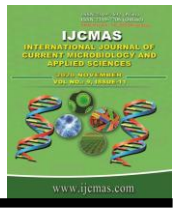
Int.J.Curr.Microbiol.App.Sci (2020) *9*(11): 1021-1029

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 11 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.911.120

Eco-friendly Weed Management Strategies for High Density Planting System Cotton in *Vertisol* of Northern Karnataka

Kamble Anand Shankar*, A. S. Channabasavanna, M. Y. Ajayakumar, Koppalkar, B. G. Mahadevswamy and A. Amaregouda

University of Agricultural Sciences, Raichur, Karnataka, India

**Corresponding author*

Keywords

Eco-friendly Weed management, High density planting

Article Info

Accepted:
10 October 2020
Available Online:
10 November 2020

A B S T R A C T

Field experiment was conducted to study the efficiency of new formulation of pre-emergence herbicide clomazone 50 EC for weed management in HDPS cotton. Clomazone 50 EC was tested at different doses, @ 250, 500 and 750 g *a.i.* ha^{-1} and compared with Pendimethalin @ 680 g *a.i.* ha^{-1}, Pyrithiobac sodium 10 EC and Quizalofop ethyl 5 EC @, cultural; method like one HW at 25 DAS and IC at 50 and 75 DAS, weed free check and other integrated methods. Application of Clomazone 50 EC @ 250 g *a.i.* ha^{-1} not showed phytotoxic injury to the germinating cotton and recorded lower weed density and biomass. It has resulted increased seed cotton yield of 38.5 % over unweeded control and higher net returns. Application of Clomazone 50 EC @ 250 g *a.i.* ha^{-1} PE *fb* HW at 25 DAS and IC at 50 and 75 DAS is ideal for better weed control efficiency is good integrated weed control practice.

Introduction

Cotton (*Gossypium sp.*) is popularly known as "the white gold or the king of fibre crops" ranks fifth in area and third in production of cotton after USA and China. The productivity of cotton is 505.46 kg/ha much lower than the world average (621 kg/ ha). Among the cotton growing states, Karnataka ranks eighth with an area (5.46 lakh ha) and seventh in production with 18.0 lakh bales of lint with an average productivity of 560.44 kg of lint per ha (Anon., 2018). The high density planting system (HDPS) is now being conceived as an alternate production system having a potential for improving productivity and profitability, increasing efficiency, reducing input costs and minimizing risks associated with India's cotton production system. Of many problems faced by the cotton growers, the most troublesome one is the control of weeds particularly during early stages of crop growth. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to an extent 50 to 85 per cent (Venugopalan *et al.,* 2009). Thus, if proper weed control measures are followed, there would be greater availability of nutrients and moisture for the benefit of crop (Jalis and Shah, 1982). Cotton with minimal weed competition during the initial phase *i.e*., 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. Thus, there is need for selection of new molecules of pre-emergence to control weeds during initial crop period.

Materials and Methods

Experiment was conducted in 2017 and 2018 at Department of Agronomy, College of Agriculture, UAS, Raichur. The soil of the experimental site is medium black with clay loam texture. During the crop growth period in 2017 the amount of rainfall received during cropping season was 874.2 mm in 47 rainy days. In 2018 total rainfall received during the cropping period was 216.1 mm in 20 rainy days. Experiment was laid out in Randomized Completely Block Design with three replications. Cotton variety Suraj was selected for the study in both the years. Seeds were hand dibbled at a spacing of 60 cm x 20 cm. Crops were planted in July and August months in 2017 and 2018 respectively. Treatments consist of Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE followed by (*fb*) HW at 25 DAS and IC at 50 and 75 DAS, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} at 25 DAS as POE, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as POE, Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE *fb* Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25DAS as POE, One HW at 25 DAS and IC at 50 and 75 DAS, weed free check and unweeded control.

Pre-emergent herbicides were applied at planting and post emergent herbicides are applied at 25 DAS and hand weeding was done at 25 DAS as per treatments. Intercultivation was done on50 and 75 DAS as per the treatment schedules. Rest of the production practices were followed as per the University package of practices recommended for the region.

Observations on weed density, weed dry weight, growth and yield attributes weed control efficiency (WCE), weed Index (WI) and economics were analysed following the procedure given by Gomez and Gomez (1984) for RCBD. The data pertaining to weeds were transformed to square root scale of $\sqrt{(X+1)}$ and analysed as suggested by Snedecor and Cochran (1967). Whenever significant difference existed, critical difference was constructed at 5 per cent probability level. That treatment, where the difference was not significant was denoted as NS.

