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EFFECT OF DIFFERENT WEED CONTROL PRACTICES AND SOWING METHODS ON WEEDS AND YIELD OF COTTON

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Abstract

The field experiment was carried out to study the effect of different weed control treatments namely; manual hoeing, wheat straw mulching at 6 t ha^{-1}, acetachlor at 125 g a.i. ha^{-1} and pendimethalin+prometryne at 875 g a.i. ha^{-1} along with a weedy check under ridge and flat sowing, on weed growth and yield of cotton during the year 2007 and 2008. The density of the weeds under study was decreased significantly with all weed control treatments compared with weedy check and weed control efficiency varied from 32.27 to 73.55%, 54.61 to 7.28%, 16.38 to 72.88% and 28.21 to 59.60% for *Cyperus rotundus*, *Trianthema portulacastrum*, *Convolvulus. arvensis* and *Cynodon dactylon* at early growth stages. The number of monopodial and sympodial branches and mature bolls per plant, seed weight and seed cotton yield was also increased with all weed control practices over weedy check. Pendimethalin+prometryne @ 875 g a.i. ha^{-1} resulted in significantly the maximum seed cotton yield of 2249.18 kg ha^{-1}. Among sowing methods, ridge sowing was the better method in terms of controlling weeds, reducing dry weight of weeds, increasing monopodial and sympodial branches per plant, total number of bolls per plant, number of mature bolls per plant, seed cotton weight and seed cotton yield. To obtain maximum seed cotton yield and net returns in cotton, pendimethalin + prometryne @ 875 g ha^{-1} applied to control weeds and cotton should be sown on ridges under agro ecological conditions of Faisalabad, Pakistan.

Introduction

Cotton is an important cash crop of Pakistan and is a significant source of foreign exchange earnings. It is also a major oilseed crop of the country. Weeds are one of serious menace responsible for blocking the way of improvement in the yields of agronomic crops. Weed compete for nutrients, water, light and thus reduce the yield of cotton substantially (Bukun, 2004; Iftikhar *et al.*, 2010). Any of the weed control method, effective in particular conditions may not be feasible or effective in other set of conditions. Tunio (2000) reported that weeds population and losses could be minimized through better weed control. Use of chemicals is efficient method for controlling weeds. However, it may cause environmental and human health hazards (Judith *et al*., 2001). Weeds resistant to herbicides is another problem that is emerging due to continuous use of same herbicide and is also a cause of concern (Heap, 2007). Chemical weed control decreases the weed infestation. Khan *et al*., (2001) reported that application of pendimethalin and oxadiazon significantly reduce the weed density and increased the number of bolls per plant and seed cotton yield. Non chemical weed control is easy, environmentally safe although it is weather dependent and laborious in particular situation. Growth behavior of weeds may also be different under different planting methods. In flat sowing weeds are present everywhere on soil whereas ridge sowing results in accumulation of upper soil along with weeds at a specific place. Activity of herbicides also varies under different sowing methods. In flat sowing it is easy to incorporate soil applied herbicides into soil to avoid volatilization losses. Incorporation of herbicides into the soil is not possible in ridge sowing (Maqbool *et al*., 2001). As the reviews available are contradictory, therefore it was realized to initiate a study for evaluating the economical and environment friendly methods for weed control and a suitable sowing method in cotton.

Materials and Methods

A field experiment was carried out to evaluate weed control options for cotton sown under different sowing methods at the Agronomic Research Area University of Agriculture Faisalabad, Pakistan during summer 2007 and 2008. The statistical design used in the experiment was Randomized Complete Block Design. The experiment was replicated thrice having a net plot size of 5 × 4.5 m. Experiment comprised two sowing methods i.e. flat and ridge sowing and different weed control treatments namely manual hoeing (30 and 60 days after sowing), mulching (wheat straw) @ 6 t ha^{-1}, acetachlor (Acetore-50 EC) 125 g a.i. ha^{-1} and pendimethalin + prometryne (Panthaline-35EC) @ 875 g a.i. ha^{-1} along with a weedy check for comparison. The cotton variety MNH-786 was planted on well prepared seed bed in 75cm spaced rows with a hand drill in flat sowing. For ridge sowing, 75cm apart ridges were made and sowing was done with the help of a dibbler. A recommended dose of fertilizer @ 120-60 kg nitrogen and phosphorus ha^{-1} was applied as Urea and Diammonium phosphate, respectively. The nitrogen was applied in three splits, on third at sowing whereas, remaining nitrogen fertilizer with 1st and 2nd irrigation in equal splits. The Phosphorus was applied as basal dose at the time of sowing. Thinning was done to maintain 30 cm plant to plant distance in case of flat sowing. Herbicides were sprayed just after sowing using a hand operated knapsack sprayer fitted with flat fan nozzle. The calibration was done before spraying for calculating the volume of water. Unchopped wheat straw was spread within the rows manually just after the sowing of crop. Two manual hoeings 30 and 60 days after sowing were done in manual hoeing treatment. Weed population and biomass was recorded from an area of 50 cm × 50 cm at different intervals and was converted to one square meter. The plant population per plot was counted at

