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Effect of Pre and Post-sowing Weed Management on Weeds and Summer Irrigated Cotton

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Abstract: Field experiments were conducted at Agricultural College and Research Institute, Madurai during summer seasons of 2003 and 2004 to study the effect of pre and post sowing weed management practices on weeds and growth of summer irrigated cotton. The experiments were conducted in split plot design and replicated thrice. Pre sowing weed management practices viz., normal sowing (S_1), stale seedbed by slight hoeing (S_2) and stale seed bed by paraquat application (S_3) were assigned to main plots. Under Post-sowing weed management practices, Pre-emergence applications of fluchloralin 1.0 kg ha^{-1} succeeded with each of MW 30 DAS, glyphosate 1.5 and 1.0 kg ha^{-1} separately and were assigned to W_1, W_2 and W_3 treatments, respectively. While, MW 20 DAS succeeded with each of glyphosate 1.5 and 1.0 kg ha^{-1} (40 DAS) and MW on 20 DAS separately and were allotted to W_4, W_5 and W_6 treatments, respectively. These were compared with unweeded control (W_7) under sub plots. The results revealed SSB by paraquat application registered significantly lower N, P_2O_5 and K_2O depletion by weeds. The lowest nutrient depletion by weeds was achieved by post sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1}. Whereas, nutrient depletion was higher in unweeded control. As a result, Weed Control Efficiency (WCE) was higher under pre sowing weed management practice of SSB paraquat application, which was followed by SSB, by slight hoeing practice. Among the Post-sowing weed management, MW (20 DAS) fb glyphosate 1.5 kg ha^{-1} recorded higher WCE. The plant growth analysis such as LAI, CGR, RGR and Plant DMP values were increased appreciably in SSB by paraquat application. In post sowing weed management practices, manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} increased the above growth analysis and parameters.

Key words: Stale seed bed, WCE, N, P_2O_5, K_2O depletion, growth analysis

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) the king of apparel fibre known as White gold is an important commercial crop sharing around 85% of raw material supply in Indian textile industry (Basu, 1989). It has immense potentiality to share foreign exchange of 38% of total export of Indian economy besides providing employment to 60 million people in India (Kairon and Venugopalan, 2000). Cotton also played significant part in generating foreign exchange of more than Rs 55,000 crores during 2000-01 through export of cotton fibre, yarn and textile (Anonymous, 2002). India ranks first in area under cotton covering 2.2 lakh ha. Though the productivity of cotton in Tamil Nadu (324 kg lint ha^{-1}) is marginally higher than the national average (300 kg ha^{-1}) it is far lower than the world average of 500 kg ha^{-1} (Natarajan, 2004). There are lot of factors, which reduce growth, and development of cotton and final yield. Among these, the prime factor, which is often responsible for poor growth performance of cotton, is weed that competes with cotton for space, nutrients, moisture and sunlight. Initial slow growth and adoption of wider spacing favours the weeds to grow luxuriously in cotton fields. The Post-sowing weed management reduces the weed competition in the later vegetative phase of the crop. However, the growth was affected due to undue delay in weeding. Timely weed control after establishment of the crop is not feasible due to high cost and non availability of labourers during peak cultivation period. Under the above situation, adoption of Pre-sowing weed management practice is vital need to reduce weed competition in the initial stage of cotton crop. The Pre-sowing weed management practices such as Stale Seed Bed (SSB) preparation gains importance in the recent years. In Stale Seed Bed (SSB) method, weed seeds from top 4-5 cm surface soil are induced to germinate and emerge before cropping. These seedlings can be destroyed either with a contact herbicide spray (or) by

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slight hoeing so that a part of weed population could be eliminated. Advantage of this technique (SSB) is that crop germinated in weed free environment. This method can be highly effective in controlling weeds in crops planted in a rainless period with the help of irrigation like summer cotton. Traditional methods of weed management like manual weeding and hoeing though used widely by the cultivators are laborious, time consuming and expensive on account of scarcity of labourers during peak periods of cultivation of crops. Therefore, chemical weed control seems to be viable alternative for effective and timely weed management. Pre-emergence application of herbicides to kill the germinating weeds would be appropriate not only for minimize early weed competition but also for reducing the workload. However, Pre-emergence herbicides take care of weeds only for a limited period and do not give long-term weed control in a long duration crop like cotton where the problem of late emerging weeds arises. So it is necessary to include either manual weeding (or) sequential application of post emergence herbicide after Pre-emergence application. Under these circumstances, the integration of Pre-sowing weed management practices (SSB) followed by Post-sowing application of Pre-emergence herbicides/manual weeding practice is thus warranted to attain satisfactory weed management in cotton. With these facts the present study was undertaken.

