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EFFECT OF DIFFERENT WEED CONTROL PRACTICES ON COTTON WEEDS AND ITS YIELD

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The influence of different weed control practices on cotton cv. NIAB 78 and some Kharif weeds under two fertility levels on a sandy clay loam soil was investigated in a field trial during 1987–88. The results revealed that hand weeding (3 hoeings) was most effective in reducing weed biomass by 72.5%. Plastic mulch and wheat straw mulch were also effective in suppressing weed dry weight by 63.5 and 21.5%, respectively but were un-economical due to high cost of plastic and straw. Pendimethalin and Haloxyfop were effective against ***Trianthema portulacastrum*** *L. but had little effect on* ***Cyperus rotundus*** *L. These herbicides had no phyto toxic effect on cotton germination and growth. Incorporation of wheat roots inhibited weed biomass upto 9% but cotton plant height by 14.3%. The effect of wheat roots on cotton was mitigated with the addition of fertilizer, increasing seed cotton yield by 4.3% over the control.*

INTRODUCTION

Unchecked weeds in cotton could reduce its yield in the range 20-55% (Zimdahl, 1980). Weed control through the use of hand tools has been common among farmers since long but scarcity of farm labour has forced cotton growers to use herbicides. However, the costs of chemicals and risks of hazards involved in their use limit the scope of chemical control. Various mulches (Plastic or paper sheets, plant materials as straw, sawdust, wood chips, grass clipings) are used for weed control. The mulching material itself may be costly or its application cost may be high. Perennial weeds usually are not controlled well with mulches because the vigorous plants can push through particulate mulches and occasionally through plastic mulches (Ross and Lembi, 1985).

The allelopathic effects of sorghum residues on wheat and its weeds have been recorded (Cheema, 1988) however, the allelopathic effects of wheat residues on succeeding cotton crop have not been fully investigated. The initial work (Cheema *et al.* 1987) revealed that water extracts of wheat straw exhibited allelopathic effects on cotton by suppressing its germination. The growth of bindweed was also inhibited with wheat straw extract. Response of weeds and crops to allelopathic substances under low fertility may be different than that of higher fertility (Stowe and Osborn, 1980) but little information is availa-

ble in Pakistan on this aspect of the problem.

Keeping in view the economic importance of wheat-cotton rotation and weed infestation in cotton fields, the study was initiated with the objective to compare the effectiveness of different weed control practices in cotton weeds and its yield. Another objective was to investigate the allelopathic effects of wheat residues (straw or roots) on the cotton germination and its weeds.

MATERIALS AND METHODS

The investigation was carried out during 1987-88 at University of Agriculture, Faisalabad on sandy clay loam soil. The experimental site was previously under wheat crop. Cotton cv. NIAB 78 was planted on June 2, 1987 at a seed rate of 20 kg ha^{-1} with single row hand drill in 90 cm apart rows. Thinning was done at 20 cm height to maintain 30 cm plant to plant distance. Irrigations and insecticidal sprays were given according to crop requirement.

The experiment was laid out in split plot design with four replications. Main plots (28.2 x 6 m) were either fertilized (90 kg ha^{-1} each of N and P_2O_5) or kept without fertilizer. Weed control practices were in the sub-plots (6 x 3.6 m). Experimental field was soaked with a light irrigation to facilitate removal of wheat stubbles from the treatment plots except one in which wheat roots (stubbles) were incorporated into soil. Stomp 330 E (Pendimethalin) was applied pre-emergence @ 1.3 kg ha^{-1} and a post-emergence herbicide X G A–2057 12.5 EC (Haloxyfop ME) was sprayed 20 days after sowing @ 0.2 kg ha^{-1}. The herbicidal spray was done with a knapsack (CP-3) hand sprayer fitted with four flat fan nozzles (8003) on a specially made boom.

