Rejuvenation, Characterization and Evaluation of Cotton Germplasm

M R Amin[1]

Abstract

The experiment was conducted at Cotton Research Center, Rangpur during the crop season 2017-18 to rejuvenate the old stock of germplasm and also to observe their agronomic, ginning and qualitative performance. Twenty four stocked cotton germplasm were taken for rejuvenation whose accession numbers were BC-0496 to BC-0512, HC-2, BC-0042/A, BC-0042/B, BC-0111, BC-0113, BC-0119 and BC-0120 respectively. About 200 to 700 g selfed seeds were obtained from each accession. The accession number BC-0497 produced highest seed cotton yield (3.96 t/ha) which was followed by BC-0501 (3.52 t/ha), BC-0042/B (3.41 t/ha) and BC-0505 (3.18 t/ha) respectively. The accession number BC-0496 shown highest number of bolls per plant (73) which was followed BC-0498 (68), BC-0042/B (65) and BC-0497 (63) respectively. The highest single boll weight (6.2 g) was found in BC-0501, BC-0503 and BC-0508 which was followed by BC-0502 (6.0 g), BC-0507 (6.0 g), BC-0499 (5.9 g) and BC-0510 (5.8) respectively. Highest ginning out turn (45.24) percentage was found in BC-0512 which was followed by BC-0511 (42.99), BC-0501 (42.27), BC-0510 (41.90) and BC-0504 (41.12) percentage respectively.

Introduction

Plant genetic resources one of the most fundamental inessential of all resources on Earth, is seriously threatened. Their lost will touch each one of us can endanger to future generation. For food security and sustainable development all plant genetic resource should conserve in Gene Bank nationally as well as internationally. Cotton Development Board is aware of it. Cotton Development Board already established cotton Gene Bank at Cotton Research Center, Rangpur. Cotton Development Board conserved 524 cotton germplasms upto 2017 for short term i.e, ten to twelve years. From this storage accession the breeder can easily developed high yielding, short duration, disease resistance, high oil content, insect resistance cotton variety in a much shorter time according to target groups desired. At regular intervals i.e., before the conserved period over, those preserve genetic resources should be replaced by a new lots of the same progenies due to storage environment the preserved genetic materials lost its viability and germination percentage came down bellow standard. So, rejuvenation or renewal of these genetic materials is essential before loosing its viability. The conserved germplasm were renewed in three to four years ago and germplasm were shifted into new Gene Bank, so rejuvenation of those germplasm is essential. For these reason, twenty four cotton germplasms were taken under rejuvenation program. At the same time we will be able to identify some better genotypes by observing their different agronomic and ginning performance.

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Materials and Methods

The experiment was conducted at Cotton Research Center, Rangpur during the crop season 2017-18. In this program twenty four germplasm encoded BC-0496 to BC-0512, HC-2, BC-0042/A, BC-0042/B, BC-0111, BC-0113, BC-0119 and BC-0120 were included. The experiment was laid down in augmented design with no replications. Unit plot size was 9.9 m x 0.9 m and plant spacing was 90 cm x 90 cm. At the time of land preparation decomposed poultry manure was applied before final land preparation at the rate of 770 kg/ha. Seeds were sown at the date of 22 July, 2017. Each entry was sown one row only in each plot. Four to five seeds were sown at each hole during sowing time. Thinning was performed after 10 days and 21 days after sowing. Finally one seedling was kept in one stand. All intercultural operation was done properly. Pest was kept under control by using IPM procedures. As a result, friendly agro-ecosystem was existed. Irrigation water was not applied for the cotton growing season of 2017-18 due to availability of soil moisture. Off type plants were roughed out. Selfing was done in all plants of the row. Passport data, qualitative and quantative data were collected according to the rules of IPGRC. To evaluate the germplasms agronomic data such as number of vegetative branches per plant, node number of first fruiting branch, number of primary fruiting branches per plant, secondary fruiting branches per plant, days to first flowering, days to first boll split, plant height at harvest, number of bolls per plant, single boll weight, seed cotton yield per plant and seed cotton yield per line were recorded. Ginning out turn percentage (GOT%), Seed index, Lint index etc. ginning data were collected and calculated. At the harvesting time selfed and non-selfed seeds of a row were collected separately.

Results and Discussion

Passport data, qualitative data, agronomic (quantative) data and ginning data have been shown in the table 1 and 2 respectively. The giving accession numbers from BC-0496 to BC-0512, HC-2, BC-0042/A, BC-0042/B, BC-0111, BC-0113, BC-0119 and BC-0120 were shown. In table-2, it was seen that all accession number showed erect growth habit except BC-0500 showed compact growth habit. All accession greenish purple colour of plants except BC-0496, BC-0497, BC-0500 to BC-0502, HC-2, BC-0113 and BC-0119 showed green respectively and BC-0120 showed purple colour of plant, leaf short hairy and entire leaf shape were found except BC-0113 showed okra and BC-0042/A and BC-0042/B showed half okra leaf shape. All accession showed cream petal colour except BC-0500 showed yellow petal colour. Cream pollen colour were found in all accession numbers except BC-0500 and BC-0111 showed yellow and BC-0120 showed purple pollen colour. Petal spots were absent in all the accession number. Accession number BC-0500, HC-2, BC-0111, BC-0113 and BC-0120 showed conical boll shape; BC-0042/A showed round boll shape and all others accession numbers showed oval boll shape. Accession number BC-0500 and BC-0120 showed naked seed and others accession numbers showed fuzzy seed. All accession numbers showed gray fuzz colour except HC-2, BC-0111, BC-0113 and BC-0119 showed brown and BC-0120 showed green fuzz colour respectively. All accession numbers showed lint colour white

except HC-2, BC-0111, BC-0113 and BC-0119 showed brown and BC-0120 showed greenish lint colour.

From the recorded data the accession number BC-0497 produced highest seed cotton yield (3.96 t/ha) which was followed by BC-0501 (3.52 t/ha), BC-0042/B (3.41 t/ha) and BC-0505 (3.18 t/ha) respectively. The accession number BC-0496 shown highest number of bolls per plant (73) which was followed BC-0498 (68), BC-0042/B (65) and BC-0497 (63) respectively. The highest single boll weight (6.2 g) was found in BC-0501, BC-0503 and BC-0508 which was followed by BC-0502 (6.0 g), BC-0507 (6.0 g), BC-0499 (5.9 g) and BC-0510 (5.8) respectively. Highest ginning out turn (45.24) percentage was found in BC-0512 which was followed by BC-0511 (42.99), BC-0501 (42.27), BC-0510 (41.90) and BC-0504 (41.12) percentage respectively. About 200 to 700 g selfed seeds were obtained from each accession.

Conclusion

Considering yield performance, GOT% and other traits, the accession number BC-0501 and BC-0497 may be forwarded to the non replicated progeny row trial and others germplasm should preserve in the "Gene Bank".

References

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Table 1: Seed cotton yield and yield attributes of rejuvenated germplasm at Rangpur, 2017-18

Accession No.	N.F. B (no)	Vegetative Branches/ Plant (no)	PFB (no)	SFB (no)	1st Flowering (days)	1st Boll Split (days)	Plant Height (cm)	Bolls/ Plant (no)	Single Boll Weight (g)	Seed Cotton Yield (t/ha)	Lint Index (g)	Seed Index (g)	GOT%
BC-0496	8.5	0.6	16.5	47.5	68	135	117.5	73	4.7	1.44	5.4	8	39.24
BC-0497	6.6	3.4	18.0	26.1	67	131	131.6	63	5.4	3.96	7.2	11	40.04
BC-0498	7.5	0.8	18.0	30.5	67	129	131.5	68	5.1	1.15	5.9	10	37.21
BC-0499	6.7	1.7	21.1	18.2	69	134	160.7	40	5.9	1.87	6.5	10	38.37
BC-0500	9.3	2.3	21.1	14.5	70	145	180.3	23	3.6	0.30	7.2	11	31.84
BC-0501	6.6	0.4	23.9	3.9	65	122	161.1	55	6.2	3.52	5.7	10	42.27
BC-0502	7.4	1.4	20.3	5.7	68	122	156.3	42	6.0	2.43	7.1	11	43.85
BC-0503	6.5	2.5	21.6	19.7	68	135	131.3	48	6.2	2.69	6.4	10	33.25
BC-0504	6.4	1.9	19.5	8.9	70	129	136.9	39	5.5	2.04	7.2	11	41.12
BC-0505	6.5	2.0	18.7	13.3	65	124	133.5	56	4.8	3.18	7.3	11	38.56
BC-0506	7.1	2.7	16.5	19.6	68	129	141.4	40	5.3	2.46	7.6	12	34.24
BC-0507	7.0	0.4	19.3	1.6	68	126	138.6	41	6.0	2.27	7.2	11	36.52
BC-0508	6.9	0.4	18.0	1.6	68	125	131.5	35	6.2	1.99	6.3	10	36.62
BC-0509	6.7	0.6	18.9	4.9	66	128	150.9	32	5.1	1.78	6.7	10	36.42
BC-0510	7.1	0.6	22.4	6.1	65	121	160.0	44	5.8	2.64	7.2	11	41.90
BC-0511	6.1	1.9	19.6	12.7	65	122	125.3	42	5.1	2.64	7.5	11	42.99
BC-0512	7.0	0.5	19.6	2.1	65	120	133.9	40	5.4	2.40	6.1	9	45.24
HC-2	9.0	5.6	18.9	51.3	71	135	146.9	40	2.5	0.91	6.4	10	40.37
BC-0042/A	6.0	1.1	17.7	10.4	67	128	110.9	42	5.6	1.75	6.7	11	35.93
BC-0042/B	6.3	2.4	19.8	20.9	63	113	132.6	65	5.4	3.41	5.2	8	35.26
BC-0111	6.6	2.2	18.8	16.7	68	126	122.0	41	4.6	1.60	6.5	10	30.67
BC-0113	7.0	3.1	18.6	25.3	65	124	85.0	42	3.7	1.57	6.8	10	33.33
BC-0119	7.5	3.9	17.8	32.7	69	131	115.1	46	4.0	1.72	6.8	10	23.25
BC-0120	7.5	2.3	22.0	16.4	68	135	154.5	56	3.9	1.58	6.8	10	22.89

Table 2: Characterization and evaluation of rejuvenated cotton germplasm at Rangpur, 2017-18

Accession No.	Growth Habit	Colour of Plant	Hairiness	Leaf Shape	Petal Colour	Petal Spot	Pollen Colour	Boll Shape	Seed Fuzz	Fuzz Colour	Lint Colour
BC-0496	Erect	Green	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0497	Erect	Green	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0498	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0499	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0500	Compact	Green	Short hairy	Entire	Yellow	Present	Yellow	Conical	Naked	Gray	White
BC-0501	Erect	Green	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0502	Erect	Green	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0503	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0504	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0505	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0506	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0507	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0508	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0509	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0510	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0511	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0512	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
HC-2	Erect	Green	Short hairy	Okra	Cream	Absent	Cream	Conical	Fuzzy	Brown	Brown
BC-0042/A	Erect	Greenish Purple	Short hairy	Half okra	Cream	Absent	Cream	Round	Fuzzy	Gray	White
BC-0042/B	Erect	Greenish Purple	Short hairy	Half okra	Cream	Absent	Cream	Oval	Fuzzy	Gray	White
BC-0111	Erect	Greenish Purple	Short hairy	Entire	Cream	Absent	Yellow	Conical	Fuzzy	Brown	Brown
BC-0113	Erect	Green	Short hairy	Okra	Cream	Absent	Cream	Conical	Fuzzy	Brown	Brown
BC-0119	Erect	Green	Hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Brown	Brown
BC-0120	Erect	Purple	Short hairy	Entire	Cream	Present	Purple	Conical	Naked	Green	Greenish

Non-Replicated Progeny Row Trial

M R Amin[1]

Abstract

The experiment was conducted at Cotton Research Center, Rangpur, during the season 2017-18. Nine entries were tested lines with one CB-14 was local check. The highest (34) number of bolls per plant per square meter was observed in accession number BC-0490. The highest single boll weight (6.3 g) was shown in accession number BC-0509 which was followed by BC-0419 (6.2 g) and BC-0415 (6.1 g) respectively. The highest seed cotton yield (3.20 t/ha) and lint yield (1264 kg/ha) was produced by accession number BC-0490. The highest ginning out turn percentage (42.5%) was found in BC-0436 which was followed by accession number BC-0488 (41.5%) and BC-0515 (40%) respectively.

Introduction

Cotton is not fully self pollinated crop nor a cross pollinated crop. Cross pollination may occur 15-60% if pollen vector is available. So heterozygosity of cotton is available. Many authors and researcher reported that heterozygosity is favorable for high yielding. About 95% of the field crops had come in cultivation through selection procedure. So, selection procedure is the most effective method to screen out the desirable lines from collected or reserved germplasms. As a task of that work, this experiment was designed to select some better lines.

Materials and Methods

The experiment was conducted at Cotton Research Center, Rangpur during the crop season 2017-18. The entries encoded as BC-0488, BC-0515, BC-0410, BC-0415, BC-0419, BC-0490, BC-0436, BC-0442, BC-0509 were tested and CB-14 were used as control. The experiment was laid down in augmented design with no replications. Unit plot size was 9.9 m x 3.6 m and plant spacing was 90 cm x 45 cm. Seeds were sown at the date of 16 July, 2017. Three to four seeds were sown at each hole during sowing time. Each entry was sown four rows in each plot. Gap filling with seeds were done at 11 days after sowing. Thinning was performed after 14 days and 23 days after sowing. Finally one seedling was kept in one stand. At the time of land preparation decomposed poultry manure was applied before final land preparation at the rate of 770 kg per hectare. The nutrient elements such as nitrogen (N), phosphorus (P), potassium (K), sulpher (S), boron (B) and magnesium (MgSo4) were applied in the row at the rate of 6.45-16-11-5-0.92 and

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5.4 kg per hectare respectively as basal dose. At the 1st side dressing the nutrient elements such as nitrogen (N), potassium (K) and Zn were applied at the rate of 9.6-15 and 1.94 kg per hectare at 18 days after sowing one side of the cotton row. After 39 days of sowing the second side dressing was applied at the rate of 24.19-12.00-27.5-5.76-1.22 kg per hectare. Nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively just opposite side of the 1st side dressing. When the plants appeared at 57 days third side dressing was done at the rate of 24.19-12.00-33.00-5.03-0.925 kg per hectare of nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively opposite side of the 2nd side dressing. The last or fourth side dressing was done at the plant age of 92 days at the rate of nitrogen 16.13 kg and potassium (K) 22 kg per hectare respectively. The nutrient was applied at 5-8 cm away from the plant, which was covered up with soil immediately to protect the volatilization loss of nitrogen. Weeding was done two times. Mulching between the rows by power tiller was done three times. Irrigation water was not applied for the cotton growing season of 2017-18 due to availability of soil moisture. After 17 days of sowing, first spray of chloropyriphose was applied against sucking pests such as Jassid and Aphid etc. Other seven sprays of chloropyriphose in combine with pyrithroid were applied to control sucking and chewing (boll worms) pests. In all cases scouting based spray was followed. Hand picking, Light trap and Pheromone trap were also used to kill moths and adults of the insects. As a result, more or less insect reproduction was stopped which encouraged friendly agro-ecosystem to some extent. To protect the fungal diseases, Dithane-M-45 and Autostien were sprayed at seedling and vegetative stage of the plant. Insect attack and disease incident was keenly observed line by line. Data were collected on number of vegetative branches, number of main stem node of first fruiting branches (N.F.B), number of primary fruiting branches per plant, number of secondary fruiting branches, days to first flowering, days to first boll split etc. Seed cotton yields and all data were collected from middle two rows (9.9 m x 1.8 m) of each plot to minimize border effects. Plant height, number of plants at harvested area, number of boll per plant, single boll weight were collected from ten randomized selected plants of each plot. Ginning out turn percentage (GOT%), Seed index, Lint index, Fuzz grade etc. ginning data were collected. Mean values were used for statistical analysis according to A Gomez and A Gomez, and Zaman *et al.* 1982.

Results and Discussion

Agronomic and important qualitative traits are presented in the table 1 and 2.

The highest (34) number of bolls per plant per square meter was observed in accession number BC-0490 and lowest (19) was in accession number BC-0415. The highest single boll weight (6.3 g) was shown in accession number BC-0509 which was followed by BC-0419 (6.2 g) and BC-0415 (6.1 g) respectively. The highest seed cotton yield (3.20 t/ha) and lint yield (1264 kg/ha) was produced by accession number BC-0490. Others tested all accession number produced lower seed cotton yield and lower lint yield than control variety CB-14. The highest ginning out turn percentage (42.5%) was found in BC-0436

which was followed by accession number BC-0488 (41.5%) and BC-0515 (40%) respectively.

Conclusion

Considering yield, lint production and lint characteristics it suggested that BC-0490 performed better result. It may be forwarded to replicated progeny row trial and the rest should need further investigation through non replicated progeny row trail.

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Table 1. Performance of yield and yield contributing traits of tested strains of non replicated progeny row trial, Rangpur, 2017-18

Genotypes	Number of vegetative branches /plant	Node number of 1st fruiting branch (N.F.B)	Number of primary fruiting branches /plant	Number of secondary fruiting branches /plant	Days to 1st flowering	Days to 1st boll split	Plant Height (cm)	Number of bolls/ plant	Single boll weight (g)	Yield of seed cotton (t/ha)	Seed cotton yield as% of CB-14
1. BC-0488	1.0	6.5	17	5	63	123	111.8	25	5.0	2.12	82
2. BC-0515	0.0	6.2	18	0	60	115	119.2	25	5.5	1.99	77
3. BC-0410	2.5	7.5	18	12	58	123	108.5	24	5.7	2.28	88
4. BC-0415	0.9	7.5	17	3	65	129	100.5	19	6.1	1.67	64
5. BC-0419	0.7	6.3	19	5	62	125	109.1	24	6.2	2.20	85
6. BC-0490	0.9	6.8	20	6	61	114	100.9	34	4.9	3.20	123
7. BC-0436	0.4	7.3	18	3	65	124	135.8	29	4.9	2.21	85
8. BC-0442	2.1	7.1	18	10	65	128	120.3	25	5.5	1.73	67
9. BC-0509	0.5	7.7	20	6	62	125	154.0	21	6.3	2.40	92
10. CB-14	0.8	6.5	20	4	58	113	122.8	24	5.8	2.60	100

Table 2. Ginning data of tested strains of non replicated progeny row trial, Rangpur, 2017-18

Genotypes	Seed Cotton Yield (t/ha)	GOT (%)	Yield of Lint (kg/ha)	Yield of Lint as % of CB-14	Seed index	Lint Index
1. BC-0488	2.12	41.5	880	88	9	6
2. BC-0515	1.99	40.0	796	80	9	6
3. BC-0410	2.28	35.0	798	80	10	5.5
4. BC-0415	1.67	37.5	626	63	10	6
5. BC-0419	2.20	36.3	799	80	10	5.7
6. BC-0490	3.20	39.5	1264	127	9	5.9
7. BC-0436	2.21	42.5	939	94	8	5.9
8. BC-0442	1.73	36.4	630	63	11	6.3
9. BC-0509	2.40	36.2	869	87	11	6.3
10. CB-14	2.60	38.25	995	100	9	5.6

Preliminary Yield Trial of Upland Cotton

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Abstract

This experiment was conducted at 4 (four) Cotton Research Farm, located in Mahigonj, Rangpur, Sadarpur, Dinajpur, Jagodishpur, Jashore and Sreepur, Gazipur during the year 2017-18. In this experiment, the performance of nine genotypes viz. JA-09/G, BC-0511, SR-17, JA-13/X, JA-08/B, Ra-16, JA-11/L, BC-0512, SR-18 were evaluated against control variety CB-14. Among the tested strains CB-14 showed the highest seed cotton yield (3.09 t/ha) than others treatment in Rangpur farm. The highest single boll weight (6.20 g) and (6.06) was found from the genotype JA-11/L and Ra-16 respectively. Seed cotton yield and yield yield contributing chharacters were found significantly difference among all the treatments of Sadarpur, Dinajpur. The highest amount of seed cotton yield was produced by JA-13/X (4.02 t/ha) which was followed by JA-09/G (3.96 t/ha), SR-18 (3.66 t/ha) and BC-0511 (3.46 t/ha) respectively and produced 26%, 24%, 15% and 8% higher seed cotton yield than control variety CB-14. The highest amount of seed cotton yield (3.69 t/ha) was produced by control variety CB-14 than all others tested genotypes in Jagodishpur. The result of Sreepur farm indicated that all the traits showed significantly different among themself. Among the tested strains JA-13/X gave highest seed cotton yield (3.37 t/ha) which was followed by control variety CB-14 (3.29 t/ha). Treatment wise combine mean data of four locations among the tested strains control variety CB-14 produced the highest mean seed cotton yield (3.31 t/ha) which was followed by JA-13/X (3.29 t/ha). The highest ginning out turn percentage (41.95%) was recorded in SR-18 which was followed by Ra-16 (41.18%) and JA-08/B (41.02%).

Introduction

Cotton is called the silver cash crop of Bangladesh. Cotton cultivation in Bangladesh received impetus in 1977 under comprehensive cotton development program of the Cotton Development Board. At the periods of 1994 to 1999, cotton cultivation was popular but after 2000-the extension of cotton cultivation showed descending trend due to lack of high yielding and short duration variety. To improve this situation, Cotton Development Board designed such type of experiment to find out the high yielding and short duration variety.

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So assortment of comparative performance (agronomic and ginning) of the selected entries should need to compare with local control CB-14 (smooth leaf, high yielding and medium GOT (%) through preliminary yield trial. So, the objectives of the trial to test the yield and quality performance of the tested entries through comparing their agronomic and ginning characteristics with the control varieties was justified.

Material and Methods

This trial was conducted at 4 (four) Cotton Research Farm, located in Mahigonj, Rangpur, Sadarpur, Dinajpur, Jagodishpur, Jashore and Sreepur, Gazipur during the year 2017-18. In this experiment, the performance of nine genotypes viz. JA-09/G, BC-0511, SR-17, JA-13/X, JA-08/B, Ra-16, JA-11/L, BC-0512, SR-18 were evaluated against control variety CB-14. The experiment was laid down in Randomized Complete Block Design (RCBD) with 3 (three) replications. Seeds were sown at the date of 15-07-2017 to 19-07-2017 in different locations. Unit plot size was 9.9 m x 3.6 m and plant spacing was 90 cm x 45 cm. Three to four seeds were sown at each hole during sowing time. Gap filling with seeds were done at 11 days after sowing. Thinning was performed after 14 days and 23 days of sowing. Finally one seedling was kept in one stand. Decomposed poultry manure was applied at the rate of 770 kg per hectare at the time of final land preparation. The nutrient elements such as nitrogen (N), phosphorus (P), potassium (K), sulpher (S), boron (B), and magnesium (MgSo4) were applied in the row at the rate of 6.45-16-11-5-0.92 and 5.4 kg per hectare respectively as basal dose. At the 1st side dressing the nutrient elements such as nitrogen (N), potassium (K) and Zn were applied at the rate of 9.6-15 and 1.94 kg per hectare at the seedling age of 18 days after sowing one side of the cotton row. After 39 days of sowing the second side dressing was applied at the rate of 24.19-12-27.5-5.76-1.22 kg per hectare nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively just opposite side of the 1st side dressing. When the plants appeared at the age of 57 days, third side dressing was done at the rate of 24.19-12-33-5.03-0.925 kg per hectare of nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively opposite side of the 2nd side dressing. The last or fourth side dressing was done at the plant age of 92 days at the rate of nitrogen 16.13 kg and potassium (K) 22 kg per hectare respectively. The fertilizer was applied at 5 to 8 cm away from the plant, which was covered up with soil immediately to protect the volatilization loss of nitrogen. Weeding was performed, two times. Mulching between two rows was done by power tiller. One to two irrigations were applied due to drought situation in different locations. After 25 days of sowing first spray of chloropyriphose was applied against sucking pests such as Jassid and Aphid etc. Others five spray of chloropyriphose in combination with pyrithroid were applied to control sucking and chewing (boll worms) pests. In all cases scouting based spray was followed. Attack of spodoptera was severe but drastic control measures by using pheromone trap the insects was kept under control. Hand picking, light trap, pheromone trap and bird trap were also used to kill moths and adults of the insects. As a result more or less insect reproduction was stopped which encouraged friendly agro-ecosystem to some extent. To protect the fungal diseases, Dithane-M-45 and Autostien were sprayed at seedling and vegetative stage of the plant. Insect attack and disease

incident was keenly observed line wise. Seed cotton yields and all data were collected from middle two rows (9.9 m x 1.8 m) of each plot to minimize border effects. Yield contributing characters were collected from the number of vegetative branches, number of main stem node of first fruiting branch (N.F.B), number of primary fruiting branches per plant, number of secondary fruiting branches per plant, days to first flowering, days to first boll split, plant height, number of plants at harvested area, number of bolls per plant and single boll weight. Data of above agronomic traits were collected from ten randomized selected plants from each plot. Ginning out turn percentage (GOT %), Seed index, Lint index, Fuzz grade etc. ginning data were collected. Mean values were used for statistical combine analyses according to A Gomez and A Gomez, and Zaman *et al*. (1982).

