Research Article

Effect of Pre and Post Emergence Herbicides on Growth and Yield of *Bt* Cotton under Varied Agro Meteorological Environments

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Abstract

A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during 2015-16 to evaluate efficacy of pre and post emergence herbicides response to weeds and cotton productivity in varied environment condition. Result indicate that pre-emergence pendimethalin 38.7% CS followed by post-emergence pyrithiobac sodium 5% EC 62.5 g/ha recorded lower weed density (80.6 No./m^2) dry weight (42.7 g/ m^2) and higher weed control efficiency (86.0 %) at 40 DAS in 1st August sowing. Higher weed density and weed dry weight drastically increased in beyond 15th August sowing. Better growth, higher yield parameters and seed cotton yield were recorded when sowing was done on 1st August (1971 kg/ha) and lower seed cotton yield was observed at 15th September (1335 kg/ha) sowing.

Keywords: *Bt* cotton, herbicides, pendimethalin, pyrithiobac sodium, time of sowing

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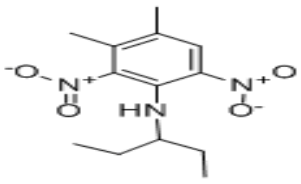
Introduction

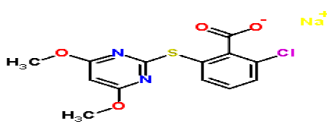
Successful weed control is essential for economic cultivation of cotton. The greatest competition of weeds usually occurs early in the growing season. Cultural methods adopted by farmers are time consuming and expensive. Also herbicide applied at the time of sowing will not give season long control of weeds. Pre-emergence applications has the initial advantage of cotton over the weeds. Once this achieved, then post-emergence directed applications can be utilized to extend the weed control throughout the cropping season. Hence that, objective to evaluate pre and post emergence herbicides in varied environment condition resultant of time of sowing in cotton.

Pendimethalin is dinitroanaline family of herbicides was registered for cotton in 1975 [1]. Pendimethalin controls weed by inhibition of microtubule formation in cells. This causes disruption of cell division. As the microtubule spindle fibers that guide chromosomes are absent, the cell plate does not appear and cells do not divide. The microtubules are also responsible for microfibril orientation in the cell wall. In their absence, microfibrils become disoriented and cells expand to a rounded rather than elongated shape. It is a pre-emergent herbicide controlling a wide range of grass and small seeded broadleaf weeds [2].

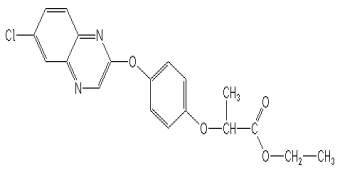
Pyithiobac sodium is a broad spectrum systemic herbicide, which inhibits enzyme acetolacetate synthase, a key enzyme in biosynthesis of branched chain amino acids. It is reported to control troublesome broadleaf weeds when applied as post emergence herbicide at 2-3 leaf stage) without affecting the cotton [3]. Quizalofop ethyl is a selective systemic herbicide, applied at post emergence herbicide for the control of annual and perennial grass weeds. It is a biochemicaly Acetyl CoA carboxylase inhibitor; inhibition of fatty acid biosynthesis and mode of action systemic herbicide, absorbed from the leaf surface, with translocation throughout the plant, moving in both the xylem and phloem, and accumulating in the meristematic tissue.



Pendimethalin



Pyrithiobac sodium



Quizalofop ethyl

Methodology

Experiment consisting four dates of sowing (1st & 15th August and 1st &15th September)) in the main plots and six weed control treatments (pre-emergence herbicides of pendimethalin 30% EC & 38.7% CS of 1.0 and 0.68 kg/ha followed by post-emergence herbicdes of pyrithiobac sodium 5% EC 62.5 g/ha and quizalofop ethyl 5% EC 50 g/ha at 2-3 leaf stages of weeds, Hand weeding on 20 and 40 DAS and weedy check in the sub-plots. Trial was laid out in split plot design with three replications. The land was prepared for cotton by giving two dry ploughings with disc plough followed by clod crushing to achieve fine seed bed. Cotton was sown manually keeping the distance of 90 cm × 60 cm in different time of sowing after sowing the seed, immediately a light irrigation was given to the crop for uniform germination. Pre-emergence herbicide are sprayed on 3 DAS and post- emergence herbicides are sprayed at 2-3 leaf stages of weeds in respect of treatment using hand operated knapsack sprayer fitted with a flat fan type nozzle with spray volume of 500 litres /ha**.** Metrological data were recorded during the cropping season 2015-16 (**Figure 1**).

