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EFFECT OF CHEMICAL METHOD ON WEED MANAGEMENT IN HYBRID COTTON

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Abstract

A field experiment was conducted during winter season 2015 at Annamalai University Experimental Farm, Annamalainagar, to study the effect of chemical method on weed management in hybrid cotton. The experiment was laid out in Randomized Block Design with three replications and twelve treatments. The treatments were, T_1-Unweededcontrol, T_2- Alachlor 1.5 kg ha^{-1} , T_3- Pendimethalin 0.68 kg ha^{-1}, T_4- Alachlor 1.5 kg ha^{-1} + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS, T_5- Pendimethalin 0.68 kg ha^{-1} + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS, T_6- Alachlor 1.5 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS, T_7- Pendimethalin 0.68 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS, T_8- Two hand weeding on 20 and 45 DAS, T_9- Alachlor 1.5 kg ha^{-1} + hand weeding on 45 DAS, T_{10}- Pendimethalin 0.68 kg ha^{-1} + hand weeding on 45 DAS, T_{11}- One hand weeding on 20 DAS + Quizalofopethyl 0.025 kg ha^{-1}on 40 DAS, T_{12}- One hand weeding on 20 DAS + Paraquat 0.75 kg ha^{-1} on 40 DAS. Observations on total weed count, weed biomass and weed control efficiency were recorded. Cotton growth and yield attributes and seed cotton yield were observed and economics in terms of net returns and benefit cost ratio were computed. Results of the experiment, it can be concluded that combined application of pre-emergence herbicide pendimethalin 0.68 kg ha^{-1}+ post emergence herbicide paraquat 0.75 kg ha^{-1} on 40 DAS is the most remunerate approach for obtaining higher seed cotton yield and maximum economic returns in hybrid cotton besides obtaining broad spectrum weed control throughout the crop growth period.

Key words: weed control, chemical method and hybrid cotton

Introduction

Cotton (*Gossypium hirsutum* L.) is an important commercial crop in India and contributes more than 80 per cent of raw materials to textile industry. Cotton is the most valued natural fibre plant among several fibre yielding plants. It is the world's most important non-food agricultural commodity. Cotton plays a pivotal role in agriculture economy of the country. India is the second largest producer and consumer of cotton in the world after China. India devotes more land to cotton than any other country in the world and today ranks first in area (11.70 m. hectares) accounting for 30 per cent of world coverage under this crop. It accounts for about 22 per cent (353 lakh bales of lint) of the world cotton production and 16 per cent (540 kg lint ha^{-1}) of world cotton consumption. Cotton is cultivated in three distinct zones in India *viz*., North, central and south zones. In Tamil Nadu, 1.17 lakh hectares is under cotton cultivation with a production of 2.80 lakh bales and productivity of 726 kg ha^{-1} (AICCIP, 2014). The major constraints which decide the continuance of cotton cultivation is agro-climatic requirement prevailed during cropping period, severe pest infestation especially the bollworm complexes, indeterminate nature of growth and improper management of weeds and fertilizers.

Cotton, being long duration, wide spaced and relatively slow growing crop in early stages, is subjected to a severe weed menace. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to the extent of 74 per cent (Rajiv Sharma, 2008). The critical period of weed competition in cotton was found to be from 15 to 60 days. The hybrid cotton is cultivated under wider plant spacing and heavy fertilizer nutrients, which in turn invite multiple weed species infestation. Inadequate weed control is considered as a major constraint for high yield. Manual weeding is not always practicable, being expensive and time consuming. Availability of labour for timely weeding may be inadequate owing to peak season of labour demand. An

estimate of 400-600 man hrs ha^{-1} (Tajuddin, 1996) is the normal labour requirement for hand weeding, which also depends upon weed infestation. Mechanical weeding was partially effective because most of the weeds growing in intra rows escaped during weeding. Vivek *et al.* (2002) reported that maximum cotton yield was obtained with pendimethalin at 1.0 kg ha^{-1} followed by hand weeding on 30 DAS. Thus weed management through chemical became a promising means to control weeds at initial stages of crop growth. Many pre-emergence are presently used in cotton for weed control that take care of weeds only for a limited period and hence late emerging weeds were not controlled. So, there is an ample scope for controlling weeds by the application of post-emergence herbicide. This necessitates the development and testing of post emergence herbicides for weed control in later stages of cotton along with a pre-emergence herbicide. Hence, a field experiment was conducted to find out effect of chemical method pre-emergence herbicides *viz.*, alachlor, pendimethalin and post emergence herbicides *viz.*, quizalofop-ethyl and paraquat for the control of weeds in hybrid cotton.