Wheat straw (3 cm) and plastic sheet (transparent) were spread in between rows two weeks after sowing as mulch. Plots specified for hand weeding were given three hoeings with a hand hoe (Kasola). First dry hoeing was done two weeks after sowing, second and third hoeings were given after first and sec and irrigation.

Cotton germination and weed population was recorded from a unit area (1 m^2) randomly selected at two different sites in each plot. Weed population and weed dry weight were recorded at two weeks interval till eight weeks after sowing the crop. The seed cotton yield was recorded on plot basis (5 x 3.6 m) and calculated per hectare.

The data were analysed by using analysis of variance technique and least significance difference test (LSD) was used to compare the treatment means at 5% probability (Steel and Torrie, 1980). Economic analysis was done by determining net benefits for each treatment, then dominance analysis and marginal analysis were performed (Cimmyt, 1988) to compare different weed control practices.

RESULTS AND DISCUSSION

Cyperus rotundus was the dominant weed while the density of other weeds (*Eleusine indica, Echinochloa colona* and *Trianthema*

portulacastrum) was very low (Table 1). Plastic mulch was the most effective in supperessing the density of *Cyperus rotundus* while pendimethalin had non-significant effect. However, total weed dry weight was significantly reduced by all the weed control treatments (Table 2). Plastic mulch and hand weeding reduced weed dry weight by 45-76% and 62-79%, respectively. Pendimethalin (Pre-emergence) and Haloxyfop (Post-emergence) also caused considerable suppression (9–60 and 13–54%, respectively) of weed growth. The degree of reduction in weed dry weight was relatively less with pendimethalin, because it was not effective against *Cyperus rotundus* L.

Wheat straw mulch and wheat roots incorporation also caused statistically significant reduction in weed dry weight (Table 2). The suppression of weed dry weight (3-16%) with wheat roots under field conditions is important observation.

The response of weed dry matter to the addition of fertilizer in most of the treatments was similar as observed in the case of zero fertilizer but wheat roots incorporation showed relatively less effect (Table 2) Cotton germination was reduced by 34–36% with incorporation of wheat roots in the presence or absence of fertilizer (Table 3). Cotton plant height was also reduced by 14% with wheat roots incorporation in case of zero fertilizer, but was not affected with addition of fertilizer

Table 1. Weed population and individual species in cotton 4 weeks after sowing (plants m^{-2}).

Treatment	*C. rotundus*	*E. indica*	*E. colona*	*T. portulacastrum*
Pendimethalin (Pre-em.) 1.3 kg ha^{-1}	224.6	0.6	1.4	0.0NS
Haloxyfop ME (Post-em.) 0.2 kg ha^{-1}	209.3	1.8	0.9	0.0
Hand weeding (3 hoeings)	122.9	0.3	0.5	0.4
Wheat straw mulch (3 cm)	175.6	1.3	1.6	0.5
Plastic mulch (Transparent)	85.0	0.5	0.8	0.3
Wheat roots incorported	195.9	1.6	1.8	0.3
Control (Weedy check)	228.3	2.3	2.4	1.9
LSD(P = 0.05)	5.42	0.97	0.81	NS

NS = Non significant

Weedicide rates of application are active ingredient.

Table 2. Influence of different weed control practices on weed dry weight (g m^{-2})

