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EFFECT OF VARIOUS WEED INFESTED PERIODS ON OKRA UNDER AGRO-CLIMATIC CONDITIONS OF D.I. KHAN, PAKISTAN

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ABSTRACT

A field study in order to assess the effect of various weeds infested periods on okra crop {Abelmoschus esculentus (L.) Moench} was conducted during summer 2012, at Horticulture Research Area, Faculty of Agriculture, Gomal University Dera Ismail Khan. The aim of the study were to determine the critical period of weed competition in okra, and to investigate the most destructive weed competition period for the optimum growth and In-vivo okra yield. Study was laid out in randomized complete block design with seven treatments and four replications. The data were taken on various vegetative growth and yield parameters at different time intervals (15, 30, 45, 60, 75, 90 days after sowing (DAS) and a weedy check for comparison). The results revealed that, maximum data of pod length (10.39 cm), pod diameter (1.75 cm), number of pods (16.31 plant^{-1}), pod weight (178.65 g plant^{-1}), number of leaves (10.07 plant^{-1}), plant height (53.21 cm), stem diameter (1.65 cm), chlorophyll content in leaf (51.0 µg cm^{-2}) and pod yield (9.90 t ha^{-1}) were founded for 30 DAS which was followed by 15 DAS of weeding. Furthermore, the minimum data of plant height (33.85 cm), number of leaves (6.88 plant^{-1}), stem diameter (1.03 cm), chlorophyll content in leaf (37.11 µg cm^{-2}), pods length (4.98 cm), pod diameter (1.06 cm) and pod yields (2.54 t ha^{-1}) were recorded for weedy check. It was concluded from this study that the weeded at 30 DAS showed best results regarding okra crop vegetative growth and yield parameters as compared to other days after sowing and weedy check because that was the most critical period of weeds competition for resources. Therefore, it is recommended for the farming community to adopt 30 DAS weeding practice in okra fields for better vegetative growth, yield and economic return as well.

Key words: Competition periods, growth, okra, yield and weeds.

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INTRODUCTION

The okra [*Hibiscus / Abelmoschus esculentus* L. Moench)] vegetable is one of most broadly used species of the Malvaceae family (Bayer and Kubitzki, 2003; Naveed *et al*., 2009). It is originated from Ethiopia, but nowadays broadly grown throughout the world (Khalid *et al*., 2005). Most profitable vegetable used in fresh and canned forms (PROTA, 2010). During 2009 the worldwide was about 4.8 million tons annual productions; in which India (4.528 M tons) share, Nigeria (0.826 M tons), Sudan (0.249 M tons), Pakistan (0.116 M tons), Cote d' Iviore (0.115 M tons) and Egypt (0. 100 tons) and Iraq (0.153), which was respectively in percentage 70, 15, 4, 5, 2, 2 and 4 and 1.7 (FAOSTATE, 2009).

In Pakistan, it's summer vegetable and mostly cultivated in the province of Punjab and Sindh plain area (Anwar et al. 2011). During 2006 in Pakistan, the area under okra cultivation was 14689 ha, with 112154 tons yields at an average production 7.6 tons ha^{-1}, while in KPK grown on 2151 ha, with the total yields 19203 tons at the average rate of return production 8.9 tons ha^{-1} (MINFAL, 2006). Due to increasing its growers and high market demand throughout the world, Pakistan only 1.25% productions contribute. As compare to developed worlds, in developing country the yields are so low. Okra average yields in Pakistan are 76.642 hg ha^{-1} (hectogram/ hectare) (Anonymous, 2012).

