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Effect of High Density Planting and Weed Management Practices on Weed Drymatter, Weed Indices and Yield of Bt Cotton

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ABSTRACT

An experiment was conducted during kharif, 2015 at College Farm, College of Agriculture, Rajendranagar, Hyderabad to find out the growth and yield of Bt cotton as influenced by high density planting system and different weed control management practices. The treatments comprised of four planting densities andfour weed management practices. Among the plant densities, the plant density of 1,11,111 plants ha^{-1} normal planting (60 cm x 15 cm) produced significantly more kapas yield (3134 kg ha^{-1}), reduced weed drymatter with higher weed control efficiency (61.88%) as against high plant density of 1, 11,111 plants ha^{-1} paired row planting and 1, 48,148 plants ha^{-1}. Among the weed management practices, pre emergence application of pendimethalin 1.0 kg ha^{-1}fbPoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40 and 60 DAS recorded more kapas yield (3119 kg ha^{-1}), with higher weed control efficiency (73.24%) with reduced weed drymatter.

Key words: *Bt cotton, HDPS, Weed control efficiency, Weed index, Yield.*

INTRODUCTION

Cotton is an important cash crop of India owing to its pivotal role in agriculture, industrial development and employment generation. Almost 95 per cent Indian cotton farmers cultivated the genetically modified Bt cotton. But the farmers arefacing a problem of stagnating yields from Bt cotton hybrids due to increased labour demand, increased labour costs, increased seed costs and increased costs for cotton picking and nutrient requirements. All these facts point to the dire need for sustainable practices. So, to sustain the productivity, high density planting systems, with narrow and ultra-narrow spacing for rainfed soils and developing suitable management options for improving yields and also to improve input use efficiency is the need ofthe hour. The concept on high density cotton planting, more popularly called Ultra Narrow Row (UNR) cotton was initiated by Briggs *et. al.*[2].

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In general, lower plant densities produces high values of growth and yield attributes per plant, but yield per unit area was higher with higher plant densities[12]. However,moderate increase in plant densities may not increase the yield but decrease due to competition between plants for nutrients, water, space and light[9]. It is sensitive to weed competition during initialgrowth stages due to slow growth and wider spacing. Weeds compete for nutrients, water, light and thus reduce cotton yield substantially[3,6]. Optimum cotton yield and quality for high-density planting cotton requires good weed control throughout the growing season. The weeds can severely decrease cotton productivity. In view of the above, present research work is carried out with the objective to find out the effect of High Density Planting System (HDPS) and weed management practices on Weed Drymatter, Weed Indices and Yield of Bt cotton.

MATERIALS AND METHODS

An experiment was conducted during *kharif*, 2015 at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The farm is geographically situated an altitude of 542.6 m above mean sea level on 18' 50^o N latitude and 77.53^o E longitude. The soil of the experimental field was sandy loam in texture,pH(8.7)and EC(0.225 ds m^{-1}), low in available N (250 kg ha^{-1}), medium in available phosphorus (21.68 kg P_2O_5 ha^{-1}) and high in available potassium (685.6 kg K_2O ha^{-1}). The treatments comprised of four planting densities 55,555 plants ha^{-1} (D_1), 1,11,111 plants ha^{-1}normal planting (D_2), 1,11,111 plants ha^{-1} (D_3) paired row planting, 1,48,148 plants ha^{-1} (D_4) and weed management practices (pendimethalin 1.0 kg ha^{-1} as pre emergence fbpyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50g ha^{-1} at 20, 40 and 60, DAS (W_1), pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 15 DAS as early post emergence fb glyphosate ammonium salt 2.13 kg ha^{-1} at 45 DAS (W_2), pendimethalin 1.0 kg ha^{-1} as pre emergence fb HW at 20 and 45 DAS (W_3) and unweeded control (W_4). The experiment was laid out in randomized block design (with factorial concept) and replicated thrice. The weed control efficiency[8] and weed index[5] was calculated by the following formula :

