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Research Paper

Crossed seed yield and yield attributing characters as influenced by date of sowing of parents, growth regulators and micronutrient sprays in NHH-44 Bt. cotton hybrid

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ABSTRACT

The influence of three date of sowings *viz.*, D_1, D_2 and D_3 and two growth regulators and four micronutrient sprays were studied for crossed seed yield and yield attributing characters. Among the staggered sowing of male parent, D_2 recorded higher number of female flower buds crossed per plant (90.58), crossed bolls per plant (34.75), crossed seed cotton yield (1019 kg/ha), and crossed seed yield (664 kg/ha) compared to other two staggered sowing treatments and also simultaneous sowing of both the parents recorded higher crossed boll weight (3.72), crossed seed weight per boll (2.10), compared to other two staggered sowing treatments. Among the chemical spray, the boom spray recorded higher number of female flower buds crossed per plant (94.00), crossed bolls per plant (36.50), crossed seed cotton yield (1034 kg) and crossed seed yield (656 kg/ha). The staggered sowing of male parent, 50 per cent first male sowing + 100 per cent female sowing, remaining 50 per cent male seeds were sown seven days after the first male sowing in combination with boom spray recorded higher number of female flower buds crossed per plant (97.00), crossed bolls per plant (37.50), crossed seed cotton yield (1056 kg/ha) and crossed seed yield (698 kg/ha) compared to the other combinations.

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Key words : Date of sowing, Lihocin, NAA, Crossed seed yield

INTRODUCTION

The major barrier in hybrid seed production is perfect synchronization of flowering between female and male in order to get higher crossed seed yield with better quality due to less insect damage, the square and flower dropping is less flower setting, locule damage are less and hence there is increase in number of retention of squares/flowers in Bt version of female parent (BN1) of NHH-44 hybrid cotton. Therefore, the already standardized staggered planting may also be expected to change. Due to less insect damage, retention of good opened bolls is also more. Hence, there is a need to supplement the plant proper micronutrients and growth regulators to retain the crossed bolls on the plant for final harvest so that crossed seed yield can be increased with high quality. So, in order to ascertain the quality of hybrid seed (NHH-44 Bt cotton) produced at different date of sowing of parent, micronutrient, growth regulator spray, the present experiment was planned.

MATERIALS AND METHODS

An experiment on inter hirsutum (BN1 x AC-738) Bt cotton hybrid (NHH-44) seed production was laid out at Agricultural Research Station, Dharwad during *Kharif* 2009 in Factorial Randomized Complete Block Design. The 1st factor consisted of three date of sowing of parents *viz.,* D_1, D_2 and D_3. The second factor consisted of two growth regulators *viz.,* NAA (10 ppm), lihocin (100 ppm) and four micronutrients *viz.,* $MgSO_4$ (1%), Boron (1%), boron (2 ml/litre), viagro (1 ml/litre) were used for foliar application to the female parent.

The picked crossed kapas from each treatment combinations were separately cleaned, ginned and the crossed seeds were collected, ginned and the crossed

seeds were collected. The observation on crossed seed index, germination percentage, root length, shoot length, seedling dry weight, and seedling vigour index recorded for each treatment and statistical analysis of the data was done by analysis of variance technique.

RESULTS AND DISCUSSION

The data on yield components *viz.,* seed yield and seed cotton yield in hybrid seed production of NHH-44 Bt cotton hybrid obtained during 2009-10 indicated that there was significant variation in the yield components. The seed yield and its attributes such as boll weight, seed weight per boll and seed index, number of crossed bolls, seed cotton yield and seed yield per ha were also significant.

The D_2 staggering recorded significantly higher number of crossed bolls (34.75) per plant (Table 2) followed by D_3 (34.25), which were at par with each other. This may be due to higher number of buds crossed at this staggering (D_2). These results are in agreement with the findings in DHB-105 hybrid seed production (Anonymous, 1995) and similarly Doddagoudar *et al.* (2006) in DHH-543 and DHB-290 hybrid seed production.

The T_5 chemical spray recorded significantly higher number of crossed bolls (36.50) per plant followed by T_6 (36.33), which were at par with each other. This may be due to significantly higher number of buds crossed at this treatment and their retention is more.

