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Research Communication

Assessment of critical period of crop-weed competition in forage cowpea (*Vigna unguiculata*) and its effect on seed yield and quality

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ABSTRACT

An experiment on crop-weed competition was conducted during the rainy (*kharif*) season of 2014 at Karnal, Haryana, to determine the critical period of forage cowpea [*Vigna unguiculata* (L.) Walp.] and its effect on seed yield and quality. Dominated weed species associated with the crop were *Trianthema monogyana* L., *Commelina benghalensis* L. and *Digera arvensis* Forssk. among broad-leaf weeds; and *Cyperus rotundus* L., *Echinochloa colona* L., among narrow leaf weeds. Seed yield of cowpea reduced significantly with increase in the duration of crop-weed competition beyond 20 days after sowing (DAS). The seed yield increased significantly with the increase in initial duration of weed-free condition up to 60 days after sowing (DAS) which was at par with 80 DAS and season-long weed-free situation. Critical period of crop-weed competition was found to be between 25–57 days after sowing. Higher net returns and benefit: cost ratio can be realized keeping the crop weed free for first 60 DAS.

Key words : Competition, Cowpea, Critical period, Quality, Seed yield, Weed-free, Weedy-check

Cowpea is grown throughout India for its long, green vegetable pods, seeds, and foliage for fodder. In India, cowpea is grown on about 0.5 million ha with, an average productivity of 6.0 to 7. quintal seeds/ha (Ahlawat and Shivakumar, 2005). For getting nutritious fodder every season, availability of quality seed with higher germination capacity is required. Among other factors limiting fodder cowpea seed production, inadequate weed control had been identified as a major yield limiting factor. Frenda *et al*. (2013) reported that, the weed interference reduced cowpea seed yield up to 90%. Crop losses by weeds could be aggravated by delay in weeding or inability to weed control throughout the crop-growth period. However, studies of the threshold levels of weeds have shown that complete weed eliminations is not essential for high yields, probably because the crop can also compete strongly with weeds, after the critical period of weed interference. Hence determination of critical period of weed competition will help in better management of weeds when it is actually required with economical point of view. Furthermore, information on critical period of crop-weed competition is essential to optimize herbicide use. Keeping all these points, an experiment was conducted to determine the critical period of crop-weed competition in fodder cowpea seed crop and its effect on seed yield and quality in north-western part of India.

A field experiment was conducted during the rainy (*kharif*) season of 2014 at the Research Farm of ICAR-National Dairy Research Institute, Karnal, Haryana. The soil was sandy clay loam, with *p*H 7.6 and electrical conductivity 0.6 dS/m. The organic carbon content and available N, P and K were 0.60%, 193 kg/ha, 21.6 kg/ha and 260 kg/ha respectively. The experiment was laid out in a randomized block design with 4 replications. There were 10 treatments, consisting of initial weed-free periods of 20, 40, 60, 80 DAS and season long and weedy up to 20, 40, 60, 80 DAS and season long (Table 1). Cowpea cv 'C 152' was sown on 23 June 2014, with row distance of 45 cm and seed rate 25 kg/ha. The crop was fertilized with recommended doses of nitrogen (15 kg N/ha), phosphorus (40 kg P_2O_5/ha) and potassium (25 kg K_2O/ha) as basal application. A total of 422.9 mm rainfall received during the crop season of *kharif* 2014. One supplemental irrigation was given at 23 DAS of crop. The weed dry matter from each plot was periodically recorded with help of a

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quadrate of 50 cm × 50 cm size. Weed dry matter were recorded at 20, 40, 60 and 80 DAS with their respective period of crop-weed competition, as per the treatments. For statistical analysis, the data were subjected to square-root transformation $\sqrt{X+1}$. The cowpea crop was harvested at 120 DAS and seed was threshed plot-wise to record the yield. Critical period of crop-weed competition was determined as per the procedure given by Kumar (2001). Seed-quality parameters were recorded according to ISTA (1985).

The weed flora of the cowpea field comprised *Cyperus rotundas*, *Echinochloa colona*, among narrow leaf weeds and *Trianthema monogyana* L., *Commelina benghalensis* L. and *Digera arvensis* among broad-leaf weeds as dominated weed species and *Phyllanthus niruri* L., *Dactyloctenium aegyptium* (L.) Wild., *Digitaria sanguinalis* (L.) Scop. as the other weeds of minor importance during crop season.