$$WCE\ (\%) = \frac{DM_C - DM_T}{DM_C} \times 100$$

Where,

DM_C : Dry weight of weeds in unweeded check

DM_T : Dry weight of weeds in treated plot

$$Weed\ Index\ (\%) = \frac{X - Y}{X} \times 100$$

Where,

X : Yield from minimum weed competition plot

Y : Yield from treatment plot

RESULTS AND DISCUSSION

Weed indices

Total weeds Dry matter

Data obtained on total weed drymatter during crop growing season was analysed statistically and was presented in the Table 1. Plant densities did not influence drymatter of total weeds up to 90 DAS, but there after significant effect was observed on weed drymatter. At 120 DAS, significantly less dry matter of total

weeds was noticed with plant density of 1,11,111 plants ha^{-1} (D_2) normal planting and it was on par with 1,11,111plants ha^{-1} (D_3) paired row planting. In turn this was on par with 1, 48,148 plants ha^{-1} (D_4) and 55,555 plants ha^{-1} (D_1). At harvest stage the significant difference in weed drymatter production was not observed due to different planting methods. However, the highest weed dry matter was recorded in 55,555 plants ha^{-1} (D_1)and the lowest drymatter production was observed in 1,11,111plants ha^{-1} (D_3) paired row planting. This might be due to sufficient space provided to crop which in turn resulted in better nourishment for growth of crop, thereby creating smothering effect on weeds population and its growth [10].

Weed management practices showed significant difference in weed drymatter of total weeds at all the stages. At all the stages the highest weed drymatter production was recorded under unweeded control (W_4). At 30 DAS, the lowestdrymatter of total weeds was observed with pendimethalin 1.0 kg ha^{-1} (PE) fb HW at 20 and 45 DAS (W_3) and was on par with early PoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1}at 15 DAS fb directed spray of glyphosate ammonium salt 2.13 kg ha^{-1} at 45 DAS (W_2), this in turn on par with pendimethalin 1.0 kg ha^{-1}fbPoE application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40, 60 DAS (W_1).But, at 60, 90, 120 DAS and at harvest stage lowestdrymatter of total weeds was observed withpre emergence application ofpendimethalin 1.0 kg ha^{-1}fbPoE application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40 and 60 DAS (W_1) and was on par with pendimethalin 1.0 kg ha^{-1} (PE) fb HW at 20 and 45 DAS (W_3) and early PoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1}at 15 DAS fb directed spray of glyphosate ammonium salt 2.13 kg ha^{-1} at 45 DAS (W_2) at 60 and 120 DAS but at final harvest it was comparable with early PoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1}at 15 DAS fb directed spray of glyphosate ammonium salt 2.13 kg ha^{-1} at 45 DAS (W_2) and pendimethalin 1.0 kg ha^{-1} (PE) fb HW at 20 and 45 DAS (W_3) respectively. These were significantly superior over unweeded control (W_4) treatment, which recorded higher weed drymatter at all the stages. This reduced dry matter in W_1 treatment might be due to imposition of treatment up to 60 DAS using selective broad leaf and grass control herbicides.

Interaction effect of plant densities and weed management practices did not show any significant influence on drymatter of total weeds in Bt cotton at all the stages of crop growth.

Weed control efficiency

Data pertaining to weed control efficiencyis presented in Table 2. At 30 and 90 DAS, the treatment which was scheduled with 55,555 plants ha^{-1} (D_1) recorded maximum weed control efficiency (WCE) of 49.84 and 61.96 %, respectively. But, at 60 and 120 DAS the maximum WCE of 61.88 and 55.33 % was registered due to the 1, 11,111 plants ha^{-1} (D_2) normal planting. At harvest stage the maximum WCE of 46.24 % was registered under 1,48,148 plants ha^{-1} (D_4). The lowest WCE of 41.88, 44.75 and 51.93 percent were registered due to the scheduling of 1,48,148 plants ha^{-1} (D_4) at 30, 60 And 90 DAS respectively.However, at 120 DAS the treatment scheduled with 1,11,111 plants ha^{-1} (D_3) paired row planting registered the lowest WCE of 36.99 %.

