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Crop-weed competition in blackgram in coastal deltaic eco-system

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ABSTRACT

A field experiment was carried out at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, U.T. of Puducherry, India during rainy season (*Kharif)* of 2019 with ten treatments replicated thrice in a randomized block design to study the critical period of crop-weed competition in irrigated blackgram in deltaic coastal ecosystem. The weed spectrum comprised of *Echinochloa colona* (L), *Dactyloctenium aegyptium* (L.), *Trianthema portulacastrum (*L.), *Cleome viscosa* (L.), *Eclipta prostrata* (L.) and *Cyperus rotundus* (L.). The density and dry weight of weeds significantly increased when crop-weed competition was prolonged from 15 days after sowing (DAS) to the maturity of the crop. The highest seed yield (706.5 kg/ in coastaha) was obtained when blackgram was maintained weed free till harvest closely followed by weed free till 60 DAS (652.1 kg/ha) and weedy condition till 15 DAS (608.6 kg/ha). The critical period of crop-weed competition was found to be 17 to 50 DAS. Weedy condition upto 15, 30, 45, 60 DAS and throughout crop growth resulted in a yield loss of 9.66, 39.19, 59.13, 75.87 and 86.30%, respectively.

Blackgram (*Vigna mungo* L.) is the third most important grain legume cultivated in India accounting 12% of total pulse production. The low productivity in blackgram is attributed to numerous biotic and abiotic factors, of which, the most important factor is weed management. Blackgram experience high weed competition during rainy season *(Kharif)* (Balyan *et al*. 2016) due to favourable weather conditions associated with sufficient moisture availability which facilitate weed emergence in succession. The yield loss due to weed competition depends on the intensity and duration of competition as well as the stage of crop growth (Singh *et al*. 1991). Lack of proper weed management is found to cause upto 80% reduction in grain yield of blackgram (Kumar and Tiwari 2004). Therefore, determination of critical period of crop-weed competition is an important step to formulate weed management practices that are effective and economical to the farmers. Most of the earlier crop-weed competition studies were conducted in light soils and no studies in blackgram in heavy soils of coastal deltaic ecosystem.

A field study was conducted during rainy season (June–August 2019) at research farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry (11° 56' N latitude, 79° 53' E longitude, 4 m above mean sea level), India. The experiment was laid out in randomized block design with ten treatments. Treatments consisted of maintaining weedy conditions for the first 15, 30, 45, 60 days after sowing (DAS) and throughout crop growth and maintaining weed- free conditions for the first 15, 30, 45, 60 DAS and throughout crop growth. Blackgram cultivar '*VBN (Bg) 4*' having a duration of 80 days was manually sown adopting a seed rate of 20 kg/ha at 30 x 10 cm spacing. Weed density and weed dry weight at specified period were recorded by employing two quadrats (0.5 x 0.5 m) placed randomly in each plot. Growth parameters, yield parameters and seed yield (12% moisture content) were recorded at harvest. Experimental data were subjected to statistical analysis as per the procedures given by Panse and Sukhatme (1967) and inferences were drawn at 5% probability level. The data on weed density and dry weight were subjected to square root transformation ($\sqrt{x+0.5}$) before statistical analysis. The Gompertz (weed free) and logistic (weedy) curves were fitted to determine the critical weed-free period at 5% acceptable yield loss level.

Effect on weeds

The experimental field was infested with diverse weed flora comprising 87.3% grasses [(*Echinochloa*

colona (L.), *Dactyloctenium aegyptium* (L.)], 7.6% sedge (*Cyperus rotundus* (L.)) and 5.1% broad-leaf weeds (BLW) [(*Trianthema portulacastrum* (L.), *Cleome viscosa* (L.), *Eclipta prostrata* (L).]. Singh *et al*. (1991) indicated that grassy species dominated the weed spectrum in blackgram with more than 70% of the total weed density. Significant increase in weed density and dry weight of grasses, BLW and total weeds was observed when crop-weed competition was prolonged from 15 DAS to maturity of the crop (**Table 1)**. Higher density (457.3 no./m^2) and dry weight (423.1 g/m^2) of grasses was recorded in weedy plot throughout crop growth. However, the density (4.0 no./m^2) and dry weight (1.8 g/m^2) of grassy weeds was significantly decreased when weed free environment was maintained. Patzold *et al*. (2020) also indicated that grassy weeds were positively correlated with available water content of the soil. Similar trend was noticed in case of density and dry weight of BLW and total weeds also (**Table 1**).

