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Critical weed-crop competition period versus yield of sesame (*Sesamum indicum* L.) at Tikamgarh district of Madhya Pradesh

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Abstract

A field experiment was conducted during two consecutive kharif *of 2009 and 2010 to estimate the critical period for weed control for sesame at Tikamgarh district of Madhya Pradesh. The treatments comprised of quantitative series of both increasing duration of weediness* i.e., *early (weedy up to 15, 30, 45, and 60 DAS) and weed free periods* i.e., *late (weed free up to 15, 30, 45, and 60 DAS) competition periods and were compared with complete weed free (CWF) and weedy check (WC). Weeds count gradually increased as the duration of weed-crop association increased up to 60 DAS. As period for weed-crop competition increased either in early and late competition situation, weed dry weight also increased. Similarly, weed control efficiency was also increased with an increase in weed free competition period. In early competition, the highest sesame seed yield of 775 kg/ha was recorded under weedy up to 15 DAS and about 59% higher sesame seed yield than WC and 18% yield loss compared to the CWF. In late competition, the highest seed yield of 856 kg/ha was obtained in weed free up to 60 DAS and resulted into 60% higher seed yield over WC and 15% yield loss than CWF. However, weed free up to 15, 30 and 45 DAS treatments were differed non-significantly among themselves for seed yield. In early competition, data clearly indicated that weedy up to 15, 30 and 45 DAS gave about 75%, 62% and 51% higher net return, respectively over WC treatment. Weed free up to 15, 30 and 45 DAS conferred about 73%, 75% and 75% higher net return, respectively over WC. The weedy up to 15 DAS, weed free up to 15 DAS, 30 DAS and 45 DAS exhibited the higher net return per rupee invested (B:C) as compared to other weed-crop competition periods. Weedy up to 15 DAS and weed free up to 30 and 45 DAS showed to reduce less than 15% to 18% sesame yield loss in margins. Similarly, difference in B:C among these treatments was also marginal* i.e., *<2.5% to 5.5%. Thus, the critical period for weed control for sesame at Tikamgarh district of Madhya Pradesh was found to be about 15 to 45 DAS.*

Key words: Critical period, *Sesamum indicum* L., weed control efficiency (WCE), weed-crop competition period, weedy check (WC)

Introduction

Sesame (*Sesamum indicum* L.) was first domesticated in India and it is popularly known as the 'queen of oilseeds' It has emerged as one of the important oil seed crops in India because of its short duration, low water requirement and good quality oil. India ranks first in the world with an area of 1.81 million ha and total production of 0.64 million ton with productivity of 354 kg/ha. In Madhya Pradesh, it has been cultivated in an area of 2,09,000 ha with a total production of 87,600 tonnes and productivity of 418 kg/ha. On the other hand, in Tikamgarh district, it has been grown on an area of 21,900 ha with total production of 57, 00 tonnes. But the average productivity is 260 kg/ha which is lower than the country's average and rest of the major sesame growing states like Karnataka (552 kg/ha) and Gujarat (470 kg/ha; Anonymous, 2010).

Out of several constraints in sesame production, weed infestation is one of the major factor limiting the yield of sesame as its seedling growth is slow during the first four weeks makes it a poor competitor at earlier stages of crop growth (Bennett *et al.*, 2003). The early growth period is the most critical stage at which stress of any kind can affect the economic yields.

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Weed competition is one of such important stress during this period (Channappagoudar, *et. al*, 2008). Insufficient weed control during early growth period of sesame may cause yield reduction between 35 to 70%. Singh *el. al* (1992) reported weed induced reductions of sesame yield up to 135% and a need for a critical weed free period up to 50 DAS. So, the presence of weeds at critical period for weed control leads to serious yield losses (Knezevic *et al.*, 2002). Upadhyay (1985) have stressed that early growth of sesame is slow, so making suppression of weed growth at crop establishing is important. Critical weed-crop competition period varied considerably with the nature and status of crop, weed flora composition, extent of weed infestation and the prevailing environment (Zimdahl, 2004). For instance, the critical period for weed competition in sesame is 60 days after seedling emergence (DAE) in Sausa and 30-35 DAE in Monteiro, Brazil (Beltrao *et al.*, 1997) and 30-45 days after sowing in India (Venkatakrishnan and Gnanmurthy, 1998). Amare *et al.* (2009) found a critical period of weed competition in sesame crop between 10 and 30 days after seedling emergence.

