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RESEARCH NOTE

Weed management in *Bt* cotton through pre-sowing application of pendimethalin capsulated suspension and emulsified concentrate formulations

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A field experiment was replicated thrice in Randomized Complete Block Design at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad on medium black soil during *kharif* 2015-16 to study the effect of pre-sowing application of Pendimethalin capsulated suspension (CS) and emulsified concentrate (EC) formulation against weeds in *Bt* cotton. There were 10 treatment combinations which consisted of Pendimethalin 37.8 CS @ 500, 700 and 900 g a.i. ha^{-1} pre-sowing application (2-3 days) followed by POE (post emergent) of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) and Pendimethalin 30 EC @ 1.0, 1.5 and 2.0 kg a.i. ha^{-1}as pre-sowing application (2-3 days) followed by POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) in comparison with, recommended package of practices (3 intercultivations at 15 days intervals and one hand weeding),weed free check, weedy check and farmers practices (one hand weeding at 15 days after sowing (DAS) and one intercultivation at 20 DAS). The seed cotton yield differed significantly among different herbicide applications, the pre sowing application of Pendimethalin 37.8 CS @ 900 g a.i. ha^{-1} followed by POE application of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) recorded higher seed cotton yield (31.28 q ha^{-1}), yield per plant (146.06 g) and stalk yield (39.91 qha^{-1}). Among herbicide treatments, higher gross return, net return and BC ratios recorded with pre-sowing application of Pendimethalin 37.8 CS 900 g a.i. ha^{-1} followed by Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (₹140700, 96147 and 3.2, respectively).

Key words: Cotton, Pendimethalin CS and EC formulations

Cotton (*Gossypium* spp.) is an important commercial fibre crop grown under diverse agro-climatic conditions around the world. It is called as "White gold" and "King of fibre crops". It is cultivated in tropical and subtropical regions of more than 111 countries. It provides the main raw material for textile industries. Cotton is the most important global cash crop and controls economy of many nations. It provides gainful employment to several million people during its cultivation, trade, processing, manufacturing and marketing. Cotton and cotton textile industries are engines of economic growth in both developed and developing countries. In cotton, weeds cause several direct and or indirect negative impacts, such as reducing crop yield, reducing fibre quality, reducing irrigation efficiency, increasing production costs and serving as hosts and habitat for insect pests, disease causing pathogens, nematodes and rodents. Timely and effective weed management practices also play an important role in boosting the productivity of cotton (Patel *et al.,* 2014). In many instances it is difficult to control weeds through cultural operations due to unfavorable weather conditions *viz.,* incessant rains, wetness, *etc*. Thus, the progressive modernization of agriculture involving intensive use of herbicides is gaining popularity in recent years due to lower cost, easy and timely application and effectiveness in controlling weeds. A number of broad spectrum pre emergence (Pendimethalin, Butachlor, Alachlor, Diuron and Oxyfluorfen) and post emergence (Pyrithiobac sodium, Quizalofop-p-ethyl, Fenaoxaprop-p-ethyl, Propaquizafop) herbicides are available for use in cotton (Rao, 2011). These herbicides proved effective in controlling annual weeds during critical period of crop-weed competition.

The field experiment was replicated thrice in Randomized Complete Block Design at the Main Agricultural Research Station, Dharwad during *kharif* season of 2015-16 on "Weed management in *Bt* cotton through pre-sowing application of Pendimethalin capsulated suspension (CS) and emulsified concentrate (EC) formulation". There were 10 treatment combinations *viz*., Pendimethalin 37.8 CS (500 g a.i. ha^{-1}) as pre-sowing application (2-3 days), POE of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_1), Pendimethalin 37.8 CS (700 g a.i. ha^{-1}) pre-sowing application (2-3 days) POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_2), Pendimethalin 37.8 CS (900 g a.i. ha^{-1}) as pre-sowing application (2-3 days) POE of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_3), Pendimethalin 30 EC (1 kg a.i. ha^{-1}) as pre-sowing application (2-3 days) POE of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_4), Pendimethalin 37.8 EC (1.5 kg a.i. ha^{-1}) pre-sowing application (2-3 days) POE of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_5), Pendimethalin 30 EC (2 kg a.i. ha^{-1}) pre-sowing application (2-3 days) POE of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (T_6), Recommended package of practices (three intercultivations at 15 days intervals and one hand weeding) (T_7), Weed free check (T_8), Weedy check (T_9), and Farmers practices (one hand weeding and one intercultivation) (T_{10}). The soil was medium deep black soil with pH 7.10, the available N, P_2O_5 and K_2O contents were 253.0, 33.0 and 290 kg ha^{-1}, respectively. The gross plot size was 7.2 x 6.0 m and net plot size was 5.4 x 4.8 m. Two seeds per hill were dibbled at a spacing of 90 x 60 cm. The fertilizer dose @ 120:60:60 kg/ha N:P_2O_5:K_2O applied in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively. As basal dose, 60 kg N and entire dose of P_2O_5 and K_2O per ha was applied at the time of planting. Remaining 60 kg N was applied (in the ring formed 5 cm away from the plant with a depth of 4-5 cm) as top dressing in two equal splits at 45 and 70 days after sowing.

