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RESPONSE OF Bt. COTTON TO POST EMERGENCE HERBICIDES IN VERTISOLS OF KRISHNA ZONE

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ABSTRACT : Cotton, a long duration crop coupled with heavy rains during the early vegetative stage inhibit manual and mechanical methods of weed control causing heavy yield loss . A field experiment was conducted to evaluate the efficacy of different post emergence herbicides applied at 45 DAS *viz*; glufosinate ammonium 15% SL @ 300 g *a.i* ha^{-1}, glufosinate ammonium 15% SL @ 375 g *a.i* ha^{-1}, glufosinate ammonium 15% SL @ 450 g *a.i* ha^{-1}, paraquat 24 SL @ 300 g *a.i* ha^{-1}, glyphosate 4l SL @1025 g *a.i* ha^{-1} on productivity of Bt. cotton entry NCS 145 BG II against *Cyprus rotundus, Commalina bengalensis, Corchorus acutangulus*, *Amaranthus viridis, Abutilon indicum, Phyllanthus niruri* ,*Celosia argentia*, *Parthenium sp* etc from 2008 to 2010 in vertisols under rainfed conditions at Regional Agricultural Research Station, Lam, Guntur. The seed cotton yield increased significantly due to all the treatments to the magnitude of 66-75% as compared to weedy check. The highest seed cotton yield of 3094 kg ha^{-1} was recorded with glufosinate ammonium 15% SL @ 375g *a.i* ha^{-1} followed by hand weeding at 20, 40 and 60DAS (3062 kg ha^{-1}) and glyphosate 41 SL @ 1025 g *a.i* ha^{-1} (2902 kg ha^{-1}). The weed density and weed dry matter recorded were lowest with the application glufosinate ammonium 15% SL @ 375g *a.i* ha^{-1} and glufosinate ammonium 15% SL @ 450g *a.i* ha^{-1} when compared to other treatments.

Key words : cotton, weed, post emergence, glufosinate ammonium

INTRODUCTION

Cotton crop, the king of fibers which contributes major portion in the national economy is mostly grown under rainfed conditions in black cotton soils under aberrant weather situations in Krishna zone of Andhra Pradesh. This crop suffers losses due to presence of un-wanted plants called weeds. Weeds not only compete with the crop for nutrients, moisture, light, heat energy and space but, also harbor insects and disease organisms (Anderson, 1983), reducing the growth and yield of cotton due to weed competition (Papamichail *et al*., 2002). In addition, weeds exert stress to the cultivated crops through their allelopathic and parasitism effect and the crop must be kept free from weeds in critical stages to prevent crop yield loss (Knezevic *et al*., 2002). Weeds consume 5 to 6 times nitrogen, 5 to 12 times phosphorus and 2 to 5 times potash more than cotton crop at the early growth stages and thus reduce seed cotton yield from 54 to 85% (Jain *et al*., 1981). Cotton, a long duration crop coupled with heavy rains during the early vegetative stage inhibit manual and mechanical methods of weed control causing heavy yield loss. Manual weeding has traditionally been a labor intensive operation and hence there is no other alternative rather than use of post emergence herbicides for control of weeds in cotton. Gill *et al*., (1985) reported that herbicide is an economic alternative when labor is a problem or in abnormal weather situation where fields are not accessible for mechanical weeding. Chemical weed control became more important and attractive to farmers (Zhang and Huang, 1999).

To be effective, however, herbicides need to be matched with the weed problem. Successful weed control is essential for economic cotton production.
Keeping the above, in view, a field experiment was conducted to evaluate the efficacy of different post emergence herbicides applied at 45 days after of sowing on productivity of Bt. cotton entry NCS 145 BG II .