The growth and yield depends on so many factors including the cultural practices, seed quality, climatic conditions and nutrition (Kusvuran, 2012). Furthermore, like others factors such as: temperature, precipitation, moisture content, solar radiation, disease/ pests etc. involves to decrease the yields, no proper weeds management also play key role to reduce the quality and yields of okra and others field crops (Khan *et al*. 2002a; Khalid *et al*., 2005). Therefore, the weeds infestation is considered as one of the major factors of low yield, due to weeds the losses have been recorded much more than the insect, pest and disease (Khalil and Jan, 2002). Due to no proper management and policy of weeds control, annual average 30-45 % losses of the total production (Usoroh, 1995). So the Nwafor *et al*. (2010) defined the weed as that plant which growing out of place and doing more harm as compared to benefits. Therefore, the presence of the weed in crops or where not require can cause side

effects on the growth performance as well as productions of the crops by denying them of the plant resources (Gworgwor, 2000; Khan *et al.* 2002b). Weeds competition varies from crop to crop, depends upon the type of crop, type of weeds, weeding time and management practice. Hence, the objective of study: to determine the critical period of weed competition in okra in order to determine the most destructive weed competition period for the efficient control of weeds and hence to increase the growth and yield of okra in field conditions.

MATERIALS AND METHODS

A field study was conducted during summer 2012, at Horticulture Research Area, Faculty of Agriculture, Gomal University D.I. Khan, Pakistan. The research trail were laid out in randomized complete block (RCB) design having seven treatment with four time repeated and net plot size of 3×3 m^2. The treatments were included on different weeding regimes (Days after sowing, DAS); weedy check, 15-DAS, 30-DAS, 45-DAS, 60-DAS, 75-DAS and 90-DAS.

Table-1. Meteorological data for rainfall and temperature during okra growing season at District Dera Ismail Khan Pakistan (PMDP, 2012)

Months	Rainfall (avg)	Temperature (avg)		Total Temperature
		Maximum	Minimum	
June	7.2	42.4	26.1	34.25
July	83.7	39.4	26.4	32.9
August	133.7	37	26.1	31.55
September	120	37	23.2	30.1
Total	344.6	155.8	101.8	128.8

Avg= average

The selected field was prepared by plugging and the recommended doses of FYM 25 t ha^{-1} applied one month before sowing. The fertilizers NPK (120:90:60) ha^{-1} was applied at the time planting**.** The okra (Sabz pari) variety was sown with row to row distance of 60 cm while plant to plant distance kept at 30 cm. The data were recorded on plant height (cm), number of leaves $plant^{-1}$, stem diameter (cm), chlorophyll content in leaf by SPAD Chlorophyll meter (Minolta Japan) (µg cm^{-2}), days to flowering, number of pods $plant^{-1}$, pod length (cm), pod diameter (cm), weight of pods $plant^{-1}$ (g), pod yield (t ha^{-1}), weeds density (m^{-2}), fresh weeds biomass (g m^{-2}) and dry weed biomass (g m^{-2}).

The data were analyzed statistically by using the analysis of variance technique (Steel and Torri, 1997) and subsequently least significance test

(LSD) was applied for comparing the treatment means by using MSTATC computer software.

RESULTS AND DISCUSSION

Plant height (cm)

Data regarding okra plant height (cm) shown in Table-1 were significantly affected ($P \leq 0.05$) by different infested periods. The maximum plant height (53.21 cm) was observed for 30-DAS followed by 15-DAS, while the minimum plant height (33.85 cm) was recorded for control or weedy check. In 30-DAS the okra vegetable maximum plant height mostly due to low competition with weed for basic plant growth resources. Our results are similar with the findings of (Iyagba et al., 2013), who reported that weeding beyond the 3 weeks after planting adversely affected the plant height of the okra vegetable.

Number of leaves plant^{-1}

Statistical analyzed data concerned to okra number of leaves plant^{-1} presented in Table-1 as significantly ($P \leq 0.05$) affected by different weed infested period. The outmost data of number of leaves (10.07 plant^{-1}) were recorded for 30-DAS followed by 15 and 45 DAS. Whereas, the okra least number of leaves (6.88 plant^{-1}) were remarked for weedy check. The higher number of leaves plant^{-1} in treatment for 30-DAS may be due to timely removal of weeds, which could not compete with okra for light, space, water and nutrients, hence at this stage the weed management in okra decrease the competition ability. This result was similar to (Dada and Fayinminnu, 2007) they examined the maximum number of leaves and leaf area plant^{-1} of okra for minimum weed competition up to 3-6 weeks after transplanting.

