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Determination of critical period of crop-weed competition in sesame

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ABSTRACT

A field experiment was conducted during summer season of 2006 and 2007 under irrigated condition in a sandy loam soil at Sriniketan, West Bengal to determine the critical period of crop-weed competition in sesame. Results revealed that weed-free condition between 15 and 45 days after sowing (DAS) significantly increased the yield of sesame, whereas the lower yield of was recorded when weeds were allowed to grow during this period. The maximum competition between crop and weed was between 15 and 45 DAS, which can be considered as critical period of crop-weed competition. However, the extrapolated critical period was determined from 19-42 DAS. To avoid the yield loss, weed management should be done in such a time so that minimum weed infestation is achieved in summer sesame.

Key words: Critical period, Precision Sesame, Weed competition, Weed management

Sesame ranks third in terms of total oilseed area and fourth in terms of total oilseed production in India. The average yield of sesame is very low (274 kg/ha) (Anonymous 2012a). It is one of the important oilseed crops in West Bengal mainly grown on marginal lands with minimum care. Sesame is cultivated in summer, *Kharif* and post- *Kharif* season on an area of about 0.18 m ha (Anonymous 2012b). The area, production and productivity of sesame are higher in summer season than other seasons. Out of several factors, weed competition is considered to be the most important responsible for low productivity of the crop. Prevalence of high temperature with high relative humidity and frequent rainfall during the crop season coupled with slow early growth favour luxuriant weed growth since seedling emergence, resulting in about 50-75% reduction in seed yield (Bhadauria *et al.* 2012). Determination of exact critical period of weed competition in sesame is essential for timely and effective weed management and higher productivity and profitability. The present investigation was carried out to determine the critical period of weed competition in summer sesame of West Bengal.

MATERIALS AND METHODS

An experiment was conducted at agricultural farm of the Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal in summer season of 2006 and 2007. The soil of the experimental field was sandy-loam in texture, poor in organic C, medium in fertility status and acidic in nature. Ten treatments, *viz*. weedy for initial 15, 30, 45 and 60 DAS and then weed-free, and weed-free for initial 15, 30, 45 and 60 DAS and then weedy, weed-free and weedy up to harvest were assigned in a randomized block design with three replications. The sesame variety '*Rama*' ('*Improved Selection-5*') was sown with seed rate of 4.5 kg/ha in rows 30 cm apart. The crop was fertilized with 80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha in the form of urea, single superphosphate and muriate of potash, respectively. Half of the N and full dose of P and K were broadcast at the time of sowing, while the remaining N was applied at 30 DAS. The net plot size was 5.0 × 3.0 m. Complete weed removal was practiced through hand weeding in weed-free plots right from the germination. However, later weeds were hand pulled as and when emerged. In weedy plots no weed control measures had been employed. In all other weedy treatments, *viz.* weedy up to 15, 30, 45 and 60 DAS, the weeds were allowed to grow up to the respective days, thereafter, complete weed removal was practiced. In other treatments having certain weed-free periods *viz.* weed-free up to 15, 30, 45 and 60 DAS, the weeds were completely removed from the plot up to the respective days and after that the weeds were allowed to grow freely. Seed yield of each treatment was recorded and worked out as per cent of weed-free check.

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RESULTS AND DISCUSSION

Weed flora

The total number of weed species present in the experimental field was eight under four families and two categories – four broad-leaved and four grasses. The species under grass category were: *Digitaria sanguinalis, Echinochloa colona, Eleusine indica* and *Dactyloctenium aegyptium* and those under broad-leaved were *Spilanthes*

acmella, *Trianthema portulacastrum*, *Tephrosia purpurea* and *Ageratum conyzoides*. Species-wise data of weed composition revealed that *Digitaria sanguinalis* among the grassy weeds and *Spilanthes acmella* among the broadleaved weeds were the most dominant at 60 DAS. The grassy weed *Digitaria sanguinalis* was the most predominant (66.7%) among the total weed species present followed by *Spilanthes* (15.5%). The experimental field was mostly dominated by grassy weed, which comprised of about 80% of the total weed population.