Keeping in view the importance of well defined critical weed-crop competition period, the critical weed-crop competition period in sesame was studied under agro-climatic conditions of district Tikamgarh, Madhya Pradesh.

Materials and Methods

Field studies were conducted at the Agronomic Research Farm, College of Agriculture, Tikamgarh (24°.26 to 25°.40 latitude and 78°.26 to 79°.56 longitudes with altitude of 426.7m above msl), Madhya Pradesh during two consecutive years 2009 and 2010 *kharif* seasons to find out the critical weed-crop competition period in sesame by subjecting the crop to various weed competition periods and then evaluating their effect on weed density and biomass, seed yield and economics of sesame. The soil of the experimental site was sandy to sandy loam with a pH of 6.5. Climate of district is moderate, generally dry except rainy season. The district receives an average annual rainfall of 1001 mm in 32 rainy days. Average temperature in summer varies from 23 °C to 44 °C and average temperature in winter season varies from 4.5° to 25.4 °C.

The experiment comprised of 10 weed-crop competition periods (WCCP) in two series *i.e.*, early (weedy up to 15, 30, 45, and 60 DAS) and late (weed free up to 15, 30, 45, and 60 DAS) competition periods were compared with two checks viz., complete weed free (CWF) and weedy check (WC). Weed free conditions during rest of growing season in respective treatments and whole growing period were maintained by hand hoeing using 'khurpa', while in case of full season competition no weed control was employed. In case of weed free check weeds were removed as and when they emerged. Experiment was laid out in randomized complete block design with three replications. Net plot size was 4.0 m x 3.4 m. Sesame variety JTS-8 was used as a test crop. Crop was sown in the second fortnight of July using a seed rate of 5 kg ha^{-1} at row-to-row distance of 45 cm. Plant to plant distance of 10 cm was maintained by thinning after 15 to 20 days of crop emergence. The crop was fertilized with N, P and K @ 40, 30 and 20 kg per hectare, respectively. The crop was harvested in first fortnight of October. All other agronomic operations and plant protection measures were followed as per recommendations. Weed density (m^{-2}) and weed biomass (g/m^2) in each treatment were taken by counting and uprooting weeds from an area of one square meter from two randomly selected places at the time of completion of their respective competition periods and dry weights were determined. The means of these two were calculated by taking their averages. The crop was harvested at physiological maturity and the yield was expressed as kg/ha. Yield loss due to weeds was estimated by comparing mean sesame yield obtained from treated and complete weed free treatments. Weed control efficiency (WCE) was calculated by following the formula given below. The economics of the weed management practices was also worked out. The rainfall received during *kharif* seasons (June-October) of 2009 and 2010 were 609 mm and 487 mm, respectively.

$$WCE\ (\%) = \frac{DWC - DWT}{DWC} \times 100$$

Where; DWC = dry weight of weeds in WC plots and DWT = dry weight of weeds in treated plots

Results and discussion

Weed density

Data pertaining to the effect of different weed-crop competition periods on weed density is depicted as Fig, 1. The number of weeds gradually increased as the duration of weed-crop association increased up to 60 DAS ($43.2/m^2$). The maximum weeds count ($46.3/m^2$) was reported in plots where weeds were allowed to compete with crop for full growing season (weedy check) which was numerically highest among all other treatments. On the other hand, minimum weed count ($8.1/m^2$) was observed when field was weed free up to 60 DAS. Increased weed population with prolonged competition period might be due to the extra time availed by weeds to germinate and continue their growth. Zafar *et al.* (2010) who also reported that there was an increase in weed population with an increase in weed-crop competition period. Likewise Singh *et al.,* (1992) and

