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EFFECT OF CULTURAL AND CHEMICAL WEED CONTROL METHODS ON WEED POPULATION AND YIELD OF COTTON

A. TANVEER, N.H. CHAUDHRY, M. AYUB AND R. AHMAD*

Department of Agronomy
**Department of Crop Physiology,*
University of Agriculture, Faisalabad, Pakistan.

Abstract

Effect of cultural and chemical weed control methods on weed population and yield of cotton (*Gossypium hirsutum* L.) cultivar "CIM-443" was studied under field conditions during 1999. Weed control treatments were: no weeding (control), two hoeings [(3 + 6 weeks after sowing (WAS)], one hoeing (3 WAS) + one earthing-up (6 WAS), S-metolachlor @ 2.4 kg a.i.ha^{-1}, S-metolachlor @ 2.4 kg a.i.ha^{-1} + one hoeing (6WAS), S-metolachlor @ 2.4 kg a.i. ha^{-1} + one earthing-up (6WAS). All weed control treatments increased sympodial branches per plant, total number of bolls per plant, number of open bolls per plant, seed cotton yield and decreased weed biomass significantly over control. Maximum seed cotton yield (2207.77 kg ha^{-1}) was obtained in S-metolachlor treated plots and minimum from weedy check (1377.77 kg ha^{-1}). Different weed control treatments gave 39.85% to 60.24% more yield and 29.40% to 53.14% more net monetary return over the control.

Introduction

Cotton is an important cash crop of Pakistan. Average seed cotton yield in Pakistan is 511.86 kg ha^{-1} (Anon., 1998) which is far below the yield obtained by many of the cotton growing countries of the globe. The main reason for low yield is presence of weeds which grow luxuriously particularly during rainy season. A decrease of 42.0-49.6% in cotton yield had been reported by Ibrahim *et al*., (1991) due to presence of weeds throughout the growth period of cotton. Besides other management practices proper weed control can increase yield of cotton.

Anwarul-Haq *et al*., (1981) obtained subtending weed control and increased cotton yield by pre-emergence application of promatryne and fluometuran. Soliman (1981) reported that herbicide (UBI-S734) increased number of fruiting branches per plant than other compound and the check. Salome (1982) reported that adverse effects of weeds was more on yield and less on boll and seed size. Malik *et al*., (1983) stated that herbicides and weeding with "kasola" improve yield contributing factors over control. El-Deed *et al*., (1984) reported that chemical weed control was more effective and gave higher cotton yield than hand weeding. Hurst (1985) reported that chemical/cultural methods decreased weed biomass as compared to controls. Zaki *et al*., (1988) reported that pendimethalin followed by Dowpon-M provided a higher seed yield (1480 kg ha^{-1}) and net profit (Rs. 6628 ha^{-1}) than hand weeding. Khan *et al*., (1995) stated that stomp-330E (pendimethalin) @ 3.75 l ha^{-1} alone or with one cultivation + one sohaga, stomp-330 E @ 1.25 l ha^{-1} as band application + 2 inter-row cultivations, stomp-330E @ 1.25 l ha^{-1} as band application + karandi + 2 inter-row cultivations gave statistically similar increase in seed cotton yield over check. Rejeswari & Charyulu (1996) reported that pre-emergence herbicide alone or + manual weeding produced larger number of cotton bolls per plant.

Keeping in view the importance of weeds, present study was undertaken to find out most feasible and economical method of weed control in cotton and to obtain maximum seed cotton yield.

Materials and Methods

The experiment was conducted at the University of Agriculture, Faisalabad during 1999 in randomized complete block design with three replications. Plot size was 2.25 x 6m. Cotton cultivar "CIM-443" was sown in the last week of May with a single row hand drill using a seed rate of 20 kg ha^{-1} in rows 75 cm apart. An inter plant distance of 30 cm was maintained by thinning out the extra plants when the crop grew up 30 cm height. Nitrogen and phosphorus was applied @ 170 and 57 kg ha^{-1} respectively in the form of urea, diammonium phosphate and triple superphosphate. Nitrogen was aplied in three splits, 42.5 kg ha^{-1} at sowing, 42.5 kg ha^{-1} with first irrigation and 85 kg ha^{-1} at flowering while whole of phosphorus was side dressed with single row cotton drill just after sowing the crop. Treatments comprised: Control (weedy check), two hoeings (3 + 6 weeks after sowing), one hoeing (3 WAS) + one earthing-up (6 WAS), S-metolachlor @ 2.4 kg a.i. ha^{-1}, S-metolachlor @ 2.4 kg a.i. ha^{-1} + one hoeing (6 WAS) and S-metolachlor @ 2.4 kg a.i ha^{-1} + one earthing-up (6 WAS).