maturity. For recording parameters like number of monopodial and sympodial branches, boll number per plant and cotton weight per boll, ten plants were selected at random from each plot. The seed cotton yield was recorded on per plot basis and converted to kg ha^{-1}. 100 cotton seed weight was calculated by taking three samples of 100 cotton seeds randomly from each plot and the average was calculated. Three representative samples of seed cotton weighing 50 grams were taken from each plot. Samples were cleaned, sun dried and then single roller electric ginning machine was used to gin these samples. The ginning out turn was calculated by dividing the weight of lint with weight of seed cotton of the sample and was expressed in percentage. The year effect on all the parameters under study could not reach to the level of significance so the means of both years were analyzed by applying Fisher's analysis of variance technique using statistical software of M-Stat C. The Least Significant Difference (LSD) test at 5% probability level was used for comparing the differences among the treatment means (Steel *et al.*, 1997). On the basis of costs that varied in different treatments, the economic analysis was performed by following the procedures evolved by Anonymous (1988) to evaluate the differences in cost and benefit of different treatments.

Results

Weed control practices had a significant effect on weed density recorded at 30, 60 DAS and at harvest (Table 1). The density of all the weeds was the maximum where no weed control practice was used. It was followed by plots where wheat straw mulching for all the weeds for 30 and 60 days after sowing however, at harvest manual hoeing treatment followed the weedy check. The minimum density of *Cyperus rotundus, Convolvulus. arvensis* and *Cynodon dactylon* was found in plots where manual hoeing was done 30 and 60 days after sowing, however, in case of *C. arvensis* it was statistically at par with pre-emergence application of pendimethalin+prometryne @ 875 g a.i. ha^{-1} 30 days after sowing and minimum density of *C. dactylon* 60 days after sowing was recorded with pendimethalin+prometryne @ 875 g a.i. ha^{-1}. The minimum density of *Trianthema portulacastrum* 30 days was recorded with pendimethalin + prometryne @ 875 g a.i. ha^{-1} and was statistically at par with manual hoeing while 60 day after sowing the density of *T. portulacastrum* was recorded with manual hoeing remaining statistically similar to pre-emergence application of pendimethalin + prometryne @ 875 g a.i. ha^{-1}.

At harvest the density and dry weight of all the weeds under study was significantly maximum in weedy check treatment which was followed by manual hoeing treatment. Among herbicides the application of acetachlor (Acetore-50 EC) 125 g a.i. ha^{-1} resulted in higher density of weeds compared with pendimethalin + prometryne @ 875 g a.i. ha^{-1}. The minimum density and dry weight of all the weeds at harvest was recorded with pendimethalin + prometryne @ 875 g a.i. ha^{-1}. Sowing methods had significant effect on the weed population at 30, 60 DAS and at harvest. The ridge sowing resulted in significantly lower weed density and dry weight than flat sowing.

Table 1. Effect of weed control practices and sowing methods on weeds population (m^{-2}) in cotton.