The combination of D_2T_5 recorded significantly higher number of crossed bolls per plant (37.50) followed by D_3T_6 (37.00). This may be due to the availability of sufficient number of male flowers to pollinate female flowers throughout the crossing period. Because of this, number of buds crossed, boll setting and crossed bolls retained were more in the female parent.

The boll weight was significantly influenced by staggering of male parent. Higher boll weight (3.72 g) was recorded in the staggering D_1 followed by D_3 (3.68 g) (Table 4). This variation in the individual boll weight in different staggering of male parent may be due to the variation in retention of crossed bolls per plant *i.e.,* wherever the number of bolls per plant were more the individual boll weight was less. This may be due to the fact that the available photosynthates would equally be distributed among all the bolls on the plant. The less number of bolls in a plant would get more photosynthates for full boll development which may be the reason for increase in the individual boll weight. The variation in boll weight was also due to variation in number of seeds per boll (Yadav *et al.*, 1998).

The boll weight was also significantly influenced by chemical spray. Among the chemical spray the T_4 chemical spray recorded significantly highest boll weight (3.86 g) followed by T_3 (3.82 g) which were at par with each other. The differences in boll weight may be due to the variation in the retention of crossed bolls per plant. Whenever, the numbers of bolls per plant were more, the boll weight was less. This may be due to fact that when the boll number is increased per plant the limited photosynthates may be equally distributed among all the

Table 1: Effect of staggered sowing of male parent and chemicals spray on number of female buds crossed per plant in NHH-44 Bt. Cotton hybrid seed production

Treatments	number of female buds crossed per plant						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	84.50	85.50	84.00	86.00	90.00	92.00	86.83
D_2	86.50	92.50	84.00	89.00	97.00	94.50	90.58
D_3	85.00	87.00	83.00	87.00	95.00	94.00	88.50
Mean	85.00	88.33	83.67	87.33	94.00	93.50	88.64
For comparing means of		S.E. ±				C.D. (P=0.05)	
Staggered sowing (D)		1.19				3.58	
Chemicals spray (T)		1.69				5.07	
DxT*		2.93				NS	

NS - Non significant * Interaction effect

Date of sowing of parents (D)

D_1 – Simultaneous sowing of both the parents

D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing

D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing

Growth regulators and micronutrients (T)

T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%

T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

bolls and consequently the individual boll weight was decreased. The variation in boll weight was also due to variation in number of seeds per boll (Yadav *et al.,* 1998).

The D_1 staggering (Table 6) recorded significantly higher seed weight (2.10 g) per boll followed by D_3 (2.03) which were at par with each other. The variation in seed weight per boll in different staggered sowing may be due to the numerical variation in the number of seeds per boll and development of individual seed within the boll (higher seed index). Yadav *et al.* (1998) observed positive correlation between number of seeds and seed weight per boll. Similarly, during hybrid seed production of DMSHH-4 and staggered sowing had significantly influenced the seed weight per boll (Anonymous, 2001).

Similarly, the seed weight per boll was significantly higher (2.10 g) in the T_2 chemical spray followed by T_1 (2.09 g) which were at par with each other.

The variation in seed weight per boll due to the chemical spray may be the numerical variation in the number of seeds per boll and higher seed index that might have contributed in the development of individual seed within the boll (Doddagoudar *et al.,* 2006a and b) and

Table 2: Effect of staggered sowing of male parent and chemicals spray on number of crossed bolls per plant in NHH-44 Bt. Cotton hybrid seed production

Treatments	Number of crossed bolls per plant						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	32.50	31.50	32.00	32.50	35.50	35.50	33.17
D_2	33.50	34.50	32.50	34.00	37.50	36.50	34.75
D_3	33.00	32.00	33.00	34.00	36.50	37.00	34.25
Mean	33.00	32.67	32.50	33.50	36.50	36.33	34.22
For comparing means of		S.E. ±				C.D. (P=0.05)	
Staggered sowing (D)		0.20				0.72	
Chemicals spray (T)		0.29				0.89	
DxT*		2.07				6.17	

NS - Non significant * Interaction effect
Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