MATERIALS AND METHODS

A field experiment was conducted to study the effect of pre and Post-sowing weed management practices on weed and growth of summer irrigated cotton during 2003 and 2004 at Agricultural College and Research Institute, Madurai (Tamil Nadu). The soil of the experimental field was well-drained sandy clay loam with organic carbon content of 0.45%, low, medium and high in N, P_2O_5 and K_2O , respectively. The experiment consists of three pre-sowing weed management practices viz., S_1-Normal sowing; S_2-Stale seed bed (SSB) by slight hoeing on 14th day of SSB and S_3-Stale seed bed by paraquat spray at the rate of 0.40 kg ha^{-1} on 14th day of SSB as main plot treatments and seven post-sowing weed management practices viz., W_1-Pre-emergence application of fluchloralin at 1.0 kg ha^{-1} fb MW on 30 DAS; W_2-Pre-emergence application of fluchloralin at 1.0 kg ha^{-1} fb post-emergence spray of glyphosate at 1.5 kg ha^{-1} on 30 DAS; W_3 Pre-emergence application of fluchloralin at 1.0 kg ha^{-1} fb post-emergence spray of glyphosate at 1.0 kg ha^{-1} on 30 DAS; W_4-MW on 20 DAS fb post-emergence spray of glyphosate at 1.5 kg ha^{-1} on 40 DAS; W_5-MW on 20 DAS fb post-emergence spray of glyphosate at 1.0 kg ha^{-1} on 40 DAS; W_6-MW twice on 20 and 40 DAS (farmer's practice) and W_7-Unweeded control as sub-plot treatments and replicated thrice. Under pre-sowing weed management practices, layout was taken immediately after field preparation. First irrigation was given in stale seedbed treatment plots to induce the weed seeds to germinate. At 14 days after first irrigation, slight hoeing was given in SSB by slight hoeing plots and paraquat sprayed at 0.40 kg ha^{-1} in SSB by paraquat treatment plots to destroy the emerged weeds. Whereas, under normal sowing plots, all the practices were carried out as per general recommendations just prior to sowing. In post-sowing weed management practices, pre-emergence herbicide fluchloralin was applied on 3rd DAS in the respective plots with help of deflector type of nozzle. In the case of post-emergence application, glyphosate was applied on 30 DAS in the pre-emergence applied plots and was applied on 40 DAS in plots with MW on 20 DAS with help of deflector type of nozzle fitted with hood to prevent spray drift over cotton crop. Manual weeding was given on 30 DAS in pre-emergence applied treatments and was given on 20 DAS in post-emergence treatment plots. While, it was imposed on 20 and 40 DAS in farmer's practice of MW twice. Analysis on N, P_2O_5 and K_2O content was done from the weed DMP on 60 DAS and expressed in kg ha^{-1}. WCE was worked out from the weed density at 60 DAS and given in percent. Biometric observations on LAI and plant DMP were recorded on 60 DAS. And also observations on CGR and RGR were recorded on 30-60 DAS.

RESULTS AND DISCUSSION

Depletion of N, P_2O_5 and K_2O by weeds: The Pre-sowing weed management practice of SSB by paraquat application (S_3) and SBB by slight hoeing registered lower nutrient depletion by weeds than normal sowing. The least nutrient depletion was recorded in SSB by paraquat application (S_3) treatment which registered 17.00, 4.92 and 12.71 kg ha^{-1} of N, P_2O_5 and K_2O depletion, respectively during 2003 and 13.78, 4.28 and 12.28 kg ha^{-1} of N, P_2O_5 and K_2O depletion, respectively during 2004 (Table 1). The reduction in the removal of N, P_2O_5 and K_2O depletion by weeds under Pre-sowing weed management practices of SSB by parquat application and SSB by slight hoeing was more helpful to cotton crop to take required quantity of nutrients in the earlier stages with limited crop weed competition. This was reflected in registering higher WCE in the above said treatments (Table 1). Similar result was obtained by Sanbagavalli (2001). Among Post-sowing weed management practices, manual weeding (20 DAS) fb

Table 1: Effect of pre and post-sowing weed management practices on N, P_2O_5 and K_2O depletion by weeds (kg ha^{-1}) and Weed Control Efficiency (%) in cotton

