



## RESEARCH ARTICLE

# Integrated weed management in irrigated cotton under high density planting system

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### ABSTRACT

Field experiments were conducted under irrigated condition during winter seasons of 2020-21 and 2021-22 (September to February) at Cotton Research Station, Tamil Nadu Agricultural University, Srivilliputtur to study the comparative efficacy of mechanical and chemical weed management methods in cotton. Six treatments were evaluated in a randomized block design with four replications. The treatments consisted of control (no weeding), weed free check, pre-emergence application of (PE) pendimethalin at 1.0 kg/ha followed by (*fb*) one hoeing at 45 days after sowing (DAS), pendimethalin at 1.0 kg/ha *fb* post-emergence application (PoE) of pyriithiobac-sodium at 62.5 g/ha at 25 DAS *fb* one hoeing at 45 DAS, weeding by power tiller at 25 and 45 DAS, pendimethalin PE at 1.0 kg/ha *fb* weeding by power tiller on 25 and 45 DAS. Pendimethalin PE *fb* pyriithiobac-sodium PoE *fb* one hoeing recorded the higher cotton growth and yield attributes except boll weight along with lesser weed density and biomass and higher weed control efficiency. This was on par with that of pendimethalin PE *fb* weeding by power tiller at 25 and 45 DAS and pendimethalin PE *fb* one hoeing at 45 DAS and significantly superior than weeding by power tiller at 25 and 45 DAS. Application of PE *fb* PoE herbicide *fb* one hoeing also registered the highest seed cotton yield which were comparable with that of pendimethalin *fb* weeding by power tiller at 25 and 45 DAS. The cost of cultivation was drastically reduced by mechanical weeding. The economic analysis showed that higher net income and benefit cost ratio were associated with PE herbicide application *fb* weeding by power tiller at 25 and 45 DAS followed by weeding by power tiller at 25 and 45 DAS.

**Keywords:** Cotton, Economics, Mechanical weeding, Pendimethalin, Power tiller, Pyriithiobac-sodium, Weed management

### INTRODUCTION

Cotton is the most important fibre and commercial crop of India with the largest area (41.3 per cent) of cotton in the world. However, due to its lower productivity, India's share to the total world cotton production is 25.4 per cent only. In Tamil Nadu, cotton is cultivated in an area of 1.55 lakh ha during 2020-21 with a production of 5.0 lakh bales and productivity of 548 kg/ha which is below the world average yield of 768 kg/ha (Anonymous 2021). Among the constraints of cotton production, the most troublesome is the weeds menace. Cotton is very sensitive to crop-weed competition due to slow growth during early stage and wider spacing resulting in reduction in yield of cotton of 50 to 85 per cent (Venugopalan *et al.* 2009). The labour scarcity and higher wages, are preventing farmers to timely manage weeds in cotton and hence, the chemical and mechanical weed management methods play important role. As pre-emergence herbicides effectively controlled the weeds of early stages of

crop growth, post-emergence herbicides or mechanical weeding are needed to combat the weed growth at later stages to minimize the cost of cultivation. In this context, the present study was carried out to study the combined efficacy of chemical and mechanical weed management methods in irrigated cotton under high density planting system.

### MATERIALS AND METHODS

Field experiments were conducted under irrigated condition during winter seasons of 2020-21 and 2021-22 (September to February) at Cotton Research Station, Tamil Nadu Agricultural University, Srivilliputtur. Six treatments were evaluated in a randomized block design with four replications. The treatments consisted of control (no weeding), weed free check, pre-emergence application (PE) of pendimethalin at 1.0 kg/ha followed by one hoeing on 45 (DAS), pendimethalin at 1.0 kg/ha *fb* post-emergence application (PoE) of pyriithiobac - sodium at 62.5 g/ha on 25 days after seeding (DAS) *fb* one hoeing on 45 DAS, weeding by power tiller on 25 and 45 DAS, pendimethalin PE at

