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Effect of Nitrogen Levels and Schedule on Yield, Yield Attributes and Qualtiy of Bt Cotton Hybrids

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ABSTRACT

A field experiment was conducted during the *Kharif* season of 2006-07 to study the nitrogen management in Bt cotton hybrids under rainfed conditions at the Agricultural Research Station, Adilabad. Bt cotton hybrid RCH-2 accumulated significantly larger dry matter than Bunny. The dry matter production reduced with every increment of aditional N from 92 to 150 kg ha^{-1}. The split application of N at different times was not significant. The yield attributes of Bt cotton hybrids such as plant height number of bolls per plant and number of branches per plant were responsive to increase in the level of N. The split aplication of N at 25,55,85 and 115 DAS of the crop was best schedule to maximize the production of sympodial branches per plant and number of bolls per plant. Bt cotton yield increased significantly with the increase in nitrogen levels upto 150 kg N ha^{-1}. Ginning percentage and halolength significantly improved by the application of high level of fertilizer at 120 kg N ha^{-1}, which was found to be optimum.

Key words : Nitrogen Levels, Nitrogen Schedules, Quality,Yield

The introduction of transgenics in cotton during 2001 in India greatly minimized the suicidal attempts of farmers, from the threat of crop devastation by the boll worms. The Bt cotton is cultivated over an area of 2,70,000 ha in Adilabad district of Andhra Pradesh. Nalayani *et al.*(2001) reported that Bt hybrids produced 78 -105% more seed cotton yield than the non-Bt hybrids. They also reported that these transgenics require only 75% of the recommended dose of fertilizers by the non- Bt hybrids. Therefore, an attempt was made to estimate the quantity of nitrogen and its schedule of split application to maximize the production and profit of Bt Hybrids in the soils of Adilabad district under rainfed conditions.

MATERIAL AND METHODS

The field experiment was conducted during the *kharif* 2006-07 at the Agricultural Research Station, Adilabad. The experimental soil was a vertisol with alkaline reaction having 8.5 p^H, low in availabe nitrogen (232 kg ha^{-1}), medium in available phosphorus (29.5 kg P_2O_5 ha^{-1}) and high in availabe potassium (375 kg K_2O ha^{-1}). The experiment comprised 18 treatments with the combination of three levels of nitrogen, three schedules of its application and two Bt genotypes of cotton laid out in split plot design. The main plots consisted of random allocation of factorial combinations of genotypes and level of nitrogen at random and sub plot treatments were the schedules of application of N in 4 splits at 3 differetn times viz., T_1:15-45-75-105, T_2:20-50-80-110 and T_3:25-55-85-115 days after sowing with 3 levels of N i.e 90,120 and 150 kg ha^{-1} and uniform dose of 60 kg phosphorus and potassium ha^{-1} applied in 3 equal splits.

RESULTS AND DISCUSSION

Plant height

The hybrid Bunny attained significantly tall height (113.7cm) compared to RCH-2 (88.4 cm) (Table 1). Bt cotton was responsive to increase in the level of N. The crop fertilized with 90 kg N ha^{-1} recorded a mean plant height of 88.5 cm and increased significantly to 100.6 cm at the application of 120 kg N ha^{-1} as also reported by Halemani *et al.*(2004). The crop showed further significnat response by enhancing the mean plant height to 114.0cm by the application of 150 kg N ha^{-1}.

In case of time of split application of N also had a significnat impact on the plant height of cotton. The schedule of split application of N at 20-50-80-110 DAS or at 25-55-85-115 DAS enabled the crop to grow significantly tall than its application at 15-45-75-105 days after sowing.

Drymatter production

The trend in drymatter production between the two hybrids was not consistent. The RCH-2 accumulated significantly large drymatter than Bunny. The increasing level of N increased the drymatter production of cotton at initial stages. But

the trend is reversed in later stages of the crop growth. The drymatter production reduced with every increment of addtional N from 90 to 150 kg ha^{-1} (Table1).