Results and Discussion

Weed density

Pre emergence application of clomazone 50 EC @ 250 g *a.i.* ha^{-1} (4.4) were on par with each other and recorded significantly lower total weed population. Further, increase in clomazone 50 EC from 250 to 750 g *a.i.* ha^{-1} did not show any significant differences. It was on par with application of pre emergence application of pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} (4.7). This was due to better control of all weed species by causing discolouring or whitening on target weed plants which enters through roots and emerging shoots and was transported with the transpiration stream in the xylem and inhibits the carotenoid synthesis. This results impaired chloroplast development and pigment loss in susceptible plants and showed necrosis after coming into contact with sunlight (Veeramani *et al.*, 2008). The left over weeds were controlled by hand weeding at 25 DAS and inter cultivation at 50 and 75 DAS.

Weed dry weight depicted a similar response as the total weed population in various treatments. The reduced weed density under clomazone 50 EC at 250 to 750 g *a.i.* ha^{-1} 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) (Table 1).

The biomass of grasses, sedges and broad-leaved weeds were reduced due to different weed management treatments. Madavi *et al.*, (2017) also reported reduction in weed dry weight by sequential application of pendimethalin as PE *fb* PoE pyrithiobac sodium + quizalofop ethyl was might be due to better weed control by tank mix combination of these PoE weedicides.

Weed control efficiency

The application pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE or clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE were recorded higher weed control efficiency which was attributed to effective suppression of weeds by pre emergence application of pendimethalin or clomazone at early growth stage of cotton. During 50 DAS and on wards maximum weed control efficiency was noticed with the combined application of pre emergence and post emergence herbicides. This may be attributed to effective control of weeds at early stage of growth (0-25 DAS) by pre emergence application of herbicides *viz*., pendimethalin or clomazone and later stages (after 25 DAS) by post emergence application of pyrithiobac sodium and quizalofop ethyl. Hence, application of post emergence herbicides controlled the later germinated weeds (Hiremath *et al.*, 2013 and Rajendrakumar, 2015). Thus, sequential use of pre emergent herbicides along with post emergent herbicides controlled weeds in the cotton field effectively (Table 2).

Yield attributes

Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE (14.4 cm) and clomazone 50 EC @ 250 *a.i.* ha^{-1} as PE (14.5 cm) were on par with weed free check. Increase in clomazone 50 EC @ 250 or 500 g *a.i.* ha^{-1} did not show any significant differences. 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).

The increased number of sympodials $plant^{-1}$ with the application of pre emergence herbicide, clomazone 50 EC @ 250 or 500 g *a.i.* ha^{-1} as PE with HW at 25 DAS and IC at 50 and 75 DAS and combined application of pre and post emergence herbicides was due to improvement in growth attributes such as monopodials per plant, leaf area index and total dry matter production (Table 3 and 4).

Significantly more number of bolls $plant^{-1}$ was recorded in weed free check (T_{13}: 1.8 $plant^{-1}$) and was on par with the pre emergence application of pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} (1.5) and clomazone 50 EC @ 250 g *a.i.* ha^{-1} or 500 g *a.i.* ha^{-1} with or without pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} were significantly superior over unweeded control. 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.1 Total weed density and dry weight at different growth stages in eco-friendly weed management through chemical approaches in HDPS cotton