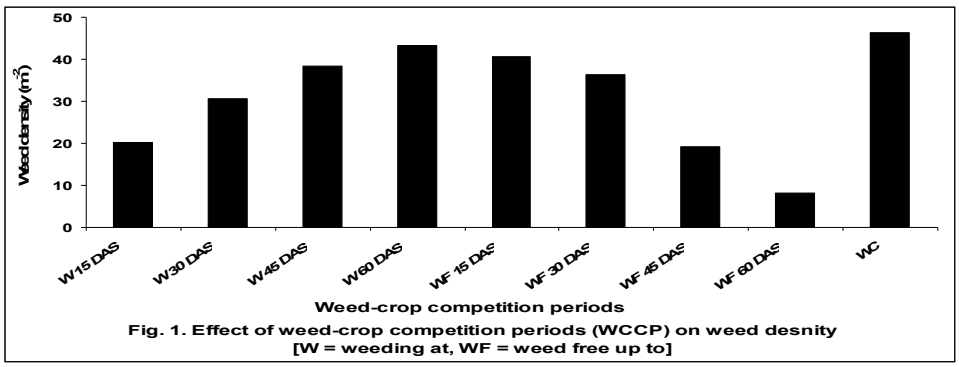

Fig. 1. Effect of weed-crop competition periods (WCCP) on weed desnity [W = weeding at, WF = weed free up to]

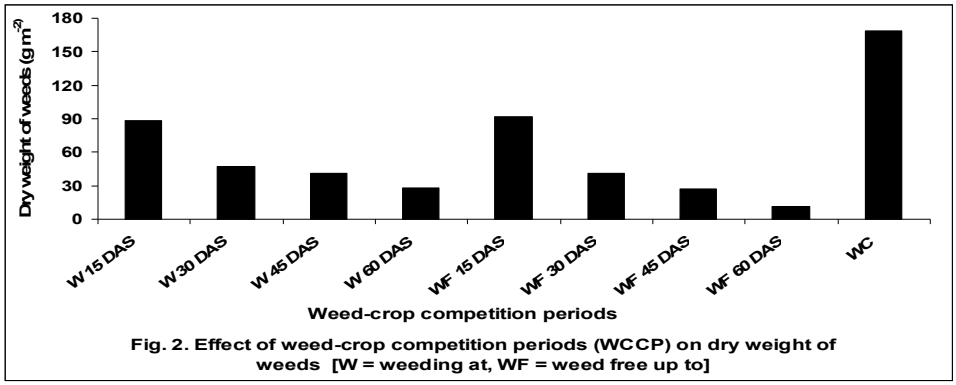

Fig. 2. Effect of weed-crop competition periods (WCCP) on dry weight of weeds [W = weeding at, WF = weed free up to]

Sootrakar *et al.* (1995) also reported that weed control for the first 28 to 55 days after sowing resulted in the reduced weed count at maturity as seedling growth was slow in this crop during initial growth stages making it to be a poorer competitor than weeds.

Weed dry weight and WCE

Weed dry weight influenced by different weed-crop competition periods depicted in Fig. 2 explain that as period for weed-crop competition increased either in early and late competition situation, weed dry weight also increased. Full season WCCP produced highest weed dry weight (169 g/m^2) which was numerically the highest over rest of the treatments. Increase in dry weight of weeds was due to increase in fresh weight of weeds as a result of prolonged weed growth. Theses results are in conformity with those of Bennett (1993) who identified that critical period of weed competition in sesame lies between 15 to 45 days after sowing which resulted in maximum weed biomass. In early competition, weed control efficiency (WCE) gradually increased from 47.9% to 83.4% as the duration of weed-crop association decreased up to 60 DAS. Similarly, in late competition, increased weed free competition period also observed increase in WCE from 45.6% to 97.0% up to weed free 60 DAS.

