Journal of crop and weed 2(1) : 13-16 (2005)

Weed management in winter irrigated cotton (*Gossypium hirsutum* L.)

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ABSTRACT

A field experiment was conducted during the winter season of 2001-2002 to evolve a suitable weed management practice in winter irrigated cotton. The experimental soil was loamy sand, slightly acidic (pH 5.7), low in organic carbon (0.39%), and available nitrogen (233kg N/ha), medium in available phosphorus (20.7 kg P_2O_5/ha) and high potassium (202 kg K_2O/ha). Ten treatment combinations i.e. paraquate dichloride @ 0.2, 0.3 and 0.4 kg/ha as post-emergency directed, spray at 30 DAS, fluchloralin @ 0.8 kg/ha as per-plant soil incorporation, alachlor @ 1.0 kg/has as per emergence application at 1 DAS, paraquate dichloride 0.2 kg/ha followed by hand weeding 60 DAS, fluchloralin @ (0.8 kg/ha) followed by hand weeding 40 DAS, alachlore (1.0 kg/ha) with hand weeding 40 DAS, hand weeding twice at 20 and 40 DAS, and unweeded control were tested an cotton MCU-5 in a randomized block design with three replications in plot size 8m x 5m. The crop was sown on 26th,November 2001. An uniform fertilizer dose of 120 kg nitrogen, 17.2 kg P and 33.2 kg K/ha along with FYM 5t/ha was applied in all the plots. The crop was grown under irrigated conditions with need based plant protection measures.

Key words : Weed management, irrigated cotton.

Total weed flora from the unweeded control plot at 90 DAS consisted of 20 different species of which 12 were broad leaved, 6 belongs to grasses and 2 were sedges with a relative density of 56.6, 25.4 and 18.0 per cent, respectively. The total weed density was 401/m^2. *Ageratum conyzoides* L., *Eleusine indica* (L.) Gaertn. and *Cyperus rotundus* L. were the predominant species with absolute densities of 56.3, 28.6 and 48.4 number of weds/m^2, respectively.

Different weed management treatments reduced weed density, and their dry weight as compared to unweeded control. Post emergence directed spray of paraquate dichloride 0.2 kg/ha at 30 DAS with one hand weeding at 60 DAS recorded the lowest weed population (28.6/m^2) and maximum weed control efficiency (81.8%) offering best weed control during critical period of crop weed competition, highest plant height (104.2cm), leaf area index (4.14), number of sympodia per plant (16.9), bolls per plants (16.6), boll weight (4.4g), increased seed cotton yield (1487 kg/ha) with benefit : cost ratio (2.41). Weeds if not control at 60 DAS can deplete the major nutrients to the extend of 87.1, 17.9 and 61.7 kg/ha of N, P and K, respectively. The quality characters like bartlett's index and ginning percent were not influenced by different weed control treatments indicating their independence from weed competition. However, pre-emergence spray of alachlor @ 1 kg/ha at 3 DAS with one hand weeding at 40 DAS or pre-planting incorporation of fluchlolin @ 0.8 kg/ha with hand weeding at 40 DAS could be considered as alternative weed management practices on the basis of better weed control, seed cotton yield and economic indices.

Cotton (*Gossypium hirsutum l.*), the white gold, is commercially cultivated as one of the major rainy season cash crops in Orissa. But being a day neutral, indeterminate forced annual, cotton has the greater potential as a sole winter irrigated crop. Among different production constraints weeds pose serious problem during initial 60 days of crop growth because of the slow growth of crop with an yield reduction of 40-85 per cent under different agro-climatic conditions (Brar and Brar 1992). Therefore, a field experiment was conducted to find out effective chemical weed control in *rabi* cotton.

