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Integrated weed management in cotton under irrigated condition of middle Gujarat

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ABSTRACT

A field experiment was conducted for two consecutive *Kharif* seasons of 2014 and 2015 at research farm of AICRP-Weed Management, AAU, Anand to study the integrated weed management in cotton under irrigated condition. Pre-emergence application of pendimethalin 1000 g/ha *fb* hand weeding twice at 20 and 50 DAS, and pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) as PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS recorded significantly lower weed dry biomass as well as higher seed cotton yield and benefit cost ratio as compared to rest of the treatments. The weed control efficiency of these treatments proved to be 90 and 86% during 2014 and 2015, respectively.

Key words: Cotton, Herbicides, Integrated weed management, Weed density, Yield

India is the leading country in terms of area under cotton in the world. Gujarat, Maharashtra and Telangana are the major cotton growing states contributing around 70% of the area and 67% of cotton production in India. Cotton crop is the main *Kharif* crop in irrigated middle-western plain of Gujarat. It covers around 27.61 lakh ha area, which is next to Maharashtra in India (Anonymous 2015). Losses in seed cotton yield due to presence of weeds is maximum. Weeds not only compete with the crop for nutrients, light, moisture, space and energy but, also harbor insects and disease organism thus, reducing the growth and yield of cotton due to weed competition (Papamichail *et al.* 2002). Cotton generally needs weed management in early stages of growth. Weed control in cotton from sowing to 8 weeks may increase the seed cotton yield from 30-40% (Jarwar *et al.* 2005). Manual measures for weed control without herbicide application is the most labour intensive and impractical method in modern agricultural production system. Under such circumstances, herbicides have remained the principal tool and foundation of most effective weed control programmes (Zhang 2003, Norsworthy *et al*. 2012). Yadav and Singh (2005) suggested the integrated use of various methods of weed control.

Therefore, the present study was undertaken to determine the efficacy of different herbicides as pre- and post-emergence, for controlling the weeds and their effect on seed cotton yield and economics of cotton.

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MATERIALS AND METHODS

A field experiment was conducted at research farm of AICRP Weed Management, Anand Agricultural University, Anand (Gujarat) during the *Kharif* seasons of 2014 and 2015. The soil of the experimental field was sandy loam in texture with pH of 8.10 and EC of 0.34 dS/m. The organic carbon, available nitrogen, phosphorus and potash of the soil were 0.46% (low), 240.57 kg/ha (low), 15.54 kg/ha (medium) and 233.29 kg/ha (medium), respectively. The experiment was comprised of ten treatments *viz.* application of pendimethalin 1000 g/ha PE *fb* HW at 20 and 50 DAS, pendimethalin1000 g/ha PE *fb* pyrithiobac-sodium 62.5 g/ha PoE, pendimethalin 1000 g/ha PE *fb* pyrithiobac + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE, pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE, pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* manual weeding 50 DAS, pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat 600 g/ha at 60 DAS, pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS, pendimethalin 1000 g/ha PE *fb* glyphosate directed spray 2000 g/ha at 45 DAS, mechanical weeding (20, 40 and 60 DAS) and weedy check. Experiment was laid out in randomized complete block design with three replications.

Bt. cotton (*GCH8*) was sown keeping the seed rate of 2.5 kg/ha with 120 cm row to row and 45 cm plant to plant distance. The crop was fertilized with 280 kg N/ha supplied through urea only. One fourth quantity of nitrogen (70 kg/ha) was applied as a basal and remaining quantity of nitrogen applied at different growth stages of cotton, *viz*. square formation,

flowering and boll formation stages as top dressing in three equal splits. The pre-emergence herbicides were applied to soil on next day of sowing, while post-emergence herbicide spray was done at 20-25 DAS based on soil moisture condition as per the treatments. The weed density and dry weight of weeds were recorded at 90 DAS. Weed control efficiency (WCE) was calculated on the basis of formulae suggested by Mani *et al.* (1973). BCR value was also worked out by considering the prevailing market price on the basis of pooled seed cotton and stalk yields.