Effect on blackgram

Significantly higher plant height (42.1 cm) was recorded when weed-free condition was maintained throughout crop growth (**Table 1**). There was 29.2% reduction in plant height, resulting in stunted blackgram plants under weedy condition throughout crop growth. Dry matter accumulation and number of pods per plant were significantly decreased with increased duration of weed competition. Significantly lower dry matter accumulation (0.65 g/plant) and pods per plant (5.4) were recorded under weedy plots. Earlier studies have also demonstrated the poor growth of blackgram under longer duration of weed competition (Kumar and Tiwari 2004).

Grain yield was significantly reduced with increase in the duration of crop-weed competition (**Table 1**). The highest blackgram yield was obtained in weed free throughout the crop period (706.5 kg/ ha), closely followed by weed free till 60 DAS (652.1 kg/ha) and weedy till 15 DAS (608.6 kg/ha). Maintaining weedy condition throughout crop growth period resulted in the lowest yield (96.8 kg/ha). Weedy condition till 15, 30, 45, 60 DAS and throughout crop growth resulted in the yield loss of 9.66, 39.19, 59.13, 75.87 and 86.30%, respectively. Kumar and Tiwari (2004) reported that yield loss in blackgram was 40.1% when crop experienced weed competition throughout crop growth.

The linear regression between pods/plant and dry matter (R^2=0.78), yield and dry matter (R^2=0.77) was significant and positive (**Figures 1a and b**) while number of pods/plant and weed dry weight (R^2=0.73), yield and weed dry weight (R^2=0.74) was significant and negative (**Figures 1c and d**). The yield of blackgram decreased with increasing amount of weed dry weight. The lower yield might be due to higher physical suppression and competition with increasing intensity and duration of weed competition. The better growth and higher yield of blackgram under weed free condition shows the reduced physical suppression and competition.

Table 1. Effect of varying crop- weed competition periods on weed and crop attributes of blackgram

Treatment	Weed density (no./m^2)				Weed dry weight (g/m^2)				Plant height (cm)	DMP (g/ plant)	Pods/ plant (no.)	Grain yield (kg/ha)	Weed Index
	Grasses	Sedge	BLW	Total	Grasses	Sedge	BLW	Total					
Weedy till 15 DAS	9.87 (88)	2.06 (3.7)	3.17 (8.0)	10.46 (100)	6.20 (32.6)	1.34 (1.3)	1.68 (1.4)	6.44 (35)	40.9	5.12	32.0	608.6	13.85
Weedy till 30 DAS	16.53 (258)	2.32 (2.3)	4.32 (14.7)	17.14 (278)	13.11 (160)	1.98 (3.3)	1.69 (1.6)	13.31 (165)	36.7	3.95	30.7	429.6	39.19
Weedy till 45 DAS	18.27 (317)	4.15 (28.0)	4.44 (16.0)	19.41 (361)	16.53 (258)	2.65 (6.9)	1.78 (1.9)	16.81 (267)	34.6	2.88	16.6	288.7	59.13
Weedy till 60 DAS	20.85 (421)	5.05 (34.7)	4.75 (18.7)	22.06 (474)	18.33 (323)	3.48 (15.2)	2.02 (2.6)	18.81 (341)	30.9	2.32	10.3	170.5	75.87
Weedy throughout crop growth	21.19 (457)	5.12 (40.0)	5.57 (26.7)	22.55 (524)	20.85 (423)	4.38 (26.2)	3.12 (7.4)	21.76 (457)	29.8	0.65	5.4	96.8	86.30
Weed -free till 15 DAS	17.45 (290)	6.33 (38.7)	4.90 (20.3)	19.14 (349)	15.30 (220)	5.82 (37.8)	2.68 (5.7)	16.69 (263)	30.7	2.19	12.6	147.1	79.19
Weed -free till 30 DAS	13.07 (158)	6.09 (34.7)	4.12 (13.3)	14.82 (206)	10.53 (101)	4.86 (21.9)	1.30 (1.9)	11.64 (124)	32.3	3.96	18.9	329.6	53.35
Weed -free till 45 DAS	9.46 (81)	5.57 (29.3)	3.16 (7.3)	11.30 (117)	8.68 (68)	4.76 (18.4)	0.88 (0.4)	9.78 (87)	34.5	4.85	26.0	549.5	22.22
Weed -free till 60 DAS	8.37 (63)	4.26 (16.0)	1.91 (3.0)	9.45 (82)	7.22 (48.6)	3.65 (10.6)	0.71 (0.1)	8.03 (59)	35.1	5.86	32.0	652.1	07.70
Weed -free throughout crop growth	2.11 (4)	1.17 (1.3)	1.24 (1.7)	3.11 (7)	1.57 (1.8)	0.97 (0.7)	0.50 (0.0)	2.03 (2)	42.1	7.37	36.5	706.5	-
LSD (p=0.05)	3.16	NS	1.76	5.30	3.48	NS	1.29	2.57	6.53	1.04	5.63	120.5	

