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EFFECT OF VARIETY AND FERTLIZER MANAGEMENT ON YIELD AND YIELD CONTRIBUTING CHARACTERS OF COTTON

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ABSTRACT

A field experiment was conducted at Regional cotton Research, Training and Seed multiplication farm, Jagadishpur, Jessore during July 2003 to March 2004 to observe the effect of variety and fertilizer management on yield and yield contributing characters of cotton. The experiment was conducted in Randomized Complete Block Design (factorial) replicated four times. The treatments consisted of two cotton cultivars and three fertilizer management. It was observed that the number of squares plant^{-1}, number of flowers plant^{-1}, number of bolls plant^{-1}, seed cotton and lint yield, seed index and lint index varied significantly due to variety and fertilizer management of cotton. However, seed cotton yield plant^{-1} and ginning percent were significant for variety but not for fertilizer management. Interaction effect of variety and fertilizer management on the number of squares plant^{-1}, number of flowers plant^{-1}, number of bolls plant^{-1}, seed cotton yield plant^{-1} and seed index were significant but other parameters were not significant. Seed cotton yield (3712 kg ha^{-1}) and lint yield (1540 kg ha^{-1}) was higher in CB-5 in comparison to CB-9 (3289.17 and 1139.04 kg ha^{-1} respectively) and which were 12.87% more seed cotton yield and 35.22% lint yield over variety CB-9. The highest seed cotton yield ((4088 kg ha^{-1}) and lint yield (1563 kg ha^{-1}) were obtained from farmers' practice. Ginning percentage was significantly influenced due to variety. Fertilizer management using farmers' practice gave maximum yields (4308.50 and 1787.60 kg lint ha^{-1} with variety CB-5). Ginning percentage of variety CB-5 was 41.50 which were significantly higher than that of CB-9 (36.15).

Key words: Fertilizer management, Cotton variety and cotton yield

INTRODUCTION

Cotton (*Gossypium spp.*) is one of the important cash crops in Bangladesh. It is the main raw materials of textile industry. Annual requirement of raw cotton for textile industry of Bangladesh is estimated as 4 million bales. Around 4-5% of the national requirement is fulfilled through the local production (0.1 million bales), remaining 95-96% requirement is fulfilled by importing raw cotton from USA (40%), CIS (35%), Australia, Pakistan, South Africa and other cotton producing countries (25%) (BTMA, 2010). Among the fiber crops, cotton is the second important cash crop in Bangladesh. The present yield of cotton is very low in comparison to other cotton growing countries. The productivity of cotton in Bangladesh is only 450 kg lint ha^{-1} against the world average of 556 kg lint ha^{-1}. Cotton yield has to be increased to make cotton more competitive. Varieties differ widely in potential yield. Depending on the varietals differences, input requirements and agronomic practices are to be adjusted through experimentation. Promising genotypes and fertilizer management are the important aspects of yield exploitations. Seed cotton yield and lint yield varied significantly due to different fertilizer management (Tomar *et al.*, 2000). Adequate supply of nutrients might have influenced cotton plant to grow vigorously with greater yield component thus elevating the yields. Mohsin *et al.* (2004) reported that combined effect of NPK (150+ 75+ 60 kg ha^{-1}) produced the highest seed cotton yield (2337 kg ha^{-1}). Due to such variations in yield an experiment was conducted to study the effect of fertilizer management on cotton varieties for getting superior yield.

MATERIALS AND METHODS

The field experiment was conducted at Regional Cotton Research, Training and Seed Multiplication Farm, Jagadishpur, Jessore (AEZ-11) during late Kharif to Rabi seasons of 2003-04. The soil was

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sandy loam in texture. Six treatment combinations comprising two levels of cotton cultivars (CB-5 and CB-9) and three levels of fertilizer management were tested in Randomized Complete Block Design (factorial) replicated four times. The three fertilizer managements were (i) CDB Recommendation (F_1): 104 kg N, 35 kg P_2O_5, 73 kg K_2O, 18 kg S, 7.2 kg Zn , 7.2 kg Mg, 3.4 kg Boron ha^{-1} + 6 tons ha^{-1} Cowdung, (ii) 50% CDB Recommendation + 15 tons ha^{-1} Cowdung (F_2) and (iii) Farmers' Practice (F_3): 118 kg N, 53.5 kg P_2O_5, 76 kg K_2O, 48 kg S , 5 kg Zn, 5.04 kg Mg, 2.38 kg Boron ha^{-1} + 15 tons ha^{-1} Cow dung, the fertilizer dose of farmer practice was determined from the average use of 220 farmers' surveyed prior to experiment set up.