Seed yield

Data regarding the effect of WCCP on seed yield are presented in Table 1 which clearly indicates that seed yield was significantly affected by duration of weed competition. Among all WCCP treatments, CWF had registered significantly higher seed yield (889 kg/ha) as compared to other treatments but at par with treatment when keeping weed free up to 60 DAS. In early competition, the highest sesame seed yield of 775 kg/ha was observed under weedy up to 15 DAS and sesame seed yield decreased to the lowest (463 kg/ha) under weedy up to 60 DAS. Weedy up to 15 DAS gave about 59% higher sesame seed yield than WC and 18% sesame yield loss compared to the CWF. In late competition, the highest sesame seed yield of 856 kg/ha was obtained under weed free up to 60 DAS and the lowest (711 kg/ha) under weed free up to 15 DAS. However, weed free up to 15, 30 and 45 DAS treatments were differed non-significantly among themselves for seed yield. Weed free up to 15, 30 and 45 DAS gave about 55%, 59% and 60% higher sesame seed yield, respectively over WC and 20%, 17% and 15% sesame yield loss, respectively compared to the CWF. Less competition for nutrients, moisture and light etc. under prolonged weed free crop growth period resulted into higher yield attributes (data not shown) and ultimately seed yield of sesame. Amare *et al.* (2009) and Narkhede *et al.*(2000) also reported higher seed yield in sesame under prolonged weed free conditions.

Net monetary return and B:C

Data related to effect of WCCP on net monetary return (NMR) and net return per rupee (B:C) in Table 1 reveals that the maximum NMR of Rs. 25539/ha among all the treatments was recorded in CWF treatment. In early competition, data clearly indicated that prolonged weed-crop competition period from weeding at 15 DAS to 60 DAS, decreased the NMR from Rs. 23481/ha to Rs. 11780/ha. Weedy up to 15, 30 and 45 DAS gave about 75%, 62% and 51% higher

Table 1: Effect of weed-crop competition periods on seed yield and economics of sesame (pooled over 2 years)

Treatments	Seed yield (kg/ha)	Yield loss (%)	WCE (%)	NMR (Rs/ha)	Increase in over weed check net return (%)	B:C ratio
Early competition						
Weeding at 15 DAS (keeping weeds upto 15 DAS)	774.5	18.2	47.9	23481	74.9	3.63
Weeding at 30 DAS (keeping weeds upto 30 DAS)	572.0	61.8	72.2	15392	61.7	2.56
Weeding at 45 DAS (keeping weeds upto 45 DAS)	489.0	66.2	75.7	12059	51.1	2.11
Weeding at 60 DAS (keeping weeds upto 60 DAS)	463.0	64.8	83.4	11780	49.9	2.27
Late competition						
Keeping weed free upto 15 DAS	710.5	20.1	45.6	21431	72.5	3.56
Keeping weed free upto 30 DAS	778.0	16.5	75.7	23628	75.0	3.65
Keeping weed free upto 45 DAS	797.5	15.2	84.0	23412	74.8	3.46
Keeping weed free upto 60 DAS	855.5	6.3	93.5	24716	76.1	3.11
Control						
Weedy check (WC)	316.5	70.6	-	5897	-	1.35
Complete weed free (CWF)	888.5	-	97.0	25539	76.9	3.06
S.Em±	29.6					
C.D. at 5%	91.2					

net return, respectively over WC treatment. Similarly, in late competition, the highest NMR of Rs. 24716/ha was obtained under weed free up to 60 DAS and the lowest NMR of Rs. 21431/ha for weed free up to 15 DAS. Weed free up to 15, 30 and 45 DAS gave about 73%, 75% and 75% higher net return, respectively over WC. The weedy up to 15 DAS, weed free up to 15 DAS, 30 DAS and 45 DAS exhibited the higher net return per rupee invested (B:C) as compared to other weed-crop competition periods.

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