Indian Journal of Weed Science **51**(1): 50–53, 2019

Print ISSN 0253-8040 Online ISSN 0974-8164

Weed management effects on cotton growth and yield

K. Nalini*[1] and C. Chinnusamy

Department of Agronomy, TNAU, Coimbatore, Tamil Nadu 641 003, India

[1]Veterinary College and Research Institute, TANUVAS, Tirunelveli, Tamil Nadu 627 358, India

**Email: naliniagr@gmail.com*

Article information

DOI: 10.5958/0974-8164.2019.00011.X

Type of article: Research article

Received : 28 November 2018
Revised : 19 January 2019
Accepted : 28 January 2019

Key words
Cotton
Economics
Weed management
Yield

ABSTRACT

Field experiments were conducted during winter seasons of 2008-09 and 2009-10 at Eastern Block Farm, Tamil Nadu Agricultural University, Coimbatore to study the efficiency of new formulation of pre-emergence herbicide pendimethalin 38.7% on growth and development of cotton with better weed management in a cost effective manner, under irrigated condition. Pendimethalin 38.7% was tried in four different doses, *viz*. 1.5, 2.0, 2.5 and 4.0 kg/ha and it was compared with pendimethalin 30% 1.0 kg/ha, early post-emergence herbicide trifloxysulfuron, power weeders and hand weeding. The pre-emergence application of pendimethalin (38.7%) at 2.0 kg/ha at 3 days after seeding (DAS) followed by hand weeding and earthing at 45 DAS did not show any phytotoxic effect on cotton and recorded lower weed density and biomass with increased the seed cotton yield by about 41.5% over unweeded control and higher net returns.

INTRODUCTION

Cotton the "*white gold* or the *king of fibres*" is one of the most important commercial crops in India. In India, cotton cultivation provides livelihood for over 4 million farming families. It produces only 3.77 million bales of lint every year with a productivity of 524 kg/ha (ICAR, Annual report, 2017-18. The key role that cotton plays in our country can be gauged that nearly 15 million farmers spread out in more than 10 states are dependent on cotton cultivation (Prasad and Prasad 2009).

Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to an extent of 40 to 85% (Sreenivas 2000, Gnanavel and Babu 2008). Weeds which emerge with cotton plants offer a severe competition and bring about considerable reduction in seed cotton yield. Reduction in seed cotton yield under irrigated conditions is primarily due to nutrient depletion caused by weeds and may vary over from 10-90 per cent (Singh 1988). Cotton with minimal weed competition during the initial phase *ie*., three to five weeks would yield better (Mohamed Ali and Bhanumurthy 1985). Thus, there is need for selection of new molecules of pre-emergence to control weeds during initial crop period.

MATERIALS AND METHODS

Field experiments were laid out in Field No. 73 and 36C during winter seasons of 2008-09 and 2009-10, respectively in Eastern Block farm of Tamil Nadu Agricultural University, Coimbatore. The farm is situated at 11° North latitude and 77° East longitude at an altitude of 426.72 m above Mean Sea Level. The mean annual rainfall of Coimbatore is 670.6 mm distributed in 47 rainy days. The mean maximum and minimum temperatures are 30.6 and 20.9°C, respectively. During winter 2008-09, maximum temperature during the cropping period ranged from 27°C to 34.7°C with a mean of 30.9°C. The minimum temperature ranged from 14^{0}C to 24.5°C with a mean of 20.6°C. The relative humidity ranged from 71 to 98% with a mean of 87.9%. A total rainfall of 321.1 mm was received in 18 rainy days during the cropping period. During winter 2009-10, maximum temperature during the cropping period ranged from 27.2°C to 33.2°C with a mean of 30.6°C. The minimum temperature ranged from 14.5°C to 24.7°C with a mean of 22.26°C. The relative humidity ranged from 70 to 97% with a mean of 87%. A total rainfall of 516.8 mm was received in 27 rainy days during the cropping period The soils of the experimental sites were sandy clay loam in texture with low in available nitrogen, medium in available phosphorus and high in available potassium. The field was irrigated once in a week and depend on the climatic condition.