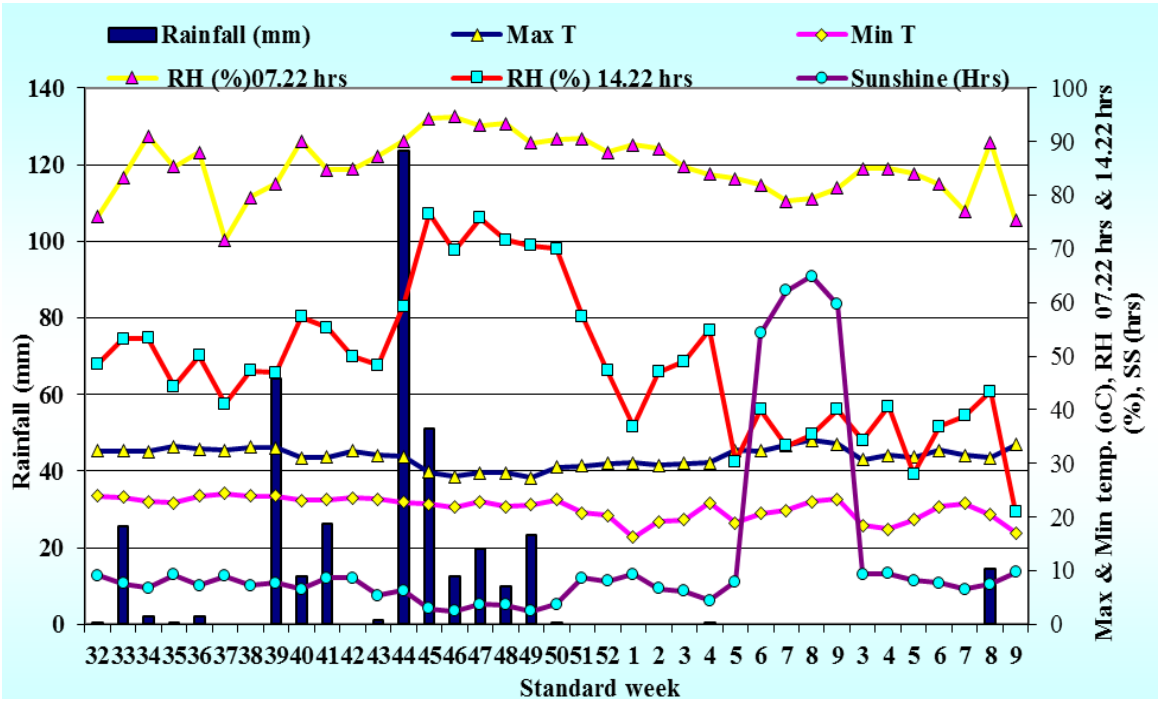


Figure 1 Weather parameters prevalied during the cropping period (Aug 2015-Mar 2016)

Weed observation

Densities of grasses, sedges and broad leaved weeds were counted using 0.5 m × 0.5 m quadrat from four randomly fixed places in each plot and collected, the weeds were after shade drying, dried in hot-air oven at 80°C for 72 hrs. The weed density (No./m^2) and dry weight (g/m^2) were recorded separately. Weed control efficiency (%) was calculated as per the procedure given by Main *et al*. (2007) [4].

$$WCE = \frac{WD_c - WD_t}{WD_c} \times 100$$

Whereas, WCE: weed control efficiency (%), WD_c: weed dry weight (g/m^2) in control plot; WD_t: weed dry weight (g/m^2) in treated plot.