MATERIALS AND METHODS

The field experiment was conducted during winter season of 2001-02 at the Orissa University of Agriculture and Technology, Bhubaneswar in a sandy loam soil having pH 5.7, organic carbon 0.39 per cent, available nitrogen, phosphorus and potassium of 234, 9.0 and 167.4 kg/ha, respectively. The experiment using MCU-5 cotton

with ten weed control treatments was laid out in a randomised complete block design with three replications. The crop was sown on 30 October 2001 with 60 cm x 45 cm spacing. The weed control treatments were viz., T_1, post emergence directed spray of paraquat dichloride @ 0.2 kg/ha at 30 days after sowing (DAS); T_2, post emergence directed spray of paraquat dichloride @ 0.3 kg/ha at 30 DAS; T_3, post emergence directed spray of paraquat dichloride @ 0.4 kg/ha at 30 DAS; T_4, pre planting soil application of fluchloralin @ 0.8 kg/ha; T_5, pre emergence spray of alachlor @ 1.0 kg/ha at 3 DAS; T_6, T_1 + hand weeding at 60 DAS; T_7, T_4 + hand weeding at 40 DAS; T_8, T_5 + hand weeding at 40 DAS ; T_9, two hand weedings at 20 and 40 DAS; and T_{10}, unweeded control. An uniform recommended fertilizer dose of 120 kg nitrogen, 17.2 kg P and 33.2 kg K / ha was applied to all the crops. The crop was grown under irrigated condition with need-based plant protection measures. Observations on weed flora, crop growth and seed cotton yield were recorded. Data on weed population and dry weight (figures in parentheses) were subjected to square root and log transformation, respectively. Nitrogen, phosphorus and potassium content in weeds at 90 DAS were analysed and their uptake were calculated. Comparative economics of all weed control treatments was worked out on the basis of prevailing input cost and market price of cotton. Weed control efficiency, weed index, Bartlett's index, ginning percentage and lint index were also worked out to assess the efficiency of different weed control treatments.

RESULTS AND DISCUSSION

The total weed flora from the unweeded control plot at 90 DAS consisted of twenty different species of weeds of which 6 belongs to grasses, 2 to sedges and 12 to broad leaved weeds with their relative weed density values of 25.4, 18.0 and 56.6 per cent, respectively (Table 1 & Fig 1) . The total weed density was 404/ m^2 with a share of 102.67 , 72.83, and 228.50 of grasses, sedges and broad leaves/m^2, respectively. *Eleusine indica* , *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, and *Cynodon dactylon* were the dominant grassy species, *Cyperus rotundus* and *Cyperus iria were the dominant sedges and Ageratum conyzoides*, *Heliotropium indicum*, *Gnaphalum indicum* and *Acanthospermum hispidum* were the dominant broad leaved weeds in the experimental field .

Different weed control treatments significantly reduced weed density and their dry weight at 90 DAS compared to unweeded control (T_{10}) , which recorded the highest total weed population of 401 / m^2 and wed dry matter of 3429 kg/ha (Table 2). The weeds in control plot continued their growth till maturity of the crop indicating the need for timely weed control. Post emergence directed spray of paraquat dichloride @ 0.2 kg/ha at 30 DAS with a follow-up hand weeding at 60 DAS significantly reduced both the population (28.6 /m^2) and dry matter (621 kg/ha) of a wide spectrum of weeds comprising of grasses, sedges and broad leaved with a highest weed control efficiency of 81.8 per cent. Paraquat dichloride being a non selective contact herbicide, caused the mortality of weeds by the directed spray and the subsequent follow-up hand weeding was highly effective in checking the further regeneration and growth of weeds conforming the results of Singh *et al.* (1992). Among the other herbicidal treatments, pre emergence spray of alachlor @ 1.0 kg/ha with a hand weeding at 40 DAS (T_8), pre planting incorporation of fluchloralin @ 0.8 kg/ha with hand weeding at 40 DAS and post emergence directed spray of paraquat dichloride @ 0.4 kg/ha at 30 DAS alone (T_3) were also found effective and statistically at par with a weed control efficiency of 79.9 , 76.2 and 72.2 per cent , respectively. Hand weeding twice (T_9) and other herbicidal treatments alone (T_1, T_2, T_4 and T_5) were found to be ineffective in containing the weed growth and their dry matter at this stage due to gradual regenerated weed population under favourable soil moisture provided by irrigation. Directed spray of paraquat dichloride @ 0.2 kg/ha followed by hand weeding at 60 DAS (T_6) also significantly reduced the depletion of nitrogen, phosphorus and potassium nutrients by the weeds to the maximum of 80.7, 16.2 and 57.2 kg/ha, respectively at this stage due to lowest weed population and their dry weight compared to unweeded control as well as other treatments (Singh and Brar 1990).

