indicate that higher seed yield and quality of onion crop can be realized when crop is kept free of weeds for the first 60 days.

SUMMARY

The field experiment was conducted during 2003–05 at seed production farm of regional station, Indian agricultural Research Institute, Karnal to assess the effect of weed competition on seed yield and quality of onion *(Allium cepa* L.). Significantly higher seed yield was registered when crop was kept weed free for initial 60 days after planting compared to 20 and 40 days after planting where weeds reemerged at later stages, accumulated higher weed dry matter and reduced the yield. Seed yield remained at par between weed-free check and when weeds were allowed to grow with the onion crop up to 40 days after planting, however weedy period beyond 40 days was detrimental to seed yield. Yield reduction to the extent of 53.8, 34.1 and 63.3% was observed in initial weed-free periods of 20 and 40 days after planting and season long unweeded conditions compared to weed-free season long. Critical period of crop-weed competition was found to be 40–60 days after planting. Seed quality in terms of 1 000-seed weight, per cent germination, and vigour index was maximum with weed-free season long and weedy 20 days compared to weed free 20 and 40 days, weedy 100 days and weedy check season long.

Higher seed yield and quality of onion seed crop can be realized under the treatment when the crop is kept weed free for first 60 days with higher benefit:cost ratio compared to weed free 80, 100 and weed free season long treatment.

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