RESULTS AND DISCUSSION

Effect on weeds

The predominant weeds identified in the experimental site were *Eleusine indica, Commelina benghalensis, Eragrostis major, Dactyloctenium aegyptium, Digitaria sanguinalis* and *Cyperus iria* among the monocots and *Digera arvensis, Phyllanthus niruri, Euphorbia hirta, Oldenlandia umbellate* and *Boerhavia diffusa* among dicots. Grassy weeds were predominated (72.1%) followed by broad-leaved weeds (27.9). *Eleusine indica* and *Digera arvensis* were found to be predominant weed species among the grassy and broad-leaved weeds, respectively.

All the weed control treatments caused remark able reduction in monocot, dicot and total weed density and weed dry matter production when compared with weedy check (**Table 1**). The weed density in terms of monocot, dicot and total weeds at 90 DAS was found to be non-significant due to different weed management practices. Marginally lower number of monocot, dicot as well as total weeds were recorded under application of pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha 60 DAS followed by pendimethalin 1000 g/ha PE *fb* twice hand weeding ay 20 and 50 DAS. Minimum weed dry biomass of dicot and total weeds were also registered under directed application of pendimethalin 1000 g/ha PE *fb* HW at 20 and 50 DAS followed by pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS. The reduction in weed dry weight under said treatments might be due to pendimethalin, which inhibits the cell division and root and shoot growth of the weeds preventing them from emerging, particularly during the crucial development phase of the crop. The results were in accordance with the finding of Gnanavel and Babu (2008) and Chinnusamy and Chinnagounder (2013). The highest weed dry biomass of monocot (18.1g/m^2), dicot (16.3 g/m^2) and total weed (25.6g/m^2) were recorded under weedy check treatment (**Table 1**).

Effect on crop

All the weed management practices significantly increased the seed cotton and stalk yield/ha (**Table 2**) over unweeded. Pre-emergence application of pendimethalin at 1000 g/ha *fb* hand weeding at 20 and 50 DAS, pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha 60 DAS, pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat 600 g/ha and mechanical weeding (20, 40 and 60 DAS) remained at par with each other and recorded significantly higher seed cotton yield as Gnanavel and Babu (2008) observed that application

Table 1. Weed density and biomass as influenced by integrated weed management practices at 90 DAS in cotton

Treatment	Weed density (no./m^2)			Weed dry biomass (g/m^2)		
	Monocot weed	Dicot weed	Total weed	Monocot weed	Dicot weed	Total weed
Pendimethalin 1000 g/ha PE *fb* HW at 20 and 50 DAS	5.11(25.4)	8.15(69.7)	9.66(95.0)	6.21(43.1)	4.64(22.6)	8.04(65.7)
Pendimethalin 1000 g/ha PE *fb* pyrithiobac-sodium 62.5 g/ha PoE	5.98(35.0)	3.93(14.7)	7.11(49.7)	15.8(267)	9.01(85.7)	18.2(352)
Pendimethalin 1000 g/ha PE *fb* pyrithiobac + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE	5.66(31.5)	4.37(18.8)	7.10(50.3)	14.6(230)	8.44(76.1)	16.8(306)
Pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha)PoE	8.42(70.0)	6.32(46.0)	10.7(116)	14.3(240)	13.6(186)	20.3(426)
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* manual weeding 50 DAS	6.24(39.2)	7.11(57.7)	9.76(96.8)	6.11(36.9)	5.82(37.2)	8.57(74.2)
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat 600 g/ha at 60 DAS	5.88(34.2)	6.06(36.0)	8.41(70.2)	10.4(121)	7.21(51.8)	12.8(173)
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS	5.08(29.4)	2.59(5.90)	5.68(35.2)	7.69(66.8)	4.44(19.6)	9.00(86.4)
Pendimethalin 1000 g/ha PE *fb* glyphosate directed spray 2000 g/ha at 45 DAS	5.31(27.4)	5.24(29.0)	7.45(56.4)	13.5(183)	7.58(57.9)	15.5(241)
Mechanical weeding (20, 40 and 60 DAS)	7.07(50.7)	6.43(47.0)	9.57(97.7)	10.5(110)	4.22(20.7)	11.4(131)
Weedy check	7.58(57.2)	4.67(22.0)	8.90(79.2)	18.1(358)	16.3(295)	25.6(653)
LSD (p=0.05)	NS	NS	NS	NS	5.64	6.45