Weed control treatment T_6 also significantly improved all the growth characters and yield attributes like plant height, LAI, number of sympodia, bolls/ plant and boll weight that resulted in the highest seed cotton yield of 1487 kg/ha followed by T_8 and T_7 with 149, 134 and 116 per cent increase in seed cotton yield over unweeded control (Table 3) with 597 kg seed cotton /ha and the highest weed index of 60 per cent. The follow up hand weeding after herbicide application is the important reason for higher yields as it removed chemically uncontrolled weeds as well as the regenerated ones providing effective control for a prolonged period. Directed spray of paraquat dichloride (T_6) also accrued

maximum net return (Rs 20704/-) and benefit: cost ratio (2.41) due to effective control of weeds followed by T_8, T_7 and T_3, respectively. The quality characters like Bartlett's index, lint index and ginning per cent were not influenced by varying weed competition levels commensurate with different weed control treatments indicating their independence characters from weed competition. Singh and Nagwaker (1989) reported that chemical weed control methods had no effects on ginning percentage of cotton.

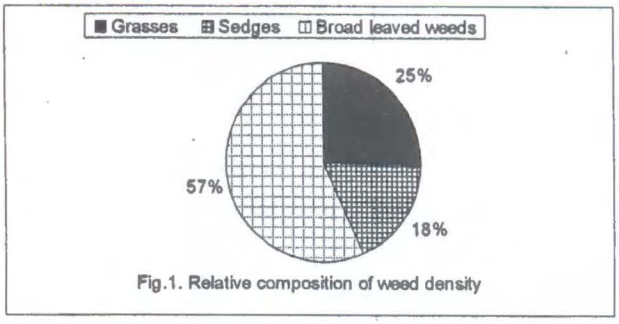

Fig.1. Relative composition of weed density

Table 1 Absolute and relative weed density of the experimental field at 90 days after sowing

	Name of weed or Scientific name	Absolute density (no. m^{-2})	Relative density (%)
A	**Grasses**		
	Elusine indica L.	28.62	7.0
	Dactyloctenium aegyptium (L.) Beauv.	24.51	6.1
	Digitaria sanguinalis L.	20.93	5.2
	Cynodon dactylon (L.) pers.	16.57	4.1
	Echinochloa colonum (L.) Link	8.26	2.0
	Digitaria ciliaris L.	3.78	1.0
	Total	**102.67**	**25.4**
B.	**Sedges**		
	Cyperus rotundus L.	48.36	11.9
	Cyperus iria L.	24.47	6.1
	Total	**72.83**	**18.0**
C.	**Broad leaf Weeds**		
	Ageratum conyzoides L.	56.32	13.9
	Heliotropium indicum L.	43.26	10.7
	Gnaphalum indicum L.	33.58	8.3
	Acanthospermum hispidium L.	26.32	6.5
	Borreria hispida L.	19.51	4.9
	Melochia corchorifolia L.	14.96	3.8
	Scoparia dulcis L.	11.23	2.7
	Eclipta alba L.	7.25	1.8
	Cleom rutidosperma L.	3.34	0.9
	Others (5)	12.73	3.1
	Total broad leaf weeds	**228.5**	**56.6**
	Total weed population	**404.0**	**100.0**

Table 2 Effect of weed management practices on weed population, their dry weight, weed control efficiency and nutrient depletion by weeds in cotton at 90 DAS