Results and Discussion

Seed cotton yield and yield attributes of Mahigonj, Rangpur were showed significant difference among all the treatments (Table-1). Among the tested strains CB-14 showed the highest seed cotton yield (3.09 t/ha) than others treatment. The highest single boll weight (6.20 g) and (6.06) was found from the genotype JA-11/L and Ra-16 respectively. Seed cotton yield and yield yield contributing chharacters were found significantly difference among all the treatments of Sadarpur, Dinajpur. The highest amount of seed cotton yield was produced by JA-13/X (4.02 t/ha) which was followed by JA-09/G (3.96 t/ha), SR-18 (3.66 t/ha) and BC-0511 (3.46 t/ha) respectively and produced 26%, 24%, 15% and 8% higher seed cotton yield than control variety CB-14 (Table-2). In the location of Jagodishpur, Jessore statistically differences were shown among all the treatments. The highest amount of seed cotton yield (3.69 t/ha) was produced by control variety CB-14 than all others tested genotypes. The result of Sreepur farm indicated that all the traits showed significantly different among themself. Among the tested strains JA-13/X gave highest seed cotton yield (3.37 t/ha) which was followed by control variety CB-14 (3.29 t/ha) (Table-4).

Treatment wise combine mean data of four locations showed statistically differences were shown among all the treatments in seed cotton yield. Among the tested strains control variety CB-14 produced the highest mean seed cotton yield (3.31 t/ha) which was followed by JA-13/X (3.29 t/ha) (Table-5).

Among the tested strains the highest ginning out turn percentage (41.95%) was recorded in SR-18 which was followed by Ra-16 (41.18%) and JA-08/B (41.02%) (Table-6).

Conclusion

Considering seed cotton yield and GOT% the promising two lines JA-13/X and JA-08/B may be forwarded to the advanced yield trial and the rest should need further investigation through preliminary yield trial.

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Table 1. Yield and Yield Attributes of Preliminary Yield Trial at Mahigonj, Rangpur, 2017-18

Genotypes	Number of Vegetative Branches/ Plant	Node Nnumber of 1st Fruiting Branch (N.F.B)	Number of Primary Fruiting Branches/ plant	Number of Secondary Fruiting Branches/Plant	Days to 1st Flowering	Days to 1st Boll Split	Plant Height (cm)	Number of Bolls /Plant	Single Boll Weight (g)	Seed Cotton Yield (t/ha)	Yield as % of CB-14
1. JA-09/G	0.73	6.87	18.33	3.07	64	114	122.80	22	5.56	2.53	82
2. BC-0511	1.20	6.27	20.33	5.23	61	114	126.67	31	5.13	2.84	92
3. SR-17	0.60	6.73	17.93	2.20	66	114	119.30	22	4.86	2.54	82
4. JA-13/X	0.67	6.67	17.87	3.07	60	111	116.63	24	5.80	2.57	83
5. JA-08/B	0.50	6.47	18.97	1.63	64	118	134.23	24	5.36	2.97	96
6. Ra-16	0.80	7.20	16.50	4.37	64	117	144.10	24	6.06	2.74	89
7. JA-11/L	0.63	7.10	18.43	2.50	64	118	136.27	25	6.20	2.57	83
8. BC-0512	1.03	7.00	18.40	5.27	63	115	128.77	26	5.50	2.84	92
9. SR-18	1.10	6.93	17.80	3.57	66	121	126.87	25	5.80	2.55	83
10. CB-14	1.03	6.70	21.40	6.47	58	111	139.87	33	5.40	3.09	100
LSD (0.05)	0.29	0.70	2.57	5.23	4.63	4.17	18.92	4.91	0.70	0.61	-
CV (%)	12.83	6.31	8.50	11.50	4.93	4.18	7.96	10.37	7.75	12.87	-

Table 2. Yield and Yield Attributes of Preliminary Yield Trial at Sadarpur, Dinajpur, 2017-18

Genotypes	Number of Vegetative Branches / Plant	Node Nnumb60er of 1st Fruiting Branch (N.F.B)	Number of Primary Fuiting Branches/ plant	Number of Secondary Fruiting Branches/ Plant	Days to 1st Flowering	Days to 1st Boll Split	Plant Height (cm)	Number of Bolls /Plant	Single Boll Weight (g)	Seed Cotton Yield (t/ha)	Yield as % of CB-14
1. JA-09/G	2.77	8.00	19.77	20.43	57	114	167.27	29	5.70	3.96	124
2. BC-0511	2.03	7.77	19.63	18.00	59	120	153.87	29	5.86	3.46	108
3. SR-17	3.30	8.10	17.00	23.23	54	123	172.80	27	6.16	2.66	83
4. JA-13/X	2.17	7.77	19.33	13.87	54	110	155.27	29	6.76	4.02	126
5. JA-08/B	1.87	7.93	20.90	15.80	58	120	169.60	30	5.86	2.98	93
6. Ra-16	2.00	8.37	16.33	16.13	58	122	176.93	24	6.40	2.62	82
7. JA-11/L	1.87	7.90	17.27	13.93	60	120	173.60	24	5.73	2.12	66
8. BC-0512	2.30	8.33	17.93	23.30	59	116	160.30	29	6.23	2.38	75
9. SR-18	2.23	8.40	20.77	20.47	55	118	182.23	34	6.06	3.66	115
10. CB-14	2.23	7.33	20.20	20.53	57	121	156.47	30	4.96	3.19	100
LSD (0.05)	0.29	0.70	2.57	5.23	4.63	4.17	18.92	4.91	0.70	0.61	-
CV (%)	12.83	6.31	8.50	11.50	4.93	4.18	7.96	10.37	7.75	12.87	-

Table 3. Yield and Yield Attributes of Preliminary Yield Trial at Jagodishpur, Jashore, 2017-18

Genotypes	Number of Vegetative Branches/ Plant	Node Nnumber of 1st Fruiting Branch (N.F.B)	Number of Primary Fuiting Branches/ plant	Number of Secondary Fruiting Branches/ Plant	Days to 1st Flowering Split	Days to 1st Boll Split	Plant Height (cm)	Number of Bolls /Plant	Single Boll Weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1. JA-09/G	2.57	7.47	18.03	11.87	52	117	161.70	23	4.66	2.60	70
2. BC-0511	2.67	7.60	22.13	13.40	49	114	151.63	36	5.03	3.09	84
3. SR-17	2.97	7.00	20.20	9.67	59	122	137.43	31	4.53	2.38	64
4. JA-13/X	2.40	7.40	19.93	11.43	45	107	147.10	31	5.23	3.20	87
5. JA-08/B	1.63	7.03	20.77	8.43	42	107	154.70	29	5.46	3.26	88
6. Ra-16	2.47	7.73	20.93	10.32	51	115	170.03	24	5.10	1.95	53
7. JA-11/L	2.27	7.20	19.00	10.43	53	118	157.20	30	5.10	2.62	71
8. BC-0512	2.20	7.23	18.17	11.10	50	114	145.03	30	4.93	2.77	75
9. SR-18	1.97	7.30	19.37	9.93	54	115	155.77	26	4.90	2.57	70
10. CB-14	2.50	7.10	21.30	13.10	46	114	162.17	38	5.10	3.69	100
LSD (0.05)	0.29	0.70	2.57	5.23	4.63	4.17	18.92	4.91	0.70	0.61	-
CV (%)	12.83	6.31	8.50	11.50	4.93	4.18	7.96	10.37	7.75	12.87	-

Table 4. Yield and Yield Attributes of Preliminary Yield Trial at Sreepur, Gazipur, 2017-18

Genotypes	Number of vegetative Branches/ Plant	Node number of 1st Fruiting Branch	Number of Primary Fruiting Branches/Plant	Number of Secondary Fruiting Branches/Plant	Days to First Flowering	Days to First Boll Split	Plant Height (cm)	Number of Bolls/ Plant	Single Boll Weight (g)	Seed Cotton Yield (t/ha)	Yield as % of CB-14
1. JA-09/G	0.83	5.10	16.63	2.20	-	-	128.27	30	6.06	2.99	91
2. BC-0511	0.87	5.13	16.27	1.90	-	-	131.83	33	5.30	3.12	95
3. SR-17	0.97	5.17	17.03	2.90	-	-	128.60	33	5.53	3.02	92
4. JA-13/X	1.10	4.80	16.63	2.37	-	-	123.63	33	5.66	3.37	102
5. JA-08/B	0.40	5.60	16.77	0.90	-	-	128.43	31	5.66	3.20	97
6. Ra-16	0.53	5.53	17.97	1.20	-	-	147.80	34	5.86	2.39	73
7. JA-11/L	0.57	5.30	16.70	1.60	-	-	135.37	31	6.33	2.46	75
8. BC-0512	0.60	5.30	16.87	1.23	-	-	134.53	32	5.63	2.87	87
9. SR-18	0.50	5.73	16.77	1.43	-	-	130.77	31	6.00	2.82	86
10. CB-14	2.07	5.03	19.93	3.87	-	-	142.30	35	5.66	3.29	100
LSD (0.05)	0.29	0.70	2.57	5.23	-	-	18.92	4.91	0.70	0.61	-
CV (%)	12.83	6.31	8.50	11.50	-	-	7.96	10.37	7.75	12.87	-

Table 5. Mean Yield and Yield Attributes of Preliminary Yield Trial of Four Locations, 2017-18

Genotypes	Number of vegetative Branches/ Plant	Node number of 1st Fruiting Branch (N.F.B)	Number of Primary Fruiting Branches/ Plant	Number of Secondary Fruiting Branches/ Plant	Days to First Flowering	Days to First Boll Split	Plant Height (cm)	Number of Bolls/ Plant	Single Boll Weight (g)	Seed Cotton Yield (t /ha)	Yield as % of CB-14
1. JA-09/G	1.73	6.86	18.19	9.39	58	115	145.01	26	5.00	3.02	91
2. BC-0511	1.69	6.69	19.59	9.63	56	116	141.00	32	5.33	3.13	95
3. SR-17	1.71	6.75	18.04	9.50	60	120	139.53	28	5.27	2.64	80
4. JA-13/X	1.58	6.66	18.44	7.68	53	109	135.66	30	5.86	3.29	99
5. JA-08/B	1.10	6.76	19.35	6.69	55	115	146.74	29	5.59	3.20	97
6. Ra-16	1.45	7.20	17.93	8.00	57	118	159.72	27	5.85	2.42	73
7. JA-11/L	1.33	6.88	17.85	7.11	59	118	150.61	27	5.84	2.44	74
8. BC-0512	1.53	6.97	17.84	10.23	57	115	142.16	29	5.57	2.71	82
9. SR-18	1.45	7.09	18.68	8.85	58	118	148.91	30	5.69	2.90	88
10. CB-14	1.96	6.54	20.20	10.99	54	115	150.20	34	5.28	3.31	100
LSD (0.05)	NS	NS	NS	NS	NS	NS	18.92	4.91	NS	0.61	-
CV (%)	12.83	6.31	8.50	11.50	4.63	4.17	7.96	10.37	7.75	12.87	-

Table-6. Mean Ginning Data of the Promising strains of Preliminary Yield Trial, 2017-18

Genotypes	Seed Cotton Yield (t/ha)	G.O.T (%)	Yield of Lint (kg/ha)	Yield of Lint as % of CB-14	Seed Index (g)	Lint Index (g)	Fuzz Grade
1. JA-09/G	3.02	37.67	1138	86	11.4	6.5	8
2. BC-0511	3.13	40.60	1271	97	10.5	7.3	7
3. SR-17	2.64	39.11	1033	78	10.9	6.9	8
4. JA-13/X	3.29	40.19	1322	100	10.5	6.9	7
5. JA-08/B	3.20	41.02	1313	100	10.5	7.1	8
6. Ra-16	2.42	41.18	997	76	10.8	7.7	7
7. JA-11/L	2.44	40.99	1000	76	10.9	7.7	8
8. BC-0512	2.71	40.31	1092	83	10.6	7.2	7
9. SR-18	2.90	41.95	1217	92	11	8.0	7
10. CB-14	3.31	39.80	1317	100	10.5	7.0	7

Advanced Yield Trial of Upland Cotton

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Abstract

The experiment was conducted out with six advanced genotypes viz. Ra-2, Ra-5, JA-13/R, Ra-9, SR-15 and JA-10/55 were evaluated against one commercial check variety CB-14 to observe the yield potentiality and to select the best genotype. This experiment was conducted at 4 (four) Cotton Research Farm, located in Mahigonj, Rangpur; Sadarpur, Dinajpur; Jagodishpur, Jashore and Sreepur, Gazipur during the year 2017-18. Among the tested strains JA-10/55 showed the highest seed cotton yield (3.33 t/ha) which was followed by Ra-5 (3.32 t/ha), JA-13/R (3.29 t/ha) and SR-15 (3.27 t/ha) respectively and produced 5 to 7% higher seed cotton yield than control variety CB-14 in Rangpur farm. Single boll weight was higher (6.10 g) in JA-10/55 than control variety CB-14. In Sadarpur, Dinajpur all treatment produced higher yield than control variety CB-14 except Ra-9. In Jagodishpur farm the highest amount of seed cotton yield (3.36 t/ha) was produced by JA-10/55 and others all treatments should lower seed cotton yield than control variety CB-14. The result of Sreepur farm indicated that among the tested strains JA-10/55 gave highest seed cotton yield (3.66 t/ha) which was followed by JA-13/R (3.31 t/ha), Ra-2 (3.28 t/ha) and Ra-5 (3.25 t/ha) which produced 22%, 10%, 9% and 8% higher seed cotton yield than the control variety CB-14 respectively. JA-10/55 produced highest seed cotton yield (3.57 t/ha) which was followed by JA-13/R (3.37 t/ha) and lowest seed cotton yield (2.74 t/ha) was found in Ra-9. Among the tested strains the highest ginning out turn percentage (40.99%) was recorded in JA-13/R. JA-10/55 produced highest lint yield (1428 kg/ha) which was followed by JA-13/R (1381 kg/ha) and produced 12% and 9% higher lint yield than control variety CB-14.

Introduction

As a major and leading natural fiber crop in the world, cotton has a potentially broad genetic base reflected in the collection of Gossypium species and selection of the best one. The fundamental way to realize the target of high yield and good quality was to adjust the time of flowering and boll position to coincide with local climatic and ecological conditions. In cotton, shorter plant height, lowest number of days to flower and boll split, are desirable (Alam *et al.,* 1996). Wu-J-X *et al.* (2004) reported that boll number and boll weight interacted to affect lint yield, indicating that balanced selection for boll weight and

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boll number is needed in high yielding line development. Stoilava *et al*. (2003) showed that boll weight and seed cotton yield is positively correlated. Some promising genotypes were selected under the variety development programme of Cotton Development Board. These genotypes were tested through progeny row trial and preliminary yield trial in the succeeding year. As a final step of that work Ra-2, Ra-5, JA-13/R, Ra-9, SR-15 and JA-10/55 needs to test with the existing cultivar CB-14 for better selection and to observe multi-location adaptability.

Materials and Methods

This trial was conducted at 4 (four) Cotton Research Farm, located at Mahigonj, Rangpur, Sadarpur, Dinajpur, Jagodishpur, Jashore and Sreepur, Gazipur during the year 2017-18. In this experiment, the performance of six genotypes viz. Ra-2, Ra-5, JA-13/R, Ra-9, SR-15 and JA-10/55 were evaluated against control variety CB-14. The experiment was laid down in Randomized Complete Block Design (RCBD) with 4 (four) replications. Seeds were sown at the date of 15-07-2017 to 19-07-2017 in different locations. Unit plot size was 9.9 m x 3.6 m and plant spacing was 90 cm x 45 cm. Three or four seeds were sown at each hole during sowing time. Gap filling with seeds were done at 11 days after sowing. Thinning was performed after 14 days and 23 days of sowing. Finally one seedling was kept in one stand. At the time of land preparation decomposed poultry manure was applied at the rate of 770 kg per hectare at the time of final land preparation. The nutrient elements such as nitrogen (N), phosphorus (P), potassium (K), sulpher (S), boron (B), and magnesium (MgSo4) were applied in the row at the rate of 6.45-16-11-5-0.92 and 5.4 kg per hectare respectively as basal dose. At the 1st side dressing the nutrient elements such as nitrogen (N), potassium (K) and Zn were applied at the rate of 9.6-15 and 1.94 kg per hectare at the seedling age of 18 days after sowing one side of the cotton row. After 39 days of sowing the second side dressing was applied at the rate of 24.19-12-27.5-5.76-1.22 kg per hectare nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively just opposite side of the 1st side dressing. When the plants appeared at the age of 57 days, third side dressing was done at the rate of 24.19-12-33-5.03-0.925 kg per hectare of nitrogen (N), phosphorus (P), potassium (K), sulpher (S) and boron (B) respectively opposite side of the 2nd side dressing. The last or fourth side dressing was done at the plant age of 92 days at the rate of nitrogen 16.13 kg and potassium (K) 22 kg per hectare respectively. The fertilizer was applied at 5 to 8 cm away from the plant, which was covered up with soil immediately to protect the volatilization loss of nitrogen. Weeding was performed, two times. Mulching between two rows was done by power tiller. One to two irrigations were applied due to drought situation in different locations. After 17 days of sowing first spray of chloropyriphose was applied against sucking pests such as Jassid and Aphid etc. Others five spray of chloropyriphose in combination with pyrithroid were applied to control sucking and chewing (boll worms) pests. In all cases scouting based spray was followed. Attack of spodoptera was severe but drastic control measures by using pheromone trap the insects was kept under control. Hand picking, light

trap, pheromone trap and bird trap were also used to kill moths and adults of the insects. As a result more or less insect reproduction was stopped which encouraged friendly agro-ecosystem to some extent. To protect the fungal diseases, Dithane-M-45 and Autostien were sprayed at seedling and vegetative stage of the plant. Insect attack and disease incident was keenly observed line wise. Seed cotton yields and all data were collected from middle two rows (9.9 m x 1.8 m) of each plot to minimize border effects. Yield contributing characters were collected from the number of vegetative branches per plant, number of main stem node of first fruiting branch (N.F.B) per plant, number of primary fruiting branches per plant, number of secondary fruiting branches per plant, days to first flowering, days to first boll split, plant height, number of plants at harvested area, number of bolls per plant and single boll weight. Data of above agronomic traits were collected from ten randomized selected plants from each plot. Ginning data such as GOT %, seed index, lint index etc. were collected and calculated. Mean values were used for statistical combine analyses according to A Gomez and A Gomez, and Zaman *et al*. (1982).

Results and Discussion

Seed cotton yield and yield contributing characters of Mahigonj, Rangpur were showed significant difference among all the treatments (Table-1). Among the tested strains JA-10/55 showed the highest seed cotton yield (3.33 t/ha) which was followed by Ra-5 (3.32 t/ha), JA-13/R (3.29 t/ha) and SR-15 (3.27 t/ha) respectively and produced 5 to 7% higher seed cotton yield than control variety CB-14. Single boll weight was higher (6.10 g) in JA-10/55 than control variety CB-14. Seed cotton yield and yield contributing chharacters were found significantly difference among all the treatments of Sadarpur, Dinajpur. All treatment produced higher yield than control variety CB-14 except Ra-9. In the location of Jagodishpur, Jessore significance differences were found among all the treatments. The highest amount of seed cotton yield (3.36 t/ha) was produced by JA-10/55 and others all treatments should lower seed cotton yield than control variety CB-14. The result of Sreepur farm indicated that among the tested strains JA-10/55 gave highest seed cotton yield (3.66 t/ha) which was followed by JA-13/R (3.31 t/ha), Ra-2 (3.28 t/ha) and Ra-5 (3.25 t/ha) which produced 22%, 10%, 9% and 8% higher seed cotton yield than the control variety CB-14 respectively (Table-4).

Treatment wise combine means all the tested strains showed statistically similar seed cotton yield among all the treatments (Table-5). JA-10/55 produced highest seed cotton yield (3.57 t/ha) which was followed by JA-13/R (3.37 t/ha) and lowest seed cotton yield (2.74 t/ha) was found in Ra-9. Among the tested strains the highest ginning out turn percentage (40.99%) was recorded in JA-13/R. JA-10/55 produced highest lint yield (1428 kg/ha) which was followed by JA-13/R (1381 kg/ha) and produced 12% and 9% higher lint yield than control variety CB-14 (Table-6).

Conclusion

Considering seed cotton yield, GOT%, lint weight and single boll weight tested JA-10/55 and JA-13/R genotypes may be forwarded to candidate variety trial and the rest treatments need further investigation through advanced yield trials.

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Table 1. Yield and Yield Contributing Characters of Advanced Yield Trial of Upland Cotton at Rangpur, 2017-18

Sl. No.	Genotypes	Number of vegetative branches/ plant	Node number of first fruiting branch (N.F.B)	Number of primary fruiting branches/ plant	Number of secondary fruiting branches /plant	Days to 1st flowering	Days to 1st boll split	Plant height at harvest (cm)	Number of bolls per plant	Single boll weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1.	Ra-2	1.35	6.75	20.35	9.15	61	115	144.70	35	5.98	3.08	99
2.	Ra-5	2.03	6.60	19.15	15.10	61	119	150.63	38	5.83	3.32	107
3.	JA-13/R	1.48	6.40	21.43	9.28	57	111	153.55	36	5.88	3.29	106
4.	Ra-9	1.00	6.33	20.30	5.83	61	116	141.73	38	5.75	2.89	93
5.	SR-15	1.25	6.48	20.33	6.55	61	114	141.10	32	5.53	3.27	105
6.	JA-10/55	0.93	6.53	23.65	4.41	59	116	163.83	34	6.10	3.33	107
7.	CB-14	1.43	6.35	23.28	10.08	56	111	150.78	37	4.93	3.11	100
LSD (0.05)		0.54	0.49	2.13	5.41	3.28	4.46	15.02	4.79	0.69	0.48	-
CV (%)		13.54	5.30	7.99	11.23	4.23	2.75	7.37	10.75	8.80	10.86	

Table 2. Yield and Yield Contributing Characters of Advanced Yield Trial of Upland Cotton at Sadarpur, Dinajpur, 2017-18

Sl. No.	Genotypes	Number of vegetative branches/ plant	Node number of first fruiting branch (N.F.B)	Number of primary fruiting branches/ plant	Number of secondary fruiting branches /plant	Days to 1st flowering	Days to 1st boll split	Plant height at harvest (cm)	Number of bolls per plant	Single boll weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1.	Ra-2	2.48	7.48	18.15	16.15	55	111	142.65	27	6.63	3.28	100
2.	Ra-5	3.43	7.58	16.63	26.40	54	114	146.88	26	5.80	3.59	109
3.	JA-13/R	2.75	7.08	19.13	17.63	55	110	157.63	29	6.60	3.77	115
4.	Ra-9	1.80	7.10	18.38	12.00	54	113	152.88	24	5.88	2.62	80
5.	SR-15	2.20	7.40	20.05	15.90	53	113	159.88	31	5.70	3.30	101
6.	JA-10/55	1.65	7.20	20.43	7.88	55	113	160.30	28	6.33	3.93	120
7.	CB-14	2.28	7.23	21.30	15.65	53	111	163.85	27	5.85	3.28	100
LSD (0.05)		0.54	0.49	2.13	5.41	3.28	4.46	15.02	4.79	0.69	0.48	-
CV (%)		13.54	5.30	7.99	11.23	4.23	2.75	7.37	10.75	8.80	10.86	-

Table 3. Yield and Yield Contributing Characters of Advanced Yield Trial of Upland Cotton at Jagadishpur, Jessore, 2017-18

Sl.No.	Genotypes	Number of Vegetative Branches/ Plant	Node Number of First Fruiting Branch (N.F.B)	Number of Primary fruiting Branches / Plant	Number of Secondary Fruiting Branches/ Plant)	Days to 1st Flowering	Days to 1st Boll Split	Plant Height at Harvest (cm)	Number of Bolls per Plant	Single Boll Weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1.	Ra-2	2.15	7.15	18.38	10.68	48	115	125.43	30	4.70	2.75	85
2.	Ra-5	2.78	7.40	17.40	14.38	49	118	118.80	35	4.73	3.02	93
3.	JA-13/R	2.30	7.23	18.40	11.48	53	118	124.70	35	4.90	3.12	97
4.	Ra-9	2.23	7.10	20.75	10.40	48	113	141.90	29	4.80	2.52	78
5.	SR-15	2.38	7.45	20.88	11.13	55	117	146.33	30	4.85	2.70	84
6.	JA-10/55	1.13	6.98	21.98	6.28	46	115	152.23	32	5.05	3.36	104
7.	CB-14	1.98	6.88	19.05	10.05	47	116	129.78	34	4.83	3.23	100
LSD (0.05)		0.54	0.49	2.13	5.41	3.28	4.46	15.02	4.79	0.69	0.48	-
CV (%)		13.54	5.30	7.99	11.23	4.23	2.75	7.37	10.75	8.80	10.86	-