The experiment was laid out in a randomised blocks design with three replications. The treatments were allotted at random in each replication. The weed management practices evaluated in the present study consisted of chemical weed control (application of pre-emergence, Pre-emergence application on 3rd day after sowing and early post-emergence herbicides, early post-emergence was applied 10 days after sowing), cultural practices (mulching with straw) and manual weeding (hand weeding once and twice) and weed free situation (hand weeding 10 times) and unweeded control. The weed management practices tested include: pendimethalin PE at 1.5, 2.0, 2.5 and 4.0 kg/ha followed by (*fb*) hand weeding (HW), pendimethalin PE at 1.0 kg/ha *fb* HW, trifloxysulfuron at 10 g/ha early post-emergence (EPoE) *fb* HW, pendimethalin PE at 1.0 kg/ha *fb* PWW, pendimethalin at 1.0 kg/ha *fb* CRM + HW, PWW on 25 and 45 DAS, hand weeding twice at 25 and 45 DAS, weed free and unweeded checks were included. The soils of the experimental sites were sandy clay loam in texture with low in available nitrogen, medium in available phosphorus and high in available potassium. Cotton (*Gossypium hirsutum* L.) variety MCU 13 was raised during winter season of 2008-09 and Thulsi Bt during 2009-10.

RESULTS AND DISCUSSION

Effect on weed

Pendimethalin (38.7%) at 2.0 to 4.0 kg/ha *fb* one hand weeding at 45 DAS 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 coleoptile and shoot of the seedling below the ground. (Vencill 2002) Thus, grasses were effectively controlled with this herbicide. The left over weeds were controlled by manual weeding at 45 DAS. Application of pendimethalin at higher dose of 1.5 kg/ha recorded weed density when compared to lower doses as was reported by Chander *et al.* 1997.

Weed biomass depicted a similar response as the weed density in various treatments. The reduced weed density under pendimethalin (38.7%) at 2.0 to 4.0 kg/ha had resulted in reduced weed biomass at all the stages of crop growth. This might be attributed to rapid depletion of carbohydrate reserve of the weeds through rapid respiration (Prakash *et al.* 1999). The biomass of grasses, sedges and broad-leaved weeds were reduced due to different weed management treatments. Panwar *et al.* (2001) also reported that application of pendimethalin at 1.0 kg/ ha has reduced weed density and biomass significantly over the unchecked weed growth.

Cotton growth attributes

Pendimethalin 2.0 kg/ha *fb* hand weeding recorded higher plant height and was closely followed by pendimethalin 2.5 kg/ha *fb* hand weeding. This might be due to better weed control in the above treatments which resulted in efficient utilization of light, water and nutrients than other treatments. Unchecked weed growth in unweeded control reduced the plant height. This was attributed to suppressing effect of weeds on crop plants (Chander *et al*. 1997). Heavy weed competition reduced the nutrient uptake by crop and reduced the growth of crop as evidenced from the lowest plant height in unweeded control (Balasubramanian 1985).

Leaf area index, an important growth parameter which decides the photosynthetic activity and the dry matter production of crop. Among different weed management methods, the cotton with pendimethalin 2.0 kg/ha *fb* hand weeding treatment had higher leaf area index followed by pendimethalin 2.5 kg/ ha *fb* hand weeding due to increased WCE and reduced weed density. The next best treatment was pendimethalin 1.0 kg/ ha *fb* hand weeding at 45 DAS.

Table 1. Effect of treatments on total weed density and biomass at 25 DAS

Treatment	Weed density (no./m^2)		Weed biomass (kg/ha)	
	Winter 2008-09	Winter 2009-10	Winter 2008-09	Winter 2009-10
Pendimethalin 1.5 kg/ha *fb* hand weeding (HW)	10.14(34.7)	9.81(33.1)	10.54(111.1)	8.16(66.7)
Pendimethalin 2.0 kg/ha *fb* HW	8.27(23.2)	7.91(21.8)	8.34(69.5)	5.71(32.6)
Pendimethalin 2.5 kg/ha *fb* HW	8.26(23.0)	7.79(21.3)	8.31(69.0)	5.45(29.7)
Pendiimethalin 4.0 kg/ha *fb* HW	7.98(21.5)	7.65(20.4)	8.25(68.1)	5.25(27.5)
Pendiimethalin 1.0 kg/ha *fb* HW	10.44(36.8)	10.04(34.5)	10.92(119.3)	8.40(70.6)
Trifloxysulfuron 10 g/ha EPoE *fb* HW	11.83(58.0)	11.36(51.6)	10.91(118.9)	11.76(138.2)
Pendiimethalin 1 kg/ha *fb* PWW	10.66(38.6)	10.13(35.3)	11.05(122.2)	8.56(73.2)
Pendiimethalin 1 kg/ha *fb* CRM *fb* HW	10.75(39.3)	10.17(35.8)	10.88(118.4)	8.55(73.0)
PWW at 25 and 45 days after sowing	17.25(102.4)	17.03(100.6)	21.60(466.6)	20.20(408.0)
HW at 25 and 45 days after sowing	17.53(106.7)	16.52(94.7)	20.98(440.3)	19.93(397.1)
Weed free check	6.52(14.5)	6.48(14.6)	3.02(9.1)	2.75(7.6)
Unweeded control	18.19(114.5)	17.68(108.6)	22.38(500.8)	20.51(420.5)
LSD (p=0.05)	0.73	0.70	1.46	1.18