Stem diameter (cm)

Data about the okra plant stem diameter (cm) shown in Table-1 as significant ($P \leq 0.05$) affects by different infested weeds period. The highest okra plant stem diameter (1.65 cm) was observed for 30-DAS followed by 15-DAS. Meanwhile, the lowest okra plant stem diameter (1.03 cm) was noted for weedy check. In 30-DAS the maximum stem diameter of the okra might be due to weed removal at early stage and the crops plant fully utilized all the essential nutrients for its growth and development without any external competition. Our findings are supported to (Smith and Ojo, 2007) they observed the maximum stem diameter of okra where weeding was done at 3 week after planting.

Chlorophyll content in leaf (ug cm^{-2})

The statistical analyzed data regarding okra plant chlorophyll content in leaf as presented in Table-1 significantly ($P \leq 0.05$) affected by different weed infested periods. The higher chlorophyll content in okra leaf (51.0 µg cm^{-2}) was recorded for 30-DAS followed by 15-DAS.

Whereas, the lower chlorophyll content in okra plant leaf (37.11 µg cm^{-2}) was recorded for weedy check. The higher chlorophyll content in leaf for 30-DAS was appeared due to weeding in early stage, which give longer weed free period for the utilizing enough light, air, water and nutrients. Our results are same with (Olorunmaiye, 2010) who investigated that, the weeding durations significantly influenced the chlorophyll content of the field crop, and chlorophyll content became reduced from the weed competition. According to Hakim *et al.* (2013) that the reduction in leaf chlorophyll content index due to weed competition and salinity stress may limit photosynthesis and yield.

Days to flowering

The analyzed data in Table-2 indicated that the different weeds competition period was significantly affected ($P \leq 0.05$) the days taken to flowering. The highest days to flowering of the okra plant (40.26) were recorded for 30-DAS followed by 45-DAS. Meanwhile, the minimum days taken to flowering (33.55) were observed for the weedy check. So, the increasing days to flowering in 30-DAS are may be due to weeds removal which reduced the weed competition with crops. The crops were fully utilized all the necessary macro and micro nutrients during the late stages and hence its development stage took more days to flowering as compared to weedy check. Therefore, our finding are opposite to (Smith and Ojo, 2007) who observed the minimum days taken to flowering of okra in the days after sowing have less weed competition periods.

Number of pods $plant^{-1}$

About okra number of pods $plant^{-1}$ shown in Table-2 were significantly affected ($P \leq 0.05$) by various weeds infested period. The highest number of pods $plant^{-1}$ (16.31) was founded for 30-DAS followed 15-DAS. Furthermore, the lowest number of pods $plant^{-1}$ (9.32) was verified for weedy check and 90-DAS. So, the number of pods $plant^{-1}$ increasing in 30-DAS might be due to low competition of weeds at early stage with okra plants for the basic essential resources. Our resultants figures were matched to (Aladesanwa and Adejobi, 2007) who reported that the removal of the weeds after 3-4 weeks of sowing give more number of pods as a result of less resources fighting between the crop and weeds on nutrients for survival.

Pod length (cm)

Regarding okra plant pod length (cm) presented in Table-2 indicated the different critical competition periods significantly affected ($P \leq 0.05$). The outmost plant pod length (10.39 cm) was recorded for 30-DAS which is statistically followed by 45-DAS. While the least pod weight (4.98 cm) were observed for the weedy check. Therefore, for 30-DAS of the pod length increasing might be due to early stage of weeding, could not compete in later and the main crops take well

resources for its growth and development. This result is supported by (Ibrahim and Hamma, 2012) they observed, the maximum pod length of okra where the weeds competition with host plant are so low or less as compare to weedy plot.

Pod diameter (cm)

In Table-2 the okra plant pod diameter (cm) was significantly different ($P \leq 0.05$) among the different weeding regimes. The maximum pod diameter (1.75 cm) was noted for 30-DAS followed by 45-DAS. Whereas the minimum pod diameter (1.06 cm) was observed for weedy check and 90-DAS. So, in 30-DAS the pod diameter elongation due to early stage weeding, that could reduce the competition at later stage. Our finding are matched to (Onunkun, 2012) who founded that in okra crop the plots weed infested throughout the crop's life significantly lower pod diameter as compare to weed management in different period.