The highest weed dry weight in plots kept weedy for season long was observed during 40 to 60 DAS, indicating high degree of competition during this period. Weed dry weight reduced with increase in weed-free period (Table 1). The maximum values regarding yield attributes were observed in season long weed-free plot (Table 1) which was at par with 60 DAS weed-free and weed infestation up to 20 DAS. Keeping the weedy conditions up to 20 DAS did not reduce the yield attributes significantly compared with weed-free season long treatment. Significant reduction in seed yield was recorded when weeding was delayed by 40 days after sowing. There was reduction of 21.8, 28.1, 34.4 and 42.2% in seed yield at weedy 40, 60, 80 DAS and season-long weedy compared to weed-free season long. Keeping the crop weed free up to initial 40 days recorded 25.1% reduction in yield. Thus, starting weed-free days favoured the crop growth by suppressing the weeds. By using the LSD=12.5, we can observe that the seed yield was statistically at par with season long weed-free treatment, weed free up to 80 DAS and weedy check up to 20 DAS. When weedy period lasted only up to 25 days and thereafter weed-free period up to 57 days or more (Fig. 1) caused non-significant yield reduction; hence an extrapolated critical period of weed competition ranged from 25 to 57 DAS in cowpea during the *kharif* season. Tripathi and Singh (2001) reported that, critical stage of weed competition in cowpea was 15–45 DAS. Weed competition significantly affected the seed-quality parameters of cowpea. Seed weight (1,000 seeds) was significantly reduced with the increase of weedy period and lowest was found in season long weedy check followed by weedy up to 80 DAS. The 1,000-seed weight remained statistically at par between weed-free up to 60 DAS, weedy up to 20 DAS and season-long weed-free. Chopra *et al.* (2002) also reported lower 1,000-seed weight in weedy check compared to weed-free conditions.

Season-long weed-free condition recorded 20.5, 13,7 and 16.9% higher germination compared to weedy season long, weedy up to 80 DAS and weed free up to 20 DAS, respectively, which might be due to higher weed dry-matter accumulations in these treatments. Weed free up to 60 DAS showed significantly higher germination compared to weed-free up to 20 DAS and weedy season long. Seed-quality parameters were found the highest in season-long weed-free and the minimum in season-long weedy check treatment. There was reduction in the seedling length of weedy check and weed free up to 20 DAS was 14.3 and 11.2% compared to weed-free season-long, respectively. The seedling-vigour index was the maximum under season-long weed-free condition followed by weed-free for

Table 1. Effect of time of weed removal on weed dry weight and yield attributes in cowpea

Treatment	Weed dry weight (g/0.25 m^2)				Plant height (cm)	Pods/ plant	Pod length (cm)	1,000-seed weight (g)
	20 DAS	40 DAS	60 DAS	80 DAS				
WF 20 DAS	0.0	33.1	41.9	23.6	75.5	10.3	14.4	73.0
WF 40 DAS	0.0	0.0	29.5	18.5	78.1	11.0	14.4	83.0
WF 60 DAS	0.0	0.0	0.0	8.9	85.1	13.7	15.2	85.0
WF 80 DAS	0.0	0.0	0.0	0.0	85.1	13.8	15.1	89.0
Season-long WF	0.0	0.0	0.0	0.0	88.8	14.4	15.5	93.0
WC 20 DAS	18.2	0.0	0.0	0.0	86.8	13.4	15.1	84.0
WC 40 DAS	18.8	67.7	0.0	0.0	85.6	11.4	14.3	81.0
WC 60 DAS	19.2	69.2	48.4	0.0	80.8	9.8	14.2	80.0
WC 80 DAS	18.7	72.5	47.2	30.4	77.6	9.9	14.0	70.0
Season long WC	20.5	72.3	50.6	33.1	76.0	9.1	13.3	61.0
SEm±	2.1	2.0	2.3	1.7	1.6	1.1	0.2	3.0
CD (P=0.05)	6.2	5.9	6.7	5.0	4.6	3.2	0.5	10.0

WF, Weed-free; WC, weedy check; DAS, days after sowing

Table 2. Effect of time of weed removal on grain yield, quality, and economics of cowpea

Treatment	Green fodder yield (t/ha)	Grain yield (t/ha)	Cost of production (× 10^3 ₹/ha)	Gross returns (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	Benefit: cost ratio	Seed germination (%)	Seedling length (cm)	Seedling vigour index I
WF 20 DAS	23.3	0.41	38.6	74.5	35.9	0.9	78.0	42.9	3,391.3
WF 40 DAS	25.3	0.48	38.6	83.4	44.8	1.2	83.0	44.2	3,772.6
WF 60 DAS	34.3	0.58	43.6	107.5	63.9	1.5	89.0	45.3	3,708.6
WF 80 DAS	35.0	0.60	48.6	109.6	60.9	1.3	89.5	48.1	4,198.5
Season long WF	37.5	0.64	53.6	117.3	63.7	1.2	91.3	48.3	4,309.7
WC 20 DAS	31.9	0.59	48.6	104.4	55.8	1.1	87.3	47.5	4,153.7
WC 40 DAS	28.9	0.50	43.6	91.0	47.4	1.1	86.3	46.1	3,815.2
WC 60 DAS	22.5	0.46	38.6	77.0	38.4	1.0	83.3	44.3	3,739.6
WC 80 DAS	22.2	0.42	38.6	73.1	34.5	0.9	80.3	44.9	3,707.6
Season long WC	18.6	0.37	33.6	63.1	29.5	0.9	75.8	41.4	3,210.2
SEm±	2.3	0.03	–	–	–	–	3.0	1.5	213.4
CD (P=0.05)	6.8	0.08	–	–	–	–	8.7	4.4	619.4