	30 DAS				60 DAS				At harvest			
	C. rotundus	*T. portulacastrum*	*C. arvensis*	*C. dactylon*	*C. rotundus*	*T. portulacastrum*	*C. arvensis*	*C. dactylon*	*C. rotundus*	*T. portulacastrum*	*C. arvensis*	*C. dactylon*
Sowing methods												
Flat sowing	19.93a	7.83a	4.50a	16.10 a	29.57a	9.77a	10.33a	14.53	37.13a	8.67a	23.67a	39.70 a
Ridge sowing	18.83b	7.30b	4.03b	15.33 b	28.67b	9.20b	9.70b	15.00	36.10b	7.83b	22.40b	38.50 b
LSD(P<0.05)	0.1478	0.1667	0.1478	0.1819	0.1478	0.1061	0.1286	N.S	0.1819	0.1819	0.4758	0.2468
Weed control methods												
Weedy check	35.92a	17.25a	7.08a	25.42 a	59.67a	18.08a	19.92a	20.17 a	68.75a	13.50a	36.58a	70.83 a
Manual hoeing	9.50e	3.92d	1.92d	10.25 e	14.67e	4.58d	4.67e	13.83 bc	43.08b	10.75b	25.83b	40.58 b
Mulching	24.33b	7.83b	5.92b	18.25 b	29.08b	12.17b	11.42b	14.75 b	27.33c	8.00c	21.33c	34.25 c
Acetore-50 EC	15.08c	5.08c	3.75c	12.83 c	22.75c	7.25c	7.75c	12.75 cd	23.50d	5.17d	17.75d	27.42 d
Panthaline 35 EC	12.08d	3.75d	2.67d	11.83 d	19.42d	5.33d	6.33d	12.33 d	20.42e	3.83e	25.83e	22.42 e
LSD(P<0.05)	1.159	0.4782	0.8831	0.7413	0.9554	1.475	0.8761	1.469	1.371	0.5292	2.751	4.444

Dry weight of weeds is an important measure showing the extent to which weeds have competed with the main crop and how weed growth has been affected by weed control practices. Results concerning dry weight of weeds as influenced by sowing methods and weed control practices had significant effect on dry weight of weeds (Table 2). The results show that minimum dry weight (12.66 g) of weeds was recorded in case of pendimethalin + prometryne @ 875 g a.i. ha^{-1}. While, the maximum dry weight was observed in plots where no weed control treatment was applied (35.92 g). However, the sowing methods and interaction between sowing methods and weed control practices showed non-significant effect on dry weight of weeds. Sowing methods also significantly affected the dry weight of weeds. It was significantly lower (37.95 w.d.w.) in ridge sowing as compared to flat sowing. However treatment where crop was planted on ridges and manual hoeing was done had lower dry weight (65.00 g) of weeds. Combination effect of weed control practices and sowing methods was significant in case of dry weight of weeds. The maximum dry weight of weeds was observed in weedy check where flat sowing was done (104.58). While significantly minimum dry weight of weeds (11.75 g) was recorded in plots where cotton was sown on ridges and Panthaline (pendimethalin+prometryne) was applied to control weeds.

Table 2. Effect of weed control practices and sowing methods on weeds dry weight (g) at harvest and BCR and Net return in cotton.

Treatments	Weed dry weight at harvest (g m^{-2})	BCR	Net return (Rs.)
Sowing methods			
Flat sowing	39.59 a	1.31	15934
Ridge sowing	37.95 b	1.30	16798
LSD($p<0.05$)	0.8455	NS	NS
Weed control methods			
Weedy check	102.46a	0.73	-13582
Manual hoeing	39.05b	1.34	17813
Mulching	24.65c	1.41	21614
Acetore-50 EC	15.03d	1.46	24202
Panthaline 35 EC	12.66 e	1.59	31784
LSD ($p<0.05$)	0.9545	NS	NS

Any two means with in a column not sharing a letter in common differ statistically at 5% probability level

The maximum weed control efficiency was recorded with manual hoeing treatment at 30 and 45 days after sowing for all the weeds under study, however at harvest the maximum weed control efficiency was recorded with application of pendimethalin + prometryne (Figs. 1- 4). The comparison between the herbicide treatments showed that the application of pendimethalin + prometryne gave better efficiency than acetore at all harvests and for all the weeds except control efficiency of *C. rotundus* at 30 DAS where application of acetor resulted in higher control efficiency (Fig. 1).