Treatments	Total weed density (no. m^{-2})				Weed dry weight (g m^{-2})			
	25 DAS	50 DAS	75 DAS	100 DAS	25 DAS	50 DAS	75 DAS	100 DAS
Pendimethalin 38.7 CS @ 680 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	4.7 (20.7)	5.5 (29.7)	5.5 (29.3)	5.7 (31.7)	2.43 (4.93)	7.41 (54.1)	8.45 (70.4)	**9.3 (85.9)**
Clomazone* 50 EC @ 250 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	4.4 (18.7)	5.3 (28.0)	6.1 (37.0)	5.2 (26.0)	2.39 (4.71)	6.29 (39.0)	7.30 (53.0)	**9.4 (87.1)**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	4.3 (18.0)	4.8 (22.7)	5.5 (29.7)	5.2 (27.0)	2.41 (4.83)	5.67 (31.2)	7.46 (54.7)	**8.9 (78.2)**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	4.4 (18.3)	5.6 (30.7)	6.1 (36.7)	5.6 (30.0)	2.38 (4.93)	6.45 (40.6)	8.40 (69.6)	**9.4 (86.9)**
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* pyrithiobac sodium¥ 10EC 75 g *a.i.* ha^{-1} at 25 DAS	4.7 (20.7)	5.7 (32.3)	6.0 (35.3)	5.3 (27.3)	2.33 (4.48)	5.82 (33.0)	7.35 (54.7)	**8.9 (78.5)**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	4.3 (17.7)	4.8 (23.3)	5.6 (31.0)	5.4 (28.3)	2.32 (4.56)	5.44 (29.4)	7.29 (52.4)	**9.0 (79.8)**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	4.9 (23.3)	5.6 (30.3)	5.5 (29.3)	5.7 (32.3)	2.35 (4.55)	6.78 (45.2)	7.20 (52.4)	**8.9 (79.0)**
Clomazone 50 EC @ 250 g *a.i.*/ha *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS¥	5.0 (24.7)	5.1 (25.3)	5.9 (34.0)	6.0 (35.3)	2.47 (5.12)	6.60 (42.7)	7.06 (49.4)	**8.5 (71.2)**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	4.0 (15.0)	5.1 (25.0)	5.0 (23.7)	5.7 (31.3)	2.45 (5.04)	5.81 (32.8)	7.18 (50.7)	**8.0 (62.5)**
Clomazone 50 EC @ 750 g *a.i.* ha_{-1} *fb* pyrithiobac sodium 10 EC @75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	4.4 (18.7)	5.4 (29.0)	4.8 (22.7)	5.4 (29.0)	2.49 (5.19)	6.65 (43.4)	7.31 (52.6)	**9.1 (82.4)**
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	4.3 (17.3)	4.2 (17.3)	5.2 (25.7)	5.5 (29.0)	2.53 (5.42)	6.95 (48.0)	7.62 (57.1)	**9.0 (79.3)**
HW at 25 DAS and IC at 50 and 75 DAS	6.9 (47.3)	4.5 (19.7)	5.7 (31.3)	5.3 (27.7)	3.12 (8.75)	7.00 (49.5)	7.78 (59.7)	**9.2 (84.1)**
Weed free check	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.00 (0.00)	1.00 (0.00)	1.00 (0.0)	**1.0 (0.0)**
Unweeded control	8.9 (78.7)	9.3 (86.7)	10.7 (113.0)	10.8 (114.7)	3.51 (11.3)	12.54 (156.2)	13.66 (186.0)	**16.2 (262.1)**
S.Em.±	0.7	0.5	0.5	0.6	0.14	0.41	0.42	**0.26**
CD at 5%	**2.2**	**1.5**	**1.5**	**1.7**	**0.42**	**1.20**	**1.23**	**0.76**

* Figures in parenthesis indicate original values ** Values are square root transformed √x+1

Table.2 Weed control efficiency (%) at different growth stages in eco-friendly weed management through chemical approaches in HDPS cotton

Treatments	25 DAS	50 DAS	75 DAS	100 DAS	125 DAS	At harvest
Pendimethalin 38.7 CS @ 680 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	56.1	65.2	61.7	66.4	70.8	**75.3**
Clomazone* 50 EC @ 250 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	58.1	74.9	71.1	66.9	72.8	**76.6**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	56.8	79.9	70.3	69.7	73.3	**77.9**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	54.9	74.0	62.2	66.3	72.4	**74.7**
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	60.6	78.7	69.5	69.8	74.7	**74.5**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	60.5	80.9	71.5	69.2	75.9	**79.0**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	59.1	71.1	71.1	69.9	75.3	**76.7**
Clomazone 50 EC @ 250 g *a.i.*/ha *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS¥	54.1	72.6	73.1	72.5	76.6	**73.4**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	54.5	78.8	72.4	75.5	78.0	**70.2**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	53.5	72.3	71.3	68.3	73.8	**74.5**
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	52.2	69.4	69.5	69.4	72.2	**71.8**
HW at 25 DAS and IC at 50 and 75 DAS	22.7	67.9	67.4	67.6	68.2	**74.4**
Weed free check	100.0	100.0	100.0	100.0	100.0	**100.0**
Unweeded control	0.0	0.0	0.0	0.0	0.0	**0.0**
S.Em.±	5.8	3.5	3.2	1.7	1.5	**2.6**
CD at 5%	**16.8**	**10.1**	**9.3**	**4.9**	**4.3**	**7.5**

Table.3 Sympodial branches, bolls per plant and boll weight at harvest in eco-friendly weed management through chemical approaches in HDPS cotton