Table 4. Yield and Yield Contributing Characters of Advanced Yield Trial of Upland Cotton at Sreepur, Gazipur, 2017-18

Sl.No.	Genotypes	Number of vegetative branches/ plant	Node number of first fruiting branch (N.F.B)	Number of primary fruiting branches/ plant	Number of secondary fruiting branches /plant	Days to 1st Flowering	Days to 1st Boll Split	Plant height at harvest (cm)	Number of bolls per plant	single boll weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1.	Ra-2	0.68	4.93	15.43	2.00	-	-	132.25	30	5.88	3.28	109
2.	Ra-5	0.85	5.05	15.35	3.65	-	-	131.98	32	5.58	3.25	108
3.	JA-13/R	0.48	5.15	16.40	1.48	-	-	149.78	32	5.60	3.31	110
4.	Ra-9	0.78	5.20	15.70	1.88	-	-	135.35	32	5.93	2.92	97
5.	SR-15	0.43	5.13	15.78	1.60	-	-	140.70	31	5.48	2.58	86
6.	JA-10/55	0.55	5.08	16.88	1.73	-	-	148.98	33	5.98	3.66	122
7.	CB-14	0.75	5.15	15.60	1.08	-	-	140.80	31	5.65	3.00	100
LSD (0.05)		0.54	0.49	2.13	5.41	-	-	15.02	4.79	0.69	0.48	-
CV (%)		13.54	5.30	7.99	11.23	-	-	7.37	10.75	8.80	10.86	-

Table 5. Mean Yield and Yield Contributing Characters of Advanced Yield Trial of Upland Cotton of Four locations, 2017-18

Sl.No	Genotypes	Number of vegetative branches/ plant	Node number of first fruiting branch (N.F.B)	Number of primary fruiting branches/ plant	Number of secondary fruiting branches /plant	Days to 1st flowering	Days to 1st boll split	Plant height at harvest (cm)	Number of bolls per plant	Single boll weight (g)	Seed cotton yield (t/ha)	Yield as % of CB-14
1.	Ra-2	1.66	6.58	18.08	9.49	55	114	136.26	30	5.79	3.10	98
2.	Ra-5	2.27	6.66	17.13	14.88	55	117	137.07	33	5.48	3.04	97
3.	JA-13/R	1.75	6.46	18.84	9.96	55	113	146.41	33	5.74	3.37	107
4.	Ra-9	1.45	6.43	18.78	7.53	54	114	142.96	30	5.59	2.74	87
5.	SR-15	1.56	6.61	19.26	8.79	56	115	147.00	31	5.39	2.96	94
6.	JA-10/55	1.06	6.44	20.73	5.07	53	114	156.33	32	5.86	3.57	113
7.	CB-14	1.61	6.40	19.81	9.46	52	113	146.30	32	5.31	3.15	100
LSD (0.05)		0.54	0.49	2.13	5.41	3.28	4.46	15.02	4.79	0.69	0.48	-
CV (%)		13.54	5.30	7.99	11.23	4.23	2.75	7.37	10.75	8.80	10.86	-

Table 6. Combined Mean of Ginning and Lint Characteristics of the Advanced Lines at Four Locations, 2017-18

Genotypes	Yield (t/ha)	G.O.T (%)	Yield of Lint (kg/ha)	Yield of Lint as % of CB-14	Seed Index (g)	Lint Index (g)	Fuzz Grade
1. Ra-2	3.10	40.79	1264	99	11.3	7.8	7
2. Ra-5	3.04	38.22	1162	91	11.7	7.1	6
3. JA-13/R	3.37	40.99	1381	109	10.9	7.7	8
4. Ra-9	2.74	39.81	1091	86	10.7	7.0	7
5. SR-15	2.96	39.51	1169	92	10.7	6.9	8
6. JA-10/55	3.57	40.01	1428	112	10.2	7.1	8
7. CB-14	3.15	40.37	1272	100	10.2	6.9	7

Candidate Variety Trial of Upland Cotton

M R Amin[1], M Farid Uddin[2], M Akhteruzzaman[3], M M A Ali[4], M M Islam[5] and H M S Azad[6]

Abstract

The experiment was conducted at thirteen locations of different zones during the year 2017-18. Two super advanced lines encoded Ra-3 and JA-11/M were included in this experiment and CB-14 was taken as local control. Numerically the highest mean seed cotton yield (3.01 t/ha) were recorded from Ra-3 which was followed by JA-11/M (2.99 t/ha). JA-08/9 and JA-11/M produced 2% and 1% higher than the control variety CB-14. The single Boll weight (4.64 g) was higher from Ra-3 which was followed by JA-11/M. Days to first flowering and days to first boll split was lower 58 and 124 days than others. The highest ginning out turn percentage (40.25%) and produced highest lint yield (1203 kg/ha) which was followed by Ra-3 (1193 kg/ha) and lint productions were recorded 2% and 1% higher than control variely CB-14.

Introduction

In breeding procedures, testing of strains at on-farm level is the prerequisite for variety development programme. The results of the experiment, that conducted at on station level dose not co-incide with the results of on-farm level experiment. To minimize the yield gape between on-station and on farm level experiment, emphasis should give to the on-farm level experiment. Depending upon the results of on farm level, crop variety is released. So it is the important step of variety releasing procedures. The adaptability and stability analysis is an important tools to the plant breeders to assess the potentiality of a genotype over multi environment conditions (Meredith *et al*., 2012). The present study aims to understand the performance of cotton advance lines over different locations of Bangladesh.

Materials and Methods

The experiment was conducted at thirteen zones such as Jashore, Jhenaidha, Chuadanga, Kustia, Bogura, Rajshahi, Rangpur, Thakurgaon, Dhaka, Mymensingh, Rangamati,

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Khagrachari and Bandarban. Two advanced lines were included in this experiment, encoded Ra-3 and JA-11/M. CB-14 was taken as local control. Seeds were sown at the date of 21-07-2017 to 08-08-2017 in different locations. Unit plot size was 22.5 m × 19.8 m. The augmented design was followed and 90 cm × 45 cm plant spacing was maintained. Three to four seeds were sown per hole. Two times thinning was done. First thinning was done after 10 to 12 days and 2nd thinning was done after 20 to 23 days after sowing keeping one seedling per stand. The nutrient elements such as Nitrogen (N), Phosphorus (P), Potassium (K), Sulpher (S), Boron (B), and Magnesium (MgSo4) were applied in the rows at the rate of 6.45-16-11-5-0.92 and 5.4 kg per hectare respectively as basal dose. At the 1st side dressing the nutrient elements such as Nitrogen (N), Potassium (K) and Zn were applied at the rate of 9.6-15 and 1.94 kg per hectare at the seedling age of 25 days after sowing one side of the cotton row. After 45 days after sowing the second side dressing was applied at the rate of 24.19-12.00-27.5-5.76-1.22 kg per hectare Nitrogen (N), Phosphorus (P), Potassium (K), Sulpher (S) and Boron (B) respectively just opposite side of the 1st side dressing. When the plants appeared at 60 days, third side dressing was done at the rate of 24.19-12.00-33.00-5.03-0.925 kg per hectare of Nitrogen (N), Phosphorus (P), Potassium (K), Sulpher (S) and Boron (B) respectively opposite side of the 2nd side dressing. The last or fourth side dressing was done at the plant age of 75 days at the rate of Nitrogen 16.13 kg and potassium (K) 22 kg per hectare respectively. Recommended cultural and intercultural operations were done just in time. Data were collected on days to first flowering, days to first boll split, plant height, number of bolls per plant, single boll weight, seed cotton yield per plot and plant population at harvest. The agronomic mean data of different locations were presented in this report.

Results and Discussion

Numerically the highest mean seed cotton yield (3.01 t/ha) were recorded from Ra-3 which was followed by JA-11/M (2.99 t/ha). JA-08/9 and JA-11/M produced 2% and 1% higher than the control variety CB-14 (Table-1). The single Boll weight (4.64 g) was higher from Ra-3 which was followed by JA-11/M (Table-3). Days to first flowering and days to first boll split was lower 58 and 124 days than others (Table-4 and Table-5). The highest ginning out turn percentage (40.25%) and produced highest lint yield (1203 kg/ha) which was followed by Ra-3 (1193 kg/ha) and lint productions were recorded 2% and 1% higher than control variely CB-14 (Table-7).

Conclusion

Considering seed cotton yield, GOT%, lint weight and single boll weight testedboth advance lines showed similar results.

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Table 1. Seed Cotton Yield of Candidate Variety Trial at Different Locations, 2017-18

Treatmant	Seed Cotton Yield (t/ha) at different locations									
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Mymensingh	Rangpur	Mean	Yield as % of CB-14
Ra-3	2.94	2.97	3.58	3.47	2.84	3.20	2.25	2.81	3.01	102
JA-11/M	3.21	2.86	3.65	3.76	3.03	2.81	1.91	2.72	2.99	101
CB-14	2.58	3.38	3.94	2.90	2.68	3.04	2.48	2.60	2.95	100

Table 2. Number of Bolls per Plant of Candidate Variety Trial at Different Locations, 2017-18

Treatmant	Number of Bolls per Plant at different locations								
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Rangpur	Mymensingh	Mean
Ra-3	27	25	34	36	25	39	25	26	30
JA-11/M	28	24	35	38	26	35	25	27	30
CB-14	24	28	37	33	25	38	25	28	30

Table 3. Single Boll weight (g) of Candidate Variety Trial at Different Locations, 2017-18

Treatmant	Single Boll Weight (g) at different locations								
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Rangpur	Mymensingh	Mean
Ra-3	4.52	4.83	5.00	4.10	5.20	4.20	4.90	4.4	4.64
JA-11/M	4.77	4.82	5.00	4.30	5.40	4.20	4.80	3.50	4.60
CB-14	4.46	4.90	5.00	3.80	4.80	4.30	4.50	4.50	4.53

Table 4. Days to first flowering of Candidate Variety Trial at different Locations, 2017-18

Treatment	Days to first flowering (days) at different locations								
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Rangpur	Mymensingh	Mean
Ra-3	56	57	55	57	71	63	51	57	58
JA-11/M	54	58	55	58	69	66	53	58	59
CB-14	57	60	57	59	72	63	51	56	59

Table 5. Days to first boll split of Candidate Variety Trial at different Locations, 2017-18

Treatmant	Days to first ball split (days) at different location								
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Rangpur	Mymensingh	Mean
Ra-3	121	105	122	108	166	146	123	145	124
JA-11/M	119	106	122	109	164	156	125	146	126
CB-14	123	110	121	111	169	153	123	144	126

Table 6. Plant height (cm) of Candidate Variety Trial at different Locations, 2017-18

Treatmant	Plant height (cm) at different locations								
	Khagrachari	Rangamati	Jhenidha	Chuadanga	Bogura	Kushtia	Rangpur	Mymensingh	Mean
Ra-3	121	160	155	154	132	150	113	141	141
JA-11/M	119	158	148	167	128	152	111	144	141
CB-14	123	163	147	129	124	153	113	150	138

Table 7. Ginning and Lint Characteristics of Candidate Variety Trial at Different Locations, 2017-18

Treatmant	GOT (%)					Seed Cotton Yield (t/ha)	Yield of Lint (kg/ha)	Yield of Lint as % of CB-14
	Rangamati	Jhenidha	Chuadanga	Kushtia	Mean			
Ra-3	40.40	39.00	39.20	40.00	39.65	3.01	1193	101
JA-11/M	40.40	39.00	40.90	40.70	40.25	2.99	1203	102
CB-14	40.20	40.00	40.00	40.10	40.08	2.95	1182	100

Evaluation and Characterization of Some Materials of Upland Cotton

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Abstract

The experiment was conducted at Cotton Research Farm, Jagodishpur, Jessore during the season 2017-2018 to evaluate the qualitative characteristics, seed cotton yield, cumulative % of seed cotton yield, ginning and lint of characteristics of five materials and control variety CB-14. Among them, five were encoded JA-16/1, JA-08/4, JA-08/5, JA-16/2 and JA-0510 respectively. The other was control variety CB-14. Significant difference was found among the genotypes for the traits of vegetative branches/plant, node number of first fruiting branches/plant, secondary fruiting branches/plant, days to 50% flowering, bolls/plant, un-burst bolls/plant, single boll weight (g), plant height (cm), yield (kg/ha). The line JA-08/4 produced the highest seed cotton yield (4078 kg/ha) and highest lint (1656 kg/ha) than the control variety CB-14. The line JA-0510 showed the highest GOT (40.50%) percentage. Among the five entries and control variety CB-14, the highest upper half mean length (33.47 mm), the highest strength (35.23 g/tex) value were found in the line JA-0510 and the lowest micronire value (3.56) was found in the line JA-16/1.

Introduction

As a major crop species and leading natural fiber crop in the world, cotton has a potentially broad genetic base, reflected in the collection of *Gossypium species*. The fundamental way to realize the target of high yield and good quality was to adjust the time of flowering and boll position to coincide with local climate and ecological conditions. Boll size, boll weight and fiber properties were positively correlated with flowering date and boll retention (Fan et al. 1989). In cotton , shorter plant height, lower number of days to flower and boll split are desirable (Alam et al.1996).Wu,-J-X et al.(2004) reported that, boll number and boll weight interacted to affect lint yield indicating that balanced selection for boll weight and boll number is needed in high yielding line development (Tan, 1993). Begum et al, (2005) also reported that, the highest weight of seed cotton/boll produced highest yield of seed cotton. Stoilova el al. (2003) showed that boll weight and seed cotton yield was positively correlated. To develop high yielding variety, Jagodispur Farm Jessore has colleted five materials/lines from indigenous and exotic sources. These lines were needed to be evaluated. For this purpose, these materials were tested in 2017-2018 through replicated progeny row trial at Cotton Research, Training and Seed multiplication Farm, Jagodishpur. So, the above experiment was conducted to evaluate the yield and adaptability of some materials.

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Materials and Methods

The experiment was conducted at cotton Research Farm, Jagodishpur, Jashore during the season 2017-2018. The seeds were shown at the date 31-07-2017. Five materials/lines were included in the experiment named JA-16/1, JA-08/4, JA-08/5, JA-16/2 and JA-0510 which were introduced from different sources. CB-14 was taken as control variety. Randomized Complete Block Design with three replications. Unit plot size was 4.5m x 3.6m and plant spacing was 90 cm x 45cm. Data were collected from middle two rows (4.5m x 1.8m) of each plot to minimize border effects. Two or three water soaked seeds were sown at each hole during planting time. Gap-filling were done at the date of 14-08-2017 and 28-08-2017 by seeds and plants. Thinning was performed after 10 days and 20 days of seed emergence. Finally one seedling was kept in one stand. Green manure (sun-hemp) was plough done at the age of 45 days. The fertilizers such as Urea, TSP and MOP were applied in the row at the rate of 42-150 and 30 Kg/ha respectively at basal dose during the final land preparation. After three (3) weeks at 1st side dressing Urea, Gypsum and Zinc sulphate were applied at the rate of 42-33 and 15 Kg/ha respectively. After six (6) weeks at 2nd side dressing Urea, TSP, MOP, Gypsum and Borax were applied at the rate of 42-50-60-33 and 18 Kg/ha. After nine (9) weeks at 3rd side dressing Urea, MOP, Gypsum and Magnesium sulphate were applied at the rate of 42-80-34 and 15 Kg/ha respectively. Another Urea and MOP were applied at the rate of 42 and 40 Kg/ha in 4th side dressing (within 10-12 weeks). Weeding was performed for three times. Mulching between two rows were done by power tiller. Two times irrigations were given i. e, at the 1st and third week of November.

After 30-35 days of sowing, first spray of choloropyriphose was applied against sucking pests such as Jassid, and Aphid etc. Other seven(7) sprays of chloropyriphose were applied in combination with pyrethorid to control sucking and chewing (Boll worm, spoted boll warm, spodoptera etc) pests. In all cases scouting based spray was followed. Boll worm and spodoptra attack was controlled by taking different control measures. Hand picking and Pheromone trap also used to kill larva and moths of the insets. As a result, more or less insect reproduction were stopped which encouraged friendly agro-ecosystem to some extent.

To protect the fungal diseases, Dythane-M-45 and Amistar Top were sprayed about three times at seedling and after boll formation stages of the plant. Insect attack and disease incident was keenly observed line wise. Data were collected vegetative branches/plant, NFB, primary fruiting branches/plant, secondary fruiting branches/plant, days to 50% flowering, days to 50% boll split, plant height, bolls/plant, un-burst bolls/plant, boll weight, seed cotton yield (Kg/ha) respectively. Analysis of variance was performed for all characters according to Zaman, S.M.H. et. al. (1982).

Results and Discussion

Mean performance of the tested lines for different agronomic traits, qualitative characters, cumulative % of seed cotton yield, ginning characteristics and lint characteristics were presented

in different Tables. It was observed that all qualitative characteristics were same in the tested materials/lines and control variety CB-14 (Table-1). But a little bit difference was seen in hairiness, petal color and boll shape. Four tested lines and our control variety CB-14 create glabrous type leaf except JA-0510. The tested line JA-0510 create light hairy leaf. The tested line JA-16/1 and JA-16/2 showed white petal color but other tested entries and our control variety CB-14 showed creamy petal color. Tested four lines and our control variety CB-14 produced conical shape boll and JA-0510 produced oval shape boll. In case of plant population/ha, primary fruiting branches/plant and days to 50% boll split, insignificant difference was found in the study. In case of vegetative branches/plant, significant difference at 1% level was found. The lowest and the highest vegetative branches/plant was found in the tested entry JA-0510 (1.30) and JA-08/4 (2.57) respectively. In case of node number of 1st fruiting branches/plant (NFB), significant difference at 5% level was found. The lowest and the highest NFB was found in the tested entry JA-0510 (6.13) and JA-08/5 (6.97) respectively. In case of secondary fruiting branches/ plant, significant difference at 1% level was found. The lowest and the highest number of secondary fruiting branches/plant was produced by the tested entry JA-0510 (6.97) and JA-08/4 (20.30) respectively. In case of days to 50% flowering, significant difference at 5% level was found. The tested entry JA-0510 showed the lowest days to 50% flowering and JA-16/2 showed the highest days to 50% flowering respectively. In case of bolls/plant, significant diffeenc at 1% level was found. The tested line JA-08/4 produced the highest number of bolls/plant and the tested line JA-16/1 produced the lowest number of bolls/plant respectively. In case of un-burst bolls/plant, significant diffeence at 5% level was found. The tested line JA-16/1 showed the lowest un-burst bolls/plant and JA-0510 showed the highest un-burst bolls/plant. In case of plant height, highly significant difference was found. The highest plant height was found in the tested line JA-16/2 (248.80 cm) and the lowest was in JA-08/4 (175.70 cm) respectively. For the trait single boll weight, significant difference among the entries was observed. The highest single boll weight was found in the tested entry JA-08/4 (5.07 g) and the lowest single boll weight was found in another tested entry JA-16/1 (4.47 g). The highest average weight of seed cotton/boll (5.07 g) enhance the highest seed cotton yield (Table-3), which is in agreement with that of Fan, Z.J. et al., 1989. In case of seed cotton yield, highly significant difference was found. The tested lines JA-08/4, JA-0510 and JA-08/5 were produced 14%, 12% and 4% more seed cotton yield than the control variety CB-14.

It was observed that early maturity was near about same in the tested materials/lines and our control variety CB-14. About 75-95% seed cotton was picked up at the age of 170 days (3rd picking) (Table-4). On the other hand 100% seed cotton was picked up at the age of 185 days (6 months 05 days) except the tested line JA-0510. The line JA-0510 has completed within 200 days (6 months 20 days).

In case of ginning out turn (G.O.T), the highest G.O.T percentage was found in JA-08/4 (40.60%) and the lowest was found in JA-16/1 (39.00%). Our control variety CB-14 showed 40.30% GOT respectively.

But in case of lint yield, the highest and the 2nd highest yield of lint was found in JA-08/4 (1656 Kg/ha) and JA-0510 (1626 Kg/ha) and the lowest yield of lint was found in another tested entry

JA-16/1 (1082 Kg/ha). The tested lines JA-08/4 and JA-0510 were produced 15% and 13% more lint than the check CB-14.

In case of seed index, the highest seed index was found in JA-16/1 and JA-08/4 (11.80g). The lowest seed index was found JA-08/5 (11.00 g).

In case of lint index, the highest lint index was found in the tested entry JA-08/4 (8.20 g). The lowest lint index was found in JA-08/5 (7.35 g).

In case of fuzz grade, it was ranged from 7 to 8 and the highest grade was observed in the four tested entries. The lowest fuzz grade was observed in the tested line JA-16/2.

From the table-6, In case of upper half mean length, the highest length was shown by the tested entry JA-0510 (33.47 mm) and the lowest length was shown by another tested entry JA-16/1 (30.41 mm) repectively.

In case of fiber strength, the tested entry JA-0510 (35.23 g/tex) showed the highest strength and JA-16/2 (34.70 g/tex) showed the 2nd highest strength and the lowest was shown by the another tested entry JA-08/5 (30.81 g/tex) respectively.

In case of uniformity index, all the tested lines and the control variety showed high uniformity index. When uniformity index is 83 to 85%, it is called high uniformity index. It is expressed as percentage. The tested entry JA-0510 (85.60%) showed the highest uniformity index and the another tested entry JA-16/1 (84.15%) showed the lowest uniformity index.

In case of elongation%, all the tested lines (except JA-0510) and the control variety showed high elongation of fibre. Elongation is a measurement of the elastic behavior of the fibres in the bundle. It is expressed as percentage. If the elongation range is 6.8 to 7.6, it's elastic behavior is high.

In case of moisture%, all the tested lines and the control variety CB-14 contains low moisture. If the moisture% range is from 4.5 to 6.5, it expressed the low moisture content.

In case of micronire value, the tested line JA-16/1 (3.56 µg/inch) showed the lowest mic. value and the another tested line JA-08/5 (5.09 µg/inch) showed the highest mic. value. The tested line JA-0510 showed the optimum mic. value (4.21 µg/inch).

Conclusion

From the above results and discussion, considering all the traits of the lines, the line JA-08/4 might be forwarded for preliminary yield trial in the next year due to its highest seed cotton yield, highest lint production, highest single boll weight and also showed 2nd lowest micronire value respectively. Another lines JA-0510 also might be forwarded for preliminary yield trial in the next year due its more seed cotton yield (4005 kg/ha) and more lint production (1626 kg/ha) respectively. It also showed highest fiber length (33.47 mm), highest fiber strength (35.23 g/tex), highest fiber uniformity index (85.60%) and the lowest micronire value (4.21 µg/inch). The other lines JA-16/1, JA-08/5 and JA-16/2 were needed further investigation through the replicated progeny row trial.

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Table-1. Qualitative characteristics of some materials of upland cotton

Accession Number	Variety	Growth Habit.	Colour of Plant	Hairiness	Leaf Shape	Petal Colour	Petal Spot.	Pollen Colour	Boll Shape	Seed Fuzz	Fuzz Colour	Lint Colour
JA-16/1	-	Erect	Green	Glabrous	Entire	White	Absent	Cream	Conical	Fuzzy	Grey	White
JA-08/4	-	Erect	Green	Glabrous	Entire	Cream	Absent	Cream	Conical	Fuzzy	Grey	White
JA-08/5	-	Erect	Green	Glabrous	Entire	Cream	Absent	Cream	Conical	Fuzzy	Grey	White
JA-16/2	-	Erect	Green	Glabrous	Entire	White	Absent	Cream	Conical	Fuzzy	Grey	White
JA-0510	-	Erect	Green	Light hairy	Entire	Cream	Absent	Cream	Oval	Fuzzy	Grey	White
JA-08/D	CB-14	Erect	Green	Glabrous	Entire	Cream	Absent	Cream	Conical	Fuzzy	Grey	White

Table- 2. Mean performance of some materials of upland cotton on different agronomic and yield contributing characters

Genotypes/ lines	Plant Population/ ha.	Vegetative Branches/ plant	NFB	Primary Fruiting Branches / Plant	Secondary Fruiting Branches / Plant	Days to 50% Flowering	Days to 50% Boll Split
JA-16/1	27160	1.57	6.47	26.30	7.27	57.33	120.00
JA-08/4	26748	2.57	6.90	24.93	19.00	56.67	120.00
JA-08/5	26748	2.40	6.97	25.77	20.30	57.67	120.67
JA-16/2	27160	1.57	6.37	25.87	7.63	60.00	123.67
JA-0510	27160	1.30	6.13	25.50	6.97	51.00	118.67
CB-14	27160	1.83	6.37	25.30	12.53	57.33	121.67
Level of sig.	NS	**	*	NS	**	*	NS
LSD	-	0.66	0.60	-	5.66	5.25	-
CV (%)	1.36	12.64	5.10	4.07	13.35	5.09	1.81

* Significant at 5% level of probability. ** Significant at 1% level of probability. NS= Non significant

Table-3. Mean performance of some materials of upland cotton on different agronomic and yield contributing characters.