The data regarding cotton plant population (Table 3) indicate that plant population per unit area was not affected significantly by weed control practices and sowing methods. Weed control practices however, affected plant height significantly. Application of pendimethalin + prometryne @ 875 g a.i. ha^{-1} produced the tallest plant with 157.75 cm height and differed significantly from rest of the treatments expect acetachlor @ 125 g a.i. ha^{-1}. The significantly minimum plant height (121.52 cm) was recorded in weedy check. Effect of sowing methods and interaction between weed control practices and sowing methods on plant height was non-significant. Results concerning number of monopodial branches per plant as influenced by sowing methods and weed control practices exhibited that weed control practices had significant effect on number of monopodial branches per plant. Comparison of treatment means showed that the significantly maximum number of monopodial branches per plant (3.32) was recorded in plot treated with pendimethalin + prometryne @ 875 g a.i. ha^{-1} which was statistically at par with application of acetachlor @ 125 g a.i. ha^{-1}. Whereas, treatment wheat straw mulch and manual hoeings were statistically similar. The significantly lower number of monopodial branches per plant (2.00) was recorded in weedy check. Sowing methods had also significant effect on number of monopodial branches per plant. The ridge sowing produced higher (2.99) number of monopodial branches as compared to flat sowing. Differences in number of branches due to sowing methods might have been due to differences in weed population and dry weight. However, interaction between weed control practices and sowing method was non-significant. The number of sympodial or fruit bearing branches is an important factor contributing towards seed cotton yield.

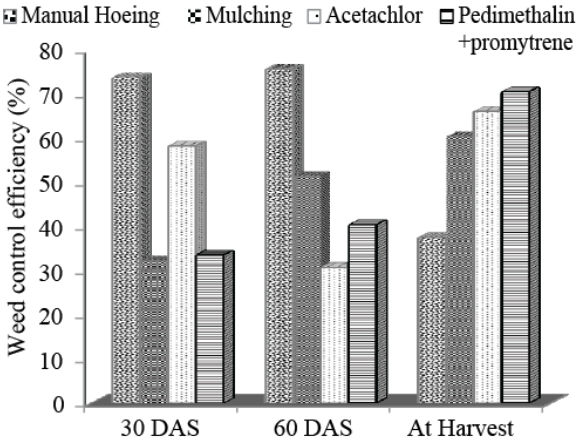


Fig. 1. Effect of weed control practices on *C. rotundus* control efficiency.

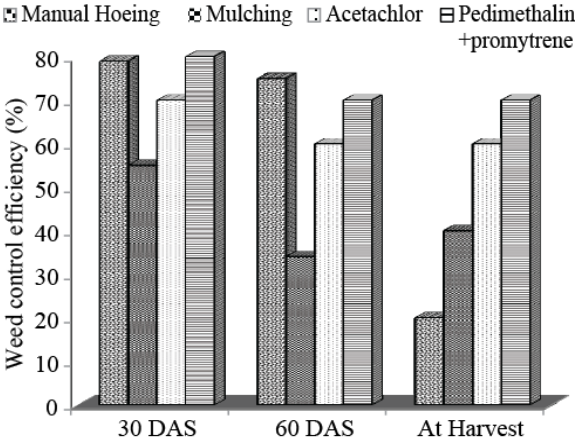


Fig. 2. Effect of weed control practices on *T. portulacastrum* control efficiency.

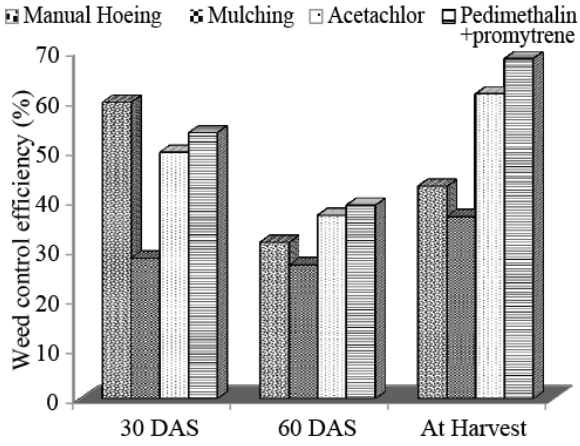
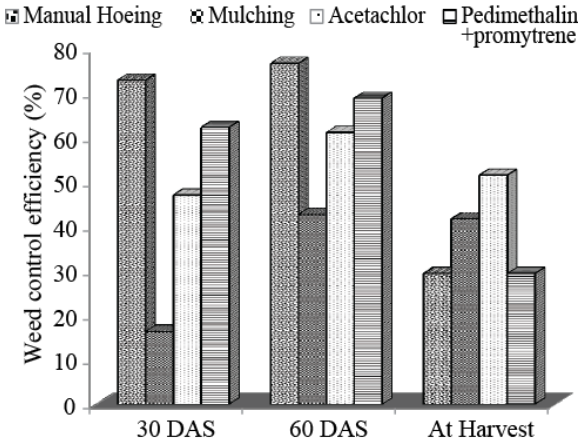