PE = Pre-emergence application; EPoE =Early post-emergence PWW= Power weeder weeding CRM= Crop residue mulch

This might be probably due to better control of grasses and broad-leaved weeds. Unweeded control recorded the least LAI of cotton after 30 DAS due to severe weed competition for light and nutrient resulting in the production of small leaves and thus leading to the reduction in leaf area (Muruganandam 1984).

Lesser weed crop competition of the crop and more conservation of the soil moisture, nutrient and space resulted in better vegetative growth and dry matter production (DMP) of crop under effective weed control treatments. Pendimethalin 2.0 and 2.5 kg/ha *fb* hand weeding showed higher cotton biomass over other herbicide treatments. This might be due to effective control of weeds at critical stages and suppression of late emerged weeds by vigorous growth of cotton crop. Among the weed management treatments, pendimethalin 4.0 kg/ha *fb* hand weeding produced lesser biomass. The reason might be due to the initial phytotoxicity of the herbicide to the crop resulted in lesser biomass. Unweeded control registered lowest biomass due to the competition by excessive weed growth. Similar finding of decrease in cotton biomass by increased weed density under ineffective weed management practices was reported by Bhoi *et al*. (2007).

Application of pendimethalin 2.5 kg/ha *fb* hand weeding recorded higher NPK uptake by cotton at 30 DAS. In the remaining stages, pendimethalin 2.0 kg/ha *fb* hand weeding enhanced the uptake of nutrients. This might be due to better control of broad-leaved weeds and sedges during early stages of crop growth, which favoured the crop to utilize the available nutrients. Due to higher weeds biomass in this treatment the crop uptake of NPK was lesser than other treatments. Similar finding of decrease in dry matter production of cotton by increased weed density with ineffective weed control situation was reported by Singh (1983).

Yield attributes

Application of pendimethalin at 2.0 kg/ha + hand weeding recorded more number of bolls/plant and was closely followed by pendimethalin at 2.5 kg/ha + hand weeding. This was in accordance with the findings of Nehra *et al.* (1988). Unweeded control treatment recorded lesser boll weight due to season long infestation of weeds.

Table 2. Effect of weed management treatments on cotton plant height, leaf area index and dry matter production

Treatment	Plant height (cm) (60 DAS)		Leaf area index (60 DAS)		Biomass (kg/ha) (60 DAS)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Pendimethalin 1.5 kg/ha *fb* hand weeding (HW)	36.63	55.43	0.82	1.06	1776	1881
Pendimethalin 2.0 kg/ha *fb* HW	44.23	63.06	0.89	1.13	1982	2116
Pendimethalin 2.5 kg/ha *fb* HW	41.00	57.40	0.87	1.11	1963	2059
Pendiimethalin 4.0 kg/ha *fb* HW	28.65	44.00	0.66	0.90	1691	1522
Pendiimethalin 1.0 kg/ha *fb* HW	36.49	54.74	0.80	1.04	1763	1866
Trifloxysulfuron 10 g/ha EPoE *fb* HW	34.78	52.49	0.82	1.06	1722	1768
Pendiimethalin 1 kg/ha *fb* PWW	35.50	56.55	0.78	1.02	1789	1857
Pendiimethalin 1 kg/ha *fb* CRM *fb* HW	34.63	55.40	0.80	1.04	1756	1827
PWW at 25 and 45 days after sowing	28.15	48.95	0.73	0.97	1600	1627
HW at 25 and 45 days after sowing	43.03	58.89	0.90	1.14	1966	2089
Weed free check	46.63	67.30	1.12	1.26	2163	2358
Unweeded control	23.20	44.43	0.60	0.84	1454	1506
LSD (p=0.05)	7.55	5.28	0.07	0.064	182	250