Nutrients were applied in the form of Urea, Triple Super Phosphate, Muriate of Potash, Gypsum, Zinc Sulphate, Magnesium Sulphate, and Borax for N, P_2O_5, K_2O, S, Zn, Mg and B respectively. For F_1 and F_2 one fourth of Urea (N) from total requirement and total amount of required TSP (P_2O_5), MoP (K_2O), Gypsum (S), $ZnSO_4$ (Zn), $MgSO_4$ (Mg) and Borax (B) and full of Cowdung were applied at the time of sowing as basal dose. The rest quantity of Urea (N) was applied as side dress in three equal splits after 21, 42 and 63 DAS. For farmers' practice the total amount of Urea (N) and Potash (K_2O) was applied in three equal splits at 25, 45 and 65 DAS as side dress. On the other hand total amount of other fertilizers such as TSP (P_2O_5), Gypsum (S), Borax (B) and $ZnSO_4$ (Zn) were applied as side dress at 20-25 DAS. Cowdung was also applied during land preparation.

The cotton seeds were sown on 3 August 2003 @ 15 kg ha^{-1}. The seeds were dibbled using 3-4 seeds/hill. Two seedlings were retained up to 10 days after sowing (DAS) and a single seedling was retained at 20 DAS. Weeding and intercultural operations were done as and when necessary. Yield contributing characters were taken from 10 randomly selected plants. Seed cotton yield from four pickings was weighed separately and were added to get seed cotton yield per plot. Seed cotton yield per plot was finally converted to seed cotton yield per hectare. The data obtained from the experiment on different parameters were analyzed statistically following analysis of variance technique with the help of computer package MSTAT and the significance of mean differences were adjudged by Least Significance Difference (Gomez and Gomez, 1984) test.

RESULTS AND DISCUSSION

Effect of variety

Irrespective of treatment differences squares plant $^{-1}$ and flowers plant $^{-1}$ were increased up to 64 DAS and 92 DAS and then decreased (Fig.1& fig 2). However, bolls plant $^{-1}$ increased up to 141 DAS (last stage of crop, Fig.3). At early stage up to 64 DAS, variety CB-9 produced greater squares plant $^{-1}$ and there by CB-5 up to 92 DAS (Fig.1).

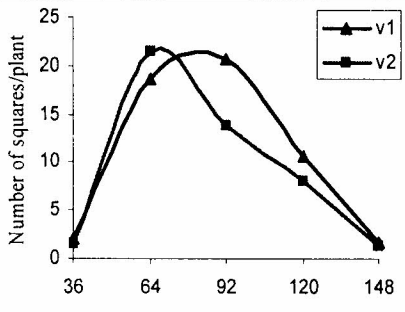

Fig.1. Effect of variery on number of squares/plant at different days after sowing.

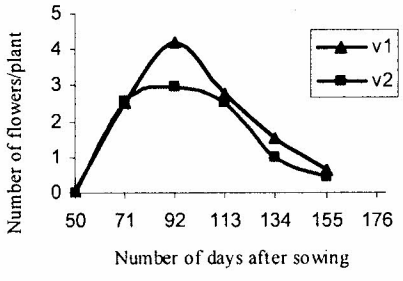

Fig. 2. Effect of variety on number of flowers/plantat differentr days of sowing.