Fig. 3. Effect of weed control practices on *C. dactylon* control efficiency.



ig. 4. Effect of weed control practices on *C. arvensis* control efficiency.

Results show that weed control practices have significant effect on number of sympodial branches per plant (Table 3). All the weed control practices had significant effect on number of sympodial branches per plant. The maximum number of sympodial branches per plant (24.05) was produced where pendimethalin + prometryne was applied @ 875 g a.i. ha^{-1}, which was statistically similar to application of acetachlor @ 125 g a.i. ha^{-1}. The minimum number of fruit bearing branches (18.02) were obtained in treatment where weeds were not controlled. Sowing methods had also significant effect on number of sympodial branches per plant. The ridge sowing produced maximum (21.87) number of branches as compared to flat sowing. However, interaction between weed control practices and sowing method was non-significant. Number of bolls per plant in cotton has a direct bearing on seed cotton yield. Weed control practices had significant effect on the parameter. It also revealed that effect of sowing methods was significant, while the interactive effect of both the treatments was not significant regarding the parameter under discussion. Significantly maximum number of bolls per plant (38.62) was recorded in plots treated with pendimethalin + prometryne @ 875 g a.i. ha^{-1}. While, treatment acetachlor @ 125 g a.i. ha^{-1} produced 36.23 bolls per plant which was statistically at par with plots where Panthaline was applied. Whereas, the significantly minimum number of bolls was observed in weedy check plots. Sowing methods had also significant effect on total number of bolls per plant. The ridge sowing produced maximum (32.18) number of bolls per plant as compared to flat sowing. However, interaction between weed control practices and sowing method was non-significant. Weed control practices had a significant effect on number of mature bolls per plant. However, the sowing methods and interaction between sowing methods and herbicides was non-significant. Comparison of treatment means showed that maximum number of mature bolls per plant (37.10) was recorded with the application of pendimethalin + prometryne @ 875 g a.i. ha^{-1}. Application of acetachlor @ 125 g a.i. produced (34.55) number of mature bolls per plant which was not different statistically from the application of Panthaline. However, the significantly minimum number of mature bolls (21.77) was recorded in weedy check. Sowing methods had also significant effect on mature number of bolls per plant. The ridge sowing produced maximum (30.82) number of mature bolls per

plant as compared to flat sowing. However, interactive effect between weed control practices and sowing method was non-significant. Weed control practices had a significant effect on the number of unopened bolls per plant. In weedy check treatment maximum number of unopened bolls (5.77) were recorded which differed significantly from all weed control practices. Significantly minimum number of unopened bolls (2.28) was recorded with application of pendimethalin + prometryne @ 875 g a.i. Sowing methods had also significant effect on number of unopened bolls per plant. The ridge sowing produced minimum (3.39) number of unopened bolls per plant as compared to flat sowing. However, interaction between weed control practices and sowing method was non-significant.

Seed cotton weight per boll is an important factor contributing towards final seed cotton yield (Table 3). Weed control practices had a significant effect on seed cotton weight per boll. An interaction between sowing methods and herbicides showed non-significant effect. Comparison of treatment means showed that application of pendimethalin + prometryne @ 875 g a.i. ha^{-1} resulted in maximum seed cotton weight per boll (3.78 g), however, it remained statistically at par with that of acetachlor @ 125 g a.i. ha^{-1} which produced (3.69 g) seed cotton weight per boll. Significantly minimum seed cotton weight per boll (2.26 g) was recorded in weedy check. Sowing methods had also significant effect on seed cotton weight per boll. The ridge sowing resulted in maximum (3.24 g) seed cotton weight per boll as compared to flat sowing. However, interactive effect between weed control practices and sowing method was non-significant. All weed control practices showed non-significant effect in case of seed index (100 seed weight); however, maximum 100 seed weight (8.10 g) was observed by the application of pendimethalin+ prometryne @ 875 g a.i. ha^{-1}.