Treatment	Weeks after sowing							
	2	4	6	8	2	4	6	8
	Without fertilizer				With fertilizer			
Pendimethalin (Pre–em.) 1.3 kg ha^{-1}	21.1 (60)	57.0 (31)	79.3 (30)	112.7 (9)	31.0 (50)	49.8 (49)	98.4 (18)	112.5 (16)
Haloxyfop ME (Post–em.) 0.2 kg ha^{-1}	*	54.9 (34)	72.5 (36)	107.5 (13)	*	45.2 (54)	92.4 (23)	108.3 (20)
Hand weeding (3 hoeings)	14.0 (74)	20.0 (76)	23.2 (79)	38.3 (69)	18.0 (71)	22.5 (77)	25.7 (79)	50.5 (62)
Wheat straw mulch (3 cm)	48.1 (10)	49.9 (40)	57.0 (49)	106.6 (14)	55.1 (11)	78.2 (20)	99.7 (17)	115.8 (14)
Plastic mulch (Transperent)	29.1 (45)	40.1 (52)	26.6 (76)	44.2 (64)	30.4 (51)	25.7 (74)	28.8 (76)	47.0 (64)
Wheat roots incorporated	49.9 (6)	71.8 (13)	95.2 (16)	115.4 (6)	59.9 (3)	86.8 (11)	110.6 (8)	123.0 (9)
Control (Weedy check)	53.3 (–)	82.6 (–)	112.6 (–)	123.3 (–)	61.5 (–)	97.4 (–)	120.2 (–)	134.7 (–)
LSD at P = 0.05	2.28	3.95	3.02	2.32	2.28	3.95	3.02	2.32

Figures given in parenthesis show per cent reduction in weed dry weight over the control.
*= Haloxyfop was not applied during second week.

Table 3. Effect of weed control practices under two fertilizer regimes on germination of cotton seed m^{-2}.

Treatment	Without fertilizer	With fertilizer	Average
Pendimethalin (Pre-em.) 1.3 kg. ha^{-1}	7.4	8.3	7.9
Wheat roots incorporated	5.5	6.4	6.0
Control	8.6	9.8	9.2
Average	7.2	8.2	

LSD at P = 0.05 for fertilizer treatment means = 0.71
LSD at P = 0.05 for weed control treatment means = 0.89
LSD at P = 0.05 for weed control and fertilizer interaction = NS
Note: Other treatments were not applied at that time.

(Table 4). This shows that cotton is sensitive to wheat residues because of allelochemicals. The allelopathic effects of wheat roots on cotton

Table 4. Effect of weed control practices under two fertilizer levels on cotton plant height (cm).

Treatment	Without fertilizer	With fertilizer	Average
Pen 1.3 kg ha^{-1}.	76.5	89.7	83.1
Haloxyfop ME (Post-em.) 0.2 kg ha^{-1}.	72.4	94.0	83.2
Hand weeding (3 hoeings)	83.2	101.1	92.2
Wheat straw mulch (3 cm)	72.5	93.9	83.2
Plastic mulch(Transparent)	89.0	107.5	98.3
Wheat roots incorporated	69.2	85.7	77.5
Control (Weedy check)	80.7	86.2	83.5
Average	77.6	94.0	

LSD at P = 0.05 for fertilizer treatment means = 6.79
LSD at P = 0.05 for weed control treatment means = 8.56
LSD at P = 0.05 for weed control and fertilizer interaction = NS

germination were not changed even with the addition of fertilizer, but the suppressive effect on cotton plant height diminished with the application of fertilizer. This in partial, supports the concept that allelopathic inhibitory effects are reduced under nutrient rich soils (Stowe and Osborn, 1980).

Cotton germination and growth was not affected by the herbicides (Pendimethalin or Haloxyfop), indicating that both the herbicides can safely be used in cotton to control many weeds except *Cyperus rotundus* L. Seed cotton yield was increased by 23–111% in all the treatments (Table 5) except wheat roots incorporation which decreased cotton yield by 14%. The reduction in yield was possibly due to the allelopathic effects (Guenzi and McCalla, 1966). However, the addition of fertilizer mitigated the allelopathic effect and the cotton yield increased by 4.3% over control.