Genotypes/ lines	Bolls/ Plant	Un-burst Bolls/ Plant	Boll Weight (g)	Plant Height (cm)	Yield (kg/ha)	Yield as % CB-14
JA-16/1	27.10	0.83	4.47	228.13	2774	78.00
JA-08/4	36.50	1.10	5.07	175.70	4078	114.00
JA-08/5	35.13	1.47	4.60	217.60	3727	104.00
JA-16/2	31.37	1.80	4.53	248.80	2984	84.00
JA-0510	36.93	2.73	5.03	213.70	4005	112.00
CB-14	35.03	2.03	5.01	189.53	3568	100.00
Level of sig.	**	*	*	**	**	-
LSD	3.81	0.70	0.53	23.64	415.60	-
CV (%)	6.25	18.90	6.12	6.12	6.49	-

* Significant at 5% level of probability. ** Significant at 1% level of probability.

Table-4. Cumulative % of seed cotton yield in every picking of some materials of upland cotton

Genotypes/lines	Cumulative % of Seed Cotton Yield				
	1st Picking (at 140 days) (%)	2nd Picking (at 155 days) (%)	3rd Picking (at 170 days) (%)	4th Picking (at 185 days) (%)	5th Picking (at 200 days) (%)
JA-16/1	40	75	90	100	-
JA-08/4	45	80	95	100	-
JA-08/5	45	80	95	100	-
JA-16/2	40	75	90	100	-
JA-0510	35	60	75	90	100
CB-14	40	75	90	100	-

Table-5. Mean performance of ginning characteristics of some materials of upland cotton

Genotypes/ lines	Seed Cotton Yield (kg/ha)	GOT (%)	Lint Yield (kg/ ha)	Lint Yield as % CB-14	Seed Index (g)	Lint Index (g)	Fuzz Grade
JA-16/1	2774	39.00	1082	75.00	12.00	7.68	8
JA-08/4	4078	40.60	1656	115.00	12.00	8.20	8
JA-08/5	3727	40.00	1491	104.00	11.00	7.35	8
JA-16/2	2984	39.40	1176	82.00	11.80	7.68	7
JA-0510	4005	40.50	1626	113.00	11.60	7.94	8
CB-14	3568	40.30	1438	100.00	11.20	7.89	7

Table -6. Mean performance of lint characteristics of some materials of upland cotton

Genotypes/ lines	UHML (mm)	Strength (g/tex)	UI (%)	Elongation (%)	Moisture (%)	Mic. Value (µ/inch)
JA-16/1	30.41	30.84	84.15	6.84	6.19	3.56
JA-08/4	32.03	32.90	85.24	6.85	5.53	4.52
JA-08/5	30.90	30.81	84.60	6.94	5.64	5.09
JA-16/2	31.09	34.70	84.75	6.80	6.50	4.78
JA-0510	33.47	35.23	85.60	6.64	5.35	4.21
CB-14	31.40	33.66	85.07	7.07	5.48	5.05

UHML = Upper Half Mean Length, UI = Uniformity Index

Screening of Upland Cotton (*Gossypium hirsutum*) for Hilly Area

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Abstract

An experiment was conducted at Hill Cotton Research Station, Balaghata, Bandanban during the season 2017-18 to evaluate the qualitative characteristics, seed cotton yield and ginning characters of five cotton varieties. Five varieties were CB-12, CB-13 CB-14, CB-Hybrid and Pupali-1 and the other was control variety CB-15, Significant difference found among the varieties for the traits of primary fruiting branches/plant, secondary fruiting branches/plant, days to 1st boll split, plant height(cm) no. of boll/plant and seed cotton yield(kg/ha). Rupali-1 produced the highest seed cotton yield (4.60 t/ha) and CB-14 followed it (4.55 t/ha). CB-15 produced the lowest seed cotton yield (3.67 t/ha).

Introduction

Cotton is one of the most important cash crop in Bangladesh. We are trying to cultivate upland cotton at the hill slope in hilly areas. In this respect cultivate the upland cotton varieties i,e CB-12 CB-13,CB-14, CB-hybrid, Rupali -1 and CB-15 as control at the slope of hill. The objective of this experiment is to identify the better performing variety among these cultivars in respect of their yield and other traits. This type of experiments also help us to cultivate upland cotton at the hill slope and increase its production and cultivation in hill area.

Materials and methods

The experiment was conducted at hill cotton research station, Balaghata, Bandarban during the season 2017-2018. The seeds were sown on13-07-2017. Five varieties were included in the experiment named CB-12 CB-13, CB-14,CB-hybrid and Rupali -1 which were sourced cotton development board and seed company. CB-15 was taken as control. Randomized complete block design with three replication. Unit plot size was 3m x 4m and plant spacing was 30cm x 80cm. Data were collected from middle two rows. Gap-filling were done at the date 22-07-2017 & 23-07-2017 by seeds and plants. Thinning was performed after 10 days and 20 days of seed emergence. Finally one seedling was kept in one stand. The fertilizers such as Urea, TSP, MOP, Gypsum, Zinc sulphate and Magnesium sulphate were applied at recommended doses of cotton board. Weeding was performed for three times.

Results and discussion

Seed cotton yield and yield contributing characters were showed significant difference among all the treatments (table-1&2).

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Among the tested Rupali-1 showed the highest seed cotton yield (4.60 t/ha) which was followed by CB-14 (4.55 t/ha). Rupali-1 and CB-14 produced 25% and 24% higher seed cotton yield than control variety CB-15, also the CB-12 and CB-13 showed highest seed cotton yield than control variety CB-15.

Rupali-1 and CB-hybrid were showed higher ginning out turm percentage (range 41.12% & 41.23%) and control variety CB-15(39.34%) . The CB-13 variety was showed lower ginning out turm percentage(37.33%) than control variety CB-15.

Conclusion

Among the 6 varieties Rupali-1 hybrid performed better in respect to yield and yield contributing characters. For better perfection, the experiment needs further investigation for the next year.

Table 1. Yield and yield contributing characters of upland cotton varieties 2017-18.

Treatment	Number of vegetative branches/ plant	Node number of 1st fruiting branches (NFB)/ plant	Number of primary fruiting branches/ plant	Number of secondary fruiting branches/ plant	Days to 1st flowering	Days to 1st split
V_1(CB-12)	1.37	6.47	13.30c	3.80	49.67	124.33ab
V_2(CB-13)	1.43	6.77	12.17c	3.60ab	50.00	123.00c
V_3(CB-14)	1.60	7.00	17.57a	3.40ab	50.33	127.00abc
V_4(CB-Rupali-1)	1.53	6.87	16.30ab	3.90a	51.67	129.00ab
V_5(CB-Hybrid)	1.67	6.70	15.40ab	2.77c	52.33	131.33a
V6(CB-15)-Control	1.47	6.53	16.07ab	1.12d	52.33	122.67c
LSD(.05)	NS	NS	1.87	3.88	NS	5.06
CV(%)	7.09	6.69	8.10	12.04	2.20	10.12

Table 2. Yield and yield contributing characters of upland cotton varieties 2017-18.

Treatment	Plant height (cm)	Number of boll/plant	Single boll weight(g)	Seed cotton yield (t/ha)	Yield as % CB-12	GOT(%)
V_1(CB-12)	146.23ab	27.03ab	5.17	4.52ab	123	38.88
V_2(CB-13)	145.40ab	25.17ab	5.07	3.83c	104	37.77
V_3(CB-14)	140.70ab	28.57ab	5.06	4.55ab	124	37.92
V_4(CB-Rupali)	150.32ab	31.13a	5.37	4.60a	125	41.12
V_5(CB-Hybrid)	154.27a	24.13ab	5.27	4.06b	111	41.23
V6(CB-15)-Control	126.17b	22.67b	5.13	3.67d	100	39.34
LSD (.05)	26.48	8.06	NS	19.73	-	-
CV(%)	16.70	14.34	1.64	2.05	-	-

Earliness Management of Cotton by De-topping in Different Dates.

Md. Akhteruzzaman[1], M.B. Momtaz[2], Md. Kamrul Islam[3]

Abstract

To determine the effect of detopping at various dates on seed cotton yield and final harvest date is important to fit cotton in cotton-wheat cropping pattern. The effects of detopping at 4 different dates were compared with no detopping. The highest seed cotton yield (3.52 t ha^{-1}) was obtained from detopping at 30 September and the final harvest was done at 10 December.

Introduction

Cotton (*Gossypium hirsutum* L.) is the king of natural fibre. It is the main raw materials of textile industries in Bangladesh. Annual requirement of raw cotton for textile industry of Bangladesh is about 6.0-6.5 million bales and the demand is ever increasing due to expansion of RMG export. But our local cotton production is far behind the demand, so to fulfill the raw cotton demand we have to depend on importing raw cotton from India, Uzbekistan, Pakistan, and Turkmenistan and from African countries. Textile is the largest industrial sector of Bangladesh and any crisis in the sourcing of raw materials will create a serious threat to the development of this sector. Thus, Bangladesh has an urgent need to increase domestic crop production. Scarcity of available land is the main constraint for increasing local cotton production. Moreover, Cotton is a long duration crop, it is very difficult to fit cotton in major cropping pattern including wheat based cropping pattern in the northern areas of Bangladesh. Cotton is usually sown in mid July to mid August and harvested till mid February. It was reported that optimum sowing time of wheat is the mid November mid December and sowing after that wheat yield reduce significantly. Under optimum conditions, cotton boll setting started at 59-60 days after seed sowing and it requires 50-55 days for a boll splitting after pollination occurs. There is an opportunity for scheduling the cotton last harvest date before mid November by detopping cotton in September to October. The objectives of this study were to identify the optimum detopping time and the effect of detopping on cotton yield. Similler experiment had been conducted in the previous season(2016-2017) also in the Sreepur farm only,there was only difference in Cotton variety/hybrid i.e;Rupali-1.

Materials and Methods

Field experiment was carried on to study the performance of cotton hybrid DM-3 under 90x30cm plant spacing at three different Cotton Research Farm of CDB, Sreepur, Gazipur; Jagadishpur, Jashore and Sadarpur, Dinajpur on 7 July of 2017, The treatments consisted of 5 levels of detopping on 10 September, detopping on 20 September, detopping on 30 September, detopping on 10 October and no detopping (Farmers' practices).

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The experiment was conducted in randomized complete block design with 3 replications. All the required cultural operations were adopted throughout the growing period uniformly in all the treatments. For recording agronomic observations 10 plants were selected randomly from each treatment. All the collected data were subjected to analysis of variance following the procedures of Gomez and Gomez (1984).

Reult and Discussion

The effect of detopping at various dates on seed cotton yield and the date of last harvest is given in table 1. The final harvest were done on 30 November, 7 December, 10 December, 18 December and 15 February for detopping on 10 September, 20 September, 30 September, 10 October and no detopping respectively. The highest seed cotton yield 3.52 t $ha^{-1}$was obtained from detopping on 30 September and the lowest seed cotton yield 2.84 t ha^{-1} was obtained from detopping on 10 September.

Table 1. Effect of de-topping at various dates on seed cotton yield and final harvest date

Treatment	Days of de-topping	Un-burst bolls $plant^{-1}$	Yield (t $ha^{-1)}$	Crop duration	Date of final Harvest
Detopping on 10 September	65	1.3	2.85	146	30 Nov 17
Detopping on 20 September	75	1.4	3.13	153	7 Dec 17
Detopping on 30 September	85	1.3	3.52	158	10 Dec17
Detopping on 10 October	95	1.4	3.06	164	18Dec17
No Detopping		1.2	2.98	223	15Feb18
LSD (5%)	-	0.46	0.11	2.0	
CV%	-	35.31	3.70	1.22	
Level of significance	-	NS	**	**	

The effect of detopping at various dates on cotton yield contributing characters is given in table 2. The results revealed that node number of first fruiting branch, plant/ha, single boll weight are statistically insignificant., sympodial branches $plant^{-1}$ and bolls $plant^{-1}$,plant count at harvest, monopodial branches $plant^{-1}$ give significant result.

Table 2. Effect of detopping at various dates on cotton yield contributing characters

Treatment	Plant/ha	NFB	Plant-height (cm)	Monopodialbranch/plant	Sympodial branch/plant	Boll/ plant	Single-boll-weight (gm)
Detopping on 10 sept	30870	6.77	87.77	2.27	13.28	17.01	5.95
Detopping on 20 sept	32062	6.61	90	2.16	13.06	16.9	5.72
Detopping on 30 sept	30500	6.85	102.1	1.87	14.43	22.02	5.83
Detopping on 10 oct.	30224	6.84	108.56	2.05	14.83	18.26	5.8
No Detopping	29531	6.63	123.8	2.21	17.08	15	5.64
LSD	787.93	0.42	29.36	0.86	1.94	2.11	0.67
CV	5.46	6.66	30.03	18.95	14.05	4.66	12.13
Level-of-significance	NS	NS	*	*	*	**	NS

Conclusion

Results revealed that certain days of de-topping significantly influence the crop duration and seed cotton yield. De-topping at 30 September gave the highest seed cotton yield and the final harvest was done at 10 December. Another finding was that detopping in September also creates opportunity to adjust triple crops(Cotton-Wheat/ Lentil- Mungbean/Seseame) within cotton based cropping pattern. .

Reference

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Plant Spacing Effects on Cotton Yield and Yield Contributing Characters

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ABSTRACT

The field experiment was conducted to assess the performance of cotton hybrid variety (DM-3) under different plant to plant spacing (15, 20, 30 and 45 cm) at three different Cotton Research Farm, Sreepur, Gazipur; Sadarpur, Dinajpur and Jagadishpur, Jashore. It was noted that plant population-^{1}, sympodial branches plant^{-1}, bolls plant^{-1} and seed cotton yield were significantly affected by plant spacing. The highest seed cotton yield (4.48 t ha^{-1}) was obtained from 90X10 cm plant spacing. It was recorded that increasing number of plant population significantly increased seed cotton yield.

Introduction

Bangladesh is the ancient home of cotton cultivation and is the 2nd largest importer of raw cotton in the world. To reduce the import dependency, we have an urgent need to increase domestic cotton production. Seed cotton yield per hectare in country is quite low as compared to other cotton growing countries of the world. One of the most conspicuous reasons of this low production is un-awareness of various agronomic practices of which the proper space between plants is considered to be the most important practice for improving cotton yield. Kumar (1989) reported that cotton planted in optimum plant spacing (30 cm) displayed more seed cotton yield over closer and wider plant spacing, although closer plant spacing produced taller plants, while yield parameters were superior under wider plant spacing. Mukharjee (1999) observed that seed cotton yield was maximum (1650 kg ha^{-1}) under wider plant spacing (30 cm) in all three varieties due to the improvement in all yield components. Yadav (1997) reported that combination of 75x30 cm row and plant spacing displayed more seed cotton yield i.e., 1800 kg ha^{-1} and all the fiber quality traits were also superior under some row and plant spacing. Boquet and Coco (1996) suggested that little yield difference should be expected between 30 and 40 inches row spacing and that closer row spacing required higher rates for maximum yield. Singh and Singh (1998) found that yield increased as inter and intra row spacing enhanced up to 2x60 cm, this increment in yield was associated due to increase in all yield components. Sharma (1994) reported that wider space between rows and within plants resulted in improved vegetative growth and yield components, while total seed cotton yield was obtained maximum under 30x75 cm row and plant spacing combinations.

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Shrivastava (1993) reported that cotton planted at 25x75 cm inter and intra row spacing gave more seed cotton yield, when compared with 15x45, 20x60 and 30x90 cm in all varieties, while, closer space between and within plant resulted in more height. Sharma (2004) reported that the plant spacing of 60x15 cm recorded the highest seed cotton yield (954 kg ha^{-1}) compared with 60x30 and 60x60 cm spacing (826 and 764 kg ha^{-1}, respectively), further, the cultivar BH-79-5-3 recorded the highest yield (1072 kg ha^{-1}), followed by Vikram which recorded 974 kg ha^{-1}. Sarkar and Malik (2004) reported that intermediate plant-to-plant spacing of 45 cm improved the growth and yield attributes of cotton and resulted higher seed-cotton yield of 5.6 and 18.9% over the narrower and wider spacing of 30 and 60 cm, respectively. Buttar *et al*. (2005) reported that the higher seed cotton yield was recorded in April sown crop compared with March and May sown crop. Higher seed cotton yield was also recorded when alternate irrigation with canal and tube well water was adopted. Soomro *et al*. (2005) reported that the effects of spacing (60x22.5, 60x30, 75x22.5 and 75x30 cm, row-to-row and plant-to-plant spacing) on the seed cotton yield cv. Shahbaz-95 were studied in Tandojam, Pakistan. The spacing of 75x30 cm resulted in the highest yield in 1997 (2975 kg ha^{-1}) and 1998 (3246 kg ha^{-1}) and in the highest yield (2985 kg ha^{-1}). Keeping the above facts in the view the present study was carried out to determine the influence of plant spacing on the growth and yield of hybrid cotton variety DM-3. Similler experiment had been conducted in the previous season(2016-2017) also in the Sreepur farm only,there were difference in Cotton variety/hybrid i.e;Rupali-1 and plant to plant spacings, that were 45,30,20 and 15cm.

Materials and Methods

Field experiment was carried on to study the performance of cotton variety DM-3 under different plant spacing at three Cotton Research Farms of CDB, Sreepur, Gazipur; Sadarpur, Dinajpur and Jagadishpur, Jashore during 2016-2017 growing season. The treatments consisted of 4 levels of plant spacing viz. 90 × 45, 90 × 25, 90 × 15 and 90 × 10 cm. The experiment was conducted in randomized complete block design with 3 replications. All the required cultural operations were adopted throughout the growing period uniformly in all the treatments. For recording agronomic observations 10 plants were selected randomly from each treatment. All the collected data were subjected to analysis of variance following the procedures of Gomez and Gomez (1984).

Result and Discussion

Plant population is a yield contributing parameter and has direct effect on the yield of cotton crop. It is evident from the data that there were significant differences among plant populations at different plant densities. In case of 10 cm plant spacing there were 42900 plants per hectare and at 15 cm there were 39200 plants per hectare, at 25 cm there were 28350 plants per hectare and at 45 cm number of plants were recorded as 20978 per hectare. So the number of plants per plot decreased significantly with increase in plant spacing and highest numbers of plants were

recorded in case of 10 cm plant spacing. Increase in plant population with decrease in plant spacing has also been reported by Brar *et al.,* (2002).

Table 1: Effect of spacing on cotton yield and yield contributing charasteristics.

Treatment	Plant/ha	NFB	Plant-height (cm)	Monopodial - branch/plant	Sympodial branch /plant	Boll/ plant	Single-boll-weight (gm)	Yield (t/ha)
T_1	20.978	7.15	148.48	1.4	19.0	19.3	5.8	2.5278
T_2	28.350	7.06	151.33	1.1	15.1	14.2	5.3	3.0100
T_3	39.200	6.9	150.03	1.2	14.5	13.3	5.1	3.4933
T_4	42.900	7.03	148.87	1.1	13.5	12.0	5.0	4.4844
LSD	5.3	0.25	26.26	1.01	1.12	1.89	0.56	0.12
CV	17.02	3.8	18.23	84.90	7.48	11.35	11.09	3.89
Level-of-significance	**	NS	NS	NS	*	*	NS	**

Data regarding node number of first fruiting branch, plant height at harvest, monopodial branch/plant and single boll weight/plant were not differ significantly (Table 1). The non significant results among genotypes had also been reported by Brar *et al.,* (2002). Greater number of sympodial branches per plant is an indication of good yield. Data regarding number of sympodial branches per plant as affected by plant spacing showed significant results. Significantly maximum number of sympodial branches per plant (19) was found when crop was sown with 45 cm plant spacing. However significantly minimum number of sympodial branches per plant (13.5) was recorded in case of 10 cm plant spacing. The increase in number of sympodial branches per plant might be due to more availability of space and less competition among crop plants. These results are in line with those of Alfaqeih (2002).

Number of bolls per plant is an important yield contributing parameter. Data from the table shows that by increasing plant spacing there was significant increase in number of bolls per plant. Maximum number of bolls per plant (19.3) was recorded in case of 90 × 45 cm plant spacing against the minimum (12.0) in 90 × 10 cm plant spacing. Increase in number of bolls per plant with increasing plant spacing can be attributed to more availability of space, less competition and more number of sympodial branches per plant. These results are in line with those of Siddiqui (2007) who stated that increase in density decreases number of bolls per plant.

It is evident from the data that average boll weight was not affected significantly by plant spacing. Statistically same average boll weight (5.8 g) was obtained in 90 × 45 cm plant spacing and the

minimum value of (5.0g) in case of 90 × 10 cm plant spacing. So the greater average boll weight at higher plant spacing might be due to less competition and availability of resources. These results are in line with those of Hussain *et al.,* (2000) and Boquet (2005) who reported that by increasing plant density average boll weight decreases.

It is evident from the data that varying plant spacing had significant effect on seed cotton yield. Significantly maximum seed cotton yield (4.48 t ha-1) was recorded when crop was sown at 10 cm plant to plant spacing. The lowest seed cotton yield (2.52 t ha-1) was obtained from 90 × 45 cm plant spacing. This decrease in yield may be due to the number of plant per hectare.

Conclusion

Plant spacing is an important agronomic practice for increasing seed cotton yield. From our study we found that the boll number and boll weight decreased with the increasing plant population. However, the highest seed cotton yield (4.48 t ha-1) was obtained from the lowest spacing i.e. 90 × 10 cm. This result is almost similar to previous season findings.

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Effect of transplanting and seedling age on growth, yield attributes and seed cotton yield of

Hybrid cotton (Gossypium hirsutum)

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ABSTRACT

An experiment conducted during *kharif* 2017 on 5 farmers fields of Jossore region had 2 treatments viz (i) 20 days old hybrid cotton (*Gossypium hirsutum* L.) seedlings grown in polythene bags and were transplanted in the field on mid august and (ii) direct sowing was done on the same dates to ascertain the comparison of growth and yield dynamics. Twenty days old seedlings resulted better yield and other attributes than that of direct seeding. Phonology attributes show earlier in seedling transplanting than direct seedlings. Seedling transplanting treatment recorded higher yield (4380kg/ha) and direct sown crop on same date recorded (4084kg/ha). Net returns and BCR also revealed the possibility of transplanting cotton to raise a profitable crop under compelling circumstances as a potentially exploitable technology.

Introduction

Farmers of Bangladesh practices dibbling as convenient method of sowing in July and August. Generally, flat bed method is used for sowing cotton. Land preparation is difficult during the recommended sowing time (ie July- August) for heavy rainfall and standing water on the field. As a result, timely sowing of cotton is severely hampered. Due to heavy rainfall poor plant stand of the crop. Ultimately poor plant stand of the crop results in huge reduction in seed cotton yield. Under such circumstances, raising crop by growing seedlings in the nursery and later transplanting them at an appropriate time has an exploitable potential.

Transplanting of cotton has been tried not only in India (Pundarikakshudu *et al.* 1992, Sarkar and Malik 2004) but also in countries like Iran (Sarvestani and Kordi 2001) and China (Dong *et al.* 2007) from where better response has been obtained than direct sowing. Though, transplanting is a costly process as compared to direct sowing but if practiced at an appropriate time, may result in equivalent/increased yield by performing better crop growth (Salakinkop *et al* 2010).

Since hybrid seed is costly, transplanting technology of raising hybrid cotton seedlings in poly bags, well in advance of planting is generating interest (Rajakumar and Gurumurthy 2008). Cotton growers are keen to improve profit margins by adopting such practices while maintaining yield loss.

High cost of *hybrid seed* coupled with poor germination and establishment under such situations has paved the way for contingency technique. Transplanting as a method for crop establishment has potential to realize aforesaid benefits. Keeping view of these points, an experiment was formulated to explore the feasibility of raising cotton crop by transplanting of seedlings previously grown in nursery and to evaluate the performance of transplanted *hybrid cotton under the agro-climatic* conditions of Bangladesh.

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Materials and Methods

The experiment was carried out at the 5 farmers field of jossore rezion during the period of august, 2017 to February, 2018. There were 5 farmers in the process of implementing the experiment in jessore region.. Out of 5 farmers, 3 farmers was involved in three sites (2 **Balgachi, and 1 Zaforpur unit**) in **Chuadanga** districts. Rest of the 2 farmers in **Meharpur** districts(1 **Kola** and I **Baradhi unit**) was involved. CDB personnel have looked after the experiment activities; at each location one field assistant engaged for the data collection of one location. Five farmers have tested hybrid variety of cotton (HSC-4). At each trial there were 2 treatments. (i) 20 days old hybrid cotton (*Gossypium hirsutum* L.) seedlings grown in polythene bags and were transplanted in the field on mid august and (ii) direct sowing was done on the same dates.

Each farmer was thus become a replication. Each farmer was with at least 16.5 decimals of land allocated for conducting the trial.

First hybrid cotton seed were shown in poly bag and after emergence 20 days old seedlings were transplanted in the main field. In direct seeding plots Cotton was planted by dibbling at same date. Three water soaked seeds per hill to ensure uniform stand, later thinned to one plant per hill. Spacing/ Planting geometry .90mx.45m. Gap filling was done immediately after emergence of seedling.