Number of branches per palnt

For the mean number of sympodial branches produced by the hybrids grown with different levels of nitrogenous fertilizers and time of split application, Bunny produced significantly more number of sympodial branches (23.97) compared to RCH-2(20.68). The increasing level of N benefited the crop to produce more number of sympodial branches per plant (Hosmath *et al.,* 2004). The crop had a mean number of 20.26 sympoidal branches when it was fertilized with 90 kg N ha^{-1} and the application of 120 kg N ha^{-1} significantly increased the sympodia to a mean of 22.61 per plant. The crop was responsive to a still high level of 150 kg N ha^{-1} resulting in the formation of maximum number of sympodial branches per plant (24.12). The split application of N at 25-55-85-115 DAS of the crop was the best schedule to maximize the production of sympodial branches per plant.

Days to square formation and full bloom

The two Bt - cotton hybrids Bunny and RCH-2 commenced square formation almost at the same time by 39 days and were in full bloom by about 51 days after sowing and the rate of N application had a significant influence on these two traits. The crop fertilized with 90 kg N ha^{-1} needed 37.38 days to commence square formation and 48.83 days for full bloom. The time needed for these two phenophases was extended to a mean of 41.22 and 53.61 days by increasing the level of fertiliser to 120 kg N ha^{-1}. This effect was statistically significnat (Ramachandran *et al.,* 1980) However further increase in the level of fertilizer application to 150 kg N ha^{-1} reduced the time needed for these phenophases to 39.11 and 51.61 days, respectively.

The time of split application of N fertilizer also regulated the time needed to square formation and full bloom and the crop needed less number of 36.50 and 50.33 mean number of days for the commencement of square formation and the stage of full bloom when the four splits of N were scheduled at 15-45-75-105 DAS compared to the other schedules. There were no significnat differences in the time needed for the fomation of square and the full bloom of flowers among the treatments of split application scheduled at 20-50-80-110 or 25-55-85-115 DAS.

Number of bolls per plant and boll weight

Bunny produced significantly more mean number of bolls (62.67) per plant compared to 57.99 bolls per plant by RCH-2 (Table 2). The bolls of Bunny were also heavier than those obtained from RCH-2 (Joshi, 1997).

Increasing level of N application had a significant influence on the number and weight of bolls. The crop fertilized with 90 kg N ha^{-1} produced a mean of 53.80 bolls per plant. The mean weight of bolls was 4.90 g. The number and weight of bolls increased significantly to 62.21 and 5.39g by increasing the level of fetilizer to 120 kg N ha^{-1} . The crop responded to a further increment of the fertilizer up to 150 kg N ha^{-1} and significantly increased the production of bolls to 64.98 per plant and the weight increased to a maximum of 6.02g.

The most appropriate schedule of split application of nitrogenous fertilizers was at 25-55-85-105 DAS. This schedule resulted in an increase in the number of bolls per plant and their weight significantly.

Kapas and Stalk yield

The Bt genotype Bunny recorded significant higher quantity (2746) of kg Kapas and 9466 kg stalk yield compared to RCH-2(Table 2).

The productivity of cotton significantly increased by the application of 120 kg N ha^{-1} (2760 kg ha^{-1}) over that with 90 kg N ha^{-1} (2283 kg ha^{-1}). Further increase in the level of nitrogen to 150 kg ha^{-1} enabled the crop to yield 2818 kg ha^{-1} kapas. However, this was not significant improvement over 120 kg N ha^{-1}. Whereas, the stalk yield increased significantly with increasing level of 'N' up to 150 kg ha^{-1}. The application of 120 kg N ha^{-1} increased the production of stalks to 8680 kg ha^{-1} and further by increasing the level of 'N' application to 150 kg N ha^{-1} . Several investigations also reported significant and favorable effects of nitrogen on cotton yield. (Sankaranarayan *et al.,* 2004 and Halemani *et al.,* 2004).

The schedule of split application of N at 20-50-80-110 DAS was significantly superior to enhance the production of kapas and stalk than at 15-45-75-105 DAS. However, maximum production of 2685 kg kapas and 8051 kg stalk was obtained by adopting the split application of 'N' at 25-55-85-115 DAS. This was significantly superior to the other two schedules.