Data in parentheses were subjected to $(\sqrt{x+1})$ transformation; Data given in parentheses are original value

Table 2. Yield and economics of cotton as influenced by integrated weed management practices

Treatment	Seed cotton yield (t/ha)	Stalk yield (t/ha)	Gross returns (x10^3 `/ha)	Additional cost over control (x10^3 `/ha)	Cost of cultivation (x10^3 `/ha)	Net returns (x10^3 `/ha)	WCE at 90 DAS (%)	Weed Index (%)	B:C ratio
Pendimethalin 1000 g/ha PE *fb* HW at 20 and 50 DAS	3.30	5.66	140.9	8.13	58.25	82.71	90	0	2.42
Pendimethalin 1000 g/ha PE *fb* pyrithiobac-sodium 62.5 g/ha PoE	2.29	4.42	98.31	4.95	55.08	43.23	44	31	1.78
Pendimethalin 1000 g/ha PE *fb* pyrithiobac + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE	2.25	4.82	97.07	6.55	56.68	40.39	52	32	1.71
Pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE	1.71	3.51	73.62	4.12	54.25	19.37	33	48	1.36
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* manual weeding 50 DAS	2.73	4.55	116.4	6.10	57.09	59.39	88	17	2.04
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat 600 g/ha at 60 DAS	2.90	5.27	124.1	5.80	55.92	68.25	72	12	2.22
Pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS	3.08	5.36	131.6	6.38	56.51	75.13	86	7	2.33
Pendimethalin 1000 g/ha PE *fb* glyphosate directed spray 2000 g/ha at 45 DAS	2.19	4.42	94.21	4.70	54.82	39.39	62	34	1.72
Mechanical weeding (20, 40 and 60 DAS)	2.78	5.01	118.9	6.00	56.13	62.86	79	16	2.12
Weedy check	0.81	1.80	35.01	0.0	50.13	-15.12	-	76	0.70
LSD (p=0.05)	0.54	0.87	-	-	-	-	-	-	-

of pendimethalin at lower dose in conjunction with hand weeding provided significantly higher seed cotton yields than application of herbicides alone at higher doses. Similarly, Ali *et al.* (2005) reported that seed cotton yield increase to the tune of 199.4% under application of pendimethalin in combination with inter-culturing and hand weeding. Among the herbicidal treatments, desired seed cotton yield was not achieved in case of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE. Similar line of results was also noticed for stalk yield. More than 79% weed control efficiency was recorded in pendimethalin 1000 g/ha PE *fb* hand weeding carried out at 20 and 50 DAS, pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* manual weeding at 50 DAS, pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS and mechanical weeding (20, 40 and 60 DAS).

Economics

Pre-emergence application of pendimethalin 1000 g/ha *fb* HW at 20 and 50 DAS recorded maximum gross, net returns and B:C ratio of ` 140900/ha, ` 827100/ha and 2.42, respectively followed by pyrithiobac + quizalofop (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate 2000 g/ha at 60 DAS, which recorded the values of ` 131600/ha, ` 75130/ha and 2.33, respectively (**Table 2**). Weedy check recorded minimum gross and net return as well as benefit cost ration as compared to other treatments.

It was concluded that pre-emergence application of pendimethalin 1000 g/ha *fb* hand weeding at 20 and 50 DAS, and post-emergence application of pyrithiobac + quizalofop (62.5 + 50 g/ha) *fb* directed spray of glyphosate 2000 g/ha were found effective for controlling weeds and increased seed cotton yield and net return with higher cost benefit ratio as compared to rest of the treatments.

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