Thinning and earthling up were completed by 20 days after emergence. In case of first thinning, two seedlings per hill were kept after 10 days of emergence. Second thinning was done 20 days after emergence keeping one seedling per hill. N, P, K, S, was fertilized @ 120 : 45 : 131 : 27 kg ha^{-1} in the form of urea, triple super phosphate, murate of potash, gypsum and other micro nutrient Zn, Mg, and B @ 3.3- 1.5 -1.5 kg ha^{-1} , respectively in the form of zinc sulphate, magnesium sulphate and boric acid, respectively. Total amount of triple super phosphate, gypsum, zinc sulphate, magnesium sulphate, boric acid, one fourth of urea and half of the muriate of potash were applied in the furrows during the final land preparation as basal dose. The rest amount of urea was applied in three equal splits at 20, 40 and 60 days after sowing as top dressing. Similarly, the rest mutate of potash was applied at the time of second and third split of nitrogen application.

The experimental field was kept weed free up to 60 days after emergence of seedling by hand weeding. Mulching between two rows was done by power tiller. At the third week of November and first week of December irrigation were given due to draught situation. First spraying of Volume flaxy was done at 30 days after emergence against sucking pest like Jassid and Aphid. Other three spray of Aktara in combine with Volume flaxy were applied to control sucking and chewing (bollworms) pests. In all cases, scouting based spray was followed. Hand picking, light trapping and zollaghur (molasses) traps were also used to kill moths and adults of the insects. As a result more or less insect reproduction was stopped which encouraged friendly eco-system to some extent. To protect fungal diseases, Bavestine were sprayed at 10 days after emergence as precautionary measure

Ten plants were selected randomly from each plot and tagged for taking data. Harvesting of seed cotton from the net plot and border are done in three number of picking.

The following data were recorded during the experimentation. Date ot transplanting, date of sowing. date of emergence, date of squaring, date of 1st flowering, date of 1st boll opening Nod

number of first fruiting branch. Plant height at harvest, Number of monopodial branch plant^{-1}, Number of sympodial branch plant^{-1},number of boll plant^{-1} ,Individual boll weight, Seed cotton yield.

The data obtained from the experiments on different parameters were analyzed statistically following analysis of variance (ANOVA) technique with the help of computer package, Stat-10.. Means were separated using Toky test at a significance level of 0.05 (Gomez and Gomez, 1984).

Results and Discussion

Result were obtained from the present study regarding cotton transplanting and direct deeding on the growth, yield phonology of cotton and cost benefit analysis have been presented and discussed parameter wise in this chapter. The results of the study have been presented in Table 1 to 5.

1. Phonology attribute

Number of days to 1st flowering, 1st boll opening and Nod number of first fruiting branch significantly affected by planting method (Table1). The result showed that time needed for 1st flowering and 1st boll opening decreased due to transplanting. than that of direct seeding. Days required to blooming to boll opening are important characters of cotton as it indicates the earliness of the crop. Although these are inherent characters but sometimes environmental factors also governed the time of blooming and boll opening (Sawan *et al.* 1999).

Table 1. Effect transplantation on phonology attributes of cotton

Treatment	Days to First Flowering	Node number of first fruiting branch	Days to First Boll split
Transplanting	43.4b	5.8b	161.2b
Direct seeding	57.2a	9.6a	177.2a
LSD	2.83	0.7956	7.87
CV	3.21	4.11	2.65

2. Growth attributes

Plant height, vegetative branch plant^{-1} and sympodial branch plant^{-1} of different planting methods was measured at harvest time (table2). The results showed a non significant difference in plant height and sympodial branch plant^{-1} **of different** planting methods. Such differences in number of sympodial branch per plant of cotton genotypes were also reported by Nichols *et al.* (2004) in different cotton growing environments. Vegetative branch plant^{-1} also significantly affected by planting method.

Table 2. Effect of transplantation on growth attribute of cotton

Treatment	Plant height at harvest (cm)	Monopodial branch plant^{-1}	Sympodial branches plant^{-1}
Transplanting	142.2	0.38b	17.0
Direct seeding	153.0	2.9a	17.29
LSD	NS	0.23	NS
CV	0.52	8.29	6.79

3.Yield and yield attributes

A significant difference in number of plant were observed among the planting methods. Bolls plant^{-1}, boll weight and yield among the planting methods were observed statistically identical (Table 3). Higher seed cotton yield of cotton was associated with its better yield components like number of bolls per plant and individual boll weight. The findings confirmed with the results of Tan (1993); Dhanda *et al.*(1984) who observed that seed cotton yield is positively correlated with the number of bolls per plant and individual boll weight

Table 3. Effect of transplantation on cotton yield and yield contributing characters

Treatment	plants /ha	Bolls plant^{-1}	Single Boll weight (gm)	Yield (Kg ha^{-1})
Transplanting	2036.6a	39.0a	4.625	4380a
Direct seeding	1792.4b	39.6a	4.625	4084a
LSD	133.71	NS	NS	NS
CV	3.38	5.18		9.02

4. Economic analysis

Economic analysis was done with a view to observing the comparative cost and benefit under different treatment combinations of variety and fertilizer levels. For this purpose, the inputs cost for land preparation, cotton seed, manure and fertilizer, pesticide, intercultural operation, harvesting and post harvesting cost and manpower required for all the operations including seed cotton were recorded against each treatment, which were then enumerated into cost per hectare.

Variation in cost of production was noted due to the cost of cotton seed and different plantin methods (Table 4).

The cultivation cost is higher in transplanting method than direct seeding. . The higher gross return was found in transplanting method. The higert gross margin was found when used seedling transplanting method used. Higher benefit cost ratio (BCR) was involved when seedling transplanting method used.

Table 4. Economic analysis

Treatments	Seed cotton yield ($kgha^{-1}$)	Gross return ($tkha^{-1}$)	Total variable cost ($tkha^{-1}$)	Gross margin ($tkha^{-1}$)	BCR
Transplanting	4380	262800	114906	147894	2.29
Direct seeding	4084	245040	113121	147894	2.17

Conclusions:

Based on the experimental results, it may be concluded that

i) The effect of the cotton seedling transplanting had positive impact on phonological, growth characters, yield and yield attributes.

ii) Seedling transplanting seems to be more suitable for achieving shorter growing period which can help farmers to grow next crops about 15 days earlier.

And

iii) As the experiment conducted only one year, for better perfection the experiment should be Up-scaling in geographically exponential area .

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Evaluation of Cotton Varieties under Organic and Conventional Cultivation Practices

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ABSTRACT

A field experiment was conducted during 2017-18 growing season at the Cotton Research Center, Gazipur, Bangladesh to evaluate growth and yield of cotton varieties CB-12, CB-14, CB-15, Ispahani-01 and Rupali-1 under organic and conventional cultivation practices. The experiment was conducted in split plot design and replicate thrice, where cultivation practice was placed in the main plot and variety in the sub-plot. The result of the experiment showed that organic cultivation practice reduced both plant growth and seed cotton yield compared to conventional cultivation practice. The reduction of plant growth was estimated from 41.53 to 49.95%and seed cotton yield from 63.08 up to 84.59% in organic cultivation practice compared to conventional cultivation practice.This reduction due to the lowest number of sympodial branch plant^{-1}, bolls palnt^{-1} and single boll weight in organic cultivation practice compared to conventional cultivation practice. Ginning parameters like GOT, lint index and seed index were not differed significantly among the cultivation practice.

KEY WORDS: Cultivation practice, Growth, Seed Cotton Yield, Cotton variety.

Introduction

Cotton is a major cash crop as well as row materials for the textile industries of the country. Bangladesh is the second largest cotton consumer and apparel producer in the world.Cotton and its value chain play a vital role in the economy of Bangladesh and contribute 80% of total foreign exchange earnings. Cotton is a major polluter crop in the world and consumes 15% of the total global pesticides and 25% of insecticides in the world and also consumes huge amount of different chemicals (like- fertilizers, herbicides, growth regulators, defoliators etc.). Use of these chemicals directly harms to the environment, soil fertility, health of farmers and also increases production that affects farmer's economy. Cotton which is produced by farming system under Good Agriculture Practices according toestablished standards without the use of GMO seed, synthetic chemical fertilizers, pesticides, growth regulator and defoliant are termed as organic cotton and certified by the third party. Organic cotton is now grown in 25 countries in the world of which India, Syria, China, Turkey and the United States were thetop five producers in 2010/11. Cotton is not only used for fibre but also used for edible oil, oil cake feed for dairy and fisheries and as fertilizer that enters into the human food chain. It is estimated that organic cotton reduce production cost by 30-40%.

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Organic cotton production improve soil and environment, human health, eco-balance between pest and beneficial insect and reduce insecticide resistance. Bangladesh is a small cotton producing country; can easily convert to organic cotton production for higher benefit to the farmers.Such work for evaluation of cotton varieties for organic production has not yet done in the country. The present study was undertaken with the objectives to evaluate the cotton varieties for growing under organic production system and its economic benefit.

Materials and Methods

The experiment was conducted at the Cotton Research Centre, Gazipur, Bangladesh during 2017-2018 growing season to evaluate cotton varieties feasible for growing under organic cultivation practice compared to conventional cultivation practice. The location of the experimental site was high land belongs to the Salna series and is classified as Shallow Red-Brown Terrace type which falls under the order Inceptisols of soil taxonomy and located between 24.09^{o} N latitude and 90.26^{o} E longitude with an elevation of 8.4 meter above the sea level under the Agro Ecological Zone of Madhupur Tract (Anonymous 2012; Brammer, 1996). The experiment was laid out in split plot design and replicated thrice. Five cotton varieties (open pollinated variety CB-12, CB-14, CB-15 and hybrid variety Ispahani-01 and Rupali-1 were used) and two cultivation practices viz. i) organic cultivation practice without synthetic chemicals and conventional cultivation practice with synthetic chemicals. The cultivation practice were arranged in the main plot and varieties in the sub-plot. There were 10 treatments combinations comprising 5 varieties (CB-12, CB-14, CB-15, Ispahani-1 and Rupali-1) and two cultivation practices(CP-1= Organic cultivation practice and CP-2= Conventional cultivation practice).Cultivation practices allocated in main plots and varieties allocated in sub-plots.

The unit plot size of the experiment was 3.6m×6.0m (21.6 m^{-2}) maintaining 2.5m distance between main plot and 1m between subplot. Fuzzy cotton seed ofvariety CB-12, CB-14 and CB-15 and delinted seed ofIspahani-01 and Rupali-1 was sown on 02 August 2017 in the experimental plots. The experimental land was prepared finely by tractor using one disc and two harrow. The experimental field was fertilized as per cultivation practices. The conventional cultivation practice plot was fertilized at basal with 3 tons of cowdung ha^{-1} during plowing and CDB recommended N P K S Zn B and Mg at the rate of 26.0-37.5-37.5-7.0-6.0-1.0-1.0 kg ha^{-1}, respectively were incorporated into the soil before sowing as basal dose as urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate, borax and magnesium sulphate. Remaining recommended dose of N K B and Mg were applied at the rate of 26.0-56.0-1.0-0.5 kg ha^{-1} at 25 DAS, 26.0-56.0-0.5-0.5 kg ha^{-1} at 40 DAS and 26.0-37.5-0.5-0.5 kg ha^{-1} at 60 DAS. Also

remaining recommended dose of P and S were applied at 40 and 60 days after sowing at the rate of 22.5-10.0 and 7.5-7.0 kg ha^{-1} (Anonymous 2016). Green manuring was done by using sunhemp (*Crotalaria juncea*) in the experimental field a month before cotton sowing. The organic field was fertilized with natural organic sources at the rate of 4 tones cowdung, 1.5 tones wood ash, 0.5 tones poultry litre and 0.5 tones cotton seed oil cake per hectare. Thinning and other intercultural operations were done as and when necessary. Cotton crop in the conventional practice was sprayed with Hychem and Cuplan (Thiamethoxam & Chlorantraniliprole) to control bollworm and Hymedor (Imidacloprid 200 SL) and Suntap (Thiocarbamate) to control jassid and other sucking insects using Knapsack sprayer at seedling stage and power sprayer at flowering to boll open stage. Also fungicide Proud 25 EC (Propiconazole) was sprayed to control boll rot disease. But the insect pest in the organic field was controlled by using pheromone trap, yellow trap, molasses trap and spraying botanical insecticides and mehogony seed extract.Sunflower, maize seed was sown in the border line of organic plots and one line mungbean was intercropped between two line of organic cotton and incorporated in the soil after mungbean harvest.Plant height of cotton was recorded at seedling, flowering, boll open and at harvest. Yield and yield contributing characters of cotton including boll number $plant^{-1}$, single boll weight (g), 100 seed weight (g), number of monopodial and sympodial branch $plant^{-1}$, seed cotton yield (kg) was recorded. Seed index, lint index and Ginning out turn was calculated using the following formula-

$$\text{Ginning out turn (\%)} = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

Seed index = Weight of 100-seed

$$\text{Lint Index} = \frac{\text{Weight of lint}}{\text{Weight of seed}} \times \text{Seed index}$$

All the data were analyzed following analysis of variance (ANOVA) technique using CROP-STAT software. Means were separated by Least Significance Difference (LSD) test at 5% level of significance (Gomez and Gamez, 1984).

Results and Discussion

Plant height of cotton was significantly affected by cultivation practice at different growth stages of cotton. In all stages cotton plant height was reduced in organic cultivation practice compared to conventional cultivation practice. The reduction in plant height between cultivation practices was estimated from 41.53 to 49.95%. The reduction in plant height may occur due to lower accumulation of plant nutrient by cotton plants in organic cultivation practice. Among the variety

CB-14 performed better growth both in organic cultivation practice and conventional cultivation practice in all growth stages of cotton (Table 1 and Table 2).

Table 1: Effect of cultivation practice and variety and their interaction on plant height in cotton.

Treatments	Plant height at seedling stage (cm)	Plant height at flowering stage (cm)	Plant height at boll open stage (cm)	Plant height at harvest (cm)
Cultivation practice				
Organic	10.24	63.47	72.75	81.45
Conventional	10.86	122.06	138.07	150.75
LSD (0.05)	0.327	6.50	4.39	3.48
Variety				
CB-12	10.92	91.45	101.46	114.63
CB-14	11.27	103.52	116.53	128.15
CB-15	10.80	88.03	100.70	108.55
Ispahani-01	10.15	87.40	103.67	108.35
Rupali-1	9.62	93.43	104.70	120.82
LSD (0.05)	0.52	10.28	6.94	5.50
Interaction				
VAR*SP	0.73	NS	NS	7.78

Table 2: Interaction effect of cultivation practice and variety on plant height in cotton at harvest.

Variety	Cultivation Practice		Reduction in plant height as cultivation practice (%)
	Organic	Conventional	
CB-12	77.07	152.20	49.36
CB-14	92.37	163.93	43.65
CB-15	80.10	137.00	41.53
Ispahani-01	77.13	139.57	44.74
Rupali-1	80.60	161.03	49.95

Both Sympodial and monopodial branches of cotton significantly differed within the cultivation practices and among the varieties. Organic cultivation practice produced lower number of sympodial (9.79) and monopodial (0.40) branches in cotton compared to conventional cultivation practices. Among the variety CB-14 showed highest number of sympodial branches and CB-15 produced highest number of monopodial branches. On the other hand Rupali-1 produced lowest number of sympodial and monopodial branches among the variety. Plant number did't differed among the cultivation practices but significant difference was observed in plant number among the varieties. The highest number of cotton plant was recorded from CB-14 and lowest number from Ispahani-01. Differences in plant number may observed due to failure of germination during heavy rainfall (Table 3).

Table 3: Effect of cultivation practice and variety and their interaction on different morphological parameters in cotton.

Treatments	Number of plants ha^{-1}	Sympodial branch $plant^{-1}$	Monopodial branch $plant^{-1}$
Cultivation practice			
Organic	24444.40	9.79	0.40
Conventional	23549.40	15.63	1.42
LSD (0.05)	NS	1.01	0.43
Variety			
CB-12	28858.00	13.27	0.95
CB-14	29861.10	14.22	0.82
CB-15	29759.30	12.25	1.03
Ispahani-01	12861.10	12.01	0.58
Rupali-1	18645.10	11.82	0.27
LSD (0.05)	1707.45	1.59	NS
Interaction			
VAR*SP	NS	NS	NS

Number of bolls $plant^{-1}$, single boll weight and bolls per sympodial branch also significantly affected by cultivation practices and lowest Number of bolls $plant^{-1}$, single boll weight and bolls per sympodial branch was recorded from organic cultivation practice. Among the variety number of bolls $plant^{-1}$ was also differed significantly and the lowest bolls $plant^{-1}$ was recorded from CB-12 and highest from CB-14, which is statistically similar with other three varieties.

Table 4: Effect of cultivation practice and variety and their interaction on different yield variables in cotton.

Treatments	Bolls plant^{-1}	Bollssympod^{-1}	Single boll weight (g)	Seed cotton yield (kg ha^{-1})
Cultivation practice				
Organic	7.45	0.77	4.90	761.67
Conventional	20.59	1.33	5.17	2579.94
LSD (0.05)	0.94	0.102	0.25	184.63
Variety				
CB-12	15.33	1.08	4.87	2122.53
CB-14	14.93	1.02	5.17	2164.66
CB-15	13.98	1.09	5.08	2276.23
Ispahani-01	13.85	1.07	5.02	972.22
Rupali-1	12.02	0.97	5.05	818.36
LSD (0.05)	1.49	NS	NS	291.93
Interaction				
VAR*SP	NS	4.08	NS	412.85

Seed cotton yield was significantly influenced by the effect of cultivation practices, variety and their interaction. Seed cotton yield was reduced in organic cultivation practice in all varieties compared to conventional cultivation practice. The reduction of seed cotton yield in organic cultivation practice varied from 63.08 up to 84.59% compared to conventional cultivation practice. Among the varieties lowest seed cotton yield was recorded from Rupali-1 variety and highest from CB-15. The highest seed cotton yield in conventional cultivation practice was contributed by number of bolls plant^{-1}, single boll weight, bolls per sympodial branch and number of sympodial branch plant^{-1} (Table 4 and Table 5).

Table 5: Interaction effect of cultivation practice and variety on seed cotton yield.

Variety	Cultivation Practice		Yield loss as cultivation practice (%)
	Organic	Conventional	
CB-12	981.17	3263.89	69.94
CB-14	1167.28	3162.04	63.08
CB-15	1140.43	3412.04	66.58
Ispahani-01	300.926	1643.52	81.69
Rupali-1	218.519	1418.21	84.59

Ginning out turn, Seed index and lint index doesn't influenced significantly among the cultivation practice and interaction of cultivation practice and variety but this parameters was influenced significantly among variety. The highest GOT was recorded from cotton variety Ispahani-01and lowest from CB-14(Table 6).

Table 6: Effect of cultivation practice and variety and their interaction on different ginning characters in cotton.

Treatments	Seed index	Lint Index	Ginning out turn (GOT%)
Cultivation practice			
Organic	9.23	6.68	41.26
Conventional	9.57	6.86	41.16
LSD (0.05)	NS	NS	NS
Variety			
CB-12	9.43	6.42	40.27
CB-14	9.40	5.98	38.56
CB-15	9.60	6.95	41.42
Ispahani-01	9.47	7.37	43.13
Rupali-1	9.10	7.14	42.69
LSD (0.05)	NS	0.57	0.77
Interaction			
VAR*SP	NS	NS	NS

Conclusion

Seed cotton yield and growth was significantly reduced in organic cultivation practice compared to conventional cultivation practice. Cotton variety CB-14 perform better growth and better yield in organic cultivation practice. This experiment should assess further in respect of growth, yield, insect population and quality of cotton under organic cultivation practice.

Effects of Vegetable Branch Removal at Diffrent DAS on Growth and Yiels of Cotton

M. B. Momtaz[1] and. M Shamsul Bari[2]

Abstract

An experiment was conducted at experimental field of Cotton Research, Training and Seed Multiplication Farm Sreepur Gazipur, during the period from July 2017 to February 2018 to find out the effect of vegetative branch removal on yield and yield contributing characters of Cotton. The experiment comprised of six treatments viz. ,T_1 = No removal of vegetative branches, T_2 = Removal of vegetative branch at 35 DAS,T_3 = Removal of vegetative branch at 45 DAS, T_4= Removal of vegetative branch at 55 DAS T_5 = Removal of vegetative branch at 65 DAS, T_6 = Removal of vegetative branch at 75 DAS following Randomized Complete Block Design with three replications. There is no significant increase in plant height, number of sympodia/plant, boll wt. seed cotton yield.T_2 has highest yield 2.09 t/ha and BCR 1.76. There is no significant difference in number of boll/plant. Single boll weight is highest in T_3 & T_4 that is 5.03g which is statistically similar to others.

Key words: vegetative branch removal, different time, growth & yield of cotton.

Introduction

Cotton (*Gossypium hirsutum* L.) is considered as king among the various fiber crops; also called white gold. The cotton plant has perhaps the most complex structure of any field crop. The branches of a cotton plant can be classified as either vegetative branches (monopodia) or fruiting branches (sympodia). Vegetative branches, , are referred to as monopodia (meaning "single foot") since they have only one meristem. Removal of vegetative branches (VB) has been a new practice for field management in cotton production Bangladesh, but current studies indicate that retention of VB is of great value for improving cotton yield. Therefore it is necessary to determine the feasibility of VB retention in cotton plants. Cotton plants have indeterminate growth habit and sympodial fruiting branch cause it to develop bushy shape which is difficult for management practices. The research reported of the attempts to quantify the physiology of the production of the fruiting sites which ultimately lead to lint and seed. The maintenance of vegetative branches or the removal of early fruiting branches could be an effective pathway to regulate the ratio of sink to source, C/N, and maturity performance of cotton plant. Alterations of plant architecture using removal of vegetative branch at different times and genetic strategies to improve light penetration into the canopy may increase crop yields.

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Materials and Methods

The experiment was conducted to find out the effect of vegetative branch removal on yield and yield contributing characters of Cotton at Cotton Research Farm, Sreepur, Gazipur under AEZ No-28 (Madhupur Tract), comprises six treatments during the kharif season of 2017-18. The experiment was laid out in RCB design with three replications. The treatments were T_1 = No removal of vegetative branches, T_2 = Removal of vegetative branch at 35 DAS, T_3 = Removal of vegetative branch at 45 DAS, T_4=, Removal of vegetative branch at 55 DAS T_5 = Removal of vegetative branch at 65 DAS, T_6 = Removal of vegetative branch at 75 DAS. The experiment was set up at first week of July, 2017 and the plot size was 4.5m × 3.6m. Cotton variety CB-14 was used as a test material. Total amount of TSP, gypsum, zinc sulphate, magnesium sulphate, borax and one-third urea and one-third MoP were applied as basal. The rest of Urea and MoP were applied in three equal splits as top dressing at 25 DAS (Days After Sowing), 50 DAS and 70 DAS. There was 10 cm deep drain around the plot to drain out the excess rain water. All other production practices were as farm standard Yield data was recorded from middle rows and analyzed according to STAT-10.

Results and Discussions

No significant effect was observed in plant height, number of sympodia/plant, number of boll/plant, boll weight and seed cotton yield. Cotton has indeterminate growth habit and can grow very tall under conditions of unrestrained growth. Effect of vegetative branch removal has no significant effect on plant height of cotton (Table-1). Maximum plant height of 115.43 cm was recorded from treatment T_3 which was followed by the treatment T_4 (112.7 cm) and T_5 (111.97 cm) respectively. There is no significant difference in other parameters. No. of sympodial branches was heighest in T_4 that is 18.73 followed by T_6, T_3 respectively. Seed cotton yield was better in T_2 that is 2.09 t/ha followed by T_4 (2.08 t/ha) which were statistically similar. Lowest seed cotton yield was recorded in T_1 that is 1.70 t/ha.

Table1: Effect of vegetative branch removal on growth & yield of Cotton

Treatment	Plant Height	Sympodial Branches/p	Boll/plant	SBW	Yield(t/ha)
T_1	105.97a	16.70a	22.50a	4.90a	1.70a
T_2	111.70a	17.36a	24.33a	4.96a	2.09a
T_3	115.43a	18.03a	23.60a	5.03a	1.79a
T_4	112.70a	18.73a	24.66a	5.03a	2.08a
T_5	111.97a	17.83a	24.30a	4.93a	1.77a
T_6	110.10a	18.40a	25.16a	4.96a	1.82a
CV	7.05	7.92	8.86	1.67	8.75
LSD	14.27	2.5	3.8	0.15	0.29

Note: * =significance at 5% level, ** =significance at 1% level, ns= Not significance

Economic Analysis

Economics analysis presented Table 2 revealed that highest gross margin of Tk 50675.6, and highest benefit cost ratio (1.76) was obtained from the treatment T_2 (Removal of vegetative branche at 35 DAS) although its variable cost Tk. 66510 tk/ha. The lowest gross margin (Tk 32093.2) and benefit cost ratio (1.5) were recorded from T_1.