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1.0 kg/ha *fb* weeding by power tiller on 25 and 45 DAS. The zero monopodial cotton variety CO 17 was used for the study. High density planting system was followed with a spacing of 100 x 10 cm with a fertilizer recommendation of 100:50:50 kg NPK/ha. The power tiller (model VST Sakthi 130 DI and width 80 cm) was used for weeding in the concerned mechanical weeding treatments. The data on weed density and biomass were recorded at 25 and 50 DAS. The weed control efficiency (WCE) and weed index (WI) were calculated as per standard formulae. The growth, yield attributes and seed cotton yield were recorded and economics was also worked out.

## RESULTS AND DISCUSSION

### Cotton growth and yield attributes

The weed control treatments caused significantly higher growth and yield attributes than control during both the years (**Table 1**). Among them, pendimethalin PE *fb* pyriithiobac-sodium PoE at 20 - 25 DAS *fb* one hoeing at 40-45 DAS recorded the highest plant height, number of monopodial branches and number of bolls per plant which were on par with that of pendimethalin PE *fb* weeding by power tiller at 25 and 45 DAS, pendimethalin PE application *fb* one hoeing at 40- 45 DAS and significantly higher than weeding by power tiller at 25 and 45 DAS. However there was no significant difference among the weed control treatments on boll weight. Favourable cotton growth and yield attributes due to weeding by power weeder was noticed by Malarkodi *et al.* (2017) and Bhoi *et al.* (2010).

### Effect on weeds

The pre-emergence herbicide application treatments registered significantly lesser weed density and biomass than without pre-emergence herbicide application at 25 DAS (**Table 2**). However,

at 50 DAS, the treatments which received hoeing recorded significantly lower weed densities than all other treatments. The effect of weeding by power tiller was significantly superior than control as evident from significantly lesser weed density with these treatments. The lower weed density under pre-emergence herbicides application followed by power tiller weeding twice might have been due to effective hindering the germination of weeds in the initial stages and reducing the density of grasses, sedges and broad-leaved weeds by pre-emergence herbicide and also by efficiently uprooting the weeds by power tiller. Similar results of lesser weed density with pre-emergence herbicide application and mechanical weeder were reported earlier by Kamble *et al.* (2017) and Hiremath *et al.* (2013). The beneficial effect of post-emergence herbicides in reducing the weed biomass in cotton was also reported by Veeraputhiran and Srinivasan (2015) and Mahar *et al.* (2007). The superiority of combination of chemical and mechanical weed management in Bt cotton was reported by Kamble *et al.* (2017), Nakala *et al.* (2019) and Patel *et al.* (2013).

The higher WCE and lesser weed index were observed with pendimethalin PE *fb* pyriithiobac-sodium PoE at 20-25 DAS *fb* one hoeing in both the time of observation (**Table 2**). The next higher WCE and lesser WI were recorded with pendimethalin PE *fb* weeding by power tiller at 25 and 45 DAS during both the years of study. Higher WCE in the above treatments was due to more effective controlling of weeds as result of lesser weed density and biomass. Beneficial effect of mechanical weeding with higher WCE was also registered by Nakala *et al.* (2019).

### Seed cotton yield

The weed management had significant impact on seed cotton yield (**Table 1**). The pendimethalin PE *fb* pyriithiobac-sodium PoE at 25 DAS *fb* one hoeing