Effect on weeds

Weedy check recorded significantly higher number as well as dry matter of grassy weeds at 60 DAS than that of rest of the treatments during both the years, followed by that of weedy up to 60 DAS then weed-free, and weed-free 15 DAS then weedy treatments, which were statistically at par. The other treatments *i.e.* weed -free, weedy up to 15 DAS and then weed-free, weedy up to 30 DAS and then weed-free, weedy up to 45 DAS and then weed-free and weed-free 60 DAS then weedy remained comparable with each other (Table 1). The treatment weed-free up to 30 DAS recorded significantly lower number of grassy weed than that of weed-free for first 15 DAS. However, the number of grassy weed was significantly lower in weed-free up to 45 DAS then weedy over that of weed-free 30 DAS then weedy.

Similar trend was observed in case of broadleaved weeds as well as total number of weeds where weedy check recorded significantly higher number and dry matter of broadleaved weeds and total numbers of weeds at 60 DAS and was at par with those of weedy up to 60 DAS and then weed-free, and weed-free 15 DAS and then weedy treatment. The remaining treatments including weed-free, weedy up to 15 DAS then weed-free, weedy up to 30 DAS then weed-free, weedy up to 45 DAS then weed-free and weed-free 60 DAS then weedy were at par with each other.

The highest number and dry weight of grassy, broadleaved and total weeds was recorded in the treatment where weeds were allowed to grow up to maturity, and it was equivalent with that of weedy up to 60 DAS and then weed-free, and weed-free 15 DAS and then weedy treatments when observations were taken at 60 DAS. Thus, any attempt to make weed-free condition at very initial stage of crop growth had no impact on reducing the number as well as dry weight of grassy, broadleaved and total weeds. However, when the weed-free conditions were extended from 15 DAS onwards, the number as well as dry weight of weeds progressively reduced significantly. Similar observations were reported by Das and Yaduraju (1996) and Wanjari *et al.* (2000).

Table 1. Effect of weed competition treatments on density and biomass of weed in summer sesame at 60 DAS

Treatment	Weed density (no./m^2)						Weed biomass (g/m^2)					
	2006			2007			2006			2007		
	Grasses	BLW	Total	Grasses	BLW	Total	Grasses	BLW	Total	Grasses	BLW	Total
Weedy up to 15 DAS and then weed-free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Weedy up to 30 DAS and then weed-free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Weedy up to 45 DAS and then weed-free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Weedy up to 60 DAS and then weed-free	13.92 (193.3)	8.09 (78.7)	16.50 (272.0)	14.97 (223.6)	8.89 (78.5)	17.39 (302.1)	12.20 (148.3)	2.75 (7.1)	12.48 (155.4)	11.88 (140.6)	3.03 (8.7)	12.64 (159.3)
Weed-free 15 DAS and then weedy	13.72 (187.7)	7.74 (59.4)	15.73 (247.1)	14.19 (200.9)	8.77 (76.4)	16.66 (277.3)	11.56 (133.1)	2.65 (6.5)	11.85 (139.7)	11.76 (137.7)	2.84 (7.6)	12.07 (145.3)
Weed-free 30 DAS and then weedy	10.01 (100.0)	5.52 (29.9)	11.42 (129.9)	10.49 (109.5)	6.12 (36.9)	12.1 (146.6)	0.71 (0.0)	2.12 (3.9)	9.19 (83.9)	9.24 (84.9)	2.05 (3.7)	9.44 (88.6)
Weed-free 45 DAS and then weedy	6.96 (47.9)	4.15 (16.7)	8.07 (64.7)	6.64 (43.6)	4.72 (21.8)	8.12 (65.4)	5.39 (28.6)	1.67 (2.3)	5.59 (30.8)	5.76 (32.0)	1.07 (0.6)	5.76 (32.6)
Weed-free 60 DAS and then weedy	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Weed-free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Weedy	14.84 (219.7)	8.27 (67.9)	16.97 (287.6)	15.02 (225.1)	9.30 (85.9)	17.64 (310.7)	12.26 (149.0)	2.92 (8.0)	12.59 (157.7)	12.43 (154.0)	3.04 (8.7)	12.77 (162.7)
LSD (P=0.05)	1.132	0.567	1.250	0.839	0.595	1.028	0.831	0.285	0.757	0.822	0.274	0.807