MATERIALS AND METHODS

A field experiment was conducted to evaluate the efficacy of different post emergence herbicides applied at 45 days after sowing *viz*; glufosinate ammonium 15% SL @ 300 g *a.i* ha^{-1}, glufosinate ammonium 15% SL @ 375 g *a.i* ha^{-1}, glufosinate ammonium 15% SL @ 450 g *a.i* ha^{-1}, paraquat 24 SL @ 300 g *a.i* ha^{-1}, glyphosate 4l SL @1025 g *a.i* ha^{-1} and were compared with untreated control and hand weeding as per farmers practice on productivity of Bt. cotton entry NCS 145 BG II from 2008 to 2010 in black cotton soils under rainfed conditions at Regional Agricultural Research Station, Lam, Guntur. The soil of the experimental site was slightly alkaline in reaction with pH 8.01,EC 0.25 dsm^{-1}.The soil was low in available nitrogen (189 kg ha^{-1}N), medium in available phosphorous(36 kg P_2O_5 ha^{-1}) and medium in exchangeable potassium(275 kg K_2O ha^{-1}). A set of seven treatments were laid out in randomized block design with three replications. All the package of practices except weed control were followed as per the recommendations. The herbicides were sprayed 45 days after sowing by knapsack sprayer using flood jet nozzle as per the treatments at a spray volume of 500 l ha^{-1} as protected spray using hood. Observations and data were recorded on, plant height, number of monopodia, number of sympodia, number of bolls per plant and yield. The data on weed density, weed dry matter, phytotoxicity to plants etc were recorded and presented in tables as mean for two years.

RESULTS AND DISCUSSION

Weed Density

The experimental site was predominantly infested with natural population of *Cyprus rotundus*, *Commalina bengalensis*, *Corchorus acutangulus*, *Amaranthus viridis*, *Abutilon indicum*, *Phyllanthus niruri*, *Celosia argentia* etc. Weed density and weed dry matter recorded at 45 days after sowing *i.e*., just before application of herbicide given in the (Table-1) revealed that enough weed flora was naturally found in the experimental site. On application of chemicals weed density and weed dry matter was recorded at 15, 30 and 45 days after application. The weed density and weed dry matter recorded were lowest with the application glufosinate ammonium 15% SL @ 375g a.i ha^{-1} and glufosinate ammonium 15% SL @ 450g a.i ha^{-1} when compared to other treatments (Table-2 & 3). Similar results were reported by (Askew and Wilcut 1999, Culpepper *et al*., 2000, Faircloth *et al*., 2001, Johnson *et al*., 2000, Reddy and Whiting 2000, Young *et al*., 2001).

The per cent weed control was maximum with the application glufosinate ammonium 15 SL @ 375g a.i ha^{-1} and glufosinate ammonium 15% SL @ 450g a.i ha^{-1} when compared to glufosinate ammonium 15% SL @ 300 g a.i ha^{-1} (Table-4).

Table-1 Species wise weed count/m² before spraying of post emergence herbicides

Treatments	Species wise weed count/m²
Untreated Control	*Cyprus rotundus* (16),*Commalina bengalensis* (15) *Corchorus acutangulus* (12) *Amaranthus viridis* (8) *Abutilon indicum* (7.5) *Phyllanthus niruri* (2)*Celosia argentia* (7) *Parthenium sp* (5)
Glufosinate ammonium15 SL @ 300 g a.i /ha	*Cyprus rotundus* (12),*Commalina bengalensis* (15.6) *Corchorus acutangulus* (16) *Amaranthus viridis* (6)*Phyllanthus niruri* (2)*Celosia argentia* (5) *Parthenium sp* (6) *Abutilon indicum* (8)
Glufosinate ammonium15 SL @ 375 g a.i /ha	*Cyprus rotundus* (12),*Commalina bengalensis*(7) *Corchorus acutangulus* (15) *Amaranthus viridis* (17) *Abutilon indicum*(7)Phyllanthus niruri (2) *Celosia argentia* (2.5)
Glufosinate ammonium15 SL @ 450 g a.i /ha	*Cyprus rotundus* (15),*Commalina bengalensis* (10) *Corchorus acutangulus* (9) *Amaranthus viridis* (12) *Abutilon indicum*(9)Phyllanthus niruri (5) *Celosia argentia* (3.5)
Paraquat 24 SL @ 300 g a.i /ha	*Cyprus rotundus* (14),*Commalina bengalensis*(9) *Corchorus acutangulus* (10) *Amaranthus viridis* (6) *Abutilon indicum*(4)*Phyllanthus niruri* (11) *Celosia argentia* (10)
Hand weeding as per farmers practice	*Cyprus rotundus* (3) *Phyllanthus niruri* (2) *Celosia argentia* (1)
Glyphosate 4l SL @ 1025 g a.i /ha	*Cyprus rotundus* (16),*Commalina bengalensis*(9) *Corchorus acutangulus* (10) *Amaranthus viridis* (7.5) *Abutilon indicum*(4)*Phyllanthus niruri* (11) *Celosia argentia* (10)