Treatment	Weed population / m^2				Total weed dry matter (kg/ha)	Weed control efficiency (%)	Nutrient depletion by weeds (kg/ha)		
	Grasses	Sedges	Broad leaved	Total			N	P	K
T_1	26.5 (5.16)	22.0 (4.74)	54.6 (7.42)	103.1 (10.15)	1647 (3.21)	51.9	21.3	4.2	26.8
T_2	17.5 (4.21)	17.7 (4.22)	40.2 (6.37)	75.4 (8.71)	1512 (3.17)	55.9	18.3	3.0	23.6
T_3	13.4 (3.69)	11.5 (3.46)	32.5 (5.74)	57.4 (7.60)	952 (2.97)	72.2	14.2	2.5	20.9
T_4	44.9 (6.72)	32.2 (5.75)	77.7 (8.83)	154.8 (12.48)	1324 (3.12)	61.3	19.8	4.1	18.3
T_5	31.7 (5.67)	24.5 (4.99)	86.6 (9.33)	142.8 (11.98)	1213 (3.08)	64.6	17.1	3.3	13.9
T_6	8.6 (3.02)	4.9 (2.33)	15.1 (3.94)	28.6 (5.40)	621 (2.79	81.8	6.4	1.7	4.52
T_7	21.5 (4.68)	18.7 (4.38)	31.7 (5.66)	71.9 (8.47)	814 (2.91)	76.2	13.9	1.8	8.9
T_8	19.6 (4.47)	13.7 (3.77)	26.8 (5.22)	60.1 (7.54)	689 (2.83)	79.9	12.7	1.6	6.3
T_9	40.0 (6.36)	31.7 (5.66)	73.3 (8.58)	145.0 (12.08)	1125 (3.05)	67.2	15.7	4.1	16.9
T_{10}	102.7 (10.14)	72.8 (8.55)	228.5 (15.12)	404.0 (20.10)	3429 (3.53)		87.1	17.9	61.7
CD(P=0.05)	0.92	0.73	1.26	1.03	0.08		2.35	0.99	3.87

Details of the treatments are given in the text; DAS, days after sowing

Table 3 Effect of weed management practices on growth parameters, seed cotton yield, quality and economics of cotton

Treatments	Plant height (cm)	Leaf area index	No. of sympodia/ plant	Bolls / plant	Boll weight (g)	Seed cotton yield (kg/ha)	Weed index (%)	Bartlett's index	Ginning percentage	Lint index	Net return (Rs/ha)	B : C ratio
T_1	91.9	3.62	12.4	13.7	4.0	834	43.9	0.59	34.48	4.97	6445	1.48
T_2	92.4	3.90	14.2	14.1	4.2	993	33.2	0.57	34.39	5.12	10110	1.75
T_3	99.6	4.01	14.8	14.6	4.3	1269	14.6	0.50	34.40	5.06	16545	2.21
T_4	89.5	3.79	13.6	12.9	4.0	1034	30.4	0.58	33.53	4.89	10812	1.78
T_5	93.6	3.86	14.0	13.6	4.2	1126	24.2	0.61	33.89	5.05	13014	1.94
T_6	104.2	4.14	16.9	16.6	4.4	1487	-	0.59	34.47	5.08	20704	2.41
T_7	94.5	4.04	16.0	14.9	4.2	1292	13.1	0.58	34.21	4.96	15940	2.08
T_8	103.6	4.12	16.7	16.0	4.2	1398	5.9	0.66	34.50	5.08	18474	2.25
T_9	88.6	3.97	14.7	15.3	4.0	1184	20.3	0.62	34.08	5.12	13532	1.93
T_{10}	72.2	1.62	10.7	7.8	3.9	597	59.9	0.60	24.25	5.07	1190	1.09
CD(P=0.05)	4.29	0.22	1.96	1.71	0.41	155.3		NS	NS	NS	2250	

Details of the treatments are given in the text

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