S-metolachlor was sprayed with hand sprayer and incorporated into the soil with spade just before sowing. To record data on weed biomass, weeds were harvested at maturity from a unit area of 1 sq. m. taken at random from each plot and dried in an oven at 60°C to a constant weight. Sympodial branches per plant, total number of bolls per plant and number of open bolls per plant were averaged from five plants per plot taken at random while seed cotton weight per boll was averaged from twenty bolls per plot taken at random. Economic analysis was carried out on the basis of variable costs and prevailing market prices of herbicide, cotton crop and labour charges.

The data were analysed by using Fisher's analysis of variance technique. Least significant difference test at 5% probability was applied to compare treatment means (Steel & Torrie, 1984).

Results and Discussion

The data revealed that both cultural and chemical weed control methods significantly affected the weed biomass (Table 1). Significantly maximum weed biomass (50.03 gm^{-2}) was recorded in control. Minimum weed biomass (1.02 gm^{-2}) was recorded in S-metolachlor alone which was statistically similar to all other treatments. Highest weed biomass in control treatment may be attributed to the presence of weeds throughout the growing period of the crop. Decrease in weed biomass over weedy check due to chemical/cultural methods has also been reported by Hurst (1985).

The data indicated that all weed control treatments resulted in significantly more number of sympodial branches per plant than weedy check (Table 1). Significantly minimum sympodial branches (average 13.33) were recorded in control. Maximum sympodial branches (18.73) were recorded in two hoeings, three and six weeks after sowing which was statistically at par to all other weed control treatments. More number of sympodial branches per plant as a result of weed control treatments may be attributed to vigorous plant growth, less competition for light, nutrients and space in weed free environment. These results are supported by the findings of Malik *et al*., (1983) who noted improvement in yield contributing factors due to herbicide and hand hoeing.

Table 1. Effect of cultural and chemical weed control methods on weed biomass, yield components and yield of cotton.

Treatments	Weed biomass m^{-2} (g)	No. of sympodial branches per plant	Total No. of bolls per plant	No. of open bolls per plant	Seed cotton weight per boll (g)	Seed cotton yield kg ha^{-1}
Control (weedy check)	50.03 a	13.33 b	11.23 b	10.5 b	2.42[NS]	1377.77 b
Two hoeings (3 + 6 WAS)	5.97 b	18.73 a	24.86 a	23.10 a	2.47	2030.01 a
One hoeing (3 WAS) + one earthing-up (6 WAS)	3.66 b	17.53 a	28.20 a	25.20 a	2.53	1936.94 a
S-metolachlor @ 2.4 kg a.i. ha^{-1}	1.02 b	16.46 a	29.63 a	26.63 a	2.37	2207.77 a
S-metolachlor @ 2.4 kg a.i. ha^{-1} + one hoeing (6WAS)	1.12b	17.60 a	23.83 a	21.45 a	2.53	1939.70 a
S-metolachlor @ 2.4 kg a.i. ha^{-1} + one earthing-up (6WAS)	3.29 b	16.53 a	23.63 a	21.25 a	2.36	1926.91 a
LSD 5%	19.13	2.82	6.45	6.50	------	348.96

WAS = Weeks after sowing

NS = Non-significant

Any two means not sharing a letter in common differ significantly at 5% probability.

Table 2. Economic analysis of various weed control treatments.