The application of weed control practices resulted in significant increase in seed cotton yield as compared to weedy check. Application of pendimethalin + prometryne @ 875 g a.i ha^{-1} resulted in higher seed cotton yield (2249.18 kg ha^{-1}) which differed significantly from all other weed control practices. The significantly minimum seed cotton yield (971.25 kg ha^{-1}) was noted in weedy check. The effect of sowing methods on seed cotton yield was significant. The ridge sowing resulted in higher (2249.18 kg ha^{-1}) seed cotton yield as compared to flat sowing. However, interaction between weed control practices and sowing methods on seed cotton yield (kg ha^{-1}) was non-significant. Ginning out turn (GOT) in cotton relates mainly to the genetics of the variety however significant variation in the environment may influence it. GOT was not affected by any of the weed control practices and sowing methods.

The effectiveness of any production system especially in agriculture is based on its economics. Economic analysis is the primary consideration to determine which treatment gives highest net returns (Table 2). Economic analysis showed that pendimethalin + prometryne @ 875 g a.i. ha^{-1} + ridge sowing was the most economical treatment with highest net returns (Rs. 32473) and maximum benefit cost ratio (BCR). The findings of the present studies suggest the use of pendimethalin + prometryne @ 875 g a.i. ha^{-1} + ridge sowing for economical weed control in cotton.

Table 3. Effect of weed control practices and sowing methods on yield and yield components of cotton.

	Plant pop. per unit area	Plant height (cm)	No. of monopodial branches per plant	No. of sympodial branches per plant	Total no. of bolls per plant	No. of mature bolls per plant	No. of unopened bolls per plant	Seed cotton weight per boll (g)	Seed index (g)	Seed cotton yield (kg ha^{-1})	GOT (%)
Sowing methods											
Flat sowing	58.93	142.19 b	2.63 b	20.77 b	31.66 b	29.58 b	3.77 a	3.20 b	7.57	1806.69 b	39.81
Ridge sowing	59.07	143.98 a	2.99 a	21.87 a	32.18 a	30.82 a	3.39 b	3.24 a	7.77	1827.02 a	39.98
LSD (p<0.05)	N.S	0.4052	0.04456	0.3244	0.2783	0.3423	0.1522	0.02573	N.S	13.28	N.S
Weed control methods											
Weedy check	58.33	121.52 d	2.00 c	18.02 c	24.42 d	21.77 d	5.77 a	2.26 d	7.24	971.25 e	39.26
Manual hoeing	59.00	145.33 bc	2.75 b	20.67 b	28.23 c	25.73 c	3.82 b	3.03 c	7.41	1865.61 d	39.46
Mulching	58.67	139.83 c	2.87 b	21.58 b	33.68 b	31.85 b	3.35 bc	3.35 b	7.72	1962.66 c	39.54
Acetore-50 EC	59.33	151.95 ab	3.12 a	22.27 ab	36.23 ab	34.55 ab	2.68 cd	3.69 a	7.86	2035.57 b	40.10
Panthaline 35 EC	59.67	157.75 a	3.32 a	24.05 a	38.62 a	37.10 a	2.28 d	3.78 a	8.10	2249.18 a	41.11
LSD(p<0.05)	N.S	10.80	0.2105	1.856	2.562	2.901	0.7401	0.1736	N.S	15.66	N.S

Discussion

Maximum weed population (m^{-2}) at 30, 60 DAS and at harvest was in weedy check because weeds were allowed to compete with crop throughout the season. Significantly minimum weed population 30 and 60 DAS was found in plots where manual hoeing was done. It might have been due to the reason that manual hoeing removed the weed plants and chances of establishment of new weeds were reduced because of smothering effect of crop over weeds. These results were in accordance with those of Khan & Khan (2003), Naseer-ud-Din *et al*., (2011) and Shahzad *et al*., (2012) who reported that hand weeding and herbicidal treatments reduced the weed infestation. There was no significant difference in *C. dactylon* population 60 days after sowing in flat and ridge sowing as at early stage weeds emerged from soil irrespective of whether ridges were formed or flat sowing was done. Our results were in accordance with those of Maqbool *et al*., (2001) who found that there was non-significant effect of sowing methods on weed population.