Table 2. Effect of weed competition treatments on yield components and yield of sesame at harvest

Treatment	No. of capsules/plant		No. of seeds/ capsule		1000-seed weight (g)		Seed yield (t/ha)		Seed yield (% of weed-free check)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Weedy up to 15 DAS and then weed-free	54.5	49.8	44.0	38.0	2.5	2.6	1.24	0.99	93.5	90.0
Weedy up to 30 DAS and then weed-free	39.4	35.4	33.0	31.0	2.5	2.5	0.71	0.60	53.8	54.9
Weedy up to 45 DAS and then weed-free	35.5	31.1	34.0	30.0	2.4	2.5	0.58	0.47	43.9	42.6
Weedy up to 60 DAS and then weed-free	32.1	30.8	33.0	30.0	2.4	2.4	0.51	0.41	38.4	37.7
Weed-free 15 DAS and then weedy	36.9	31.7	35.0	32.0	2.4	2.5	0.62	0.50	46.9	45.3
Weed-free 30 DAS and then weedy	46.0	46.4	40.0	36.0	2.5	2.5	1.02	0.84	77.2	76.2
Weed-free 45 DAS and then weedy	54.1	50.0	44.0	38.0	2.5	2.6	1.19	0.99	90.2	90.2
Weed-free 60 DAS and then weedy	54.3	51.1	45.0	40.0	2.6	2.6	1.27	1.06	96.2	96.9
Weed-free	58.6	51.6	46.0	40.0	2.6	2.6	1.32	1.10	100	100
Weedy	31.9	30.2	33.0	30.0	2.4	2.4	0.51	0.41	38.4	37.4
LSD (P=0.05)	6.4	3.5	6.1	4.3	NS	NS	0.15	0.11	-	-

Yield components and yield

The highest number of capsules/plant and seeds/capsule was produced in weed-free throughout the period. The treatments weed-free, weedy up to 15 DAS and then weed-free, weed-free 45 DAS and then weedy, and weed-free 60 DAS and then weedy were statistically at par with respect to production of capsules/plant and weed-free for first 30 DAS and then weedy. The lowest number of capsules/plant and seeds/capsule was observed under weedy check, which was comparable with that of weedy up to 45 DAS and then weed-free, weedy up to 60 DAS and then weed-free, and weed-free 15 DAS and then weedy treatment weed-free(Table 2). However, test weight of sesame did not vary significantly. Seed yield of sesame was significantly higher in weed-free situation maintained throughout the growing period than that of weedy check treatments, and it was at par with that of weedy up to 15 DAS and then weed-free, weed-free 45 DAS and then weedy, and weed-free 60 DAS then weedy treatments. The lowest seed yield was recorded in weedy check treatment and it was comparable with that of weedy up to 45 DAS and then weed-free, weedy up to 60 DAS and then weed-free, and weed-free 15 DAS then weedy treatments. The maintenance of weed-free condition for first 30 DAS registered significantly higher seed yield than that of the situation where weeds were allowed to grow for first 30 days and then weed-free. The weed- free conditions between 15 and 45 DAS significant increased the yield of sesame whereas the minimum yield was recorded when weeds were allowed to grow during this period (Table 2, Fig. 1 and 2). The maximum competition between crop and weeds was between 15 and 45 DAS, which can be considered as critical period of crop weed competition in case of summer sesame. The results were in conformity with Singh *et al.* (1993) and Venkatakrishnan and Gnanamurthy (1998).