Table 3: Effect of staggered sowing of male parent and chemicals spray on boll setting percentage in NHH-44 Bt. Cotton hybrid seed production

Treatments	Boll setting percentage						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	38.46	36.82	38.09	37.77	38.91	38.57	38.10
D_2	38.71	36.77	38.69	38.22	38.14	38.61	38.19
D_3	38.79	36.79	39.72	39.06	39.46	39.36	38.86
Mean	38.65	36.79	38.83	38.35	38.84	38.85	38.39
For comparing means of		S.E. ±				C.D. (P=0.05)	
Staggered sowing (D)		0.90				NS	
Chemicals spray (T)		1.27				NS	
DxT*		2.21				NS	

NS - Non significant * Interaction effect
Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

Yadav *et al*. (1998), who reported a positive correlation between the number of seeds and seed weight per boll.

Significantly higher seed index (8.82 g) was observed in D_1 staggering compared to D_2 and D_3 staggering. This may be due to the fact that in the D1 staggering the boll load per plant in female parent was low, because of less number of bolls sufficient amount of photosynthates may be translocated to individual seed development and thus resulting in increased seed index.

The seed index was significantly higher (8.87 g) in the T_2 chemical spray followed by T_1 (8.84 g). The variation in seed index due to chemical spray may be the variation observed in the development of individual seed within the bolls. Further, it was recorded that whenever the number of bolls retained per plant was more, that has produced lesser seed index in a particular planting ratio. This may be due to the variation in translocation of limited source because of competition among the bolls within the plant and also competition among the seeds within the boll for the photosynthates and consequently caused the variation in seed index. Similarly, these findings are in conformity with the report of Doddagoudar *et al.* (2006a and b) in DHH-543 and DHB-290 hybrid seed production.

The yield components such as boll weight (3.74 g),

Table 4: Effect of staggered sowing of male parent and chemicals spray on boll weight (g) in NHH-44 Bt. Cotton hybrid seed production

Treatments	Boll weight (g)						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	3.74	3.72	3.83	3.93	3.57	3.51	3.72
D_2	3.74	3.83	3.76	3.70	3.44	3.50	3.66
D_3	3.81	3.81	3.95	4.00	3.39	3.43	3.68
Mean	3.76	3.75	3.82	3.86	3.47	3.48	3.69
For comparing means of		S.E.±				C.D. (P=0.05)	
Staggered sowing (D)		0.03				0.12	
Chemicals spray (T)		0.04				0.18	
DxT*		0.08				NS	

NS - Non significant * Interaction effect
Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

Table 5: Effect of staggered sowing of male parent and chemicals spray on number of seeds per boll in NHH-44 Bt. Cotton hybrid seed production

Treatments	Number of seeds per boll						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	18.90	18.94	18.74	19.03	18.64	18.51	18.79
D_2	19.02	18.84	18.66	18.77	18.68	18.68	18.77
D_3	19.02	18.84	18.66	18.77	18.68	18.68	18.92
Mean	19.01	18.95	18.78	18.94	18.69	18.61	18.83
For comparing means of		S.E. ±				C.D. at 5%	
Staggered sowing (D)		0.35				NS	
Chemicals spray (T)		0.50				NS	
DxT*		0.87				NS	

NS - Non significant * Interaction effect
Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

seed weight per boll (2.11 g) and seed index (8.88 g) were numerically higher in the combination of D_1T_1 and D_1T_2 (3.72 g, 2.06 g and 9.02 g, respectively) than other combinations numerically higher values in these components in different combination of staggered sowing and chemical spray may be due to the numerically less number of boll load per plant. The plant with lower load would get more photosynthates due to less competition between the bolls and thereby develop more properly than the bolls present in a heavy boll load plant.

The D_2 staggering recorded significantly higher seed cotton yield per ha (1019 kg) followed by D_3 staggering (1001 kg) (Table 7). Similarly, the seed yield per ha (664 kg) was also significantly higher in D_2 staggering followed by D_3 (631 kg) which were at par with each other (Table 8). The higher seed cotton and seed yield in D_2 staggering may be due to higher number of crossed bolls per plant. These results are in line with the findings in PKV Hy-4 and PKV Hy-5 (Anonymous, 2001). Similar observations made by Doddagoudar *et al.* (2006 a and b) in DHH-543 and DHB-290 cotton hybrid seed production and DDH-2 desi cotton hybrid seed production (Khadi *et al.,* 1995) recorded higher seed cotton yield and seed yield due to staggered sowing of male parent.

