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Effect of planting geometry and fertilizer levels on weed density and biomass in Bt cotton

K. Kalaichelvi
Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)
E-mail :kalaiagri2003@yahoo.com

ABSTRACT

Field experiments were conducted to study the effect of plant spacing and fertilizer levels on weed density and weed dry matter production in Bt cotton hybrids. MECH 162 and RCH 2 Bt hybrids had lower weed density and dry matter production than MECH 184 Bt hybrid. Closer plant spacing of 90x45 and 90x60 cm and fertilizer application of 120:60:60 and 160:80:80 kg NPK/ha reduced the weed density and weed dry weight than 120x60 cm of plant spacing and 200:100:100 kg NPK/ha of fertilizer application. MECH 162 and RCH 2 Bt cotton adopted with plant geometry of 90x60 cm and applied with fertilizer level of 160:80:80 kg NPK/ha recorded higher seed cotton yield.

Key word : Bt cotton, Fertilizer level, Plant geometry

Weeds are the major hazard in cotton cultivation which reduced seed cotton yield by 16-63% (Desh Pande *et al*. 1987) and 10-90% (Halemani *et al*. 2004), depending on the crop varieties, type of weed flora and cultural practices like planting geometry and fertilizer application. But the research findings on weed infestation and their control in Bt cotton are meager. Hence, the present investigation was undertaken in Bt cotton to determine existing weed flora and influence of planting geometry and fertilizer application on growth and yield of Bt cotton.

MATERIALS AND METHODS

A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore on Bt cotton during winter and summer irrigated season of the year 2005 and 2006 in sandy clayey loam soil and clayey loam soil, respectively. The available N, P and K were 165.0 and 215.0 kg/ha, 12.0 and 11.2 kg/ha and 585.0 and 680.0 kg/ha, respectively in the soil of both sites. The experiment was laid out in split plot design with three replications. Treatments consisted of 3 Bt hybrids (MECH 184, MECH 162 and RCH 2) and 3 plant geometries of 90x45, 90x60 and 120x60 cm as main plot treatments and 3 fertilizer levels (120:60:60, 160:80:80 and 200:100:100kg N: P_2O_5: K_2O/ha) as sub plot treatments. Nitrogen, phosphorus and potassium were applied through urea, single super phosphate and muriate of potash, respectively. Weeds were controlled by pre emergence application of pendimethalin at 1.0 kg/ha on 3 DAS followed by two hand weeding 25 and 50 DAS. The weed density and dry matter production was recorded on 40 DAS and values were transformed by using the formula $\sqrt{x+1}$. The seed cotton yield was pooled from four pickings.

RESULTS AND DISCUSSION

Weed flora of the experimental field

The weed flora of the experimental field consisted of grasses, sedges and broad leaved weeds. During winter season 2005, the weed species recorded under almost all plots in the experimental field were *Cynodon dactylon*, *Panicum repens*, *Dactyloctenium aegyptium* among the grasses. *Cyperus esculentus* was the only sedge weed found in the experimental site. *Trianthema portulacastrum*, *Parthenium hysterophorus, Digera arvensis, Amaranthus viridis, Corchorus olitorius, Commelina benghalensis, Convolvulus arvensis, Euphorbia hirta* and *Phyllanthus niruri* were the predominant broad leaved weeds.

During summer season in 2006, weed flora observed were *Echinochloa crusgalli, Cynodon dactylon* and *Dicanthium annulatum* among the grasses. The major sedge weed were *Cyperus esculentus* and *Cyperus rotundus.* The major broad leaved weeds were *Trianthema portulacastrum, Gynandropsis pentaphylla, Portulaca oleracea, Flaveria australasica, Datura stramonium fastuosa, Boerhaevia diffusa, Digera arvensis* and *Acalypha indica.* Similar weed flora in cotton was earlier reported by Panwar *et al.* (1995).