Economic analysis showed that weeding (3 hoeings) was the most economical practice, followed by Haloxyfop (Table 6). The addition of

Table 5. Effect of weed control practices under two fertilizer regimes on seed cotton yield (Quintals ha^{-1})

Treatment	Without fertilizer	With fertilizer	Average
Pendimethalin (Pre–em.)	15.13	26.06	20.60
1.3 kg ha^{-1}	(30)	(14)	(20)
Haloxyfop ME (Post–em.)	16.46	28.01	22.24
0.2 kg ha^{-1}	(42)	(23)	(29)
Hand weeding	24.48	35.42	29.95
(3 hoeings)	(111)	(55)	(74)
Wheat straw mulch (3 cm)	14.34	24.54	19.44
	(23)	(7)	(13)
Plastic mulch (Transparent)	23.09	28.02	25.56
	(99)	(23)	(48)
Wheat roots incorporated	9.94	23.84	16.89
	(–14)	(4)	(–2)
Control (Weedy check)	11.62	22.85	17.23
	(–)	(–)	(–)
Average	16.44	29.89	

LSD at P = 0.05 for fertilizer treatment means = 1.02
LSD at P = 0.05 for weed control treatment means = 0.97
LSD at P = 0.05 for weed control and fertilizer interaction = 1.37

Note: Figures in parenthesis indicate the per cent increase in yield over the control.

fertilizer was still economical. By spending Rs. 1060 on fertilizer, there was an increase of Rs. 5515 and 5333 in hand weeding and haloxyfop treatments, respectively. Moreover, in the presence of fertilizer, wheat roots incorporation was also an economical practice which increased net benefit by Rs. 557 over the control (Table 6). Plastic and straw mulch, although significantly reduced weed dry weight and increased cotton yield, yet the higher costs of plastic and wheat straw did not permit their use in cotton.

Table 6. Economic (Rs.) analysis of weed control practices

Treatment	Cost	Net benefit	Marginsl rate of return (%)
		Without fertilizer	
Control (Weedy check)	–	6538	–
Wheat roots incorporated	–	6013 D	–
Haloxyfop ME	825	8538	242
Pendimethalin	885	7628 D	
Hand weeding (3 hoeings)	900	12450	5216
Wheat straw mulch (3 cm)	3000	5069 D	
Plastic mulch (Transparent)	11520	1442 D	
		With fertilizer	
Control (Weedy check)	1060	11796	
Wheat roots incorporated	1060	12353	
Haloxyfop ME	1885	13871	144
Pendimethalin	1945	12711 D	
Hand weeding	1960	17965	5459
Wheat straw mulch	4060	9753 D	
Plastic	12580	3183 D	

Hoeing: 10 men/day/ha @ Rs. 30/man
Plastic: @ Rs. 1.15/m^2
Wheat straw: @ Rs. 50/100 kg
Pendimethalin: @ Rs. 210/L
Haloxyfop: @ 487.5/L
Fertilizer: DAP @ Rs. 185 per 50 kg; Urea @ Rs. 128 per 50 kg
D = Dominated

REFERENCES

Cheema Z, A. 1988. Weed control in wheat through sorghum allelochemicals. Ph.D. Thesis Dept. Agron. Univ. Agri. Faisalabad.

Cheema, Z. A., S.Ahmad, S.Majeed and N.Ahmad. 1987. Allelopathic effects of wheat straw on germination and seedling growth of two weed species and cotton. Pak. J. Weed. Sci. Res. 1:118–122.

CIMMYT. 1988. From Agronomic data to farmer recommendations. An economics training manual, Mexico, D.F. 1930–34.

Guenzi, W.D. and T.M.McCalla. 1966. Phenolic acids in oats, wheat, sorghum and corn residues and their phytotoxicity. Agron. J. 58(3): 303–304.

Ross, M.A. and C.A.Lembi 1985. Methods of weed control. In Applied weed sci. Burgess Pub. Co. USA. PP. 20–45.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. 2nd Ed. McGraw Hill Book Co. Inc., New York, USA.

Stowe, L.G. and A.Osborn. 1980. The influence of nitrogen and phosphorus levels on the phytotoxicity of phenolic compounds. Can. J. Bot. 58: 1149–1153.

Zimdahl, R.L. 1980. Weed–crop competition: A review. Int. Plant Protection Center, Oregon State Univ. Corvallis, Oregon, USA.