Materials and methods

A field experiment was conducted during winter season 2015 at Annamalai University Experimental Farm, Annamalainagar, to study the effect of chemical method on weed management in hybrid cotton. Which is located at $11^0$24' North latitude and $79^0$41' East longitude, at an altitude of 5.79 m above mean sea level (MSL). The weather of Annamalainagar is moderately warm with hot summer months. The mean maximum temperature from 27.9^{0}C to 38.1^{0}C and the mean minimum ranges from 18.5^{0}C to 26.3^{0}C. The highest mean relative humidity is 95 per cent during December-January and the lowest is 77 per cent during May-June. The mean annual relative humidity is 88.3 per cent. The soil of the experimental field was clayey loam in texture. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium status. Hybrid cotton RCH-2 was selected for the study and approved for cultivation in south and central zone of India. This hybrid is high yielding with good quality fibre and has wider adaptability. The experiment was laid out in Randomized Block Design with three replications and twelve treatments. The treatments were,T_1-Unweededcontrol, T_2- Alachlor 1.5 kg ha^{-1}, T_3- Pendimethalin 0.68 kg ha^{-1}, T_4- Alachlor 1.5 kg ha^{-1} + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS, T_5- Pendimethalin 0.68 kg ha^{-1} + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS, T_6- Alachlor 1.5 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS, T_7- Pendimethalin 0.68 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS, T_8- Two hand weeding on 20 and 45 DAS, T_9- Alachlor 1.5 kg ha^{-1} + hand weeding on 45 DAS, T_{10}- Pendimethalin 0.68 kg ha^{-1} + hand weeding on 45 DAS, T_{11}- One hand weeding on 20 DAS + Quizalofopethyl 0.025 kg ha^{-1}on 40 DAS, T_{12}- One hand weeding on 20 DAS + Paraquat 0.75 kg ha^{-1} on 40 DAS. The experimental field was prepared to optimum tilth by ploughing twice with tractor drawn mould board plough followed by harrowing twice and levelled. The ridges were formed after levelling at an interval of 120 cm with ridge plough. Healthy viable delinted seeds of cotton hybrid RCH-2 were dibbled with the spacing of 60 cm at the rate of one seed per hill on the side of the ridges. Gap filling was done at 7 DAS so as to maintain uniform plant population. Thinning was done at 15 DAS to maintain one healthy seedling $hill^{-1}$. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash at 120:60:60 kg NPK ha^{-1} respectively. Basal dose of N and K as 50 per cent, full dose of P were applied as band placement in 5 cm away, 5 cm below the seed row. The balance dose of N and K was applied at the time of square initiation (45 DAS) followed by earthling up operation. The pre -emergence herbicides *viz.*, Alachlor 1.5 kg ha^{-1} and pendimethalin 0.68 kg ha^{-1} were mixed with water at the rate of 500 litres ha^{-1} and sprayed over the soil uniformly by hand operated backpack sprayer using deflector nozzle on 3 DAS of cotton. Immediately after herbicide spray, one light irrigation was given so as to incorporate the chemical into the soil. The post-emergence herbicides *viz.*, quizalofop-ethyl 0.025 kg ha^{-1} and paraquat 0.75 kg ha^{-1} each were mixed with water at the rate of 500 litres ha^{-1} and sprayed by knapsack sprayer using deflector nozzle with hood as per the treatment schedule on 40 DAS. Observations on total weed count, weed biomass and weed control efficiency were recorded on 45 DAS. Cotton growth and yield attributes and seed cotton yield were observed and economics in terms of net returns and benefit cost ratio were computed.

Results and discussion

Total weed count: All the treatments exerted significant influence on total weed count. Among the treatments, pendimethalin 0.68 kg ha^{-1} + paraquat 0.75kg ha^{-1} was observed to be superior in restricting the total weed population as indicated by the least total weed count of 3.99 m^{-2} at 45 DAS. This was followed by two hand weeding on 20 and 45 DAS (16.41 m^{-2}). The highest total weed count of 106.19 m^{-2} was recorded in the unweeded control. Effective weed control measures such as pre-emergence application of pendimethalin at 3 DAS and post emergence application of paraquat on 40 DAS

Table 1: Effect of Chemical method on weed management in hybrid cotton.