Table-2 Effect of glufosinate ammonium 15% SL post emergence herbicide on weed density in Bt. cotton

Treatments	Weed density/m²		
	15 DAA	30 DAA	45 DAA
Untreated Control	79	89	95
Glufosinate ammonium 15 SL @ 300 g a.i /ha	10	12	15
Glufosinate ammonium 15 SL @ 375 g a.i /ha	3	4	5
Glufosinate ammonium 15 SL @ 450g a.i /ha	2	3	5
Paraquat 24 SL @ 300 g a.i /ha	8	11	13
Hand weeding as per farmers practice	4	2	1
Glyphosate 4l SL @1025 g a.i /ha	2	4	5
SEm±	1.56	1.24	1.85
CD (p=0.05)	**4.2**	**3.9**	**5.1**

DAA – Days after application

Table-3 Effect of glufosinate ammonium 15 % SL post emergence herbicide on weed dry matter in Bt. cotton

Treatments	Weed Dry matter g/m^2		
	15DAA	30DAA	45DAA
Untreated Control	258.6	329.5	468.5
Glufosinate ammonium 15 SL @ 300 g a.i /ha	31.6	35.9	46.8
Glufosinate ammonium 15 SL @ 375 g a.i /ha	5.1	5.2	6.0
Glufosinate ammonium 15 SL @ 450g a.i /ha	3.2	4.1	4.5
Paraquat 24 SL @ 300 g a.i /ha	15.8	24.6	28.9
Hand weeding as per farmers practice	6.5	1.8	1
Glyphosate 4l SL @1025 g a.i /ha	1.8	10.2	16.2
SEm±	5.26	4.8	7.2
CD (p=0.05)	15.4	14.3	21.5

DAA – Days after application

Table-4 Per cent weed control on application of glufosinate ammonium 15% SL post emergence herbicide

Treatments	Per cent weed control		
	15 DAA	30 DAA	45 DAA
Untreated Control	-	-	-
Glufosinate ammonium 15 SL @ 300 g a.i /ha	79	89	84
Glufosinate ammonium 15 SL @ 375 g a.i /ha	90	87	95
Glufosinate ammonium 15 SL @ 450g a.i /ha	96	96	95
Paraquat 24 SL @ 300 g a.i /ha	97	96	95
Hand weeding as per farmers practice	90	88	86
Glyphosate 4l SL @1025 g a.i /ha	96	96	95

DAA – Days after application

Effect on growth, yield attributes and yield of cotton

The different treatments had no significant impact on the plant height, number of monopodia per plant and number of sympodia. Number of bolls per plant which is the main contributing factor for yield varied significantly with the treatments. Maximum number of bolls per plant were recorded with glufosinate ammonium 15% SL @ 375g a.i ha^{-1} (26.9), and was on a par with hand weeding as per farmers practice (26.3), and glyphosate 41 SL @ 1025 g a.i ha^{-1} (24.8) (Table 5). The seed cotton yield increased significantly under all the treatments to a magnitude of 66-75% as compared to untreated control. The highest seed cotton yield (3094 kg ha^{-1}) was recorded with glufosinate ammonium 15% SL @ 375g a.i ha^{-1} and was on a par with hand weeding as per farmers practice (3062 kg ha^{-1}), glyphosate 41 SL @ 1025 g a.i ha^{-1} and glufosinate ammonium 15% SL @ 450 g a.i ha$^{-1.}$ The lowest seed cotton yield was recorded in untreated control (Table-5).

Table-5 Effect of glufosinate ammonium 15% SL post emergence herbicide on growth and yield of Bt. cotton (Mean 2008-2010)

Treatments	Plant Height (cm)	No. of Mono podia	No.of Sym podia	Bolls/ plant	Yield kg/ha
Untreated Control	105	1.25	15.89	7.5	783
Glufosinate ammonium 15 SL @ 300 g a.i /ha	103	1.20	15.93	20.8	2314
Glufosinate ammonium 15 SL @ 375 g a.i /ha	106	1.26	16.82	26.9	3094
Glufosinate ammonium 15 SL @ 450g a.i /ha	109	1.33	15.50	23.9	2758
Paraquat 24 SL @ 300 g a.i /ha	110	1.26	15.24	19.5	2309
Hand weeding as per farmers practice	111	1.18	16.05	26.3	3062
Glyphosate 4l SL@1025 g a.i /ha	111	1.12	16.03	24.8	2902
SEm±	4.2	0.08	0.98	0.98	124.2
CD (p=0.05)	**NS**	**NS**	**NS**	**3.0**	**374**