These differences were found significant. Similar trend was observed for flowers plant $^{-1}$ and bolls plant $^{-1}$ (Fig. 2 and Fig. 3). The maximum number of squares, flowers and bolls plant^{-1} were noted as 22.45, 4.03 and 43.98 respectively at different growth stage of cotton. Variety CB-5 produced significantly greater number of bolls plant $^{-1}$ (43.98) and it was 25.3% higher than CB-9 (35.10).
Variety had significant effect on number of squares plant^{-1} throughout the crop growth. This might be the genetic character of both varieties as CB-9 produces square at early stage of the season and CB-5 produced squares at later stage of the crop (Anon., 2001). Both the variety produced the maximum number of flowers around 92 DAS and the highest number of flowers (4.03) was produced by V_1 whereas V_2 produced 2.98 flower plant $^{-1}$. Number of bolls plant^{-1} was higher in variety CB-9 at early stage i.e. up to 85 DAS but from 99 to 141 DAS boll number was higher in variety CB-5. This might be due to the genetic character of the variety CB-5 to produce more bolls at the later stage of the crop. This will ultimately influenced seed cotton yield in CB-5 variety (Anon., 2002).
Seed cotton yield, lint yield and plant^{-1} yield varied significantly due to variety (Table 1). Higher seed cotton and lint yield ha^{-1} was obtained in variety CB-5 (3712.35 kg and 1540.25 kg respectively) than that of CB-9. Variety CB-5 produced 12.87% more seed cotton yield and 35.22% lint yield over variety CB-9. As variety CB-5 had higher ginning out turn (GOT) (Table 1) as well as higher seed cotton yield and lint yield. CB-5 also produced 140.58 g yield plant $^{-1}$ than CB-9 (116.78 g) which might have enhance to achieve higher seed cotton yield ha^{-1}. However weight of 100 seeds (Seed index) found the higher (12.27 g) in CB-9 (Table 1) that indicated bigger seed size of CB-9 than CB-5 (8.59 g) but , weight of lint in 100 seeds (Lint index) 6.73 and ginning percentage (GP) 41.50 were higher in CB-5. It might be suggested that bigger seed size reduced the lint yield.

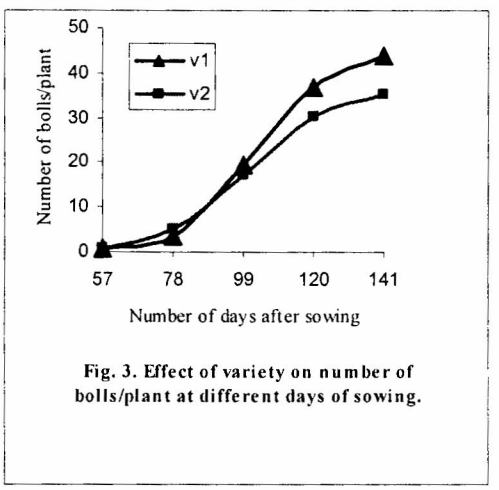

Fig. 3. Effect of variety on number of bolls/plant at different days of sowing.

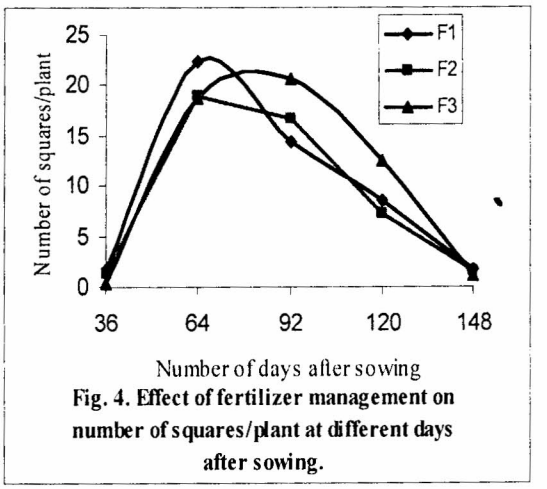

Fig. 4. Effect of fertilizer management on number of squares/plant at different days after sowing.