**Table 1. Effect of weed management treatments on growth and yield of cotton**

Treatment	Plant height at 120 DAS (cm)		No. of sympodia		No. of bolls/plant		Boll weight (g)		Seed cotton yield (kg/ha)		No. of labours used for weeding	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
	Control (no weeding)	72.6	68.4	8.3	7.4	7.3	6.7	4.12	4.07	636	528	0
Weed free check	105.6	89.8	17.0	15.6	16.2	14.2	4.96	4.56	1989	1796	72	75
Pendimethalin 1.0 kg/ha PE <i>fb</i> one hoeing at 45 DAS	101.8	84.7	16.1	13.8	14.9	12.5	4.81	4.41	1897	1691	42	45
Pendimethalin 1.0 kg/ha PE <i>fb</i> pyriithiobac-sodium 62.5 g/ha PoE at 25 DAS <i>fb</i> one hoeing on 45 DAS	105.1	89.2	17.6	15.4	15.9	13.9	4.95	4.54	1956	1753	46	49
Weeding by power tiller at 25 and 45 DAS	98.5	82.6	15.3	13.3	14.3	12.0	4.76	4.36	1788	1572	12	12
Pendimethalin 1.0 kg/ha PE <i>fb</i> weeding by power tiller at 25 and 45 DAS	103.7	87.1	16.8	14.7	15.3	13.3	4.83	4.45	1908	1704	17	17
LSD (p=0.05)	10.5	9.46	2.01	1.78	1.51	1.40	0.30	0.26	135.2	115.9	-	-

PE: Pre-emergence application; PoE: Post-emergence application; DAS: Days after seeding; *fb*: Followed by

registered the highest seed cotton yield of 1956 and 1753 kg/ha during 2020-21 and 2021-22, respectively which were comparable with that of pendimethalin PE *fb* weeding by power tiller at 25 and 45 DAS (1908 and 1704 kg/ha) and pendimethalin PE *fb* one hoeing at 45 DAS (1897 and 1691 kg/ha) and significantly higher than unweeded control (636 and 528 kg/ha) and weeding by power tiller at 25 and 45 DAS (1788 and 1572 kg/ha). The higher seed cotton yield under pre-emergence herbicide application followed by weeding twice by power tiller might be due to low weeds density during initial stage and also further control of later germinated weeds by the supplemented inter cultivation using power tiller. Similar results of higher yield with integrated management of weeds in cotton by pre-emergence herbicide and mechanical weeder was reported by Tanveer *et al.* (2003), Ali *et al.* (2013), Kamble *et al.* (2017) and Malarkodi *et al.* (2017)

**Economics**

The economic analysis (Table 3) revealed that higher gross income was noticed with pendimethalin PE *fb* pyriithiobac-sodium PoE at 20-25 DAS *fb* one hoeing during both the years of study. However, higher net income, benefit cost ratio and marginal benefit cost ratio were associated with pendimethalin PE *fb* weeding by power tiller at 25 and 45 DAS followed by weeding by power tiller at 25 and 45 DAS. The cost of cultivation has drastically reduced by mechanical weeding. As compared to pendimethalin PE *fb* one hoeing at 40- 45 DAS, reduction in cost of cultivation of Rs 6860 and Rs 7060/ha during 2020-21 and 2021-22 was observed by pendimethalin PE *fb* power tiller weeding at 25 and 45 DAS. Higher total income net income and B:C under the treatments were as a result of corresponding higher seed cotton yield confirming the reports by Kamble *et al.* (2017), Bhoi *et al.* (2010) and Malarkodi *et al.* (2017).

**Table 2. Effect of weed management treatments on weed density and biomass, weed control efficiency and weed index of cotton**