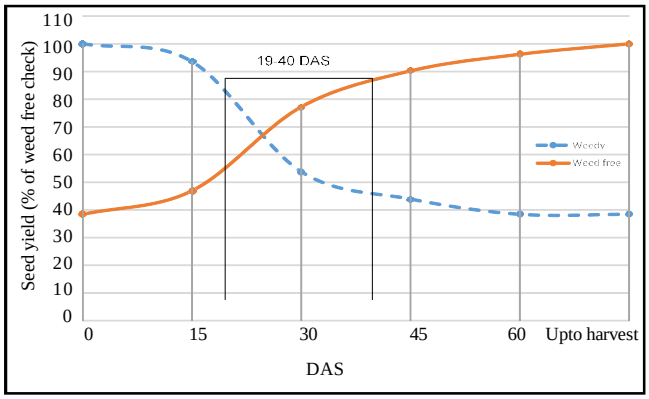

Fig. 1. Critical period of weed competition in sesame (2006)

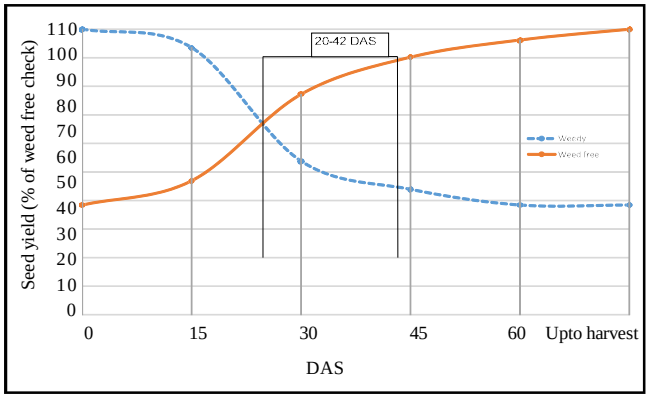

Fig. 2. Critical period of weed competition in sesame (2007)

Seed yield of sesame (% of weed-free check)

To determine the critical period of weed competition, the sesame seed yield was expressed in terms of per cent yield over weed-free check and presented in Table 2. The highest seed yield on the basis of percentage of weed-free check was recorded in the plot weed-free up to 60 DAS and then weedy, followed by that of weed-free up to 45 DAS and then weedy treatments. The lowest value was recorded in weedy check, followed by that in weedy up to 60 DAS and then weed-free, weedy up to 45 DAS and then weed-free, weed-free up to 15 DAS and then weedy, and weedy up to 30 DAS and then weed-free treatments. Maximum yield loss due to weed competition was to the tune of 61.6 and 62.6% in 2006 and 2007, respectively. Weedy for first 45 days resulted in 56.1-57.4%.

Critical period of weed competition

Weed-free condition between 15 and 45 DAS resulted in significant increase in the yield of sesame whereas the minimum yield was recorded when weeds were allowed to grow during this period. Thus, it was observed that the critical period of weed competition in sesame was between 15-45. However for determining the exact critical period of weed competition, the data on seed yield was first converted into per cent considering weed-free as 100%. Then two curves were drawn by selecting two items i. e. first some days weed-free then weedy and weed infestation for first few days and then weed-free treatments in the same graph. After analyzing the data, the LSD (P=0.05) for seed yield was determined. The value of the LSD was converted into per cent of weed-free check (8.8 and 10.0% in 2006 and 2007, respectively). By using the LSD per cent value, it was seen up to which weedy period the seed yield was statistically at par with weed-free check. From the graph (Fig. 1 and 2), an extrapolated critical period of weed competition was worked out in summer sesame under irrigated condition. It was between 19-40 and 20-42 DAS in 2006 and 2007, respectively.

To avoid the yield loss of sesame, the weed control measures should be taken in such a time so that minimum weed pressure will be there during 19-2 DAS or the effect of any weed management practices should be long enough to cover this critical period of competition in the lateritic soil of West Bengal.

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