The seed cotton yield (1034 kg) per ha was significantly higher in the T_6 chemical spray followed by

Table 6: Effect of staggered sowing of male parent and chemicals spray on seed weight (g) per boll in NHH-44 Bt. Cotton hybrid seed production

Treatments	Seed weight (g) per boll						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	2.11	2.18	2.14	2.07	2.06	2.04	2.10
D_2	2.05	2.08	2.06	2.00	1.95	1.99	2.02
D_3	2.13	2.05	2.03	1.99	1.94	2.03	2.03
Mean	2.09	2.10	2.07	2.02	1.98	2.02	2.05
For comparing means of		S.E.±				C.D. (P=0.05)	
Staggered sowing (D)		0.06				NS	
Chemicals spray (T)		0.08				NS	
DxT*		0.14				NS	

NS - Non significant * Interaction effect Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

Table 7: Effect of staggered sowing of male parent and chemicals spray on seed cotton yield (kg) per ha in NHH-44 Bt. Cotton hybrid seed production

Treatments	Seed cotton yield (kg) per ha						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	938	940	958	968	960	961	954
D_2	986	975	990	1026	1056	1086	1019
D_3	962	978	982	1011	1004	1048	1001
Mean	962	964	976	1001	1026	1034	991
For comparing means of		S.E.±				C.D. (P=0.05)	
Staggered sowing (D)		6.04				18.02	
Chemicals spray (T)		8.54				25.49	
DxT*		14.80				44.16	

NS - Non significant * Interaction effect
Date of sowing of parents (D)
D_1 – Simultaneous sowing of both the parents
D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing
D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing
Growth regulators and micronutrients (T)
T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%
T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

Table 8: Effect of staggered sowing of male parent and chemicals spray on seed yield (kg) per ha in NHH-44 Bt. Cotton hybrid seed production

Treatments	Seed yield (kg) per ha						
	T_1	T_2	T_3	T_4	T_5	T_6	Mean
D_1	586	587	598	605	600	600	596
D_2	657	650	660	641	678	698	664
D_3	601	611	613	631	660	669	631
Mean	615	616	624	626	656	646	630
For comparing means of		S.E. ±				C.D. (P=0.05)	
Staggered sowing (D)		10.36				30.92	
Chemicals spray (T)		14.65				43.72	
DxT*		25.38				75.74	

NS - Non significant * Interaction effect

Date of sowing of parents (D)

D_1 – Simultaneous sowing of both the parents

D_2 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sowing 7 days after first male sowing

D_3 – 100% female sowing + 50 per cent first male sowing, 50% male seeds were sown 10 days after first male sowing

Growth regulators and micronutrients (T)

T_1 : NAA 10 ppm T_2 : Lihocin 100 ppm T_3 : $MgSO_4$ 0.1 % T_4 : Boron 1%

T_5 : Boom 2 ml per litre T_6 : Viagro 1 ml per litre

T5 (1026 kg) which were at par with each other. In the similar way the seed yield per ha (656.0 kg) was also significantly higher in T_6 chemical spray followed by T_5 (646.0 kg) (Table 7 and 8). This indicates that the crossed bolls per plant retained in T_6 chemical spray were high, thereby accounted for higher seed yield.

The seed cotton yield (1086 kg) per ha and seed yield per ha (698.0 kg, respectively) was numerically highest in the combination of D_2T_6 followed by D_2T_5. Increased seed yield in these combinations may be due to more number of crossed bolls retained per plant. These results are in agreement with the findings of Khadi *et al.* (1995) in DDH-2 desi cotton hybrid seed production and Doddagoudar *et al.* (2006a and b) in DHH-543 and DHB-290 cotton hybrid seed production, who have recorded higher seed yield due to efficient utilization of male flowers and also better synchronization of female and male parent in the staggered sowing *i.e.,* 25 per cent male seeds sown each at 15 days before, 7 days before, along with and 7 days later than female parent seed sowing.

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