Table 3: Economic Analysis of the treatments

Treatment	Seed cotton yield(kg/ha)	Gross Return (Tk/ha)	Total Variable Cost (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	1707.8	95603.2	63510	32093.2	1.5
T_2	2092.6	117185.6	66510	50675.6	1.76
T_3	1796.3	100592.8	66510	34082.8	1.51
T_4	2088.5	116956	66510	50446	1.75
T_5	1776.3	99472.8	66510	32962.8	1.49
T_6	1829.2	102435.2	66510	35925.2	1.54

Price of cotton seed= 22Tk/kg, Price of seed cotton= 56 Tk/kg

Conclusion

The results revealed that treatment T_2 (Removal of vegetative branch at 35 DAS) produce the highest seed cotton yield 2.09 t/ha economic analysis shows BCR (1.76) (Table:2). which is not far enough from control T_1 (no removal of vegetative branch).

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Effect of Cotton Seedling Transplantation On the Yield of Upland Cotton.

K.Yesmin[1], M.B. Momtaz[2] and S. Bari[3]

Abstract

An experiment was conducted at experimental field of Cotton Research, Training and Seed Multiplication Farm Sreepur Gazipur, during the period from June 2017 to February 2018 to find out the effect of cotton seedling transplantation on the yield of upland cotton. The experiment comprised of four treatments viz.T_1= Farmer's practices, T_2= Seedling transplantation at 10 days, T_3=Seedling transplantation at 20 days, T4= Seedling transplantation at 30 days following Randomized Complete Block Design with three replications. There is a significant increase in plan height, number of monopodial branch/ plant, number of sympodial branch/plant, seed cotton yield(t/ha). Seed cotton Yield T_2 is superior than other treatments where seedling transplantation at 10 days which has highest yield 2.47 t/ha and BCR2.12. T_2 is statistically similar to T_1. There is no significant difference in number of bolls/plant, single boll wt. SBW is highest in T_3 that is 5.1 g which is statistically similar to other treatments.

Key words: *Seedling transplantation, different time, growth & yield of cotton.*

Introduction

Cotton *(Gossypium hirsutum L.*), the king of fiber crops, is an industrial commodity of worldwide importance. Cotton seed is the potential source of plant protein and oil. Cotton seed cake, an important by product of cotton, is a valuable source of protein for ruminant cattle. In addition a large number of labour forces of the country are employed in cotton cultivation and cotton processing mills (Mahmood, 1999).In spite of such importance of cotton in Bangladesh, its yield per hectare are very low (1.5 t/ha) which is even less than the world average and far below than the yield in cotton growing countries (FAO,1997). This situation of cotton in Bangladesh demands high cotton yield in unit area in order to match high demand of raw material for textile industry. Cotton yield can be increased by the development of new high yielding varieties as well as those which possible proper agronomic practices.Sowing of cotton seed in due time very important to achieve expected yield of cotton but because of heavy rainfall in cotton growing season cotton seeds cannot be sown in proper time. As a result, the expected yield cannot be achieved. Incessant rainfall affects germination of seeds and repeated gap filling thereafter causes age difference among direct sowing and gap-filling plants, which ultimately affect the yield.

To minimize the age gap among direct sowing plants and transplanted plants, and achive the expected yield of cotton, trial on seedling transplantation has been undertaken

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1&2 Cotton Development Officer, 2.Cotton Agronomist

Materials and Methods

The experiment was conducted to find out the effect of cotton seedling transplantation on the yield of upland cotton at Cotton Research Farm, Sreepur, Gazipur under AEZ No-28 (Madhupur Tract), comprises four treatments during the kharif season of 2016-17. The experiment was laid out in RCB design with three replications. The treatments were T1=Farmers practice, T2=Seedling transplantation at 10 days, T3=Seedling transplantation at 20 days, T4=Seedling transplantation at 30 days. The experiment was set up at last week of June,2017 andthe plot size was 9m x 3.6m. Cotton variety CB-12 was used as a test material.The crop was maintained well adopted agronomic practices. All others production practices were as farm standard. Yield datd was recorded from middle two lines and analyzed according to STAT-10.

Results and Discussions

Significant effect was observed in case of yield, no. of sympodial branch / plant, no. of monopodial branches/plant. T_1 sowing highest seed cotton yield that is 2.82 ton/ ha. that is statistically similar T_2 and T_3 (Table -1). Maximum single boll wt. of 5.1 was recorded from treatment T_3 which was followed by the treatment T_2 (5.09) and T_1 and T_4 (4.98) respectively. Highest no. of ball/ plant was found T_1 that is similar to all treatments. There is no significance different in case of no. of bolls/ plant and single boll wt./plant.

The experiment revealed that T_1 have highest seed cotton yield (2.82 t/ha) and BCR 2.63 (Table-2) that is statistically similar T_2 T2 comprising seedling transplanting at20 days have better next seed cotton yield 2.47 t/ha and BCR 2.12. There is no significant difference in case of SBW and no of boll/plant. Highest SBW found in treatment 2 that is 5.09. highest boll/plant found in treatment 1 that is 31.73

There is significant difference in case no of sympodial branches/plant. highest sympodial branches/plant found in treatment 1 that is 18.93. survival rate of cotton plant decreases with increasing the age of seedling transplantation.(Fig:2).

Table1: Effect of seedling transplanting yield& yield contributing characters of Cotton.

Treatment	Plant-count-at-harvest/ha	Plant height (cm)	Number of monopodial/plant	Number of sympodial/ plant	Number of bolls/plant	Single boll wt	Seed cotton yield (t/ha)
T_1	22492	138.23a	0.8a	18.93a	31.73a	4.98a	2.82a
T_2	18827	119.7a	0.76a	16.4ab	28.46a	5.09a	2.47a
T_3	17283	118.13a	0.33a	15.86b	27.8a	5.1a	2.37a
T_4	10802	116.0a	0.56a	15.33b	24.76a	4.98a	1.59b
Level of significance		*	*	*	ns	ns	*
LSD		30.53	0.68	3.03	9.56	0.3	0.77

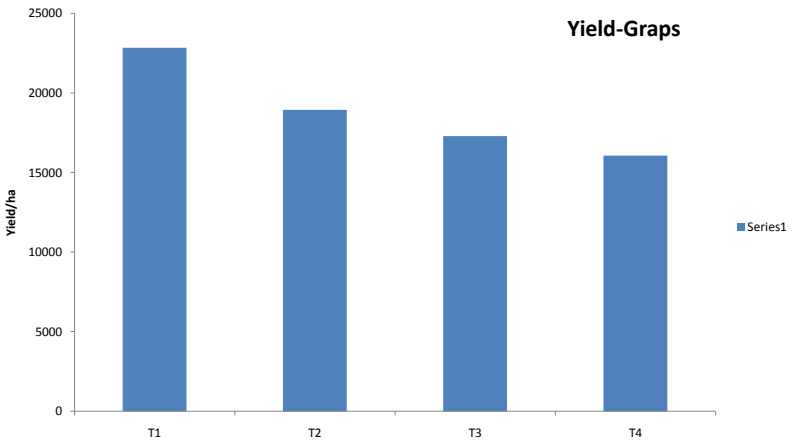

Fig 1: Yield of cotton seedling transplantation.

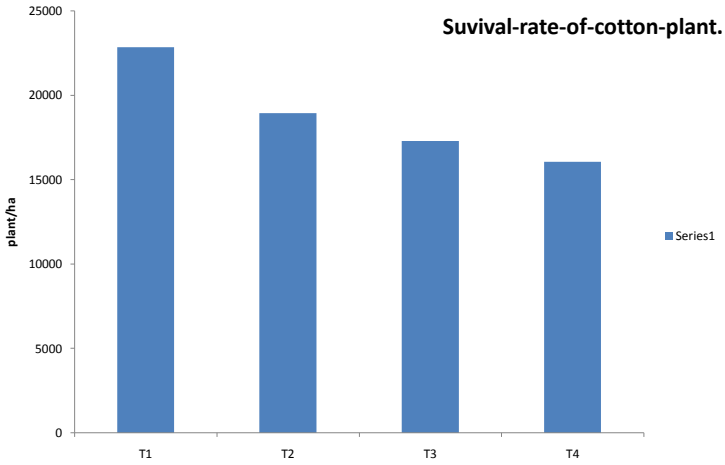

Fig 2: Plant population of seedling transplantation.

Table-2: Economic-Analysis

Treatment	Seed cotton yield(kg/ha)	Gross Return (Tk/ha)	Total Variable Cost (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	2820	157920	60000	97920	2.63
T_2	2470	138320	65000	73320	2.12
T_3	2370	132720	65000	67720	2.04
T_4	1590	89040	65000	24040	1.35

Conclusion

The results revealed that treatment T1(Farmer's practices) produce the highest seed cotton yield 2.82ton/ha economic analysis shows BCR (2.63) Table; 3. that is statistically similar T2. Treatment T2 comprising seedling transplanting at 20 days have better next seed cotton yield 2.47 ton/ha and BCR 2.12. There is no significant difference in case of SBW and no. of boll/plant. Highest SBW found in treatment 3 that is 5.1 . Highest boll/plant found in treatment 1 that is 31.73. Survial rate of cotton plant decreases with increasing the age of seedling transplantation.

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Screening for earliness cotton genotypes

Md. Jahangir Alam[1]

Abstract

The experiment was conducted at Cotton Research Farm, Sreepur, Gazipur during kharif season 2017-18. The 101 cotton genotypes were sown in randomized complete block design with three replications. To evaluate genotypes for earliness 15 quantitative plant traits were selected to classify the genotype into different groups using multivariate analysis. measured such as days to first flowering, node number of 1st fruiting branch, vegetative branches plant^{-1}. Primary and secondary fruiting branches plant^{-1}, number of bolls plant^{-1}, seed cotton yield (t/h), maturity days and GOT%. The mean squares from analysis of variances showed that genotypes differed significant ($P \leq 0.01$) for all the studied traits except GOT%. The genotypes, BC-0479, BC-0457, BC-0495, SR-16 and Rupali-1 were characterized as early maturing or short field duration cotton varieties. However, the correlation between yield and earliness traits were best criteria for developing the short duration cotton yield varieties.

Keywords: Screening, earliness, association, yields traits.

Introduction

Cotton (*Gossypium hirsutum* L.) is an important fiber crop in the world. Its seed is used as raw material in oil and forage industries due to the high percentage of the oil and protein (Efe *et al*. 2013). Early maturing varieties increase the possibility that harvest can be completed before cold and rainy weather. Earliness in cotton is a complex character which is assessed by measuring many plant traits. The traits like node of first fruiting branch, days of 1st flower and days of 1st open boll are used for assessing earliness in cotton (Baloch *et al*. 2004). It is very important in alleviating late season risks of insects/pests (particularly bollworms), diseases, unfavorable weather conditions and increase in economic return by reducing input cost (Jatoi *et al*.2012). Another advantage of growing early maturing cotton cultivars is the provision of proper time for rotation of other crops, allowing timely sowing of wheat in cotton- wheat-cotton cropping system as in Pakistan (Ali *et al.* 2003). The early maturing varieties require lesser inputs i.e. use of fertilizer, fewer sprays, irrigation and escape late season pest attack and avoid soil moisture depletion and weathering of open cotton (Shakeel *et al*. 2011). Due to these reasons, breeding for early maturing cotton varieties has become an important task in cotton breeding. Therefore, the current research was designed to identify selection criteria for the development of early maturing cotton genotypes.

Materials and Method

The present study was conducted in the experimental area of Cotton Research Farm, Sreepur, Gazipur during the crop season 2017-18. The experimental materials comprised of one hundred one cotton genotypes were collected form Cotton Research Center, Rangpur. The genotypes were cultivated in randomized complete block design with three replications. The row to row and plant to plant space was maintained at 90 and 45 cm, respectively. All the agronomic and cultural practices were performed regularly from sowing till to harvest.

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[1] Ph.D fellow and Cotton Development officer

Ten plants were chosen to record the data on days to Days to 1st flowering, Days to boll formation, Plant height (cm) at 70 DAS,90 DAS and at harvest, Number of main stem node of first fruiting branch (N.F.B), Number of vegetative branches/plant, Number of primary fruiting branches/plant, Number of secondary fruiting branches plant^{-1}, No. of bolls formed and boll split at 100, 115, 130 and 145 days after sowing, No. of bolls plant^{-1}, Single boll weight (g), Thousand cotton seed weight (g) and Seed cotton yield plant^{-1} (g).

After taking the raw data from field, the secondary data were analyzed in computer package Statistix10 version to determine analysis of variance and correlation between earliness and yield traits while graphs.

All necessary conventional agronomic and cultural practices were adopted. The data were subjected to basic statistics, including correlation analysis, principal component analysis (PCA), and cluster analysis, using IRRI software R-3.5.0 and STATISTICA v. 5.0 (Sneath and Sokal, 1973). The cluster and dendrogram analyses were carried out using K-means clustering. The above-mentioned statistical software were used to identify the models of variability between genotypes and the relationship between different clusters of particular traits (Akhtar *et al.*, 2010; Iqbal *et al.*, 2014; Saeed *et al*., 2014). In order to estimate the genetic diversity for breeding of different traits in various crops, similar statistical methods have been used successfully in many breeding programs (Coser *et al.,* 2016).

Results and Discussion

Mean Performance

The range of variation in fifteen quantitative characters of one hundred one genotypes is presented in table 1. A wide range of variation was observed in all plant characters of the genotypes. Different morphological traits were studied and co-efficient of variation (CV) of Days of 1st flowering, plant height, boll formed days to boll split and days to maturity illustrated high level of diversity among the accessions for these traits. The mean squares from analysis of variance (Table 2) showed that all the traits for earliness and yield traits were significant ($p \leq 0.01$) among the evaluated genetic resources, demonstrating that varieties performed differently for the character and these traits are best indicators for developing early maturing cotton varieties with optimum seed cotton yield. Similar results were obtained by (Baloch *et al*. 2004 and Jatoi *et al*. 2012) they also observed significant differences for the earliness and yield traits

Table 1. Summary statistics of 101 cotton genotypes for the 15 studied traits

Traits	Range	Mean±SE	SD	Variance
DF	54.33-91.67	58.94±0.35	3.51	**12.35**
PH	85.13-127.60	99.97±0.62	6.24	**38.89**
BF 145 DAS	18.93-34.33	25.50±0.32	3.26	**10.62**
BN	23.00-32.67	25.99±0.20	2.01	4.06
DBS	96.67-130.00	106.56±0.51	5.11	**26.09**
BS145 DAS	6.03-15.07	9.96±0.23	2.28	5.22
SBW	2.80-6.37	5.48±0.05	0.48	0.23
PCH	15.00-21.67	18.83±0.17	1.69	2.85
NFB	4.33-5.80	5.16±0.03	0.31	0.10
VB	0.33-2.13	1.28±0.04	0.44	0.20
PFB	12.53-15.47	14.02±0.06	0.63	0.40
SFB	0.53-6.17	3.43±0.13	1.35	1.83
Yield	1.59-4.10	3.37±0.04	0.39	0.15
GOT	37.74-42.99	40.15±0.12	1.22	1.48
MD	165.00-206.00	185.70±0.61	6.13	**37.60**

Table 2: Mean squares from analysis of variance for earliness and yield traits upland cotton genotypes

Source of Variation	DF	DFF	NFB	PCH	NOB	SBW	MD	YPT	GOT
Replication	2	38.26	0.17	223.38	49.12	0.88	85.21	0.16	1.61
Genotypes	100	37.04**	0.29**	8.99**	12.17**	0.69**	112.81**	0.45**	4.45ns
Error	200	5.32	0.19	6.04	7.38	0.21	6.67	0.06	4.34

Note: DF: Degree of Freedom; DFF: Days to 1st flowering; NFB: Number of main stem node of first fruiting branch; PCH: Plant count at harvest; NOB: Boll per plant; SBW: Single boll weight; MD: Maturity days; YPT: Yield ton per hectare; GOT: Ginning out turn.

Cluster Analysis

This is useful statistical procedure to obtain genotypes from various clusters having desirable traits. One hundred one cotton genotypes were grouped into 5 clusters based on various traits (Table 3). Cluster analysis showed that cluster 1 comprised, 46; cluster 2, 9; cluster 3, 25; cluster 4, 20 and cluster 5, 1 genotypes (Table 4). The genotypes in cluster 1 only showed reasonable values of days to 1st flower, plant height, boll number, boll split, primary fruiting branch, maturity days, yield and GOT. Similarly, cluster 2 comprised genotypes having only promising values for GOT (Table 4). The members of cluster 3 were characterized by better values of days to 1st flowering, boll split, single boll weight and GOT. The members of cluster 4 showed better results with respect to earliness related traits like days to 1st flower, days to boll split and earliness days to maturity and showed very good result with respect to seed cotton yield and this cluster showed more susceptible genotypes. The member of cluster 5 showed height days to 1st flowering, height days to 1st boll split, lowest single boll weight, lowest yield and height days to maturity. The genotypes in cluster 4 to obtain desirable traits related to earliness and resobable seed cotton yield. Amurrio *et al.* (1995) and Rabbani *et al.* (1998) reported lack of relationship between various clusters based on agronomic traits and

origins of genotype in peas (*Pisum sativum*) and mustard (*Bra-ssica juncea*) respectively. Similarly wide variations in clusters have been reported by Nazir et al. (2013). The occurrence of wide variation between the clusters is of great genetic value in providing genotypes aimed at cotton selection for adaptation to CLCuD hit areas. Similar kind of results associated to germplasm grouping has been reported (Ayana and Bekele, 1998; Grenier et al., 2001).

Table 3. Cluster analysis of various traits in cotton genotype

Traits	Cluster				
	1	2	3	4	5
DF	**59.15**	58.48	**58.63**	**57.42**	**91.67**
PH	101.07	107.81	96.9	96.37	**127.6**
BN130DAS	20.7	19.39	18.05	19.22	12.53
BN145DAS	27.79	25.2	22.51	24.28	22.13
BN	26.63	25.62	24.8	26.24	24.6
BS	**109.28**	106.07	**106.33**	**99.62**	**130**
BS130DAS	6.23	5.6	6.13	7.57	2.43
BS145DAS	10.67	10.58	9.26	9.06	7.23
SBW	5.39	5.74	**5.63**	5.52	**2.8**
PCH	18.66	20.22	18.72	18.95	15
NFB	5.08	5.08	5.24	5.25	5.67
VB	1.59	0.93	0.96	1.18	0.67
PFB	**14.09**	14.65	13.73	13.9	15.47
SFB	4.47	2.4	**2.41**	2.9	0.83
MD	**188.8**	186.22	184.68	**178.6**	**206**
Yield	**3.41**	3.55	3.3	3.36	**1.59**
GOT	**39.56**	**40.34**	**40.54**	40.97	39.4

Note: DF: Days to 1st flowering; PH: Plant height; BN130DAS: Boll no at 130 day after sowing; NFB: Number of main stem node of first fruiting branch; PCH: Plant count at harvest; BN: Boll per plant; SBW: Single boll weight; MD: Maturity days; Yield: Yield ton per hectare; GOT: Ginning out turn.

Table 4. Cluster membership of various genotypes

Cluster 1	46	CB-1,CB-2, CB-3, CB-4, CB-5, CB-6, CB-7, CB-8, CB-9, CB-10, CB-11, CB-12, CB-14, BC-0272, BC-0385, BC-0394, BC-0410, BC-0413, BC-0415, BC-0419, BC-0423, BC-0430, BC-0433, BC-0436, BC-0442, BC-0451, BC-0452, BC-0453, BC-0454, BC-0455, BC-0456, BC-0457, BC-0458, BC-0459, BC-0460, BC-0463, BC-0468, BC-0472, BC-0491, BC-0511, BC-0513, SR-17, RA-5, RA-9, RA-15 and JA-08/9
Cluster 2	9	CB-13, BC-0474, BC-0487, BC-0489, BC-0510, BC-0514, JA-08/B, JA-10/55 and JA-11/L
Cluster 3	25	CB-15, CDB-Hybrid-1, BC-0397, BC-0435, BC-0461, BC-0462, BC-0466, BC-0470, BC-0475, BC-0477, BC-0481, BC-0483, BC-0484, BC-0494, BC-0495, BC-0509, BC-0515, BC-0516, SR-15, RA-2, RA-4, RA-16, JA-09/H, JA-11/M and JA-13/R

Cluster 4	20	BC-0464, BC-0465, BC-0467, BC-0469, BC-0473, BC-0476, BC-0478, BC-0479, BC-0480, BC-0482, BC-0486, BC-0488, BC-0490, BC-0492, BC-0493, BC-0512, SR-16, RA-3, Rupali-1 and DM-3
Cluster 5	1	BC-0485

Principle component analysis (PCA)

Principle component analysis (PCA) clearly and concisely explains the genetic diversity of cotton genotypes. Mean data of 101 cotton genotypes were calculated and PCA was applied to sum up momentous variation from collected mean data. Out of eight principal components, three principal components (PCs) depicted more than one Eigen value so these three components have given due consideration for further explanation (Table 7). First two principle components PC1 and PC2 explained 28.60% and 14.00% of variation respectively with 42.60% cumulative variance among all attributes. The attributes of worthy importance in PC1 were Days to first flowering (DF), single boll weight (SBW), maturity days (MD) and yield ton per hectare (Yield) with maximum scores, depicted more contribution towards total variation. The second PC was more associated with number of boll and ginning out turn attributes (Table 7).

Table 7. Eigen values, proportion of variability and quantitative traits that contributed to the eight principle components

Statistical Variables	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Eigen value	2.286	1.121	1.077	0.993	0.958	0.792	0.480	0.294
Variability (%)	28.600	14.000	13.500	12.400	12.000	9.900	6.000	3.700
Cumulative (%)	28.600	42.600	56.000	68.500	80.400	90.300	96.300	100.000
Traits								
DF	**0.484**	0.212	0.182	0.293	0.101	0.024	0.768	0.035
NFB	0.071	0.477	0.026	0.826	0.105	0.174	0.205	0.034
PCH	0.173	0.047	0.676	0.037	0.525	0.441	0.184	0.078
NOB	0.293	**0.564**	0.403	0.281	0.159	0.370	0.165	0.407
SBW	**0.498**	0.402	0.024	0.010	0.082	0.289	0.420	0.569
MD	**0.322**	0.070	0.113	0.045	0.750	0.427	0.333	0.147
Yield	**0.520**	0.005	0.347	0.125	0.260	0.168	0.128	0.694
GOT	0.154	**0.491**	0.462	0.365	-0.201	0.586	0.060	0.001

Note: DF: Days to 1st flowering; NFB: Number of main stem node of first fruiting branch; PCH: Plant count at harvest; NOB: boll per plant; SBW: Single boll weight; MD: Maturity days; Yield ton per hectare; GOT: Ginning out turn.

Path analysis

Path analysis partitioned the observed correlation into undeviating and deviating effect of cotton variables presented in table 8. Path analysis depicted that single boll weight exhibited highest positive and undeviating effect on cotton yield. While other attributes depicted low direct effects on yield. Negative direct effect was observed for plant height and vegetative branch on yield (Table 8). Whereas, plant height and primary fruiting branch (PFB) depicted maximum indirect positive effect on seed yield via number of bolls per plant. In our study primary fruiting branch put undeviating and highly positive effect on yield via number of bolls per plant. In our

investigation ginning out turn illustrated good positive indirect effect on yield via bolls per plant.

Table 8. Path analysis of numerous attributes in (Gossypium hirsutum L.).

Traits	PH	NB	BS145	NFB	VB	PFB	SBW	GOT	MD
PH	**-0.013**	0.090	0.026	-0.005	0.000	0.092	0.003	0.000	0.006
NB	-0.004	**0.327**	0.048	-0.004	-0.003	0.049	0.020	0.000	-0.002
BS145	-0.002	0.095	**0.165**	-0.005	-0.008	0.013	-0.073	-0.001	0.006
NFB	0.001	-0.023	-0.016	**0.051**	0.006	0.001	0.023	0.000	0.003
VB	0.000	0.052	0.065	-0.014	**-0.020**	0.004	-0.048	-0.001	0.008
PFB	-0.007	0.093	0.012	0.000	0.000	**0.171**	0.030	0.000	0.001
SBW	0.000	0.015	-0.027	0.003	0.002	0.012	**0.448**	0.000	-0.011
GOT	0.001	0.006	-0.027	-0.002	0.004	0.000	0.015	**0.006**	-0.010
MD	-0.001	-0.015	0.019	0.003	-0.003	0.002	-0.089	-0.001	**0.054**

Note: Bold values representing direct effects.