	W_1	W_2	W_3	W_4	W_5	W_6	Remarks (Rs.)
Seed cotton yield (kg ha^{-1})	1377.77	2030.01	1936.94	2207.77	1939.70	1926.91	------
Seed cotton value (Rs)	22388.76	32987.66	31475.27	35876.26	31520.12	31312.28	650/40 kg
Gross benefit (Rs.)	22388.76	32987.66	31475.27	35876.16	31520.12	31312.28	------
Weed control cost (Rs.)	------	------	------	------	------	------	------
Hand hoeing	------	750+750	750	------	750	------	75/man/day (10 man/ha)
Earthing-up	------	------	750	------	------	750	75/man/day (10 man/ha)
Herbicide				1375	1375	1375	440/800 ml
Labour charges for herbicide application (Rs.)	------	------	------	166	166	166	10/tank
Rent of sprayer (Rs.)	------	------	------	50	50	50	50/day
Total cost (Rs.)	------	1500	1500	1591	2341	2341	------
Net benefit (Rs.)	22388.76	31487.66	29975.27	34285.26	29179.12	28971.28	------
Increase in net benefit due to weed control treatments	------	9098.90	7586.51	11896.50	6790.06	6582.52	------

W_1 : Control (Weedy check)
W_2: Two hoeings [(3 + 6 weeks after sowing (WAS)]
W_3: One hoeing (3WAS) + one earthing-up (6 WAS)
W_4: S=metolachlor @ 2.4 kg a.i. ha^{-1}
W_5: S=metolachlor @ 2.4 kg a.i. ha^{-1} + one hoeing (6WAS)
W_6: S=metolachlor @ 2.4 kg a.i. ha^{-1} + one earthing-up (6WAS)

Weed control treatments resulted in significantly more number of total and open bolls per plant than weedy control (Table 1). The highest number of total (29.63) and open (26.63) bolls per plant was recorded in S-metolachlor alone, which was statistically at par with all other weed control treatments. Minimum number of total (11.23) and open (10.15) bolls per plant was recorded in control which was significantly lower than that produced by any of the cultural, chemical and cultural + chemical weed control treatments. Higher production of bolls per plant may be attributed to better nutrients absorption, increased setting percentage of flower buds into bolls and increase in boll retention due to weed free conditions. Rejeswari & Charyulu (1996) had reported increase in bolls number due to herbicide application alone or + manual weeding.

The data indicated that all weed control treatments had a non-significant effect on seed cotton weight per boll. However, this weight ranged between 2.36 to 2.53 (g). Statistically similar weight of seed cotton per boll in different treatments was probably due to the fact that it is genetically controlled.

The data regarding seed cotton yield (Table 1) revealed that all weed control treatments resulted in significantly more seed cotton yield than weedy check. The highest seed cotton yield (2207.77 kg ha^{-1}) was recorded in S-metolachlor treated plots which was statistically at par with all other weed control treatments. Minimum seed cotton yield (1377.77 kg ha^{-1}) was recorded in weedy check which was significantly lower than that produced by any of the cultural, chemical, and cultural + chemical weed control treatments. The presence of weeds throughout the season reduced the yield components and consequently seed cotton yield in weedy check. On the other hand better weed control resulted in optimum utilization of environmental resources by crop plants which enhanced the yield components and finally seed cotton yield. These results are supported by findings of El-Deed *et al*., (1984), Zaki *et al*., (1988) and Khan *et al*., (1995).

The economic aspect of the treatments is the basic consideration in their application. The data regarding the economic analysis presented in Table 2 indicated that among the chemical and cultural weed control treatments the highest net benefit of Rs.34285.26 was obtained from the incorporation of S-metolachlor @ 2.4 kg a.i. ha^{-1}. It was followed by practice of two hoeings (3 + 6 WAS) with a net benefit of Rs.31487.66. The plots receiving one hoeing (3 WAS) + one earthing-up (6 WAS) and S-metolachlor @ 2.4 kg a.i. ha^{-1} + one hoeing (6 WAS) showed higher net benefit than the S-metolachlor @ 2.4 kg a.i. ha^{-1} + one earthing-up (6 WAS).

The increase in net benefit over weedy check among different weed control treatments was highest (Rs.11896.50) in S-metolachlor @ 2.4 kg a.i. ha^{-1} and lowest (Rs.3582.52) in S- metolachlor @ 2.4 kg a.i. ha^{-1} + one earthing-up (6 WAS). These results showed that incorporation of S-metolachlor @ 2.4 kg a.i. ha^{-1} was more beneficial. Zaki *et al*., (1988) had also reported more net profit due to herbicide than hand weeding.

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