Effect of Fertilizer Management

The trend of production of squares, flowers and bolls (Fig. 4, Fig. 5 & Fig. 6) due to fertilizer management were similar as found in case of variety (Fig. 1, Fig. 2, and Fig. 3). The highest number of squares plant^{-1} produced between 36 to 92 days and F_1 produced significantly the highest squares plant^{-1} (22.29) on 64 DAS followed by F_3 (20.69) on 92 DAS and F_2(18.94) on 64 DAS. Initially squares plant^{-1} started from 36 DAS and reached at peak around 64 to 92 DAS and then declined. Flower production was the highest at around 92 DAS (Fig. 5). The F_2 produced the numerical maximum flowers (4.01), closely followed by F_3 (3.85) and the minimum 2.91 by F_1 on 92 DAS but found not significant. Flower production started from 50 DAS and reached at peak around 92 DAS then began to decline. Initially boll formation was slow (Fig. 6), started at around 57 DAS up to 78 DAS. Rapid increase of boll formation started from 78 DAS up to 120 DAS and then became to decline

giving sigmoid pattern of boll formation curve (Fig.6). The F_3 produced the highest bolls plant^{-1} (40.95) followed by F_1 (39.45)

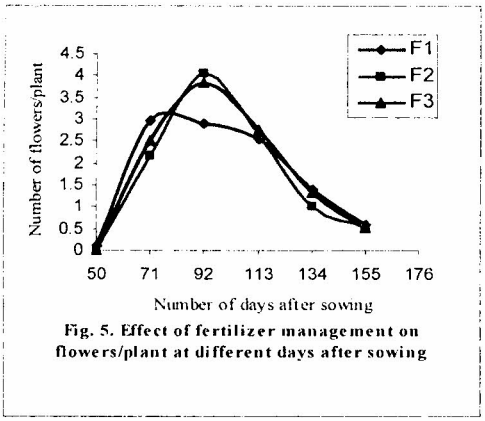

Fig. 5. Effect of fertilizer management on flowers/plant at different days after sowing

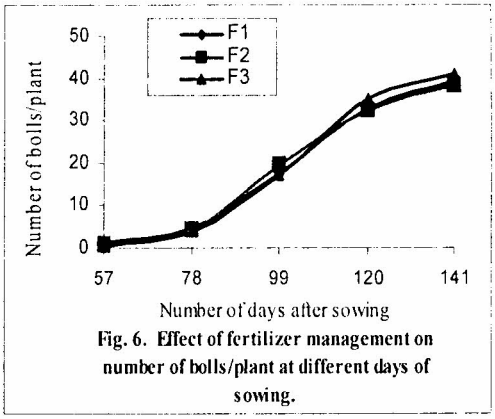

Fig. 6. Effect of fertilizer management on number of bolls/plant at different days of sowing.

and F_2 (38.23) which were not statistically significant on 141 DAS. In farmers' practice treatment, higher amount of organic matter and NPK with split application was applied. Top dressing of N by skipping basal application coincides with the peak demand for nutrients, facilitating increased uptake at flowering and boll-bursting stage. Application of K along with N resulted in better N uptake due to the reduced fixation of NH_4^{++} due to K and thereby there was higher utilization of N in this form (Sengupta *et al.*, 1971).

Significant variation observed in seed cotton and lint yield among the fertilizer treatments (Table 1). The F_3 produced the highest seed cotton (4088.08 kg ha^{-1}) and lint yield (1563.48 kg ha^{-1}) followed by F_1 (3562.63 and 1363.25 kg ha^{-1} respectively) and F_2 (2851.58 and 1092.21 kg ha^{-1} respectively). The F_3 produced 14.75 % and 14.69 % higher seed cotton yield and lint yield respectively over F_1. The yield response was due to the cumulative effect of higher number of bolls plant^{-1} and continued availability of nutrients in farmers' practice treatment ultimately helped in better boll retention and development. On the other hand, in CDB recommendation due to less amount of N might have failed to supply the required nutrients since the major portion of the applied N might have lost through leaching and volatilization (Krishnan and Christopher, 1997). The phosphorus content was higher under farmers' practice treatment in comparison to other two treatments. Significant reduction of P uptake was observed with the reduction in the fertilizer level by 25% corroborating the findings of Mayilsamy and Iruthayaraj (1980).