Significantly maximum population of *C. rotundus, T. portulacastrum, C. arvensis,* and *C. dactylon* at harvest was found in weedy check. It was due to the reason that weeds were free to grow through out the season because no weed control method was used. These results are almost in accordance with those of Khan & Khan (2003) and Iqbal & Cheema (2008) who reported reduction in weed population due to weed control practices over weedy check. Significantly minimum population of *C. rotundus, C. arvensis* and *C. dactylon* at 30 DAS was recorded in plots where manual hoeing was done because weeds were removed at specific intervals. However, at harvest the minimum density of weeds was recorded in plots where pendimethalin+ prometryne was applied @ 875 g a.i. ha^{-1}. The higher weed density in manual hoeing treatment at harvesting might have been due to emergence of more weeds than herbicide treatments as herbicides have some residual effects which might have inhibited the germination of weeds. The results are in agreement with the findings of Khan & Khan (2003) and Sandangi & Barik (2007) who report that manual weed control and herbicidal treatments reduced the weed population and increased weed control efficiency.

Population of *C.rotundus, T. portulacastrum, C. arvensis* and *C. dactylon* at 30, 60 DAS and at harvest was significantly decreased (18.83) when crop was planted on ridges compared to flat sowing. While making ridges some of the weed seeds might have been exposed above soil surface prone to weather extremities thereby reducing the number of weed seeds germinated compared to flat sowing. But these results are contradictory to that of Maqbool *et al*., (2001) who reported that weed density was not affected by changing the sowing method of cotton.

The minimum dry weight of weeds at harvest was recorded in case of pendimethalin + prometryne @ 875 g a.i. ha^{-1} while significantly maximum in weedy check. The maximum weed dry weight might have been due to the maximum weed density in weedy check. The observations are almost in line with those of Anjum *et al.,* (2007a), Awan (1990), Chandi *et al.,* (1993) and Tatla (1993). Dry weight of weeds was significantly lower in ridge sowing as compared to flat sowing because of difference of weed population. These results are not in line with those reported by Maqbool *et al*., (2001). He reported the non-significant effect of sowing methods on density and dry weight of weeds. The interactive effect of weed control practices and sowing methods on dry weight of weeds was significant. The significantly maximum dry weight of weeds was observed in weedy check where flat sowing was done because weeds were allowed to compete with crop throughout the season accumulating more photosynthates and dry matter. While minimum weeds dry weight was recorded in plots where cotton was sown on ridges and Panthaline (pendimethalin + prometryne) was applied to control weeds owing to less weed population accumulating less dry matter. These results are in contradiction with those of Maqbool *et al*., (2001) who reported non-significant effect of interaction between sowing methods and weed control practices on dry weight of weeds.

The Differences in weed control efficiency among different treatments can be attributed to the differences in the mortality of the weeds. The results are supported by the findings of Khan & Khan (2003) and Sandangi & Barik (2007) who also reported significant differences for weed control efficiency with different weed control treatments.

There was no significant effect of weed control practices and sowing methods on plant population per unit area. Similar plant population might have been due to the use of uniform seed rate and thinning at early growth stages to maintain plant to plant distance. This is supported by the work of Zaki *et al.,* (1988) and Awan (1990) who reported that herbicides produced non-significant effect on cotton plant population.

Maximum plant height among weed control was recorded in plots where pendimethalin + prometryne @ 875 g ha^{-1} were applied while minimum was noted in weedy check. Minimum plant height might have been due to early canopy closure of weeds over crop suppressing vertical growth of crop. Similar results were reported by Sandangi & Barik, (2007). There was non-significant effect of sowing method and interaction on plant height. The results are contradictory to those of Bakht *et al*., (2011) who reported taller plants for maize crop.