Treatment	Sympodial branches/ plant	Bolls per plant	Boll weight (g)
Pendimethalin 38.7 CS @ 680 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	18.8	18.7	**2.74**
Clomazone* 50 EC @ 250 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	18.0	18.9	**2.76**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	18.3	19.4	**2.85**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	18.0	17.7	**2.75**
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* pyrithiobac sodium¥ 10EC 75 g *a.i.* ha^{-1} at 25 DAS as	18.2	18.7	**2.76**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	18.4	19.1	**2.85**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	18.0	17.7	**2.76**
Clomazone 50 EC @ 250 g *a.i.*/ha *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS¥	17.9	18.6	**2.77**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	18.6	19.2	**2.93**
Clomazone 50 EC @ 750 g *a.i.* ha$_{-1}$ *fb* pyrithiobac sodium 10 EC @75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	18.0	17.8	**2.69**
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	18.2	18.6	**2.72**
HW at 25 DAS and IC at 50 and 75 DAS	15.8	15.8	**2.50**
Weed free check	19.2	20.8	**3.12**
Unweeded control	13.6	12.5	**2.08**
S.Em.±	0.5	0.8	**0.14**
CD at 5%	**1.3**	**2.3**	**0.39**

Table.4 Yield attributes in eco-friendly weed management through chemical approaches in HDPS cotton

Treatments	Weed index			Seed cotton yield (kg/ha)		
	2017	2018	Pooled	2017	2018	Pooled
Pendimethalin 38.7 CS @ 680 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	11.1	7.5	9.3	1367	1326	**1346**
Clomazone* 50 EC @ 250 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	12.0	8.5	10.3	1387	1304	**1345**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	6.8	10.8	8.8	1477	1410	**1444**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	12.5	17.2	14.9	1370	1183	**1277**
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* pyrithiobac sodium¥ 10EC 75 g *a.i.* ha^{-1} at 25 DAS as	9.0	12.9	11.0	1407	1246	**1326**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	4.7	11.1	7.9	1417	1267	**1342**
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	13.2	13.0	13.1	1361	1243	**1302**
Clomazone 50 EC @ 250 g *a.i.*/ha *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS ¥	15.6	19.9	17.7	1296	1219	**1258**
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	12.1	11.6	11.9	1407	1267	**1337**
Clomazone 50 EC @ 750 g *a.i.* ha$_{-1}$ *fb* pyrithiobac sodium 10 EC @75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	19.5	17.9	18.7	1283	1173	**1228**
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS.	17.0	14.0	15.5	1300	1230	**1265**
HW at 25 DAS and IC at 50 and 75 DAS	13.8	1.5	7.6	1159	1137	**1148**
Weed free check	0.0	0.0	0.0	1603	1431	**1517**
Unweeded control	38.5	39.5	39.0	859	865	**862**
S.Em.±	8.00	6.40	6.20	124	84	**85**
CD at 5%	**23.4**	**18.7**	**17.9**	**360**	**243**	**246**

*as pre-emergence; ¥ as post emergent

The increase in boll numbers was due to timely and effective control of weeds, which resulted in better availability of natural resources, which increased plant height, number of sympodials branches and other growth parameters and corresponding increase in the sympodials plant^{-1}. Application of pre and post emergence herbicides also increase the number of bolls due to better control of weeds at critical stage and also later germinated weeds. The lower number of bolls per plant in unweeded control treatment might be due to reduced crop dry matter and increased weed competition as the weeds were allowed freely to compete with cotton plants Madavi (2016).

Application of clomazone 50 EC @ 250, 500 or 750 g *a.i.* ha^{-1} as PE followed by one HW at 25 DAS and IC at 50 and 75 DAS, application of pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} and application of clomazone 50 EC @ 250 or 500 g *a.i.* ha^{-1} as PE followed by combined application of pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as POE. The increased boll weight in these management practices was attributed to the reduction in crop weed competition through effective control of weeds, which was favourable for better growth and enhanced leaf area contributing for the activated photosynthesis and translocation of more photosynthates to sink which increased the boll weight (Nalini, 2010).