Table 5. Mean Performance for various Quantitative Traits in Cotton Genotypes

Sl. no	Genotypes	N.F.B	Vegetative br./plant	Pri. fruiting br./plant	Days to 1st 50% flowing	Plant height at harvest	No. of Bolls/plant	Days to 1st boll split	Plant count at harvest	Single boll weight	Days to 100% cotton	Yield t/ha	GOT%
1	CB-1	5.27 a-j	1.67 c-e	13.47 e-n	60.00 b-e	99.00 d-u	24.40 h-p	113 b-h	19.00a-i	5.80 a-k	195.33 b-e	3.54 d-o	38.63
2	CB-2	5.77 ab	1.47 e-g	13.93 b-n	59.67 b-f	102.13 b-t	25.93 d-p	114 b-g	19.00a-i	5.33 f-r	193.33 c-h	3.63 b-l	38.38
3	CB-3	5.07 b-k	1.13 i-l	14.40 a-k	59.33 b-g	99.60 d-u	28.87 a-g	115 b-f	20.67a-d	5.67 a-m	196.33 bc	3.63 b-l	39.33
4	CB-4	5.47 a-g	1.67 c-e	14.60 a-h	58.33 b-h	104.87 b-n	27.93 b-l	115 b-f	17.33c-j	5.13 j-s	196.00 b-d	3.53 d-o	37.95
5	CB-5	5.57 a-f	1.33 f-i	14.00 a-n	60.33 b-e	105.13 b-m	25.80 d-p	116 bc	19.00a-i	5.90 a-i	198.67 b	3.77 a-g	39.99
6	CB-6	5.47 a-g	1.67 c-e	14.47 a-j	59.00 b-g	100.53 c-u	27.33 c-p	117 b	18.33a-j	4.67 p-t	195.00 b-f	3.60 b-m	39.27
7	CB-7	5.20 a-k	1.47 e-g	14.47 a-j	60.33 b-e	107.07 b-i	28.07 b-k	116 b-d	17.67b-j	5.80 a-k	192.00 d-j	3.60 b-m	37.77
8	CB-8	5.33 a-i	1.73 b-d	14.07 a-m	59.67 b-f	102.47 b-s	28.60 a-i	116 bc	18.00a-j	4.97 m-s	192.67 c-i	3.70 a-i	39.64
9	CB-9	5.40 a-h	1.93 ab	14.53 a-i	58.67 b-h	103.87 b-p	29.00 a-e	115 b-e	18.00a-j	5.47 c-o	193.00 c-h	3.80 a-f	39.54
10	CB-10	5.13 a-k	1.40 f-h	14.20 a-m	58.67 b-h	102.93 b-s	28.07 b-k	110 b-j	20.33a-e	5.17 i-s	190.67 g-m	3.50 d-p	38.78
11	CB-11	5.07 b-k	1.93 ab	15.27 a-c	58.67 b-h	107.13 b-i	27.47 c-o	112 b-h	19.33a-h	5.17 i-s	190.00 h-n	3.60 b-m	39.05
12	**CB-12**	**5.07 b-k**	**1.33 f-i**	**14.33 a-l**	**58.67 b-h**	**98.13 d-v**	**26.77 c-p**	**109 b-l**	**20.00a-f**	**5.73 a-l**	**188.00 j-q**	**3.53 d-o**	**39.80**
13	CB-13	5.60 a-e	1.47 e-g	14.27 a-l	58.67 b-h	113.47 b	25.60 d-p	108 b-m	21.67a	5.60 b-n	190.67 g-m	3.33 h-t	40.01
14	CB-14	5.00 d-l	1.53 d-f	14.33 a-l	59.00 b-g	105.33 b-m	27.33 c-p	110 b-i	19.00a-i	4.87 n-t	187.00 l-s	3.23 l-v	40.78
15	CB-15	5.60 a-e	0.67 o-q	13.07 i-n	57.67 c-i	92.00 q-w	24.60 f-p	111 b-h	19.67a-g	5.57 b-o	185.00 p-x	3.27 j-v	39.36
16	CDB-Hybrid-1	5.40 a-h	0.67 o-q	13.07 i-n	57.33 d-i	95.53 i-w	28.90 a-g	107 b-m	20.67a-d	5.90 a-i	181.00 x-c	3.47 e-p	41.63

17	BC-0272	5.40 a-h	1.47 e-g	14.53 a-i	60.00 b-e	100.20 d-u	29.13 a-d	112 b-h	20.00a-f	5.80 a-k	195.67 b-d	3.68 b-i	38.37
18	BC-0385	4.87 f-l	2.13 a	13.73 d-n	57.67 c-i	101.93 b-t	26.07 c-p	115 b-f	20.00a-f	5.00 l-s	185.00 p-x	3.25 k-v	40.54
19	BC-0394	5.20 a-k	1.53 d-f	13.93 b-n	60.00 b-e	96.33 h-w	27.27 c-p	110 b-j	18.00a-j	5.30 f-r	195.67 b-d	3.40 f-r	38.17
20	BC-0397	4.97 d-l	0.93 l-n	13.33 f-n	59.33 b-g	85.13 w	24.20 j-p	109 b-k	20.33a-e	5.07 k-s	183.67 r-a	2.40 c	40.37
21	BC-0410	4.67 i-l	1.93 ab	13.73 d-n	58.67 b-h	98.07 d-v	23.00 p	106 c-n	20.33a-e	5.27 f-r	187.33 k-r	2.40 c	40.72
22	BC-0413	4.77 g-l	1.67 c-e	14.13 a-m	59.67 b-f	92.20 p-w	26.67 c-p	111 b-h	21.00a-c	5.50 c-o	194.67 b-g	3.47 e-p	40.40
23	BC-0415	5.47 a-g	1.87 bc	13.07 i-n	58.33 b-h	104.87 b-n	25.47 d-p	108 b-l	21.00a-c	5.83 a-j	192.00 d-j	3.17 n-y	39.05
24	BC-0419	4.80 g-l	1.00 k-m	13.87 c-n	59.67 b-f	103.93 b-p	24.73 e-p	108 b-m	19.67a-g	6.10 a-e	190.33 h-m	3.49 e-p	40.41
25	BC-0423	4.93 e-l	1.67 c-e	14.93 a-e	59.00 b-g	108.80 b-f	28.87 a-g	108 b-l	20.33a-e	5.80 a-k	188.67 i-p	3.77 a-g	38.39
26	BC-0430	4.90 e-l	1.33 f-i	13.53 e-n	60.00 b-e	93.00 o-w	25.47 d-p	108 b-m	20.00a-f	5.80 a-k	192.33 c-i	3.58 c-m	39.95
27	BC-0433	5.27 a-j	1.47 e-g	13.73 d-n	61.33 bc	100.00 d-u	26.93 c-p	109 b-l	19.67a-g	5.40 d-p	191.00 f-l	3.53 d-o	38.17
28	BC-0435	5.07 b-k	1.07 j-m	12.53 n	60.67 b-d	92.80 o-w	26.13 c-p	108 b-m	20.00a-f	5.20 h-s	182.33 u-b	3.17 n-y	40.99
29	BC-0436	4.67 i-l	1.07 j-m	15.47 a	60.00 b-e	109.13 b-e	24.47 h-p	108 b-m	19.33a-h	5.13 j-s	183.00 s-b	3.10 p-a	41.82
30	BC-0442	5.33 a-i	1.87 bc	13.73 d-n	60.00 b-e	101.47 c-t	27.40 c-o	108 b-m	19.67a-g	5.30 f-r	191.33 e-k	3.53 d-o	39.06
31	BC-0451	4.33 l	1.93 ab	13.73 d-n	60.00 b-e	99.93 d-u	27.33 c-p	110 b-i	16.67e-j	4.17 t	190.00 h-n	2.77 y-c	38.73
32	BC-0452	4.60 j-l	1.93 ab	14.93 a-e	58.00 c-i	108.20 b-g	28.07 b-k	107 c-n	21.33ab	5.77 a-k	181.00 x-c	3.63 b-l	39.99
33	BC-0453	4.80 g-l	1.47 e-g	14.73 a-g	59.67 b-f	93.87 l-w	27.47 c-o	108 b-m	16.33f-j	5.27 f-r	189.67 h-o	3.37 g-s	39.57
34	BC-0454	5.13 a-k	1.87 bc	12.87 l-n	60.00 b-e	97.93 d-v	26.47 c-p	106 c-n	17.33c-j	4.47 st	193.00 c-h	2.70 a-c	38.80
35	BC-0455	4.73 h-l	1.87 bc	14.67 a-h	58.33 b-h	105.60 b-l	27.47 c-o	107 b-m	16.33f-j	5.87 a-j	190.67 g-m	3.73 a-h	37.74
36	BC-0456	4.93 e-l	1.07 j-m	13.33 f-n	59.67 b-f	95.73 i-w	24.33 i-p	109 b-l	15.33ij	5.07 k-s	188.67 i-p	2.75 z-c	37.83

37	BC-0457	4.80 g-l	1.87 bc	13.60 e-n	59.00 b-g	98.80 d-u	26.73 c-p	107 c-n	15.67h-j	6.10 a-e	185.00 p-x	3.97 a-c	38.63
38	BC-0458	5.20 a-k	1.87 bc	14.27 a-l	59.33 b-g	99.73 d-u	27.20 c-p	108 b-l	18.00a-j	5.90 a-i	186.67 m-t	3.80 a-f	38.80
39	BC-0459	5.47 a-g	1.87 bc	13.93 b-n	55.00 hi	91.80 r-w	28.77 a-h	100 i-n	17.33c-j	4.60 r-t	180.33 z-d	3.30 i-v	40.90
40	BC-0460	4.93 e-l	1.47 e-g	13.20 h-n	58.67 b-h	97.27 f-v	23.73 k-p	108 b-m	16.00g-j	5.33 f-r	181.00 x-c	2.90 v-b	40.27
41	BC-0461	5.07 b-k	1.27 g-j	13.27 g-n	57.00 d-i	95.80 i-w	23.27 op	107 c-n	19.67a-g	5.63 a-m	183.00 s-b	2.93 t-a	40.96
42	BC-0462	5.07 b-k	1.07 j-m	14.60 a-h	58.00 c-i	98.27 d-v	27.33 c-p	106 c-n	17.33c-j	5.20 h-s	192.33 c-i	3.40 f-r	40.12
43	BC-0463	5.07 b-k	1.87 bc	13.73 d-n	57.67 c-i	98.87 d-u	26.73 c-p	108 b-m	17.67b-j	5.63 a-m	185.33 p-w	3.73 a-h	41.19
44	BC-0464	4.87 f-l	1.13 i-l	13.80 c-n	56.67 e-i	93.13 n-w	24.13 j-p	99 l-n	18.00a-j	5.27 f-r	180.33 z-d	2.92 u-a	40.56
45	BC-0465	5.07 b-k	1.87 bc	13.73 d-n	57.00 d-i	92.40 p-w	24.87 d-p	100 i-n	16.00g-j	5.17 i-s	185.33 p-w	3.10 p-a	39.53
46	BC-0466	5.03 c-l	0.60 pq	14.47 a-j	58.00 c-i	94.87 j-w	24.20 j-p	107 c-n	17.00d-j	5.30 f-r	182.00 u-b	2.90 v-b	40.90
47	BC-0467	5.73 a-c	0.67 o-q	15.20 a-d	57.67 c-i	102.93 b-s	28.47 a-j	100 j-n	20.33a-e	5.20 h-s	181.00 x-c	3.50 d-p	40.85
48	BC-0468	4.53 kl	1.87 bc	14.67 a-h	59.67 b-f	107.87 b-h	26.20 c-p	107 c-n	15.67h-j	4.87 n-t	192.33 c-i	3.20 m-x	39.30
49	BC-0469	5.67 a-d	0.33 r	14.00 a-n	58.33 b-h	102.40 b-s	26.40 c-p	100 i-n	16.00g-j	5.23 g-r	181.00 x-c	3.47 e-p	40.00
50	BC-0470	5.13 a-k	1.87 bc	13.20 h-n	58.67 b-h	94.13 k-w	23.40 n-p	105 g-n	17.33c-j	5.83 a-j	186.00 n-u	3.10 p-a	39.81
51	BC-0472	5.33 a-i	0.93 l-n	13.20 h-n	58.00 c-i	99.33 d-u	24.67 e-p	106 d-n	16.33f-j	4.83 o-t	185.33 p-w	2.50 bc	40.34
52	BC-0473	4.93 e-l	1.87 bc	13.73 d-n	58.33 b-h	91.47 s-w	24.33 i-p	100 i-n	19.67a-g	5.87 a-j	183.00 s-b	3.57 c-n	40.87
53	BC-0474	5.13 a-k	0.87 m-o	14.80 a-ef	57.67 c-i	105.80 b-k	26.67 c-p	104 g-n	21.67a	5.67 a-m	190.00 h-n	3.53 d-o	39.60
54	BC-0475	4.80 g-l	1.20 h-k	13.73 d-n	58.67 b-h	92.73 o-w	25.53 d-p	105 e-n	19.33a-h	5.23 g-r	186.67 m-t	3.20 m-x	40.13
55	BC-0476	5.20 a-k	0.93 l-n	13.87 c-n	58.00 c-i	95.33 i-w	24.07 k-p	101 i-n	21.67a	5.27 f-r	180.67 y-c	2.80 x-c	40.51
56	BC-0477	5.00 d-l	1.73 b-d	13.67 e-n	58.00 c-i	99.60 d-u	23.87 k-p	107 b-m	19.33a-h	5.30 f-r	190.67 g-m	3.77 a-g	38.63

57	BC-0478	4.97 d-l	1.33 f-i	13.60 e-n	57.00 d-i	93.60 m-w	23.80 k-p	99 k-n	20.33a-e	5.33 f-r	180.67 y-c	3.00 r-a	42.94
58	BC-0479	5.27 a-j	0.73 n-p	13.93 b-n	54.33 i	95.47 i-w	32.00 ab	97 n	18.33a-j	5.23 g-r	**165.00 i**	**3.87 a-e**	41.01
59	BC-0480	5.33 a-i	1.53 d-f	13.80 c-n	57.00 d-i	86.67 vw	23.93 k-p	100 i-n	20.33a-e	5.90 a-i	174.00 f-h	3.40 f-r	41.50
60	BC-0481	4.80 g-l	1.67 c-e	14.07 a-m	59.33 b-g	99.80 d-u	26.20 c-p	105 g-n	21.67a	5.77 a-k	185.00 p-x	3.60 b-m	40.94
61	BC-0482	5.33 a-i	1.13 i-l	13.87 c-n	58.33 b-h	92.40 p-w	24.93 d-p	100 j-n	18.00a-j	5.47 c-o	181.33 w-c	3.40 f-r	40.83
62	BC-0483	5.03 c-l	1.13 i-l	14.07 a-m	58.67 b-h	97.00 f-v	24.87 d-p	107 c-n	19.67a-g	5.53 b-o	186.00 n-u	3.35 h-s	41.25
63	BC-0484	5.80 a	0.53 p-r	13.33 f-n	59.33 b-g	104.53 b-o	23.73 k-p	107 b-m	19.00a-i	5.60 b-n	182.67 t-b	2.99 s-a	41.27
64	BC-0485	5.67 a-d	0.67 o-q	15.47 a	91.67 a	127.60 a	24.60 f-p	130 a	15.00j	2.80 u	206.00 a	1.59 d	39.40
65	BC-0486	5.00 d-l	1.47 e-g	13.93 b-n	58.33 b-h	99.40 d-u	23.27 op	100 i-n	19.00a-i	5.27 f-r	180.00 a-d	2.92 u-a	41.55
66	BC-0487	4.77 g-l	1.27 g-j	14.53 a-i	58.33 b-h	105.47 b-l	26.87 c-p	107 b-m	19.33a-h	5.37 e-q	186.67 m-t	3.50 d-p	40.39
67	BC-0488	5.00 d-l	1.33 f-i	13.60 e-n	56.67 e-i	89.33 u-w	28.07 b-k	100 j-n	20.67a-d	5.33 f-r	172.00 h	3.22 m-w	41.02
68	BC-0489	5.20 a-k	1.07 j-m	14.27 a-l	59.00 b-g	108.47 b-g	24.53 g-p	105 e-n	20.67a-d	5.63 a-m	185.33 p-w	3.26 j-v	38.44
69	BC-0490	5.27 a-j	1.07 j-m	12.93 k-n	58.67 b-h	90.33 t-w	25.07 d-p	99 lmn	19.33a-h	5.50 c-o	179.33 b-d	3.32 i-u	42.99
70	BC-0491	5.27 a-j	1.87 bc	14.67 a-h	62.00 b	103.53 b-r	28.93 a-f	107 b-m	18.67a-j	4.63 q-t	181.33 w-c	3.11 p-z	39.60
71	BC-0492	5.67 a-d	1.33 f-i	14.00 a-n	57.67 c-i	102.40 b-s	23.93 k-p	100 i-n	20.00a-f	5.57 b-o	180.67 y-c	3.14 o-z	40.91
72	BC-0493	5.53 a-f	0.93 l-n	13.00 j-n	55.67 g-i	92.93 o-w	23.33 op	100 i-n	19.00a-i	5.73 a-l	177.67 c-f	3.13 o-z	39.13
73	BC-0494	5.20 a-k	0.93 l-n	14.13 a-m	58.67 b-h	102.53 b-s	23.73 k-p	105 g-n	16.67e-j	5.67 a-m	182.33 u-b	3.31 i-u	40.55
74	BC-0495	5.60 a-e	0.47 qr	14.27 a-l	58.33 b-h	97.00 f-v	26.73 c-p	105 g-n	17.67b-j	6.37 a	**184.33 q-z**	**4.10 a**	37.93
75	BC-0509	5.73 a-c	0.67 o-q	14.53 a-i	59.00 b-g	103.80 b-q	24.07 k-p	106 d-n	18.33a-j	5.97 a-g	185.00 p-x	3.48 e-p	40.02
76	BC-0510	5.27 a-j	0.93 l-n	14.60 a-h	58.33 b-h	109.73 b-d	23.60 l-p	107 c-n	19.67a-g	6.13 a-d	185.33 p-w	3.50 d-p	39.88

77	BC-0511	4.73 h-l	1.27 g-j	14.60 a-h	58.33 b-h	98.67 d-u	25.73 d-p	107 b-m	19.67a-g	5.53 b-o	181.67 v-c	3.50 d-p	42.45
78	BC-0512	5.20 a-k	1.27 g-j	14.07 a-m	59.00 b-g	100.00 d-u	27.83 b-m	101 i-n	20.33a-e	5.77 a-k	182.00 u-b	3.64 b-k	39.34
79	BC-0513	4.87 f-l	1.67 c-e	14.73 a-g	60.00 b-e	101.87 b-t	24.63 e-p	107 b-m	18.67a-j	5.70 a-m	185.67 o-v	3.21 m-x	39.79
80	BC-0514	4.73 h-l	0.93 l-n	15.40 ab	59.67 b-f	106.47 b-j	29.00 a-e	107 b-m	21.67a	5.70 a-m	187.33 k-r	4.00 ab	40.44
81	BC-0515	5.33 a-i	0.67 o-q	14.00 a-n	59.67 b-f	97.73 e-v	23.27 op	108 b-m	15.33ij	5.93 a-h	185.00 p-x	3.40 f-r	40.63
82	BC-0516	5.20 a-k	0.87 m-o	13.27 g-n	59.67 b-f	93.93 l-w	23.60 l-p	110 b-i	17.33c-j	5.80 a-k	183.67 r-a	3.05 q-a	40.65
83	SR-15	5.27 a-j	0.87 m-o	14.20 a-m	59.00 b-g	98.80 d-u	23.47 m-p	107 b-m	18.00a-j	5.30 f-r	183.67 r-a	3.11 p-z	42.13
84	SR-16	5.20 a-k	1.67 c-e	14.20 a-m	57.67 c-i	103.97 b-p	30.37 a-c	100 i-n	15.67h-j	5.93 a-h	176.33 d-g	3.67 b-j	42.42
85	SR-17	5.33 a-i	1.33 f-i	14.20 a-m	57.67 c-i	98.40 d-v	24.07 k-p	105 e-n	20.00a-f	5.67 a-m	183.00 s-b	3.38 g-s	40.51
86	RA-2	5.40 a-h	0.73 n-p	14.00 a-n	58.33 b-h	98.93 d-u	23.00 p	107 b-m	20.33a-e	5.83 a-j	184.67 p-y	3.24 k-v	40.11
87	RA-3	5.67 a-d	0.87 m-o	14.40 a-k	58.33 b-h	97.73 e-v	25.53 d-p	100 i-n	19.67a-g	5.43 c-o	183.67 r-a	3.38 g-s	40.24
88	RA-4	4.87 f-l	0.73 n-p	13.07 i-n	57.67 c-i	94.27 k-w	24.03 k-p	103 h-n	18.33a-j	5.77 a-k	183.67 r-a	2.82 w-b	40.57
89	RA-5	5.10 a-k	1.67 c-e	12.73 mn	59.00 b-g	99.93 d-u	26.53 c-p	104 g-n	19.33a-h	5.43 c-o	179.00 b-e	3.43 f-q	40.34
90	RA-9	5.60 a-e	1.07 j-m	13.80 c-n	59.67 b-f	103.27 b-s	26.07 c-p	105 f-n	15.67h-j	5.60 b-n	181.33 w-c	3.53 d-o	42.40
91	RA-15	4.67 i-l	1.67 c-e	13.73 d-n	58.33 b-h	100.33 d-u	25.07 d-p	107 c-n	18.33a-j	5.90 a-i	187.33 k-r	3.67 b-j	39.40
92	RA-16	5.67 a-d	0.87 m-o	14.27 a-l	59.00 b-g	105.87 b-k	24.73 e-p	105 g-n	16.67e-j	6.27 ab	181.00 x-c	3.77 a-g	40.50
93	JA-08/9	5.13 a-k	1.33 f-i	14.20 a-m	58.00 c-i	100.20 d-u	27.87 b-l	106 c-n	19.00a-i	5.53 b-o	182.00 u-b	3.63 b-l	39.38
94	JA-08/B	4.93 e-l	0.87 m-o	13.87 c-n	58.33 b-h	102.73 b-s	25.47 d-p	106 c-n	21.67a	5.50 c-o	185.00 p-x	3.42 f-q	42.77
95	JA-09/H	5.13 a-k	1.20 h-k	13.93 b-n	58.33 b-h	95.20 j-w	26.33 c-p	105 f-n	20.00a-f	5.27 f-r	185.00 p-x	3.40 f-r	41.23
96	JA-10/55	5.20 a-k	0.33 r	14.80 a-f	56.00 f-i	105.87 b-k	25.53 d-p	104 g-n	20.67a-d	6.17 a-c	182.00 u-b	3.75 a-g	40.62

97	JA-11/L	4.93 e-l	0.67 o-q	15.27 a-c	60.33 b-e	112.27 bc	23.33 op	106 c-n	15.00j	5.90 a-i	184.00 q-a	3.63 b-l	40.90
98	JA-11/M	5.33 a-i	0.67 o-q	13.00 j-n	58.00 c-i	94.60 k-w	24.87 d-p	104 g-n	19.00a-i	5.70 a-m	187.33 k-r	3.27 j-v	41.00
99	JA-13/R	5.40 a-h	0.93 l-n	14.07 a-m	59.33 b-g	97.53 e-v	26.00 c-p	104 g-n	18.00a-j	5.77 a-k	**184.00 q-a**	**3.90 a-d**	41.93
100	Rupali-1	5.30 a-j	0.87 m-o	13.53 e-n	56.00 f-i	96.80 g-w	32.67 a	98 mn	18.33a-j	6.00 a-f	**173.00 gh**	**3.90 a-d**	42.38
101	DM-3	4.73 h-l	1.27 g-j	14.87 a-e	57.67 c-i	108.67 b-f	27.73 b-n	99 k-n	18.33a-j	5.93 a-h	175.00 e-h	3.80 a-f	40.76
$LSD_{0.05}$		0.70**	0.21**	1.46*	3.71**	11.80**	4.37**	4.37**	3.96**	0.734**	4.158**	0.40**	ns
CV (%)		8.47	10.46	6.50	3.91	7.33	10.45	10.45	13.09	8.32	1.39	7.49	5.19

In order to identify the level of variation between different traits, the contribution of the first two PCs play an important role in estimating the variability. PC1 and PC2 explained the maximum variance, as reported previously by Nazir *et al.* (2013). Thus, the best performing genotype earliness incidence should be selected from PC1, which has the maximum variability and highest eigen value. A PCA is very useful for investigating evidence of extensive variation in different traits. This information could be used for selection of parents for breeding programs to earliness cotton cultivars as well as varieties with other desired traits (Malik et al., 2011). Grouping of germplasms with great variation between the clusters is of great genetic value for the selection genotypes (Grenier *et al.*, 2000).

The representative and discriminating ability of genotypes

In the present study, more vector length was observed in genotypes, thus demonstrated that genotypes variation was high in this boll split 130 DAS. Moreover, the angle between the vectors of Boll split 130 DAS was high as compared with the vectors of the other traits which clarified that relationship between boll split 130 DAS and other traits was relatively less. Remaining six traits showed a close angle among their vectors and thus depicted a close relationship with one another. Regarding seed cotton yield and single boll weight performance, all the seven traits were clustered as one mega traits (Figs.1 and 2).