Pods weight (g)

Regarding pod weight plant^{-1} data variations as affected by various weed infested period, indicated in Table-2. The outmost pods weight plant^{-1} (178.65 g) was recorded for 30-DAS followed by 45-DAS. Meanwhile the least pod weight (45.90 g) was counted for weedy check. Therefore, in 30-DAS the maximizing weight of pod due to initial 3-4 weeks weeding which create better chance to utilizing the resources in later stage. Our results are supported by (Ogbomo et al. 2013) they observed the variation between weedy and weed free fields, in the field where weed management was done thrice as pods reach marketable. Therefore, the yield was assessed and estimated as number of pods per plant, pod weight per plant and pod yield.

Pods yield (t ha^{-1})

Concerning crops pod yield (t ha^{-1}) depicted in Table-2 were significant disparity ($P \leq 0.05$) among the treatment means. The maximum pod yield (9.90 t ha^{-1}) was founded for 30-DAS followed by 15-DAS. While the minimum pods yield (2.54 ton ha^{-1}) were observed for weedy check. So, the weeding in 30-DAS give higher pod yield (t ha^{-1}) as compare to others, so the proper time of weed management don't give chance to faced serious resource fighting between crops and weeds. Our results are closely related to (Dada and Fayinminnu, 2007) they reported the highest okra plant pod yield (t ha^{-1}) the weeding best 3-6 weeks of the crops transplanting because that is weed critical periods with crops.

Weeds parameters

The presented data in the Table-3 revealed that different critical competitions periods was significantly affected ($P \leq 0.05$) by the individual weed density (m^{-2}) like; *Cyperus rotundus, Echinochloa crus-galli, Melilotus indica, Chenopodium album* and *Cynodon dactylon.*

The highest number of individual weed density (m^{-2}) like; *Cyperus rotundus* (31.75 m^{-2}), *Echinochloa crus-galli* (52.60 m^{-2}), *Melilotus indica* (16.25 m^{-2}), *Chenopodium album* (17.25 m^{-2}) and *Cynodon dactylon* (12.50 m^{-2}) were counted for weedy check respectively. Whereas the lowest weeds density (m^{-2}) like; *Cyperus rotundus* (22.66 m^{-2}), *Echinochloa crus-galli* (43.67 m^{-2}), *Melilotus indica* (6.57 m^{-2}), *Chenopodium album* (9.57 m^{-2}) and *Cynodon dactylon* (5.06 m^{-2}) were notified for 15-DAS) respectively. Therefore, the variations in weed density are due to the passage time and disturbance of the weeds in crops fields. Our findings are in agreement with Tunio *et al*. (2004) they observed in the weed free plots minimum density because weeds were eradicated while in weedy check out most weed density. The present study results with confirmity to Lanjar and Sahito (2007) who observed eight different weed species i.e. Waho (*Crataegus monogyna*), Lulur (*Digera arvensis*), Kabbah (*Cyperus rotundus*), Lonak (*Portulaca oleracea*), Chabbar (*Cynodon dactylon*), Kheirola (*Polygonum plebeium*), Bhauphali (*Córchorus antichorus*) and Naro (*Convolvulus arvensis*) in the okra crop field. Mostly these weed species were found throughout the experimental course.

Data regarding fresh and dry weed biomass as independently recorded that could indicate significant effects ($P \leq 0.05$) among the different infested period. The statistically analysis of data of fresh and dry weed weight (g m^{-2}) were individually recorded. The highest fresh weeds weight (715.50 g m^{-2}) was recorded for weedy check, while lowest fresh weight (202.43 g m^{-2}) was noticed for 15-DAS. Likewise, the maximum dry weeds weight (332.69 g m^{-2}) was recorded for weedy check, whereas the minimum dry weight (96.38 g m^{-2}) was noticed for 15-DAS). So, the weeds critical period of resources fighting different from crop to crops depending on coming out time, weed type, density and controlling methods. The resultant figures same to (Shehzad *et al*. 2013) they examined that when critical competition period became lengthy that could raised the fresh and dry weight of weeds (g m^{-2}).