Statistical Analysis

Data were statistically analysed following the procedure given by Gomez and Gomez (2010) [5]. Data pertaining to weeds were transformed to square root scale $\sqrt{(X+2)}$ whenever significant variation existed, critical difference was

assembled at five per cent probability level. Such of those treatments where the difference are not significant are denoted as NS.

Results and Discussion

Weed interference

Weed flora of the experimental field consisted of eleven species of broad leaved weeds, seven species of grasses and a sedge weed. Dominant among grassy weeds was *Cynodon dactylon* (L.) Pers. and *Trianthema portulacastrum* (L.) and *Digeria arvensis* (Forsk.) were the dominant among the broad leaved weeds. *Cyperus rotundus* (L.) was the only sedge present in the experimental fields. Distinctive time of sowing in cotton impact the weeds development. Lower total weed density (80.6 No./m^2) and weed dry weight (46.1 g/m^2) were recorded when sowing was done on 1st August (**Table 1**) and it on par with 15th August sowing. Late sown cotton (15th September) recorded higher total weed density (113.3 No./m^2) and weed dry weight (65.2 g/m^2) compared to early sown *Bt* cotton hybrid (1st August). It might be, optimum time of sowing provided better vigour to crop and encountered lesser weeds competition. Similar results were earlier reported by Malik and Ashok Yadav (2014) [6].

Table 1: Effect of time of sowing and weed management practices on total weed density, dry weight of *Bt* Cotton at 40 DAS

Treatment	Total weed density ((No. /m^2)					Total weed dry weight (g /m^2)				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
S_1	7.01 (48.7)	6.57 (42.7)	7.30 (52.8)	8.36 (69.4)	7.34 (53.4)	4.91 (23.6)	5.19 (26.4)	6.07 (36.3)	6.63 (43.4)	5.74 (32.4)
S_2	7.31 (52.9)	6.88 (46.9)	7.46 (55.1)	6.14 (37.2)	6.96 (48.0)	5.03 (24.8)	5.94 (34.8)	6.14 (37.2)	4.76 (22.2)	5.50 (29.7)
S_3	6.47 (41.4)	6.00 (35.5)	5.17 (26.2)	9.79 (95.4)	7.08 (49.6)	4.59 (20.6)	5.16 (26.1)	4.28 (17.8)	8.17 (66.2)	5.76 (32.7)
S_4	7.93 (62.4)	7.93 (62.4)	7.24 (51.9)	7.73 (59.2)	7.71 (59.0)	5.98 (35.3)	6.24 (38.4)	5.69 (31.9)	6.10 (36.7)	6.01 (35.6)
S_5	9.91 (97.7)	10.04 (100.3)	11.22 (125.4)	12.90 (166.0)	11.09 (122.4)	7.77 (59.9)	7.47 (55.3)	8.61 (73.6)	9.99 (99.3)	8.51 (72.0)
S_6	13.45 (180.4)	13.74 (188.3)	14.16 (200.1)	15.91 (252.7)	14.35 (205.4)	9.62 (92.1)	9.80 (95.6)	10.47 (109.2)	11.14 (123.7)	10.28 (101.2)
Mean	9.01 (80.6)	8.94 (79.4)	9.26 (85.3)	10.67 (113.3)		6.57 (42.7)	6.83 (46.1)	7.18 (51.0)	8.11 (65.2)	
	M	**S**	**M x S**	**S x M**		**M**	**S**	**M x S**	**S x M**	
CD (0.05)	0.37	0.33	0.71	0.66		0.29	0.26	0.55	0.51	

Figure in parenthesis are mean of original value; Data subjected to square root transformation

M_1- 1st August
M_2- 15th August
M_3-1st September
M_4- 15th September

S_1- PE pendimethalin 0.68 kg/ha fb HW 40 DAS
S_2- PE pendimethalin 0.68 kg/ha fb PoE pyrithiobac sodium 62.5 g/ha
S_3- PE pendimethalin 0.68 kg/ha fb PoE quizolofob ethyl 50 g/ha
S_4- PE pendimethalin 1.0 kg/ha fb HW 40 DAS
S_5- HW 20 and 40 DAS
S_6 -Weedy check