Among the weed management practices, at 30 DAS the highest WCE of 73.00 percent was noticed due to pendimethalin 1.0 kg ha-1 (PE) fb HW at 20

and 45 DAS (W3). But later stages the highest WCE of 73.34, 84.66, 75.25 and 61.40 percent were registered with the application of pendimethalin 1.0 kg ha-1 fbPoE application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40, 60 DAS (W1) at 60, 90, 120 DAS and at harvest stage respectively.The lowest WCE was registered under weedy check (W4) treatment during all the stages of crop growth.The higher WCE was attributed due to lower dry weight of weeds[4]. This might be due to effective weed control achieved under effective method of weed management in terms of reduced biomass of weeds and higher weed control efficiency[10].

Weed Index

The data pertaining to weed index (WI) is presented in Table 2. Among the plant densities the lowest WI (0.00) was recorded due to the scheduling of 1, 11,111 plants ha^{-1} (D_2) normal planting and the highest WI of 30.29 percent was registered due to the scheduling of 55,555 plants ha^{-1} (D_1).

The weed index was drastically reduced in herbicide applied treatment when compared to control treatment (W_4). Among weed management practices the lowest WI (0.01) was noticed by the application of pre emergence application of pendimethalin 1.0 kg ha^{-1}fbPoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40, 60 DAS (W1) and the highest WI (70.35) was registered in weedy check (W_4). In unweeded control (W_4), higher weed index values indicates reduced yield due to weeds. The reduced weed index values might be due to higher dry matter accumulation of weeds, consequently, reduced the seed cotton yield[7].

Kapas yield (kg ha^{-1})

Data pertaining to kapas yieldunder varied plant densities and weed management practices are furnished in Table 1. Among the plant densities the highest kapas yield of 3134 kg ha^{-1} was registered with the treatment of 11,111 plants ha^{-1} (D_2) normal planting and it was significantly superior over rest of the treatments. The lowest kapas yield of 2184 kg ha^{-1} was registered in the treatment where the plant population was low i.e., 55,555 plants ha^{-1} (D_1). Higher plant density at closer spacing recorded significantly higher seed cotton yield than lower plant density at wider spacing due to significantly more number of bolls m^{-2} and higher plant stand per ha[1].

Application of herbicides at different stages in different formulation significantly increased the kapas yield as against un-weeded control plot (W4). Among weed management practices the lowest kapas yield of 925 kg ha^{-1} was recorded in control plot and the highest kapas yield of 3119 kg ha^{-1} was recorded due to the application of pre emergence application of pendimethalin 1.0 kg ha^{-1}fbPoE tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40, 60 DAS (W_1) . However, the remaining two treatments which were reciving herbicides (W2 and W3) also registered similar kapas yield to W_1 treatment, this indicates that different herbicides did not influenced the kapas yield significantly. The yield reduction of 70.34% was observed from unweeded control (W_4) treatment. Cotton being a widely spaced and relatively slow growing crop during its initial stages suffers from severe weed competition and causing substantial reduction in seed cotton yields[13].

The increased kapas yield due to occurrence of less competition between cotton plants and weeds leading to more number of bolls and resulted in higher seed cotton yield[7]. Further, timely and effective control of weeds through herbicides coupled with cultural methods which resulted in better availability of soil moisture and nutrients[11].

Table 1: Weed drymatter of total weeds and Kapas yield of Bt cotton under varied plant densities and weed management practices during *kharif*-2015