Treatments	2003				2004			
Pre-sowing	N	P_2O_5	K_2O	WCE	N	P_2O_5	K_2O	WCE
S_1	31.02	8.10	15.81	42.71	25.80	7.20	14.61	42.27
S_2	23.22	6.54	13.62	43.88	19.33	5.77	13.17	49.11
S_3	17.00	4.92	12.71	51.96	13.78	4.28	12.28	55.06
CD (p = 0.05)	9.554	1.806	1.805	-	6.405	1.652	1.332	-
Post-sowing								
W_1	28.79	7.53	15.23	30.56	24.32	6.89	14.58	35.82
W_2	15.54	4.74	13.06	52.16	13.35	4.41	12.43	54.16
W_3	23.17	6.29	13.90	40.84	20.41	5.11	13.51	44.07
W_4	6.12	1.78	11.17	75.21	5.69	1.66	11.03	77.38
W_5	10.26	2.81	11.85	67.00	8.81	2.62	11.67	68.84
W_6	14.13	4.17	12.41	57.79	10.63	3.06	12.13	61.40
W_7	68.21	18.31	20.73	-	56.01	16.51	18.13	-
CD (p = 0.05)	12.334	2.698	1.625	-	8.442	2.460	1.187	-

Table 2: Effect of pre and post-sowing weed management practices on LAI, CGR (g m^{-2} day^{-1}), RGR (g g^{-1} day^{-1}) and plant DMP (kg ha^{-1}) in cotton

Treatments	2003				2004			
Pre-sowing	LAI	CGR	RGR	Plant DMP	LAI	CGR	RGR	Plant DMP
S_1	2.747	1.563	0.0192	624	2.771	1.547	0.0194	627
S_2	2.764	1.729	0.0195	688	2.788	1.720	0.0197	694
S_3	2.781	1.891	0.0197	750	2.807	1.918	0.0198	769
CD (p = 0.05)	0.0322	0.148	0.0002	58	0.0202	0.210	0.0002	81
Post-sowing								
W_1	2.723	1.066	0.0172	459	2.760	1.093	0.0172	472
W_2	2.760	1.640	0.0199	658	2.780	1.691	0.0204	672
W_3	2.750	1.522	0.0202	606	2.780	1.552	0.0202	623
W_4	2.826	2.708	0.0220	1042	2.850	2.705	0.0216	1047
W_5	2.803	2.457	0.0214	956	2.820	2.449	0.0212	956
W_6	2.786	1.934	0.0204	768	2.800	1.931	0.0204	770
W_7	2.701	0.768	0.0152	328	2.740	0.678	0.0164	342
CD (p = 0.05)	0.0288	0.295	0.0011	98	0.0175	0.342	0.0010	120

glyphosate 1.5 kg ha^{-1} (W_4) had achieved reduction in N, P_2O_5 and K_2O by weeds of 6.12, 1.78 and 11.17 ha^{-1}, respectively during 2003 and 5.69, 1.78 and 11.03 kg ha^{-1}, respectively during 2004 (Table 1). However, this treatment (W_4) was comparable with manual weeding (20 DAS) fb glyphosate 1.0 kg ha^{-1} (W_5), which in turn comparable with manual weeding twice (20 and 40 DAS) practice (W_6) during both years.

Very fast growing nature of weeds absorbed more quantum of nutrients than crop resulting in inadequate supply of nutrients to the crop. In addition to that slow growth nature of cotton in the early stage permitted the weeds as efficient competitor for nutrients. This competition was nullified by reducing crop weed competition by suppressing the weeds in early period of crop growth and thereby increasing the availability of nutrients to cotton crop with the help of Post-sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1}. This weed management practice was found to be highly efficient in enhancing WCE but also to reduce the N, P_2O_5 and K_2O depletion by weeds. This was reported by Chandler (1994) that herbicides alone (or) in combination with one manual weeding reduced nutrient depletion by weeds significantly.

Weed control efficiency: Weed Control Efficiency (WCE) was higher under Pre-sowing weed management practice of SSB by paraquat application (S_3), which registered the WCE of 51.96% during 2004 (Table 1). This might have been achieved due to better weed control in this treatment. This was in agreement with the findings of Satao *et al*. (1998) who reported that the highest WCE of 62.67% in SSB by paraquat applied plots. The least WCE was noticed in normal sowing (S_1) under Pre-sowing weed management practice. WCE was increased under Post-sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} (W_4), which recorded WCE of 75.21% during 2003 and 77.38% during 2004 (Table 1). The complete removal of weeds by manual weeding and effective control of regenerated weeds through subsequent spraying of glyphosate could have contributed for increased WCE in the above said treatments.