In weed management, pre-emergence pendimethalin 38.7% CS 0.68 kg/ha followed by post emergence pyrithiobac sodium 5% EC 62.5 g/ha significantly recorded lower total weed density (48.0 No./m^2) total weed dry weight (29.7 g/m^2) and higher weed control efficiency (86 %) (**Figure 2**) and it was on par with PE pendimethalin 38.7% CS 0.68 kg/ha followed by PoE quizalofop ethyl 5% EC 50 g/ha. Higher total weed density (252.7 No. /m^2) and weed dry weight (123.7 g/m^2) are recorded in unweeded check. It is mainly due to sequential application of herbicides along with inter cultivation could be attributed to weed free situation during initial stages and further control of new flush of weeds by application of post emergence herbicides at 30-35 DAS followed by inter cultivation at 60 DAS and thus, reducing the weed competition during critical initial to peak growth period of *Bt* cotton. Similar results were reported by Hiremath *et al*. (2013) [7].

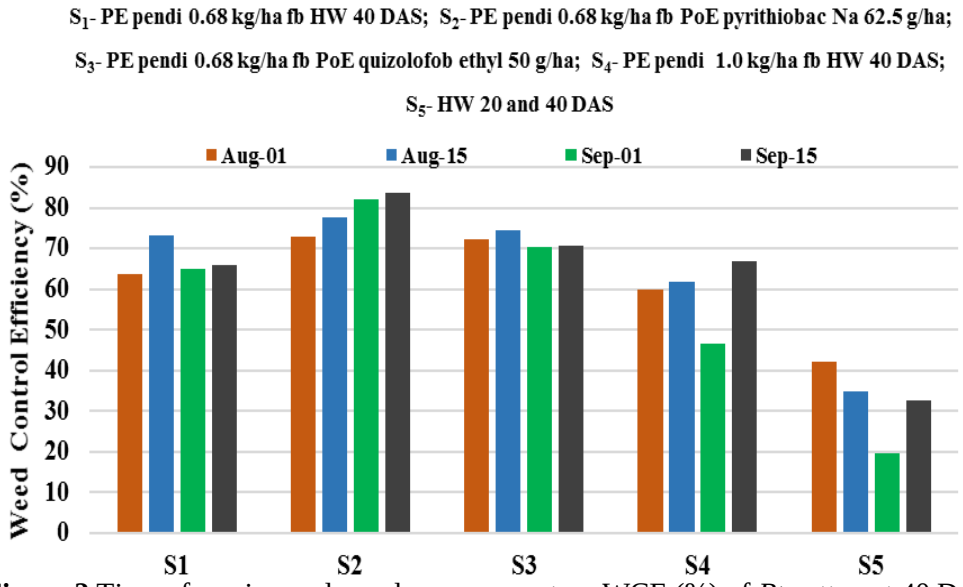


Figure 2 Time of sowing and weed management on WCE (%) of *Bt* cotton at 40 DAS

Cotton productivity

Results indicated that, seed cotton yield was significantly higher when sowing was done on 1st August (1971 kg/ha) and the lower seed cotton yield (1335 kg/ha) was observed at 15th September sowing. Seed cotton yield of *Bt* cotton (**Table 2**) was reduced drastically when the sowing was delayed beyond 15th August. It might be due to the reduction of cumulative GDDs under delayed sowing in all the phenological stages (**Figure 3**). Early sowing (1st August) recorded higher cumulative GDD_S of 1314 compared to delay sowing 15th September (GDDs of 1119). Optimum heat unit system (GDDs) facilitated cotton through higher photosynthesis, which might have led to higher plant height, dry matter production, sympodial branches, bolls/plant and seed cotton yield as compared to late sown *Bt* cotton hybrid. Buttar *et al.* (2010) [8] also observed that under Punjab condition, higher seed cotton yield was obtained in early sown American cotton *(G. hirsutum)* as compared to late sown.