Table 1. Effect of variety and fertilizer management on seed cotton yield, lint yield, plant^{-1} yield, seed index, lint index and ginning percentage of cotton yield

Treatments	Seed cotton yield (kg ha^{-1})	Lint yield (kg ha^{-1})	Yield plant^{-1} (g)	Seed index (g)	Lint index	GP
V_1	3712.35	1540.25	140.58	8.59	6.73	41.50
V_2	3289.17	1139.04	116.78	12.27	6.54	36.15
LSD (0.05)	115.28	43.31	12.75	0.10	0.12	0.35
F_1	3562.63	1363.25	127.29	10.41	6.50	38.60
F_2	2851.58	1092.21	120.08	10.58	6.84	39.60
F_3	4088.08	1563.48	138.58	10.29	6.57	38.82
LSD (0.05)	141.30	53.08	NS	0.13	0.15	NS
CV (%)	3.79	3.72	11.07	1.12	2.12	1.00

NS = Non-significant, V_1 = CB-5; V_2= CB-9, F_1 = CDB recommendation, F_2 = 50% CDB, recommendation plus cowdung @15 t/ha, F_3 = Farmers' practice, GP = ginning percent

The application of fertilizers under farmers' practice treatment by skipping basal and applying the same in two splits was found advantageous to cotton yield. Again, fertilization at peak-flowering and boll bursting stage of cotton ultimately resulting in higher seed cotton yield. Mohsin *et al.* (2004) reported that combined effect of NPK (150 + 75 + 60 kg ha^{-1}) produced highest seed cotton yield (2337 kg ha^{-1}). They observed increase in seed cotton yield due to progressive increase in NPK application.

The F_2 produced the highest seed index (10.58) followed by F_1 (10.41) and F_3 (10.29). In case of lint index F_2 also produced the highest value (6.84) followed by F_3 (6.57) and F_1 (6.50) that differed significantly. However, ginning percentage was not significant among the fertilizer management treatments. It might be due to narrower difference in seed index and lint index. The F_2 produced the highest GP (39.60) followed by F_3 (38.82) and F_1 (38.60).

Interaction effect of variety and fertilizer management

Significant variation found among the interactions of variety and fertilizer in case of number of squares plant^{-1} (Fig. 7), number of flowers plant^{-1} (Fig. 8), number of bolls plant^{-1} (Fig. 9), yield plant^{-1} and seed index (Table2). Squares production plant^{-1} of interactions V_1F_1, V_2F_1,V_2F_2 and V_2F_3 reached at peak around 64 DAS and V_1F_3 (24.03) and V_1F_2 (20.50). The highest number of squares plant^{-1} produced by V_2F_1 (25.45) around 64 DAS which differed significantly from other interactions. Flowering reached at peak around 64 to 92 DAS (Fig. 8). The V_1F_3 and V_1F_2 reached at peak on 92 DAS but the other interactions reached at peak on 64 DAS.

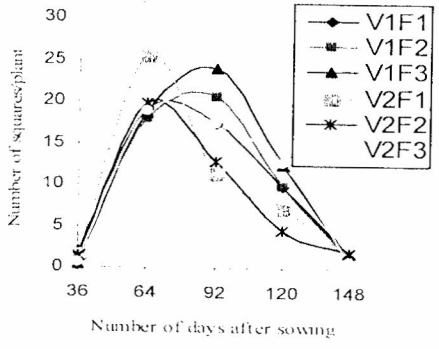

Fig. 7. Interaction effect of variety and fertilizer management on number of squares/plant at different days after sowing.

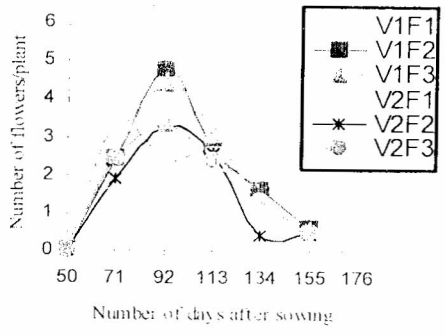

Fig. 8. Interaction effect of variety and fertilizer management on flowers/plant at different days after sowing.

Sigmoid pattern of boll formation curve observed (Fig.9). The highest boll formation observed around 141 DAS and V_1F_3 (45.43) and V_1F_1 (45.43) found the maximum and closely followed by V_2F_3 (41.30). V_1F_2 (40.60). The V_2F_2 produced the lowest bolls (31.03) plant^{-1} among the six interaction treatments. The differences were found significant.