	Total weed count (m^{-2}) on 45 DAS	Weed biomass (kg ha^{-1})	Weed control efficiency (%)	No. of bolls $plant^{-1}$	Seed cotton yield (kg ha^{-1})
T_1 – Unweeded control	10.33 (106.19)	1474	-	13.20	930
T_2 – Alachlor 1.5 kg ha^{-1}	9.85 (96.53)	1337	9.10	14.73	1129
T_3 – Pendimethalin 0.68 kg ha^{-1}	9.34 (86.75)	1197	18.30	16.22	1327
T_4 – Alachlor 1.5 kg ha^{-1} + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS	7.27 (52.36)	764	50.69	21.07	1984
T_5 – Pendimethalin 0.68 kg ha^{-1} + Quizalofop ethy l 0.025 kg ha^{-1} on 40 DAS	5.34 (28.02)	398	73.61	24.65	2480
T_6 – Alachlor 1.5 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS	7.05 (49.33)	698	53.54	21.65	2082
T_7 – Pendimethalin 0.68 kg ha^{-1} + Paraquat 0.75 kg ha^{-1} on 40 DAS	2.11 (3.99)	102	96.24	27.60	2886
T_8 – Two hand weeding on 20 and 45 DAS	4.11 (16.41)	254	84.54	26.15	2685
T_9 – Alachlor 1.5 kg ha^{-1} + hand weeding on 45 DAS	7.96 (62.94)	870	40.72	19.74	1874
T_{10} – Pendimethalin 0.68 kg ha^{-1} + hand weeding on 45 DAS	6.26 (38.73)	550	63.52	23.17	2281
T_{11} – One hand weeding on 20 DAS + Quizalofop ethyl 0.025 kg ha^{-1} on 40 DAS	8.79 (76.84)	1059	27.63	17.67	1528
T_{12} – One hand weeding on 20 DAS + Paraquat 0.75 kg ha^{-1} on 40 DAS	8.20 (66.82)	916	37.07	19.14	1749
S.Ed	**0.22**	**61.07**	**-**	**0.65**	**94.23**
CD (p=0.05)	**0.46**	**126.42**		**1.35**	**195.06**

(Figures in parenthesis indicates the original value)

might have helped in minimizing the weed population and thereby reducing the weed competition for light, moisture and nutrients as compared to all other treatments. Weed density as well as weed dry weight were reduced significantly due to pre-emergence herbicide application. Pendimethalin resulted in effective control of grasses, broad leaved weeds and to some extent sedges due to its broad spectrum action. It enters grasses through the coleoptiles and shoot of the seedling below the ground. Thus, grasses were effectively controlled with this herbicide. The left over weeds were controlled by post emergence herbicide paraquat on 40 DAS. Paraquat dichloride being a non selective contact herbicide caused the mortality of weeds by the direct spray. The paraquat application due to its contact action killed all the existing weeds after application. Similar results obtained by Veeramani *et al.,* (2008).

Weed biomass:

The weed biomass was significantly influenced by all the treatments.Among the different weed control treatments, the least weed biomass of 102 kg ha^{-1} was recorded in pendimethalin 0.68 kg ha^{-1}+paraquat 0.75 kg ha^{-1}. This was followed by two hand weeding on 20 and 45 DAS (254 kg ha^{-1}). The highest weed biomass of 1474 kg ha^{-1} was recorded in the unweeded control. Weed dry weight was reduced significantly due to pre-emergence herbicide application. Pendimethalin resulted in effective control of grasses, broad leaved weeds and to some extent sedges due to its broad spectrum action. It enters grasses through the coleoptiles and shoot of the seedling below the ground. Thus, grasses were effectively controlled with this herbicide. The left over weeds were controlled by post emergence herbicide paraquat on 40 DAS.

Weed control efficiency (WCE):

Among the different weed control treatments, pendimethalin 0.68 kg ha^{-1} + paraquat 0.75 kg ha^{-1} was found to be superior as indicated by the highest weed control efficiency of 96.24 per cent at 45 DAS. This was followed by two hand weeding on 20 and 45 DAS (84.54 per cent). This might be attributed to the efficiency of pendimethalin in controlling the dominant weed species in early stages and paraquat application due to its contact action killed all the existing weeds after their application.

Number of bolls $plant^{-1}$

All the treatments exerted significant influence over

the number of bolls plant^{-1}. The highest number of bolls plant^{-1} (27.60) was recorded in pendimethalin 0.68 kg ha^{-1} + paraquat 0.75 kg ha^{-1} treatment. This was followed by two hand weeding on 20 and 45 DAS (26.15). The lowest number of bolls plant^{-1} of 13.20 was observed in unweeded control. It could be attributed to significantly lower weed population, dry matter accumulation of weeds and hence higher number of sympodial branches and number of bolls per plant in this treatment. The superior performance might be attributed to reduce crop-weed competition in crop growth stages which helped in synchronization of number of sympodial branches, number of monopodial branches and number of bolls per plant.

Seed cotton yield:

Seed cotton yield was significantly influenced by all the weed control treatments.

Among the weed control measures, pendimethalin 0.68 kg ha^{-1} + paraquat 0.75 kg ha^{-1} treatment recorded the highest seed cotton yield of 2886 kg ha^{-1}. This was followed by two hand weeding on 20 and 45 DAS (2685 kg ha^{-1}). The least seed cotton yield of 930 kg ha^{-1} was recorded in the unweeded control. This combination also offers efficient and prolonged weed control which might have favoured the crop with better rooting, higher LAI, pre and post flowering photosynthesis and yield attributes. This might be due to timely and effective control of weeds by combination of herbicides which resulted in better availability of soil moisture and nutrients and also could be due to higher yield parameters and seed cotton yield. Similar results were reported by Gnanavel and Babu, (2008) and Prabhu *et al.,* (2012).

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