Weed density

The population of grasses, sedges, broad leaved weeds individually and total weed density were significantly influenced by Bt cotton, plant geometries and fertilizer levels

(Table 1). The lower weed density was observed with RCH 2 Bt cotton as they have taller plants and more canopy spread thus faced minimum weed competition and pronded shading effect on weeds. This is in consonance with the findings of Singh *et al.* (2003a) that more lateral canopy faced minimum weed competition in chickpea cultivars. Closer plant geometries of 90x45 and 90x60 cm had recorded lower density of all weeds mainly due to the higher population pressure and more competitive ability of the Bt cotton. Lower weed population in higher crop density might be attributed to more smothering potential of the crop with thick stand compared to wider spacing with thin stand as earlier reported by Brar and Walia (2001) in rice and Singh *et al.* (2003b) in *Tagetus* spp. Application of fertilizers at the rate of 120:60:60 and 160:80:80 kg NPK/ha led to record lesser densities of grasses, sedges, broad leaved and total weeds over application of 200:100:100 kg NPK/ha. This is in accordance with the findings of Singh *et al.* (2005) that under low and medium weed pressure, lesser application of fertilizer recorded higher yield over higher level of fertilizers applied in potato.

Weed dry weight

Among the Bt cotton, MECH 162 and RCH 2 recorded lesser weed dry weight over MECH 184 at 40 DAS (Table 2) during both the years of experimentation because of the higher dry matter production by the crop varieties. The plant geometries of 90x45 cm and 90x60 cm and application of fertilizers at the rate of 120:60:60 and 160:80:80 kg NPK/ha suppressed the weed growth due to the higher population pressure and better crop growth and thus resulted into reduction of weed dry weight.

Table 1. Effect of planting geometry and fertilizer levels on weed density (no./m^2)in Bt cotton at 40 DAS

Treatments	Grasses		Sedges		Broad leaved weeds		Total weeds	
Bt hybrids	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**
MECH 184	2.51(20)	1.37(3)	2.11(12)	2.70(16)	3.32(29)	3.31(27)	4.08(61)	3.76(45)
MECH 162	2.98(20)	1.15(2)	2.63(20)	2.56(13)	3.03(23)	3.19(23)	4.09(63)	3.64(38)
RCH 2	2.48(22)	1.06(1)	1.93(11)	1.92(6)	2.76(14)	3.27(25)	3.77(47)	3.49(32)
LSD (P = 0.05)	NS	0.08	0.20	0.18	0.18	NS	0.25	0.26
Plant spacing								
90 x 45 cm	2.53(16)	1.09(2)	2.21(12)	1.86(6)	2.67(15)	3.16(22)	3.73(42)	3.41(30)
90 x 60 cm	3.26(32)	1.20(2)	1.67(8)	2.53(12)	3.01(20)	3.27(25)	4.03(60)	3.67(39)
120 x 60 cm	2.19(14)	1.29(2)	2.79(24)	2.80(16)	3.42(32)	3.34(27)	4.18(69)	3.81(45)
LSD (P = 0.05)	0.2	0.08	0.2	0.18	0.18	0.16	0.25	0.26
Fertilizer levels								
120:60:60 kg NPK/ha	2.68(20)	0.81(1)	2.17(12)	2.53(12)	2.87(20)	3.30(26)	3.93(52)	3.67(38)
160:80:80 kg NPK/ha	2.20(12)	0.89(1)	1.58(6)	1.90(7)	2.94(18)	3.03(19)	3.60(37)	3.30(27)
200:100:100 kg NPK/ha	3.10(29)	1.88(5)	2.91(24)	2.75(15)	3.28(29)	3.44(29)	4.41(82)	3.92(50)
LSD (P = 0.05)	0.23	0.09	0.2	0.20	0.21	0.19	0.26	0.17

Figures in parenthesis denotes original values

Table 2. Effect of plant spacing and fertilizer levels on weed dry weight (kg/ha) in Bt cotton at 40 DAS (2005)