Seed cotton yield

Increased concentration of clomazone from 250 g *a.i.* ha^{-1} to 500 g *a.i.* ha^{-1} or 750 g *a.i.* ha^{-1} did not increase the seed cotton yield, indicating clomazone @ 250 g *a.i.* ha^{-1} was optimum. These treatments were on par with weed free check but significantly superior over unweeded control and HW at 25 DAS and IC at 50 and 75 DAS. These treatments were increased yield with the tune of 43.2%, 35.9% and 35.8 over unweeded control. The variation in seed cotton yield may be attributed to be positive association between yield and yield contributing characters like sympodial branches, number of bolls plant^{-1}, mean boll weight and dry matter production. The improvement in growth and yield component in these treatments was due to reduced weed growth and weed dry weight. Better growth of cotton plants in these treatments might be due least competition with weeds for moisture, nutrients, space *etc.* Shahzad *et al.*, (2012) reported that, hand weeding and herbicidal treatments reduced the weed infestation, resulted in higher seed cotton yield over weedy plots. This was due to heavy infestation of weeds and poor yield components such as lower number of bolls plant^{-1}, less number of sympodial branches, lower seed index under unweeded control.

In conclusion the application of clomazone 50 EC @ 250 g *a.i.* ha^{-1} PE *fb* HW at 25 DAS and IC at 50 and 75 DAS is ideal for better weed control efficiency is good integrated weed control practice. Under scarcity of labours or unfavourable condition like continuous rainfall to employ labour to weeding at later stages, sequential application of clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* post emergence application pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} at 25 DAS controlled the weeds effectively and increased seed cotton yields of high density planting system.

References

Anonymous, 2018. ICAR-Central Institute for Cotton Research statewise cotton area, production and productivity. *www.cicr.org.in/database/dbcapp5.html.*

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.

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

Gomez, K. A. and Gomez, A. A., 1984. Statistical Procedures for Agricultural Research, 2nd Editn. A wiley Inter-Science Publications, New York (USA).

Hiremath, R., Yadahalli, G. S., Chittapur, B. M., Siddapur, A. D., Yadahalli, V. G. and Koppalkar, B. R. G., 2013. Efficacy of chemical weed management in Bt cotton (*Gossypium hirsutum* L.). *Acta Biologica Indica*, 2 (2): 425-429.

Jalis, A. and Shah, M.L. 1982. Weed control in cotton resume. *The Pak Cottons*. 26 (3):141-148.

Madavi, B., 2016. Impact of high density planting and weed management practices on growth and yield of *Bt* cotton. M.Sc. Thesis, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India.

Madavi, B., Leela Rani, P., Sreenivas, G., Madhavi, A. and Surekha, K.,2017. Impact of high density planting and weed management practices on yield attributes, yield and quality characters of Bt. Cotton. *Int. J. Curr. Microbiol. App. Sci.*, 6(8):194-202.

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

Nalini, K., 2010. Evaluation of pre-emergence herbicide in winter irrigated cotton and its residual effect on succeeding crops. Ph.D., Thesis, Tamil Nadu Agric. Univ., Coimbatore, Tamil Nadu, India.

Nehru, D. S., Bishnoi, L. K., Kairon, M. S., Sharma, B. D. and Malik, R. K.,1988. Chemical weed control in cotton (*Gossypium hirsutum* L.). *Cotton Development*, 13(3&4): 32–35.

Rajendrakumar, 2015. Integrated weed management in *Bt* Cotton. M. Sc., Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India.

Rajendrakumar, 2015. Integrated weed management in *Bt* Cotton. M. Sc., Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India.

Shahzad, M. A., Nadeem, M. A., Sarwar, G. M., Naseeruddin and Allah, F., 2012. Comparative efficacy of different post-emergence herbicides in wheat (*Triticum aestivum* L.). *Pakistan J. Agri. Sci.*, 49: 27-34.

Veeramani, A., Prema, P. and Ganesaraja, V., 2008. Pre and post-sowing control of weeds, their influence on nutrient uptake in summer irrigated cotton (*Gossypium hirsutum* L). *Res. J. Agri. Biological Sci*., 4 (6): 643-646.

Venugopalan, M. V., Sankaranarayanan, K., Blaise, D., Nalayini, P., Prahraj, C. S. and Gangaiah, B., 2009. Bt cotton (*Gossypium sp*.) in India and its agronomic requirements A review. *Indian J. Agron.* 54 (4): 343-360.

How to cite this article:

Kamble Anand Shankar, A. S. Channabasavanna, M. Y. Ajayakumar, Koppalkar, B. G. Mahadevswamy and Amaregouda, A. 2020. Eco-friendly Weed Management Strategies for High Density Planting System Cotton in *Vertisol* of Northern Karnataka. *Int.J.Curr.Microbiol.App.Sci.* 9(11): 1021-1029. doi: https://doi.org/10.20546/ijcmas.2020.911.120