Significantly maximum number of monopodial branches per plant (3.32) was recorded in plot treated with pendimethalin + prometryne @ 875 g a.i. ha^{-1} which was statistically at par with application of acetachlor @ 125 g a.i. ha^{-1}. The significantly lower number of monopodial branches per plant (2.00) was recorded in weedy check. Our results were in contradiction with those reported by Zaki *et al.,* (1988) and Tatla (1993) who reported that herbicides had non-significant effect on monopodial branches per plant. This contradiction in results might have been due to differences in genetic makeup of crop plants and type of weed control practices. Sowing methods had also significant effect on number of monopodial branches per plant. Differences in number of branches due to sowing methods might have been due to differences in weed population and dry weight. These results are different with those of Maqbool *et al*., (2001)

who reported that sowing methods had non-significant effect on number of monopodial branches per plant.

Other yield related parameters like sympodial branches per plant (the favorable condition that existed during the early growth period due to low weed population resulted in a vigorous growth leading to higher number of sympodial branches per plant in plots where weed control practices were used.), total number of bolls per plant, number of mature bolls per plant, seed cotton weight per boll and seed cotton yield had greater values in plots treated with pendimethalin + prometryne while minimum in weedy check. This might have been due to the reason that in weedy check the weed population and dry weight was higher than all the treatments while minimum population and dry weight in case of plots treated with pendimethalin + prometryne. Tatla (1993), Awan (1990), Rajeswari & Charyulu (1996), Tanveer *et al.,* (2004), Sandangi & Barik (2007) and Panwar *et al*., (1995) also reported that weed control practices increased number of sympodial branches per plant, total number of bolls per plant, number of mature bolls per plant., seed cotton weight per boll and seed cotton yield. Ridge sowing was significantly better than flat for the above mentioned parameters. These may be due to differences in weed population and dry weight. In contradiction to our results Maqbool *et al*., (2001) reported that sowing methods had non-significant effect on above parameters. Interaction between weed control practices and sowing methods was non-significant as reported by Maqbool *et al*., (2001). Number of unopened bolls per plant was maximum in weedy check and minimum in plots treated with pendimethalin + prometryne. Lower number of unopened bolls might have been due to lower weed population and dry weight. These observations are almost in line with those of Tatla (1993). As far as sowing method is concerned, ridge sowing was significantly better than flat sowing with less number of unopened bolls per plant. It might have been due to higher weed population and dry weight in flat sowing. These results are not in accordance with the findings of Maqbool *et al*., (2001).

There was statistically no significant difference in seed index for weed control and sowing methods although seed index was higher in plots treated with pendimethalin + prometryne. The increase in yield under weed control treatment is probably due to decreased crop-weed competition and proper nutrient availability to crop plants. The highest seed cotton yield in case of pendimethalin + prometryne @ 875 g a.i. ha^{-1} can be attributed to the increase in main yield component like number of sympodial branches per plant, number of mature bolls per plant and seed cotton weight per boll. The minimum seed cotton yield was recorded in weedy check because there was maximum uptake of nutrients by weeds (Anjum *et al*., 2007b) and other resources were also abundant favoring the growth of weeds over crop. The less seed cotton yield (kg ha^{-1}) in case of manual hoeing was due to the early weed-crop competition and higher weed population at later stages of crop growth. These results were almost in accordance with the findings of Tanveer *et al.,* (2004), Tatla (1993), Sandangi & Barik (2007) and Panwar *et al.,* (1995) who report that weed control treatments were at par in reducing the weed infestation and increasing seed cotton yield. The ridge sowing resulted in higher seed cotton yield as compared to flat sowing. Our results were in contradiction with those of Maqbool *et al*., (2001) who reported non-significant effect of sowing methods on seed cotton yield. However, interaction between weed control practices and sowing methods on seed cotton yield (kg ha^{-1}) was non-significant. Our results were in accordance with those of Maqbool *et al*., (2001) who reported non-significant effect of interaction between sowing methods and weed control practices on seed cotton yield. The effect of weed control practices and sowing methods was non-significant on G.O.T. (%). Contrary to our results Anjum *et al.,* (2007a) reported that weed control methods had significant effect on G.O.T.

The differences among weed control treatments and sowing methods for BCR can be attributed to differences in the cotton yields and cost of the treaments. The results are supported by the findings of Nasrullah *et al*., (2011) who reported that that highest net income was obtained with ridge sowing.

Conclusion

Based on the present finding it is concluded that the maximum seed cotton yield and net returns can be obtained by the application of pendimethalin + prometryne @ 875 g ha^{-1} with ridge sowing under agro ecological conditions of Faisalabad

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