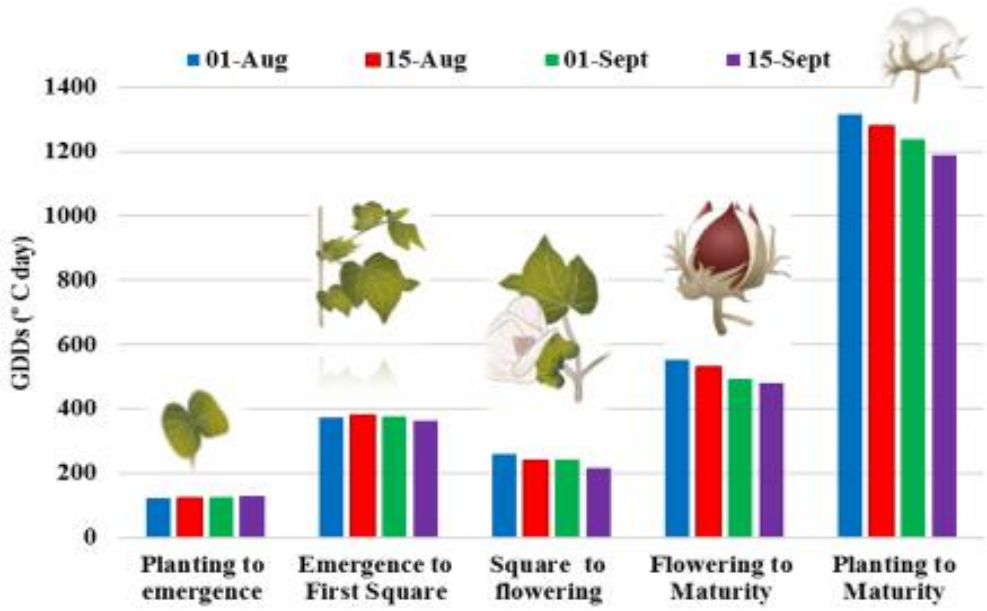


Figure 3: GDDs of *Bt* cotton in different dates of sowing in various stages

Number of bolls per plant was significantly reduced due to delayed sowing compared to normal sowing. Similar findings, were reported by Prakash *et al.* (2010) [9]. Many squares in the late sowing cotton did not form bolls and sowing date differences in final square number and boll numbers were due to a combination of temperature and early boll retention as observed by Liu *et al.* (2013) [10]. Dry season production also alleviated many other constraints to cotton production in the wet season, such as water logging and flower abortion due to rain [11].

Table 2: Effect of time of sowing and weed management practices on yield and yield parameter of *Bt* cotton

Treatment	Seed cotton yield (kg/ ha)					No. of bolls / plant				
	M_1	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
S_1	1473	1448	1183	1091	1299	74.2	66.8	62.3	64.3	64.4
S_2	1971	1723	1532	1335	1640	87.2	76.9	69.9	71.9	81.5
S_3	1360	1229	1270	1184	1261	67.4	63.7	57.7	61.2	60.0
S_4	1304	1192	1164	1107	1194	67.3	65.3	55.5	50.3	59.6
S_5	1778	1531	1468	1291	1517	81.3	72.0	63.0	64.2	70.9
S_6	836	810	784	765	799	37.0	42.2	45.5	27.0	35.4
Mean	1454	1322	1234	1129		70.7	64.4	58.9	56.5	
	M	**S**	**M x S**	**S x M**		**M**	**S**	**M x S**	**S x M**	
CD (0.05)	59	57	119	114		3.1	2.5	5.6	5.1	

Conclusion

Based on experimentation, it is concluded that early sowing (1st August) of *Bt* cotton with higher GDDs of 1314 decreased the weed interaction and accompanied by integrated weed management of pre emergence herbicide pendimethalin 38.7% CS 0.68 kg/ ha followed by post emergence herbicide pyrithiobac sodium 5% EC 62.5 g/ha resulted higher weed control efficiency and higher productivity of *Bt* cotton.

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