The seed cotton yield differed significantly among different herbicide applications, the pre-sowing application of Pendimethalin 37.8 CS @ 900 g a.i. ha^{-1} followed by POE application of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) recorded higher seed cotton yield (31.28 q ha^{-1}), yield per plant (146.06 g), stalk yield (39.91 q ha^{-1}). However, it was on par with pre sowing application of Pendimethalin 30 EC @ 900 g a.i. ha^{-1} followed by POE application of Quizalofop ethyl 5 EC (50 g a.i.

Table 1. Yield and yield components and economics of *Bt* cotton as influenced by pre-sowing application of Pendimethalin 37.8 CS and Pendimethalin 30 EC formulations

Treatment details	Yield (q ha^{-1})	Yield plant^{-1}(g)	Stalk yield (q ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	BC ratio
Pendimethalin 37.8 CS (500 g a.i. ha^{-1}) pre-sowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	26.62	127.88	35.15	119700	75427	2.7
Pendimethalin 37.8 CS (700 g a.i. ha^{-1}) pr-esowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	30.09	143.64	35.60	135450	91027	3.0
Pendimethalin 37.8 CS (900 g a.i. ha^{-1}) pre-sowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	31.28	146.06	39.91	140700	96147	3.2
Pendimethalin 30 EC (1 kg a.i. ha^{-1}) pre-sowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	26.11	123.03	34.72	117450	72832	2.6
Pendimethalin 30 EC (1.5 kg a.i. ha^{-1}) pre-sowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	29.58	139.39	35.54	133050	88112	3.0
Pendimethalin 30 EC (2 kg a.i. ha^{-1}) pre-sowing application (2-3 days) fb POE Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS)	30.48	143.64	39.25	137100	91842	3.0
Recommended package of practices (3 intercultivations 15 days intervals and one hand weeding)	27.39	129.09	39.25	123150	79654	2.8
Weed free check	34.61	163.04	41.48	155700	110324	3.4
Weedy check	12.22	57.58	26.95	54900	16884	1.4
Farmers practices (one hand weeding and one intercultivation)	25.23	123.78	34.18	113550	66294	2.4
S.Em.±	1.72	7.41	1.70	10430	10430	0.2
C.D. at 5 %	5.12	22.01	5.06	30987	30987	0.5

POE: Post Emergence, DAS: Days after sowing, fb: followed by

ha^{-1} at 30 DAS) with respect to seed cotton yield, yield per plant, stalk yield (Table 1). This was due to the competition free period for crop under above treatments resulted in increased uptake of nutrients and consequent increased growth, improved plant architecture, sink development and efficient translocation of photosynthates to sink/fruiting part ultimately resulted in improvement of yield parameters as compared to weed free check. Similarly, increased seed cotton yields under weed free conditions also reported by Patel *et al.* (2013) and Rao (2011).

Higher gross return, net return and BC ratio were obtained in weed free check (Table 1). Among herbicide treatments, higher gross return, net return and BC ratio were recorded with pre-sowing application of Pendimethalin 37.8 CS 900 g a.i. ha^{-1} followed by Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) (₹ 140700, 96147 and 3.2, respectively) compared to other treatments and it was on par with pre-sowing application of Pendimethalin 30 EC @ 1 kg a.i. ha^{-1} followed by POE application of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS). With respect to marginal benefits of net return obtained in weed free check, it is quite important to note that keeping the land free of weeds throughout the crop growing period is practically impossible for the farmers since it involves huge cost on labour. Continuous rains during particular crop growth period further aggravate the situation even though the labour force is available. Besides, it is also found that weeds cause considerable losses by the time they are removed, thus reflecting on seed cotton yields. This is also partly applicable in integrated and farmers weed control methods (Kumaraswamy, 1998 and Vivek *et al.,* 2002).

In the present investigation, based on the weed control efficiency, net return and BC ratio, the treatment pre-sowing application of Pendimethalin 37.8 CS 900 g a.i. ha^{-1} followed by POE application of Quizalofop ethyl 5 EC (50 g a.i. ha^{-1} at 30 DAS) proved effective in controlling the weeds in *Bt* cotton ecosystem and found to be the best alternative method of weed management in comparison to Recommended Package of Practice (3 inter cultivations at 15 days intervals and one hand weeding).

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