Treatment	Total weed density (no/m <sup>2</sup> )				Total weed dry weight (g/m <sup>2</sup> )				Weed control efficiency (WCE) (%)				Weed index	
	2020-21		2021-22		2020-21		2021-22		2020-21		2021-22		2020-21	2021-22
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS		
Control (no weeding)	504.7 (22.5)	509.6 (22.6)	410.2 (20.3)	131.5 (20.8)	92.2 (9.6)	130.5 (11.4)	80.6 (9.0)	110.7 (10.5)	0	0	0	0	68.02	70.60
Weed free check	0	0	0	0	0	0	0	0	100.0	100.0	100.0	100.0	0	0
Pendimethalin 1.0 kg/ha PE <i>fb</i> one hoeing at 45 DAS	96.0 (9.8)	46.9 (6.9)	990.3 (9.5)	40.2 (22.5)	9.6 (3.2)	5.8 (2.5)	7.7 (2.9)	5.1 (2.4)	89.58	95.56	90.45	95.39	4.62	5.84
Pendimethalin 1.0 kg/ha PE <i>fb</i> pyriithiobac-sodium 62.5 g/ha PoE on 25 DAS <i>fb</i> one hoeing at 45 DAS	90.5 (9.5)	29.6 (5.5)	85.4 (9.3)	26.8 (22.5)	9.8 (3.2)	4.1 (2.1)	6.5 (2.6)	4.2 (2.2)	92.62	96.86	91.93	96.20	1.66	2.44
Weeding by power tiller at 25 and 45 DAS	478.2 (2.9)	112.0 (10.6)	423.1 (20.6)	146.3 (22.5)	90.5 (9.5)	17.9 (4.3)	14.4 (3.9)	17.0 (4.2)	1.84	86.23	82.13	84.64	10.10	10.47
Pendimethalin 1.0 kg/ha PE <i>fb</i> weeding by power tiller at 25 and 45 DAS	95.6 (9.8)	109.3 (10.5)	89.6 (9.5)	94.5 (22.5)	10.2 (3.3)	14.6 (3.9)	12.1 (3.5)	14.5 (3.9)	86.77	88.81	84.99	86.90	4.07	5.12
LSD(p=0.05)	20.74	19.22	19.47	17.69	6.26	6.74	5.27	5.78	-	-	-	-	-	-

Figures in parentheses indicate  $\sqrt{x+0.5}$  value; PE: Pre-emergence application; PoE: Post-emergence application; DAS: Days after seeding; *fb*: Followed by

**Table 3. Effect of weed management treatments on economics of cotton cultivation**

Treatment	Cost of cultivation (x10 <sup>3</sup> /ha)				Gross income (x10 <sup>3</sup> /ha)	Net income (x10 <sup>3</sup> /ha)	Benefit Cost ratio		Marginal Benefit Cost ratio					
	Common		Treatment				2020-21	2021-22	2020-21	2021-22	2020-21	2021-22		
	2020-21	2021-22	2020-21	2021-22										
Control (no weeding)	53.20	55.40	0	0	53.20	55.40	33.07	43.30	-20.13	-12.10	0.62	0.78	0	0
Weed free check	53.20	55.40	20.36	21.08	73.56	76.48	103.43	147.27	29.87	70.79	1.41	1.93	1.42	3.36
Pendimethalin 1.0 kg/ha PE <i>fb</i> one hoeing at 45 DAS	53.20	55.40	12.00	13.00	65.20	68.40	98.64	138.66	33.44	70.26	1.51	2.03	2.78	5.40
Pendimethalin 1.0 kg/ha PE <i>fb</i> pyriithiobac-sodium 62.5 g/ha PoE on 25 DAS <i>fb</i> one hoeing at 45 DAS	53.20	55.40	15.75	16.75	68.95	72.15	101.71	143.75	32.76	71.60	1.48	1.99	2.08	4.27
Weeding by power tiller at 25 and 45 DAS	53.20	55.40	5.25	6.05	58.45	61.45	92.98	128.90	34.53	67.45	1.59	2.10	6.58	11.15
Pendimethalin 1.0 kg/ha PE <i>fb</i> weeding by power tiller at 25 and 45 DAS	53.20	55.40	8.89	9.69	62.09	65.09	99.22	139.73	37.13	74.64	1.60	2.15	4.17	7.70

Thus, it may be concluded that economical weed management and higher cotton yield are obtainable with pre-emergence application of pendimethalin 1.0 kg/ha followed by weeding by power tiller at 25 and 45 DAS in winter irrigated cotton under high density planting system.

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