Table 3. Effect of weed management treatments on cotton N, P and K uptake

Treatment	Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)		Potassium uptake (kg/ha)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Pendimethalin 1.5 kg/ha *fb* hand weeding (HW)	13.57	14.38	3.71	3.93	20.05	21.24
Pendimethalin 2.0 kg/ha *fb* HW	15.65	16.71	4.36	4.65	23.54	25.13
Pendimethalin 2.5 kg/ha *fb* HW	14.69	15.41	4.15	4.36	22.45	23.55
Pendiimethalin 4.0 kg/ha *fb* HW	12.50	11.05	3.16	2.79	17.07	15.09
Pendiimethalin 1.0 kg/ha *fb* HW	14.46	15.08	3.66	3.82	19.78	20.63
Trifloxysulfuron 10 g/ha EPoE *fb* HW	12.75	13.32	3.37	3.52	18.20	19.03
Pendiimethalin 1 kg/ha *fb* PWW	13.05	13.75	3.39	3.57	18.33	19.30
Pendiimethalin 1 kg/ha *fb* CRM *fb* HW	14.76	15.35	3.37	3.51	18.23	18.96
PWW at 25 and 45 days after sowing	13.12	13.33	3.07	3.12	16.61	16.88
HW at 25 and 45 days after sowing	12.70	13.49	4.16	4.42	22.49	23.90
Weed free check	16.43	17.92	4.82	5.26	26.07	28.42
Unweeded control	9.96	10.32	2.40	2.48	12.96	13.42
LSD (p=0.05)	2.91	3.05	0.79	0.83	4.29	4.51

PE = Pre emergence application; EPoE =Early post-emergence PWW= Power weeder weeding CRM= Crop residue mulch

Table 4. Effect of weed management treatments on yield attributes and yield of cotton

Treatment	Winter 2008-09			Winter 2009-10		
	No. of bolls/plant	Boll weight (g/boll)	Seed cotton yield (t/ha)	No. of bolls/plant	Boll weight (g/boll)	Seed cotton yield (t/ha)
Pendimethalin 1.5 kg/ha *fb* hand weeding (HW)	18.64	3.80	1.38	33.14	4.84	2.60
Pendimethalin 2.0 kg/ha *fb* HW	22.55	4.00	1.67	37.05	5.07	3.27
Pendimethalin 2.5 kg/ha *fb* HW	20.67	3.97	1.52	35.17	5.04	2.94
Pendiimethalin 4.0 kg/ha *fb* HW	14.40	3.20	1.32	28.90	4.23	2.47
Pendiimethalin 1.0 kg/ha *fb* HW	18.40	3.90	1.49	32.90	4.67	2.83
Trifloxysulfuron 10 g/ha EPoE *fb* HW	18.23	3.75	1.44	32.73	4.82	2.79
Pendiimethalin 1 kg/ha *fb* PWW	17.45	3.78	1.34	31.95	4.85	2.55
Pendiimethalin 1 kg/ha *fb* CRM *fb* HW	18.57	3.60	1.33	33.07	4.67	2.58
PWW at 25 and 45 days after sowing	16.60	3.79	1.30	31.10	4.88	2.33
HW at 25 and 45 days after sowing	22.50	3.50	1.66	37.00	4.92	3.24
Weed free check	26.46	4.10	1.82	40.96	5.17	3.50
Unweeded control	10.00	2.90	0.98	24.50	3.97	1.62
LSD (p=0.05)	3.85	0.12	0.14	1.78	0.18	0.22

PE = Pre-emergence application; EPoE =Early post-emergence PWW= Power weeder weeding CRM= Crop residue mulch