Ginning percentage

The ginning percentage of seed cotton of Bunny Bt cotton hybrid was 35.51. This was

Table 1. Crop growth attributes of Bt cotton hybrids as influenced by level of N and time of Application

Treatments	Plant height (cm)	Dry matter (kg ha^{-1})	No.of branches	Days needed for Square formation	Days needed for Full bloom
Hybrid					
RCH-2	88.4	8733	20.68	39.22	51.70
Bunny	113.7	5959	23.97	39.25	51.00
SE ±	0.9	407	0.15	0.67	1.04
CD 5%	2.0	907	0.35	NS	NS
N levels Kg ha^{-1}					
N_1 90 kg N ha^{-1}	88.5	8070	20.26	37.38	48.83
N_2 120 kg N ha^{-1}	100.6	6698	22.61	41.22	53.61
N_3 150 kg N ha^{-1}	114.0	7270	24.12	39.11	51.61
SE ±	1.1	498	0.19	0.82	1.28
CD 5%	2.5	1110	0.43	1.83	2.86
Time of application					
15-45-75-105 DAS	97.8	8436	21.80	36.50	50.33
20-50-80-110	101.3	7064	22.34	40.27	52.66
25-55-85-115	104.1	6538	22.84	40.94	51.05
SE ±	0.7	197	0.07	1.19	1.11
CD 5%	1.4	408	0.16	2.47	2.30

DAS = Days after sowing

Table 2. Yield attributes, yield and quality of Bt cotton as influenced by levels on N and time of application

Treatments	Yield attributes: No.of bolls per plant	Yield attributes: Boll weight (g)	Yield (kg ha^{-1}): Kapas	Yield (kg ha^{-1}): Stalk	Quality Parameters: Ginning %	Quality Parameters: Halolength
Bt Cotton hybrids						
RCH-2	57.99	5.29	2495	6241	33.66	22.12
Bunny	62.67	5.58	2746	9466	35.51	24.27
SEm ±	0.39	0.06	53	55	0.72	0.17
CD 5%	0.88	0.14	119	123	1.61	0.39
Nitrogen level						
N_1 90 kg N ha^{-1}	53.80	4.90	2283	4784	33.22	22.03
N_2 120 kg N ha^{-1}	62.21	5.39	2760	8680	35.00	23.52
N_3 150 kg N ha^{-1}	64.98	6.02	2818	10097	35.55	24.03
SEm ±	0.48	0.08	65	68	0.88	0.27
CD 5%	1.07	0.17	145	151	1.98	0.47
Time of application						
T1 15-45-75-105 DAS	58.68	5.28	2567	7622	33.72	23.11
T2 20-50-80-110 DAS	60.43	5.47	2609	7888	35.66	23.01
T3 25-55-85-115 DAS	61.88	5.56	2685	8051	34.38	23.47
SEm ±	0.39	0.03	27	78	0.50	0.15
CD 5%	0.80	0.07	56	162	1.03	0.30

significantly more than the ginning value of 33.36 percent in RCH-2(Table2).

The ginning per cent was significantly improved by the application of high level of fertilizer at 120 kg N ha^{-1}. This is evident from the ginning value of 35 per cent compared to 33.22 per cent due to the application of 90 kg N ha^{-1} . The ginning per cent at 150 kg N ha^{-1} was on par with the treatment of 120 kg N ha^{-1} and confirmed with the findings of Sharma *et al.* (2000).

The ginning percent of cotton improved significantly by the split application of N at 20-50-80-120 DAS than at 25-55-85-115 DAS. This quality was deterred to a low value of ginning per cent due to the split application of N at 15-45-75-105 DAS.

Halolength

The halolength of fibre of the two genotypes was influenced by the level and time of 'N' application. The Bunny possessed significantly longer halolength (24.27 mm) than the fibre of RCH-2 (22.12 mm) (Table 2).

The halolength improved significantly with increase in the level of N and it was 22.03 mm by fertilizing the crop with 90 kg N ha^{-1} and 23.52 mm with 120 kg N ha^{-1}. Maximum halo length was recorded by fertilizing the crop with 150 kg N ha^{-1} (24.03). The split application of N at 25-55-85-115 DAS recorded maximum halo length of 23.47 mm while it was 23.01 m.m by adopting the split application schedule of 'N' at 20-50-80-110 DAS. The net rupee invested was also highest with 120 kg N ha^{-1}.

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