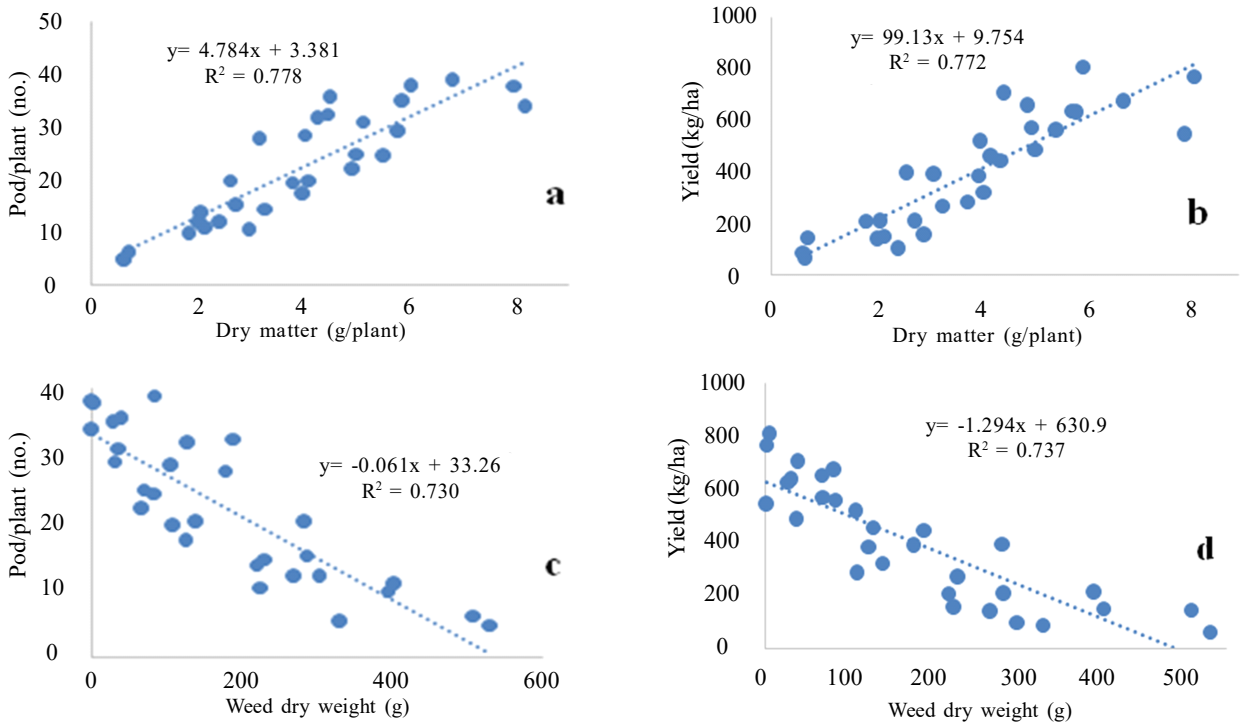

Figure 1. Simple linear regression between (a) pods/plant and dry matter of plant (b) yield and dry matter of plant (c) pods/plant and weed dry matter (d) weed dry matter and yield

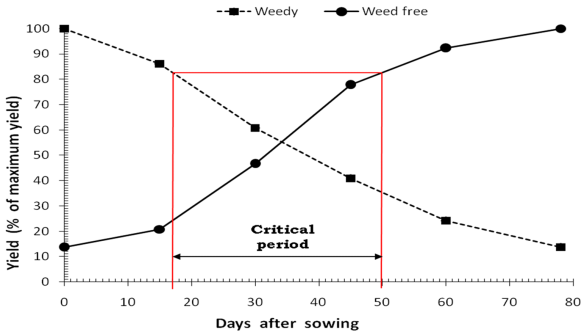

Figure 2. Critical period of crop-weed competition in irrigated blackgram

Critical period of crop- weed competition

The maximum seed yield (706.5 kg/ha) was obtained in weed free plots. Blackgram seed yield was statistically at par with maximum yield when the weedy period last up to initial 17 days and weed free period upto 50 days (**Figure 2**). Earlier studies indicated that early 20-40 days duration was critical for crop-weed competition in blackgram (Saraswat and Mishra 1993, Kumar and Tiwari, 2004). In this particular study, sandy clay loam texture of the soil with more water holding capacity might have helped the weeds to emerge in succession for longer duration. Korres *et al*. (2017) indicated that soil texture and water holding capacity influence the occurrence of the weeds for longer period.

Study revealed that the critical of crop-weed competition in blackgram cultivated in heavy soils of coastal Cauvery delta is 17 to 50 DAS. Hence, in future, extended critical period of weed competition may be considered to formulate suitable weed management methods to minimize the yield loss in irrigated blackgram.

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