Similarly the interaction of V_1F_3 produced the highest seed cotton yield (4308.50 kg ha^{-1}) followed by V_2F_3 (3867.65 kg ha^{-1}) and the minimum seed cotton yield observed in the interaction of V_2F_2 (2650.48 kg ha^{-1}). Though the interaction of V_1F_3 produced 1658.02 kg ha^{-1} more seed cotton over the minimum effect of V_2F_2 the difference was not significant. Similar to seed cotton yield, lint yield was also found not significant among the interactions of variety and fertilizer management. Here V_1F_3 also produced the highest lint yield (1787.60 kg ha^{-1}) which was 94 % higher over the lowest production of V_2F_2 (917.86 kg ha^{-1}). However significant interaction of variety and fertilizer management was found in case of yield plant^{-1} where V_1F_3 produced the highest yield (147 g plant^{-1}) that was closely followed by V_1F_2 (144.41g) and V_2F_2 was the least (95.75g). Seed index an important character which regulates the GP or lint yield. Significant variations observed in seed index and V_2F_2 produced the digest seed size (12.4 g) among the interactions that was closely followed by V_2F_1 (12.35) and V_2F_3 (12.05g). V_1F_1

produced the smallest seed size valued with 8.48 g. Similar lint index and GP produced by interaction treatments though the variation was wide in case of GP. The V_1F_2 gave the highest lint index (7.02) and other treatments produced below 7. Like wise V_1F_2 also gave the highest GP (41.81), almost same to V_1F_3 (41.46) and V_2F_1 produced the lowest GP (35.97). So it was observed that V_1F_2 produced 5.84 % more lint over the interaction on V_2F_3 that that gave the least GP.

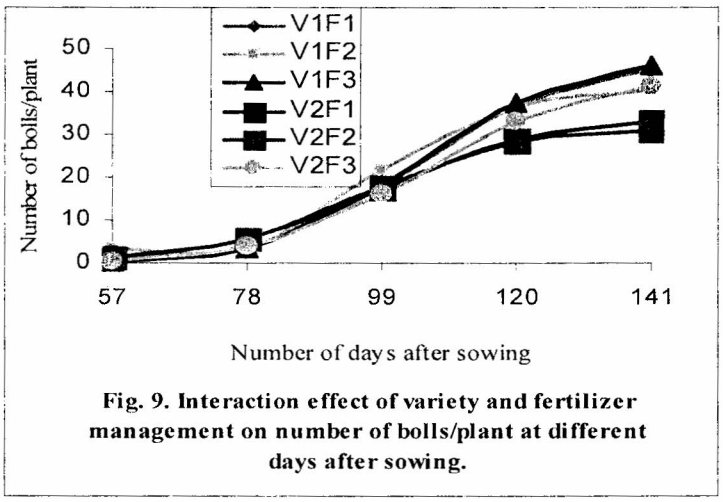

Fig. 9. Interaction effect of variety and fertilizer management on number of bolls/plant at different days after sowing.

Table 2. Interaction effect of variety and fertilizer management on seed cotton, lint and plant^{-1} yield, seed index, lint index and ginning percentage of cotton

Treatment	Seed cotton yield (kg ha^{-1})	Lint yield (kg ha^{-1})	Yield plant^{-1} (g)	Seed index	Lint index	GP
V_1F_1	3775.88	1566.61	130.17	8.48	6.50	41.21
V_1F_2	3052.68	1266.56	144.41	8.78	7.02	41.81
V_1F3	4308.50	1787.60	147.00	8.53	6.66	41.46
V_2F_1	3349.38	1159.89	124.42	12.35	6.51	35.97
V_2F_2	2650.48	917.86	95.75	12.40	6.66	36.21
V_2F_3	3867.65	1339.37	130.17	12.05	6.48	36.21
LSD (0.05)	NS	NS	21.47	0.18	NS	NS
CV (%)	3.79	3.72	11.07	1.12	2.12	1.00

CONCLUSION

It could be concluded that variety CB-5 and farmers' practice of fertilizer management produced the highest seed cotton and lint yield. Similarly from the interaction effect of CB-5 and farmer's practice fertilizer management also the highest seed cotton and lint yield. Hence as a high yielding cotton variety CB-5 and farmers' practice as improved fertilizer management could be recommended for higher yield of cotton in Jessore region (AEZ-11) of Bangladesh.

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