CONCLUSION

It's concluded that the plots which received weeding after 30 days of sowing showed best okra yields, followed by the plot that received weeding after 15 days of sowing gave best okra yield. So, it's recommended that in future the farmer's community of D.I. Khan should follow the 15-30 days after sowing weeding practice for obtaining best okra yield and sound economic returns.

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Table-1. Effect of critical competition on plant height, no. of leaves plant^{-1}, Stem diameter (cm), leaf chlorophyll content (g) and days to flowering

Weeding regimes (DAS)	Plant height (cm).	Leaves plant^{-1}	Stem diameter (cm).	Leaf chlorophyll content (µg cm^{-2})	Days to flowering
Weedy check	33.85 e	6.88 d	1.03 e	37.11 f	33.55 e
15- DAS	45.47 b	8.34 b	1.45 b	47.0 b	37.17 b
30- DAS	53.21 a	10.07 a	1.65 a	51.0 a	40.26 a
45- DAS	44.80 b	8.34 b	1.44 b	46.72 b	37.15 b
60- DAS	37.19 cd	7.29 c	1.33 c	42.19 c	36.23 c
75- DAS	38.52 c	6.98 cd	1.22 d	40.25 d	35.24 d
90- DAS	35.57 de	6.91 d	1.18 d	39.07 e	35.20 d
$LSD_{0.05}$	2.7088	0.3694	0.0980	0.4785	0.5298

Table-2. Effect of critical competition on number of pods plant^{-1}, pod length (cm), pod diameter (cm), pod weight plant^{-1}(g) and pod yield (t ha^{-1})

Weeding regimes (DAS)	Number of pods plant^{-1}	Pod length (cm)	Pod diameter (cm)	Pod weight plant^{-1}(g)	Pod yield (t ha^{-1})
Weedy check	9.32 d	4.98 c	1.06 d	45.90 g	2.54 g
15- DAS	14.78 ab	9.25 ab	1.57 b	147.13 b	8.16 b
30- DAS	16.31 a	10.39 a	1.75 a	178.65 a	9.90 a
45- DAS	13.94 bc	9.96 a	1.56 b	135.09 c	7.50 c
60- DAS	13.82 bc	8.19 b	1.29 c	88.37 d	4.90 d
75- DAS	12.54 c	5.86 c	1.23 c	75.83 e	4.20 e
90- DAS	10.29 d	5.21 c	1.19 cd	60.07 f	3.33 f
$LSD_{0.05}$	1.44	1.64	0.15	4.41	0.25

Table-3. Effect of critical competition duration on individual & total weed density, fresh and dry weeds weight

Weeding regimes (DAS)	*C. rotundus*	*E. crus-galli*	*M. indica*	*C. album*	*C. dactylon*	Total density (g m^{-2})	Fresh weight (g m^{-2})	Dry weight (g m^{-2})
Weedy check	31.75a	52.60a	16.25a	17.25a	12.50a	130.35a	715.50a	332.69a
15- DAS	22.66e	43.67e	6.57e	9.57 d	5.06 d	87.55e	202.43g	96.38d
30- DAS	24.64d	45.66d	8.59d	10.62d	5.73 d	95.25d	336.10f	162.78c
45- DAS	26.73c	47.62c	10.67c	12.62c	7.60 c	105.26c	523.95e	279.01b
60- DAS	28.68b	49.62b	12.87b	14.65b	10.80b	116.63b	576.41d	279.64b
75- DAS	30.85a	51.65a	14.65ab	16.65a	11.65ab	125.46a	649.34c	284.89b
90- DAS	31.42a	52.12a	15.22a	16.82a	11.82ab	127.43a	686.17b	322.73a
$LSD_{0.05}$	1.73	1.82	1.84	1.79	1.39	5.96	17.26	34.62

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