Price of cowpea seed, ₹90/kg, price of fodder, ₹1600/t) WF, weed free; WC, weedy check

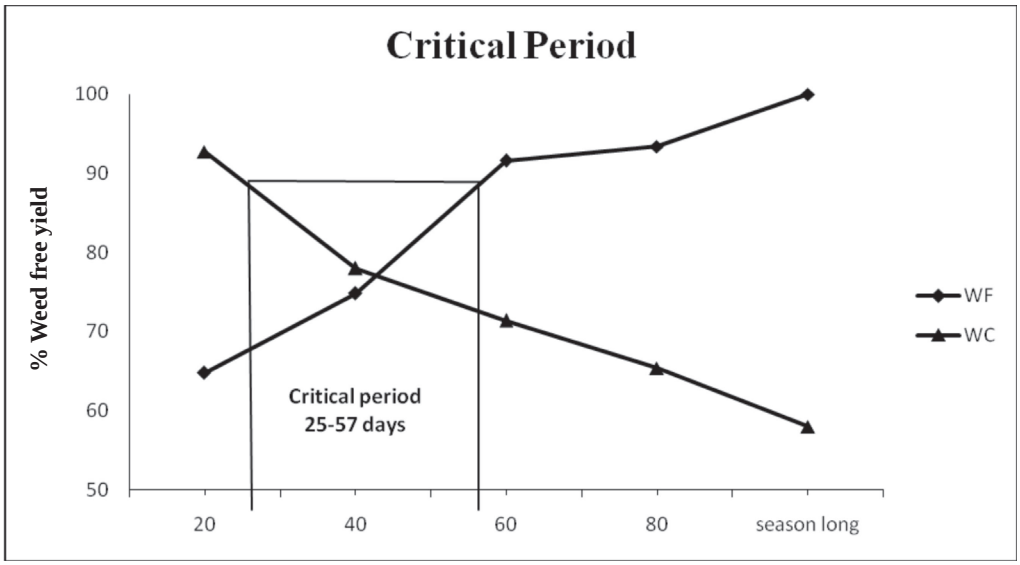

Fig. 1. Interpretation of critical period of crop-weed competition in cowpea (WF, Weed-free; WC, weedy check)

80 DAS which was at par with weedy check for 20 DAS, whereas it was significantly higher than season long weed free. The seedling-vigour index is the indicator of the quality of seed and this was being changed with weed stress, possibly because of competition between mother crop and with weeds. Highest seedling-vigour index was reported by Das *et al*. (1993) with heavier seeds in wheat.

The maximum net income was observed with weed-free up to 60 DAS with the highest benefit: cost ratio followed by season long weed-free condition and the minimum with season-long weedy check treatment with highest cost of production.

Based on this study, it can be concluded that higher seed yield and quality of forage cowpea seed may be realized by controlling the weeds for first 60 days after sowing with higher net returns and benefit: cost ratio.

REFERENCES

Ahlawat, I.P.S. and Shivakumar, G.B. 2005. *Kharif pulses.* (In) *Textbook of Field Crops Production,* Prasad, R. (Ed.). Indian Council of Agricultural Research, New Delhi.

Chopra, N.K., Chopra, N., Sinha, S.N. and Vinod, K. 2006. Effect of glyphosate spray on seed yield and quality attributes in watermelon. *Seed Research* **34**(1): 50–53.

Chopra, N., Singh, H.P. and Chopra, N.K. 2002. Effect of weed stress on seed quality of wheat. *Indian Journal of Agricultural Sciences* **72**(4): 238–240.

Das, N.R., Ghosh, N. and Mukherjee, N.N. 1993. Seed character

and seedling vigour of wheat (*Triticum aestivum*) after transplanting rice (*Oryza sativa*) as affected by tillage and fertilizer. *Seed Research* **2**: 756–762.

Frenda, A.S., Ruisi, P., Saia, S., Frangipane, B., Di Miceli, G., Amato, G. and Giambalvo, D. 2013. The critical period of weed control in faba bean and chickpea in mediterranean areas. *Weed Science* **61**(3): 452–459.

ISTA. 1985. International rules for seed testing. *Seed Science and Technology* **13**: 299–355.

Kumar, S. 2001. Critical period of weed competition in Cumin (*Cuminum cyminum* L.). *Indian Journal of Weed Science* **33**(1, 2): 30–33.

Tripathi, S.S. and Singh, G. 2001. Critical period of weed competition in summer cowpea (*Vigna unguiculata* L.). *Indian Journal of Weed Science* **33**: 67–68.