Seed cotton yield

Due to heavy infestation of weeds under unweeded check, there was 32 to 58% reduction in seed cotton yield. Hand weeding twice recorded lower seed cotton yield during winter season due to poor control of grasses and broad-leaved weeds. During both 2008-09 and 2009-10, the maximum seed cotton yield of (1.67 t/ha and 3.27 t/ha, respectively) was registered with the application of pendimethalin 2.0 kg/ha + HW and the yield under this treatment was comparable with hand weeding twice (1.66 t/ha and 3.24 t/ha, respectively). The yield increase under pendimethalin 2.0 kg/ha + HW was 9.6, 10.5 and 13.5% in 2008-09 and 10.1, 13.3 and 14.6% in 2009-10, over pendimethalin 2.5 kg/ha + HW, pendimethalin 1.0 kg/ha + HW and trifloxy-sulfuron 10 g/ha + HW, respectively during 2008-09. Pendimethalin at 2.0 kg/ha + hand weeding recorded 41.5 and 50% higher seed cotton yield of over unweeded control during 2008-09 and 2009-10, respectively. Application of pendimethalin at 1.0 kg/ha in combination with inter culturing plus hand weeding gave 199.4 per cent increase in seed cotton yield over untreated check was reported by Ali *et al*. (2005). Gnanavel and Babu (2008) also reported maximum seed cotton yield with pendimethalin and fluchloralin combination coupled with hand weeding as compared with control. Due to heavy infestation of weeds under unweeded check, there was 32 to 58% reduction in seed cotton yield.

REFERENCES

Ali H, Muhammad D and Abid SA. 2005. Weed control practices in cotton planted in beds and furrow. *Pakistan Journal of Weed Science Research* **11**(1-2): 43–48.

Anonymous. 2008. Cotton Corporation of India. http://cotcorp.gov.in/national_ cotton.asp.

Balasubramanian N. 1985. *Studies on Integrated Weed Management in Irrigated High Intensity Cropping System. Sorghum + Pulse - Finger Millet - Cotton + Pulses*, Ph.D. Thesis**,** Tamil Nadu Agric. Univ., Coimbatore, India.

Bhoi S, Lakpale R, Nanda HC and Shrivastava GK. 2007. Effect of weed management practices on productivity and economics of hybrid cotton in vertisols of Chhasttisgarh plains. *Journal of Agricultural Issues* **12**(2): 118–121.

Chander S, Panwar BS, Katyal SK and Mahendra Singh. 1997. Growth pattern of American cotton (*Gossypium hirsutum*) and weeds as affected by herbicides and fertility levels. *Indian Journal of Weed Science* **29**(3&4): 185–188.

Gnanavel I and Babu S. 2008. Integrated weed management in irrigated hybrid cotton. *Agriculture Science Digest* **28**(2): 93–96.

Mohamed Ali A and Bhanumurthy VB. 1985. *Trianthema portulacastrum* L. under irrigated conditions. *Tropical Pest Management* **31**(3): 232–234.

Muruganandam CK. 1984. Integrated weed management in cotton based cropping system. *M.Sc (Ag.) Thesis***,** Tamil Nadu Agric. Univ., Coimbatore, Tamil Nadu, India.

Nehra DS, Bishnoi LK, Kairon MS, Sharma BD and Malik RK. 1988. Chemical weed control in cotton (*Gossypium hirsutum* L.). *Cotton Development* **13**(3/4): 32–35.

Panwar RS, Malik RS, Rathi SS and Malik RK. 2001. Chemical weed control in cotton. *Indian Journal of Weed Science* **33**(1/2): 14–17.

Prakash V, Pandey AK, Singh P, Chandra S, Chauhan VS and RD Singh. 1999. Integrated weed management in tomato under north-western Himalaya. *Crop Research* **17**(3): 345–350.

Prasad VR and Prasad YE. 2009. Study of economics of cotton and its competing crops in Guntur district of Andra Pradesh. *Mysore Journal of Agricultural Sciences* **43**(2): 234–238.

Singh G. 1988. Development and fabrication techniques of improved grubher. Agricultural mechanization in Asia, *Africa and Latin America* **19** (2): 42–46.

Singh JN. 1983. Mechanical and chemical weed control in cotton. *Indian Journal of Weed Science* **15**: 69–71.

Sreenivas G. 2000. Effect of application of glyphosate with or without other pre-emergence herbicides in rainfed American cotton (*Gossypium hirsutum* L.). *Indian Journal of Weed Science* **32**(1/2): 98–100.

Vencill WK. 2002. *Weed Science Society of America Herbicide Handbook*, 8th ed. Lawrence, KS. Pp. 231–234.