Leaf area index: Maximum leaf area index (2.781 during 2003 and 2.807 during 2004) was observed in Pre-sowing weed management practice of SSB by paraquat application (S_3) (Table 2). It might be due to least crop weed competition for nutrients, moisture and sunlight. The minimum value of LAI however was recorded in normal sowing (S_1). This was because of emergence of large number of weeds under this treatment. However, it was comparable with SSB by slight hoeing (S_2). Increased WCE in Post-sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} (W_4) influenced the LAI (Table 2), which were 2.826 and 2.850 during 2003 and 2004, respectively. The next treatment in enhancing the LAI was manual weeding (20 DAS) fb glyphosate 1.0 kg ha^{-1} (W_5) which in turn comparable with the farmers practice of manual weeding twice (20 and 40 DAS) (W_6). The LAI was significantly reduced with the unweeded control (W_7). Rank growth of weeds with high depletion of nutrients by weeds obtained in the crop weed competition period could have greatly affected the manufacturing of photosynthates in cotton crop under unweeded control. Bonilla (1984) reported that leaf area index was found to be an accurate indicator for crop weed competition.

CGR and RGR: Higher CGR (1.891 and 1.918 g m^{-2} day^{-1} during 2003 and 2004, respectively) and RGR (0.0197 and 0.0198 g g^{-1} day^{-1} during 2003 and 2004, respectively) values were observed in cotton received SSB by paraquat application (S_3) (Table 2). However, this treatment was comparable with SSB by slight hoeing(S_2) except during 2003 in which it was significantly recorded higher CGR under Pre-sowing weed management practice. Better weed management with sufficient light, moisture and nutrients availability for producing increased LAI and crop DMP obtained in the above treatments to get higher CGR and RGR values of cotton. This is in agreement with the findings of Srinivas *et al*. (1989).The normal sowing of (S_1) has no influence in enhancing CGR and RGR values. This might be due to non adoption of weed control measure in this treatment prior to sowing which enabled the weeds to grow without control.

With regard to Post-sowing weed management practices, manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} (W_4) markedly increased the CGR (2.708 and 2.705 g m^{-2} day^{-1} during 2003 and 2004, respectively) values and was comparable with manual weeding (20 DAS) fb glyphosate 1.0 kg ha^{-1} (W_5) during both years. It was inferred that adoption of Pre-sowing weed management practice of SSB by paraquat application (S_3) and SSB by slight hoeing (S_2) make weed free situation on one side and on the other side it provided a favourable effect was intensified further with imposement of Post-sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} (or) manual weeding (20 DAS) fb glyphosate 1.0 kg ha^{-1} successfully increased the above growth parameters. This sort of pre and Post-sowing weed management practices provided a weed free situation during crop weed competition period in cotton as reported by Sathyanarayana *et al.* (2000). The farmer's practice of manual weeding twice (20 and 40 DAS)(W_6) ranked third in increasing the CGR and RGR values during both the years. Among the Pre-sowing weed management practices, unweeded control (W_7) recorded lesser CGR and RGR values might be due to suppressed plant growth caused by heavy weed infestation.

Dry matter production of cotton: Pre-sowing weed management practices exerted significant effect on dry matter production of cotton (Table 2). The Pre-sowing weed management practice of SSB by paraquat application (S_3) registered higher DMP of 750 and 769 kg ha^{-1} during 2003 and 2004 , respectively which was followed by SSB by slight hoeing (S_2) treatment during 2003. But the treatment S_3 was comparable with S_2 during 2004. Higher DMP can be ascribed to lower weed infestation, which reflects the better growth of crop in terms of higher values of LAI, CGR and RGR recorded in these treatments. Significantly higher DMP was recorded (1042 and 1047 kg ha^{-1} during 2003 and 2004, respectively) at Post-sowing weed management practice of manual weeding (20 DAS) fb glyphosate 1.5 kg ha^{-1} (W_4) (Table 2). However, which gave similar effect as that of manual weeding (20 DAS) fb glyphosate 1.0 kg ha^{-1} (W_5) during both the years. Increase in DMP due to CGR and RGR might be due to increased value of LAI through better weed control in the above treatments. The farmer's practice of manual weeding twice (20 and 40 DAS)(W_6) performed better next to that of above said treatments in registering the DMP during both the years. Where as unweeded control (W_7) showed no significant effect on producing DMP during both the years.

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