Treatments	Grasses		Sedges		Broad leaved weeds		Total weeds	
Bt hybrids	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**
MECH 184	2.74(28)	1.31(2)	2.54(24)	2.17(7)	5.04(156)	4.11(61)	5.32(208)	4.25(71)
MECH 162	3.16(23)	1.21(2)	3.26(42)	2.13(8)	4.26(78)	3.75(42)	4.95(143)	3.95(52)
RCH 2	2.67(26)	0.98(1)	2.41(26)	1.94(6)	4.13(61)	3.74(41)	4.70(114)	3.89(48)
LSD CD (P = 0.05)	0.14	0.07	0.15	0.15	0.33	0.19	0.22	0.14
Plant spacing								
90 x 45 cm	2.79(22)	0.99(1)	3.05(34)	1.63(4)	4.25(78)	3.75(42)	4.87(135)	3.85(47)
90 x 60 cm	3.33(37)	1.16(1)	2.14(24)	2.28(8)	4.47(98)	3.83(46)	4.99(158)	4.03(55)
120 x 60 cm	2.44(18)	0.35(3)	3.01(34)	2.32(9)	4.71(119)	4.02(57)	5.11(172)	4.20(68)
LSD (P = 0.05)	0.14	0.07	0.15	0.15	0.33	0.19	0.22	0.14
Fertilizer levels								
120:60:60 kg NPK/ha	2.86(26)	0.83(1)	3.15(36)	2.15(7)	4.41(96)	3.93(50)	5.01(158)	4.07(57)
160:80:80 kg NPK/ha	2.55(21)	0.50(1)	1.63(11)	1.65(4)	4.47(94)	3.68(38)	4.78(126)	3.79(43)
200:100:100 kg NPK/ha	3.12(31)	1.71(4)	3.43(45)	2.43(10)	4.55(105)	3.99(41)	5.18(181)	4.22(69)
LSD (P = 0.05)	0.16	0.06	0.15	0.15	NS	0.24	0.27	0.18

Figures in parenthesis denotes original values

Table 3. Effect of plant spacing and fertilizer levels on seed cotton yield of Bt cotton hybrids and interaction effect of Bt hybrids and plant geometry on seed cotton yield

Treatments	Seed cotton yield (kg/ha)		Treatments	Seed cotton yield (kg/ha)							
				2005				2006			
				Spacing (cm)							
	2005	2006		90 x 45	90 x 60	120 x 60	Mean	90 x 45	90 x 60	120 x 60	Mean
Bt hybrids			**Bt hybrids**								
MECH 184	2088	1821	MECH 184	2397	2153	1715	2088	1960	1775	1727	1821
MECH 162	2188	1897	MECH 162	2112	2430	2023	2188	1804	2103	1785	1897
RCH 2	1833	1948	RCH 2	1485	2287	1726	1833	1761	2202	1880	1948
			Mean	1998	2290	1821		1842	2027	1797	
LSD (P = 0.05)	135	95				LSD (5%)				LSD (5%)	
Plant spacing				H x S		234		H x S		164	
90 x 45 cm	1998	1842		S at F		NS		S at F		NS	
90 x 60 cm	2290	2027		F at H		NS		F at H		NS	
120 x 60 cm	1821	1797		F at S		NS		F at S		NS	
				H at F		NS		H at F		NS	
LSD (P=0.05)	135	95									
Fertilizer levels											
120:60:60 kg NPK/ha	1903	1839									
160:80:80 kg NPK/ha	2163	1954									
200:100:100 kg NPK/ha	2043	1872									
LSD (P=0.05)	168	57									

Seed cotton yield

MECH 162 and MECH 184 Bt cotton recorded significantly higher seed cotton yield over RCH 2 Bt cotton in winter irrigated season of 2005 (Table 3) which could be attributed to the increased yield attributes. This is also in agreement with the findings of Ansingkar *et al*. (2005) that productivity of MECH 162 was comparably higher over MECH 184 Bt hybrid. But in summer irrigated season of 2006, significantly higher seed cotton yield was obtained by MECH 162 and RCH 2 Bt cotton over MECH 184 Bt cotton. Plant spacing of 90x60 cm recorded significantly higher seed cotton yield. Among the fertilizer levels studied, higher seed cotton yield was obtained with application of 160:80:80 kg NPK/ha over other levels tested in both the years of experiment conducted.

RCH 2 and MECH 162 Bt cotton had recorded significantly higher yield at plant spacing of 90x60 cm (Table 3). But MECH 184 Bt cotton recorded significantly higher seed cotton yield only at closer plant spacing of 90x45 cm in 2005. This is in confirmation with the findings of Heitholt *et al*. (1992) that higher lint yields are observed with closer spacing in okra leaf genotypes.

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