	Treatment	Weed drymatter (g. m^{-2})					Kapas yield (kg ha^{-1})
Densities		**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**At harvest**	
D1	60 cm×30 cm (55,555)	7.54 (66.55)	7.14 (74.34)	7.87 (75.70)	8.29 (73.84)	6.62 (45.90)	2184
D2	60 cm×15 cm (1,11,111)	5.89 (33.02)	7.93 (79.8)	7.23 (63)	6.04 (41.60)	5.16 (27.10)	3134
D3	60 cm×15 cm (Paired row 45×75)	8.06 (75.33)	8.49 (75.02)	8.17 (84)	6.84 (53.36)	5.13 (28.10)	2595
D4	45 cm×15 cm (1,48,148)	6.95 (55.58)	8.67 (81.03)	8.13 (77)	7.76 (66.61)	6.29 (41.50)	2207
SEm±		0.57	0.63	0.54	0.52	0.33	149.43
CD(P=0.05)		NS	NS	NS	1.51	1.00	433.69
	Weed management						
W1	Pre emergence application of pendimethalin @ 1kg a.i ha^{-1}fb by POE pyrithiobac sodium @ 62.5 g a.i ha^{-1}+quizalofop-p-ethyl @ 50 g a.i ha^{-1} at 20, 40, 60 DAS	7.98 (64.97)	6.56 (54.83)	5.35 (30)	5.16 (29.97)	4.85 (24.40)	3119
W2	Early POE of pyithiobac sodium @ 62.5 g a.i ha^{-1}+quizalofop-p-ethyl @ 50 g a.i ha^{-1}at 15 DAS fb by glyphosate ammonium salt 2 kg a.i ha^{-1} at 45 DAS	5.45 (32.47)	6.68 (48.83)	5.84 (37)	6.68 (48.27)	5.13 (26.69)	3018
W3	Pendimethalin @ 1kg a.i ha^{-1} (PE) followed by HW at 20 and 45 DAS	4.89 (26.03)	6.56 (45.95)	6.90 (51)	6.44 (44.83)	5.54 (31.19)	3058
W4	Weedy check (no weed control)	10.13 (107.02)	12.42 (160.57)	13.33 (182)	10.51 (112.32)	7.67 (60.32)	925
SEm±		0.57	0.63	0.54	0.52	0.33	149.43
CD(P=0.05)		1.65	1.83	1.57	1.51	1.00	433.69
Interaction							
SEm±		1.14	1.26	1.09	1.04	0.76	298.87
CD(P=0.05)		NS	NS	NS	NS	NS	NS

Table 2: Weed control efficiency and Weed index of Bt cotton under varied plant densities and weed management practices during *kharif*-2015

	Treatment	WCE (%)					Weed index (%)
Densities		**30DAS**	**60DAS**	**90DAS**	**120DAS**	**At harvest**	
D1	60 cm×30 cm (55,555)	49.84	60.40	61.96	40.70	38.70	30.29
D2	60 cm×15 cm (1,11,111)	43.03	61.88	61.73	55.33	39.24	0.00
D3	60 cm×15 cm (Paired row 45×75)	46.96	48.99	59.74	46.16	36.99	17.21
D4	45 cm×15 cm (1,48,148)	41.88	44.75	51.93	49.74	46.24	29.60
Weed management							
W1	Pre emergence application of pendimethalin @ 1kg a.i ha^{-1}fb by POE pyrithiobac sodium @ 62.5 g a.i ha^{-1}+quizalofop-p-ethyl @ 50 g a.i ha^{-1} at 20, 40, 60 DAS	35.23	73.34	84.66	75.25	61.40	0.01
W2	Early POE of pyithiobac sodium @ 62.5 g a.i ha^{-1}+quizalofop-p-ethyl @ 50 g a.i ha^{-1}at 15 DAS fb by glyphosate ammonium salt 2 kg a.i ha^{-1} at 45 DAS	65.15	70.42	79.12	56.84	55.21	3.24
W3	Pendimethalin @ 1kg a.i ha^{-1} (PE) followed by HW at 20 and 45 DAS	73.00	72.26	71.58	59.84	44.57	1.96
W4	Weedy check (no weed control)	0.00	0.00	0.00	0.00	0.00	70.35

CONCLUSION

Significantly the lowest drymatter of weeds was recorded at 120 DAS with plant population of 1,11,111 plants ha^{-1} (D_2) normal planting and was on par with 1,11,111 plants ha^{-1} (D_3) paired row planting. But at harvest lower drymatter of weeds was noticed with 1, 11,111 plants ha^{-1} (D_3) paired row planting and was on par with 1,11,111 plants ha^{-1} (D_2) normal planting. However, plant densities did not showed any significant influence on weed drymatter at 30, 60 and 90 DAS. Significantly lower weed drymatter was recorded with pendimethalin 1.0 kg ha^{-1} (PE) fb HW at 20 and 45 DAS (W_3) at 30 DAS. However, remaining at all other stages the lowest weed drymatter was recorded with pre emergence application of pendimethalin 1.0 kg ha^{-1} fbPoE

tank mix application of pyrithiobac sodium 62.5 g ha^{-1}+quizalofop-p-ethyl 50 g ha^{-1} at 20, 40 and 60 DAS (W_1).

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