The herbicides under the test were broad spectrum, non selective and contact in nature and there was phytotoxic effect ranging from 10-20% due to spray drift (Table 6). Spray hood was used to avoid the direct chemical contact to the extent possible on cotton crop. 20% phytotoxicity was recorded with glufosinate ammonium 15% SL @ 450 g a.i ha^{-1} and glyphosate 41 SL @ 1025 g a.i ha^{-1} which clearly indicates higher dose of the herbicide glufosinate @ 450 g a.i ha^{-1} leads to phytotoxicity and that was almost on par with glyphosate 41 SL, which is a systemic non selective broad spectrum herbicide. Similar results was reported by Koger *et al*.,(2005). Phyto toxic symptoms were observed during first seven days after application. Later the plants recovered from the injury and have put up normal growth.

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Table-6 Phytotoxicity of glufosinate ammonium 15% SL post emergence herbicide in Bt. cotton

Treatments	Phytotoxicity levels			
	7DAA	15DAA	21DAA	28DAA
Untreated Control	-	-	-	-
Glufosinate ammonium 15 SL @ 300 g a.i /ha	1	0	0	0
Glufosinate ammonium 15 SL @ 375 g a.i /ha	1	1	0	0
Glufosinate ammonium 15 SL @ 450g a.i /ha	2	1	0	0
Paraquat 24 SL @ 300 g a.i /ha	1	0	0	0
Hand weeding as per farmers practice	-	-	-	-
Glyphosate 4l SL @1025 g a.i /ha	2	0	0	0

DAA – Days after application

Application of glufosinate ammonium 15% SL as post emergence herbicide at different concentrations did not influence the fibre quality during both the years of the study (Table 7 & 8).

Table-7 Effect of glufosinate ammonium 15% SL post emergence herbicide on physical and quality parameters of cotton

Treatments	Seed Index	Lint Index	GOT	2.5% Span Length
Untreated Control	10.36	5.78	33.32	33.04
Glufosinate ammonium 15 SL @ 300 g a.i /ha	10.95	5.76	34.45	33.28
Glufosinate ammonium 15 SL @ 375 g a.i /ha	11.07	5.80	34.42	32.10
Glufosinate ammonium 15 SL @ 450g a.i /ha	10.99	5.84	34.70	33.39
Paraquat 24 SL @ 300 g a.i /ha	10.83	5.89	35.21	34.48
Hand weeding as per farmers practice	10.95	5.85	34.79	33.50
Glyphosate 4l SL @1025 g a.i /ha	10.85	5.72	34.58	33.45
SEm±	0.277	0.12	0.732	0.52
CD (p=0.05)	NS	NS	NS	NS

Table-8 Effect of glufosinate ammonium 15% SL post emergence herbicide on physical and quality parameters of cotton

Treatments	Strength (g/tex)	Micronaire (10^6 g/inch)	Uniformity Ratio	Elongation (%)
Untreated Control	24.6	4.20	43.2	5.6
Glufosinate ammonium 15 SL @ 300 g a.i /ha	24.8	4.31	42.8	5.6
Glufosinate ammonium 15 SL @ 375 g a.i /ha	23.9	4.44	43.6	5.6
Glufosinate ammonium 15 SL @ 450g a.i /ha	24.6	4.29	44.7	5.5
Paraquat 24 SL @ 300 g a.i /ha	23.4	4.41	43.6	5.6
Hand weeding as per farmers practice	23.0	4.12	42.8	5.6
Glyphosate 4l SL @1025 g a.i /ha	24.2	4.09	41.9	5.5
SEm±	0.28	0.36	0.26	-
CD (p=0.05)	NS	NS	NS	NS

CONCLUSIONS

Application of post emergence herbicides glufosinate ammonium 15% SL @ 375g a.i ha^{-1} 45 days after sowing of cotton was found to be cost effective in controlling the weeds in cotton in vertisols of Krishna zone.

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