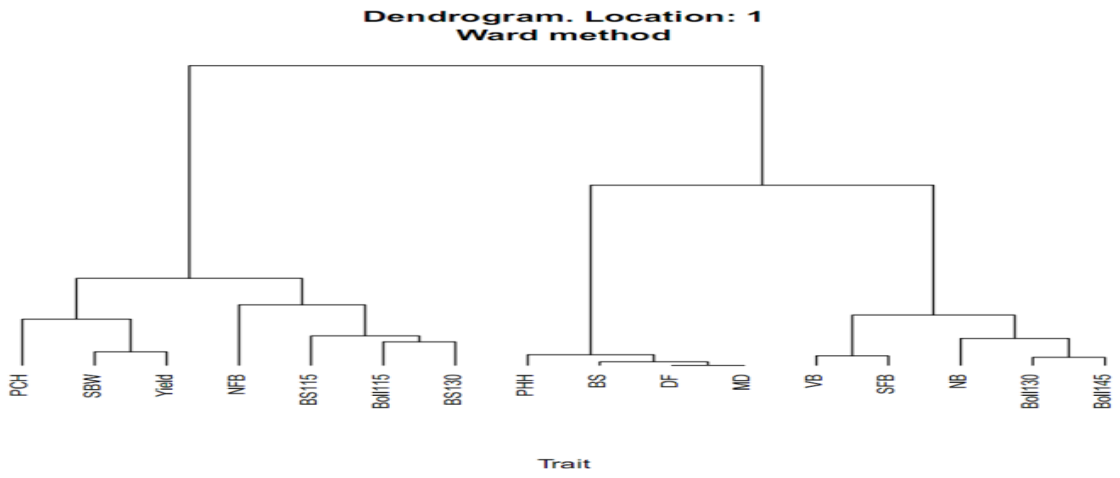

Fig.1. Dendrogram of cluster analysis of cotton genotypes by 16 traits

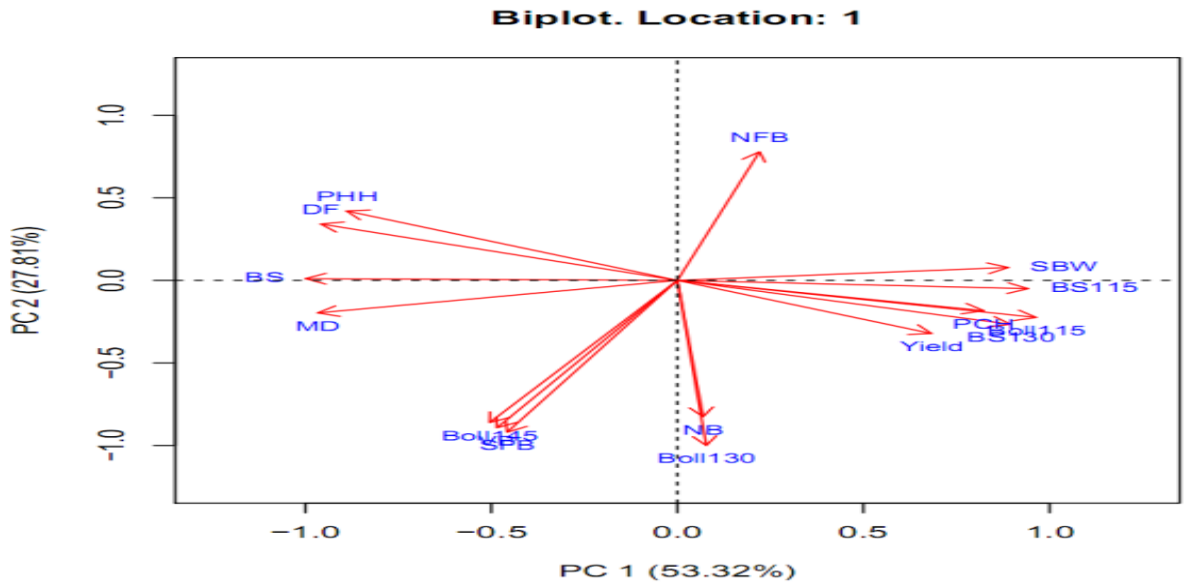

Fig. 2. Biplot between PC 1 and 2 showing contribution of various traits in variability among genotypes.

In order to estimate the genetic variation present among all studied clusters, a Ward's dendrogram was constructed as described previously (Grenier *et al.*, 2000; Nazir *et al.*, 2013). The dendrogram showed the presence of wide variation among the clusters suggesting high genetic variability among genotypes. Based on the cluster and Ward's dendrogram analyses, the members of Cluster 4 including BC-0464, BC-0465, BC-0467, BC-0469, BC-0473, BC-0476, BC-0478, BC-0479, BC-0480, BC-0482, BC-0486, BC-0488, BC-0490, BC-0492, BC-0493, BC-0512, SR-16 RA-3 cotton genotypes. These statistical tools could be used for the identification of other potential sources, for example, screening of bread wheat has been done to discover resistance against stem rust in wheat (Nzuve *et al*., 2012).

Uses of different statistical methods, like PCA, path and cluster analysis, provide information that can be used to identify and classify genotypes as earliness. These statistical instruments made it possible to select earliness genotypes that also showed optimum seed cotton yield and other valuable agronomical traits associated with increased production.

We also observed in table 2, the accession number BC-0479 was earliness character and 100% seed cotton harvest at 165days and moderate yield (3.87 t/h) which was followed by BC-0495, JA-13/R, SR-16 and Rupali-1 (yield 4.10, 3.90, 3.90 t/ha and maturity 185,184,187, 184,173 days respectably). All these accession numbers were responsible boll number, boll split, single boll weight and GOT%.

Conclusion

There exists a wide range of variation in morphological and phenotypic characters as well as yield performance of 101 cotton genotypes. Considering yield performance, GOT% and Maturity days of traits, the accession number BC-0495, JA-13/R, SR-16 and Rupali-1 were characterized as early of short field duration genotype. These genotypes can be used as breeding materials for improving the crop.

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Effect of NPKS Fertilizer on Yield and Yield Contributing Characters of Hybrid Cotton

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Abstract

A field experiment was conducted at three Cotton Research Farm Sreepur, Gazipur, Jagadishpur, Jashoreand Sadarpur, Dinajpurduring kharif season in 2017-18 to determine the Effect of NPKS Fertilizer on Yield and Yield Contributing Characters of Hybrid Cotton. The treatment combinations of the NPKS fertilizer doses (T_0= 0:0:0:0, T_1= 100:30:125:15, T_2= 125:40:150:20, T3= 150: 50:175: 25, T_4= 175: 60:200: 30 and T_5 = 200: 70:225: 35 Kg/ha) and Variety (V_1= CB hybrid-1, V_2= Rupali-1). The experiments were set up in RCB design with 2 factor and three replications. Fertilizer effect showed that, variety Rupali -1 and treatment T_5 gave highest seed cotton yield (3338.60 and 3069.20 kg/ha) respectively. The yield contributing parameters were significantly influenced by the hybrid variety and fertilizer levels. Interaction effect was highly significant on yield of seed cotton and yield contributing parameters. The highest mean seed cotton yield (3483.60 kg/ha) was obtained when 200:70:225:35 kg/ha NPKS and variety Rupali-1 but CB hybrid -1 to get higher seed cotton yield (3125.00 kg/ha) when the fertilizer application 175: 60:200: 30 kg/ha NPKS. Benefit cost analysis showed that gave the highest economic return and BCR treatment T_4V_2(2.81) and T_4V_1 (2.67). The lowest gross margin and benefit cost ratio were recorded from control treatment, respectively.

Introduction

Sustainable cotton production in the future will depend on the development of cotton varieties with higher yield potential and quality of seed cotton as well as better tolerance to biotic and abiotic stresses. In Bangladesh agriculture, cotton (*Gossypiumhirsutum* L.) is an important fiber and cash crop, which plays vital role to sustain national economy. Today, hybrid cotton is becoming popularized among the farmer community because of the protection form the bollworm menace at reduced cost besides being environmentally safe. Hybrid cotton is an exhaustive crop and needs heavy fertilization to get the target yield. Further, nutrient recommendation varies with crop response, soil condition, genotypes and climate conditions. (Patil*et al.* 2009). The cotton yield can only be increased through better crop management practices of which fertilizer are most important. Lakhande*et al.* (2006) reported that higher fertilizer levels of 100:50:50 NPK kg/ha gave significantly highest seed cotton yield. Seed cotton yield, number of bolls per plant and boll weight showed significant response to sulphur fertilization (Makhdum*et al.* 2001).

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Hybrid cotton is needs heavy fertilizer because plant bears more fruiting points and large bolls (Anonymous. 2000). Nutrient management which need based supply of nutrients ensures application at right time in desired quantities for the crop for obtaining target yield (Patil*et al.* 2009). Higher yield in cotton effective crop management practices particularly to maintain an appropriate plant population may help to get maximum seed cotton yield (Akhter, *et al.* 2002). The objectives of the present study to determine the appropriate fertilizer dose of hybrid cotton cultivation.

Materials and Methods

The experiment was conducted at Sreepur, Gazipur under AEZ No-28 (Madhupur Tract),Jagadishpur, Jashore AEZ No. 11 (High Ganges River Flood Plain) andSadarpur, Dinajpur AEZ No. 25 (Level Barind Tract) during the kharif season of 2017-18. The status of the soil has been presented in Table-1. The 2-factor experiment was conducted in RCB design with three replications in three locations. The treatment combinations of the Factor A. Fertilizer doses (Kg/ha) NPKS (T_0= 0:0:0:0, T_1= 100:30:125:15, T_2= 125:40:150:20 and T_3= 150: 50:175: 25, T_4= 175: 60:200: 30, T_5 = 200: 70:225: 35 and Factor B. Variety (V_1=CB hybrid-1, V_2= Rupali-1). The experiment was set up second week in the month of July, 2017 in a plot size 5.40 m × 4.5 m. Cotton variety Rupali-1and CB hybrid-1 was used as a test material. Total amount of TSP, gypsum, zinc sulphate, magnesium sulphate, borax and one-third urea and one-third MoP were applied as basal. The rest of Urea and MoP were applied in three equal splits as top dressing at 25 DAS (Days After Sowing), 45 DAS and 75 DAS. There was 10 cm deep drain around the plot to drain out the excess rain water. All other production practices were as farm standard Yield data was recorded from middle rows and analyzed according to STAT-10.

Table 1. Initial soil status of Experimental plot at two locations

Location	p^H	OM (%)	N (%)	K meq/100 g soil	P µg/g soil	S µg/g soil	Mg meq/100 g soil	Zn µg/g soil	B µg/g soil	Soil Texture
Sreepur Gazipur	5.3	0.87	0.04	0.20	1.95	5.58	1.90	1.12	0.18	Clay loam
Sadarpur Dinajpur	6.37	1.03	0.05	0.38	5.50	9.49	1.56	3.11	0.12	Sandy loam
Jagadishpur Jashore	7.43	1.03	0.05	0.17	5.90	12.69	0.71	1.33	0.59	Sandy loam

Results and Discussion

Combined analysis of variances for studied crop characters are given in the Table 2, 3, 4 and 5. Locations were significant due to different soil and environmental conditions. Also significant

effect was observed in plant height, number of monopodia/plant, number of sympodia/plant, number of bolls/plant, single boll weight and seed cotton yield in term of location. Highly significant variations due to NPKS fertilizer and variety for yield and of its important components were observed which indicated the existence of variation among the treatments.

Effect of Location

The three locations differ each other by mostly soil texture, structure and initial nutrient status and environmental components such as humidity, rainfall, temperature sunlight hours etc. So effect of location is expected on cotton growth, development and yield. Plant height differed significantly over locations and more plant height observed in Jagadishpur (150.84 cm) than Sadarpur (120.63 cm) and Sreepur (118.00 cm). Number of monopodia per plant varied in three locations. Significantly higher number of monopodia (1.93) produced in Jagadishpur and lowest in Sreepur (0.60). A greater number of sympodia /plant is an indication of its potential for higher production of cotton. Significant difference was observed for the three locations. The higher number of sympodia (22.96) per plant observed in Jagadishpur as justified by the higher plant height. Lower number of sympodia (13.61/plant) was found in Sadarpur. Maximum number of bolls/plant in Jagadishpur (27.76/plant) and minimum in Sreepur (23.84/plant).Significantly response of boll weight to the NPKS was observed in all locations. The highest mean boll weight of (5.47 g) was obtained with SadarpurDinajpur and the minimum boll weight (4.81 g) was observed in JagadishpurJashore. The highest mean yield of seed cotton 3013.50 kg/ha was obtained from Jagadishpur and lowest seed cotton yield 2415.10 kg/ha was found in Sreepur.

Table 2.Effect of NPKS and Variety on yield and yield attributes of cotton at three Location

Location	Plant height(cm)	No. of Monopodia/Plant	No. of Sympodia /Plant	No. of Bolls /plant	Single boll Wt (g)	Seed cotton yield (kg/ha)
Sreepur Gazipur	118.00 c	0.60 c	14.72 b	23.84 b	5.40 a	2415.10 b
Jagadishpur Jashore	150.84 a	1.93 a	22.96 a	27.76 a	4.81 b	3013 a
Sadarpur Dinajpur	120.63 b	1.53 b	13.61 b	24.84 b	5.47 a	2460.50 b
CV (%)	7.04**	34.98**	14.22*	8.92*	5.09*	10.20**
LSD (0.05)	5.02	0.26	1.39	1.26	0.14	150.68

Note: * = Significant at 5% level, ** = Significant at 1% level

Effect of Fertilizer

The effect of NPKS fertilizer on studied crop characters are also shown in the Table 3. Yield and yield attributes of cotton were significant due to effect of NPKS. The highest plant height (143.02 cm) observed in treatment T_5 and the lowest (104.31 cm) was in T_0 (No fertilizer). Hence, NPKS fertilizer enhances plant height of cotton.Ansari and Mahee (2003) also reported

increased plant height with increased fertilizer dose in cotton. The maximum number of monopodial branch/plant 1.56 found in T_5which was followed by the treatment T_3(1.50)and minimum number found in T_0 (0.98). A greater number of sympodia /plant is an indication of its potential for higher production of cotton. The highest and lowest sympodia /plant were observed 19.07 (T_5) and 14.36 (T_0), respectively that indicates highest dose of NPKS enhance sympodiaproduction over control. The increase in seed cotton yield with higher fertilizer doses might be due to more number of sympodial branches. (Bhalerao, 2010).The effect of NPKS on number of boll was significant in three locations. The average of three location, the highest bolls per plant (32.80) were recorded in T_5 which was followed by T_3 (29.45)which was followed by the T_2, T4, T5 treatment and lowest produced of bolls per plant (15.47) was observed incontrol treatment. Gradually increase of boll number observed with increasing NPKS fertilizer dose. Similarly Raut*et al*. (2005) observed the highest number of bolls/plant in 120:60:60 NPK kg/ha. Response of boll weight to the NPKS was observed significantly. The highest mean boll weight of (5.60 g) was obtained with T_5 and the minimum boll weight (4.47 g) was observed in control treatment.

Mean seed cotton yield gradually increased significantly as the NPKS dose increased. The highest mean yield of seed cotton 3069.20 kg/ha was obtained from T_5 where NPKS applied in 200:70:225:35 kg/ha which was followed by T_4 (2975.10 kg/ha) and T_3(2858.00 kg/ha) lowest seed cotton yield 1598.60 kg/ha was found in control (No fertilizer).The seed cotton yield was 1626 kg/ha at 80:40:40 kg NPK/ha and lowest seed cotton yield (1231 kg/ha) was recorded at unfertilized control (Suresh *et al.* 2006). Sharma *et al*. (2005) reported that application of 50 kg S/ha remained at par with 100 kg S/ha, producing 17.6 and 25.4% higher seed cotton yield and lint yield over the control.

Table 3. Effect of NPKS fertilizer on yield and yield attributes of cotton (Factor A)

Treatment	Plant height (cm)	No. of Monopodia /Plant	No. of Sympodia /Plant	No. of Bolls /plant	Single boll Wt (g)	Seed cotton yield(kg/ha)
T_o	104.31 c	0.98 b	14.36 b	15.47 c	4.47 d	1598.60 d
T_1	109.32 c	1.24 ab	14.49 b	20.35 b	4.80 c	2099.80 c
T_2	131.20 b	1.41 ab	17.93 a	27.41 a	5.32 b	2777.90 b
T_3	136.15 ab	1.50 a	18.04 a	28.42 a	5.42 ab	2858.00 ab
T_4	138.09 ab	1.42 ab	18.68 a	28.26 a	5.46 ab	2975.10 ab
T_5	143.02 a	1.56 a	19.07 a	27.97 a	5.60 a	3069.20 a
CV (%)	7.04**	34.98**	14.22*	8.92*	5.09**	10.20**
LSD (0.05)	8.98	0.46	2.36	2.19	0.26	260.36

Note: * = Significant at 5% level, ** = Significant at 1% level

T_0= 0:0:0:0, T_1= 100:30:125:15, T_2= 125:40:150:20 and T_3= 150: 50:175: 25
T_4= 175: 60:200: 30), T_5= 200:70:225: 35 kg NPKS/ha

Effect of Variety

Effect of Variety on studied crop characters are also shown in the Table 4. Plant height, number of monopodia/plant, number of sympodia/plant, number of bolls/plant, single boll weight and seed cotton yield were significant. The highest plant height (144.61 cm) observed in V_2 (Rupali-1)and the lowest (109.45cm) was in V_1 (CB hybrid-1) which was statistically significant. The maximum number of monopodia /plant 1.45 found in V_2 and minimum number found in V_1 (1.25) which was statistically significant.A greater number of sympodia /plant is an indication of its potential for higher production of cotton. The highest and lowest sympodia /plant were observed 19.34 (V_2) and 14.85 (V_1) which was statistically significant.

Maximum number of bolls/plant (32.00) was attained by Rupali-1 and lowest numbers of bolls/plant (24.62) were recorded by CB hybrid-1. Response of boll weight to the variety was observed significantly. The highest mean boll weight of (5.72 g) was obtained with V_2 and the minimum boll weight (4.74 g) was observed in V_1.

Seed cotton yield increased significantly at two hybridvarieties in three locations. The highest mean yield of seed cotton 3338.60 kg/ha was obtained from Rupali-1 and lowest seed cotton yield 2520.90 kg/ha was found in V_1. Lokhande*et al*.(2006) report similar findings and higher fertilizer level of 100:50:50 NPK kg/ha gave significantly highest seed cotton 1615 and 1633 kg/ha respectively. Police patil*et. al*.2012 reported that significantly higher yield and growth components and nutrient uptake (N-141.75, P-19.23 and K-166.28 kg ha-1) was recorded in 3 t ha-^{1} (F_3) targeted yield of hybrid cotton.

Table 4. Effect of Variety on yield and yield attributes of cotton

Variety	Plant height (cm)	No. of Monopodia /Plant	No. of Sympodia /Plant	No. of Bolls /plant	Single boll Wt (g)	Seed cotton yield (kg/ha)
CB hybrid-1	109.45 b	1.25 b	14.85 b	24.62 b	4.74 b	2520.90 b
Rupali-1	144.61 a	1.45 a	19.34 a	32.00 a	5.72 a	3338.60 a
CV (%)	7.04*	34.98*	14.22*	8.92*	5.09*	10.20*
LSD (0.05)	3.41	0.18	0.92	0.86	0.10	102.52

Note: * = Significant at 5% level, ** = Significant at 1% level

Interaction Effect of Fertilizer and Variety

Interaction effects of fertilizer (NPKS) and Variety were significant in studied crop parameters (Table 5) Plant height, number of monopodia/plant, number of sympodia/plant, number of bolls/plant, single boll weight and seed cotton yield were significant. The highest plant height (151.97 cm) observed inT_5V_2 and the lowest (73.29 cm) was in T_0V_1 which were statistically highly significant. The maximum number of monopodia /plant 1.60 found in $T_5V_2$and minimum number 0.82 found in T_0V_1which was statistically significant.

The interaction of fertilizer and variety on sympodia/plant was also significant. The highest and lowest sympodia /plant were observed 19.97 treatment T_5V_2 and 9.78 (T_0V_1) respectively.

Interaction effect on number of bolls/plant and boll weight to the variety and NPKS were significant. Maximum number of boll/plant (35.11) was attained by T_4V_2 which was followed by the treatment T_3V_2 and lowest numbers of boll/plant (9.51) were recorded by (T_0V_1). The highest mean boll weight of (5.90 g) was obtained with T_4V_2 and the minimum boll weight (3.98 g) was observed in T_0V_1 treatment.

The highest mean seed cotton yield of (3483.60 kg/ha) was obtained when 175: 60:200: 30 kg/ha NPKS and variety Rupali-1 respectively, followed by (3368.00 kg/ha) for 200: 70:225: 35 and (3261.80 kg/ha) for 150: 50:175: 25 kg/ha NPKS and variety Rupali-1 respectively. The lowest produced of seed cotton yield (872.20 kg/ha) no fertilizer and variety CB hybrid -1. Lokhande*et.al*.(2006) reported that treatments were combined together, a seed cotton yield and yield contributing parameters were significantly influenced by the fertilizer levels. In two location all treatments showed the best performance in highest levels of NPKS fertilizer and variety.

Table 5. Interaction effect of Fertilizer and Variety of NPKS on yield and yield attributes of Cotton (Two locations)

Fertilizer × Variety	Plant height (cm)	No. of Monopodia /Plant	No. of Sympodia /Plant	No. of Bolls /plant	Single boll Wt (g)	Seed cotton yield(kg/ha)
T_oV_1	73.29 f	0.82 b	9.78 b	9.51 e	3.98 e	872.20 f
T_oV_2	95.32 e	1.15 ab	11.92 b	10.73 e	4.00 e	937.70 f
T_1V_1	77.42 f	0.96 ab	10.33 b	20.14 d	4.50 d	1925.00 e
T_1V_2	141.22 abc	1.52 ab	18.65 a	21.45 d	4.89 d	2232.30 de
T_2V_1	119.04 e	1.45 ab	16.87 a	21.41 d	4.90 d	2482.10 cd
T_2V_2	143.51 ab	1.36 ab	19.00 a	29.96 bc	5.23 cd	2788.90 bc
T_3V_1	124.58 de	1.48 ab	16.34 a	25.30 d	5.57 abc	2582.10 cd
T_3V_2	147.72 ab	1.51 ab	19.74 a	33.42 ab	5.75 ab	3261.80 a
T_4V_1	128.28 cde	1.27 ab	17.60 a	31.50 abc	5.70 ab	3125.00 ab
T_4V_2	147.90 ab	1.57 a	19.79 a	35.11 a	5.90 a	3483.60 a
T_5V_1	134.07 bcd	1.53 ab	18.17 a	29.81 bc	5.44 bc	3043.60 ab
T_5V_2	151.97 a	1.60 a	19.97 a	32.14 abc	5.75 ab	3368.00 a
CV (%)	7.04**	34.98*	14.22*	8.92**	5.09**	10.20**
LSD value	14.14	0.75	3.84	3.57	0.42	424.16

Note: * = Significant at 5% level, ** = Significant at 1% level

Table 6. Effect of NPKS fertilizer and Variety on fiber quality of cotton

Treatment	UHML (mm)	UI (%)	SFI	Str (g/tex)	Elong (%)	Micro-nair value	MR	Rd	+b	GOT (%)
T_oV_1	29.29	84.04	7.63	34.11	6.98	4.53	0.86	72.9	4.2	40.1
T_oV_2	29.31	83.14	8.40	30.75	6.47	4.97	0.87	71.8	3.6	41.6
T_1V_1	31.53	85.11	7.03	36.02	6.98	4.98	0.88	72.2	3.5	41.8
T_1V_2	29.65	83.48	8.03	32.01	6.77	5.12	0.88	69.9	3.9	42.6
T_2V_1	31.66	85.14	7.00	34.60	7.06	4.80	0.87	72.1	4.4	42.0
T_2V_2	29.84	83.65	7.90	30.24	6.55	5.11	0.88	68.9	4.0	41.8
T_3V_1	31.57	85.12	7.03	35.39	7.20	4.87	0.87	72.2	3.9	41.6
T_3V_2	30.44	84.16	7.57	33.97	7.05	5.27	0.89	70.6	4.1	42.6
T_4V_1	31.09	84.85	7.17	34.12	6.80	4.90	0.87	71.1	3.9	41.7
T_4V_2	30.52	84.31	7.50	33.50	6.80	5.31	0.89	70.7	4.3	43.0
T_5V_1	31.45	85.09	7.07	33.59	6.85	5.03	0.88	70.8	4.6	42.5
T_5V_2	30.17	83.93	7.70	30.71	6.62	5.33	0.89	66.0	3.5	42.8

Fiber quality data is presented in Table 6. Quality besides being genetic is also determined largely by environmental factors and cultural practices. Fiber quality characteristics were relatively different for the two cultivars. Fiber length, Strength, Elongation and Micronair value (CB hybrid-1) were all higher than Rupali-1. On the other hand Rupali-1 produce higher GOT% than CB hybrid -1 variety.The results for fiber length indicate that NPKS fertilizationis the key to increased fiber length, while higher fertilizer rates ultimately reduce lint quality variables. Segarra and Gannaway (1994) established that micronaire and strength are to some extent a function of cultivar.

Benefit cost Analysis

Cost analysis presented Table 7 revealed that highest gross margin of (Tk134615/ha and 117510Tk/ha) and highest benefit cost ratio (2.81 and 2.67) was obtained from the variety Rupali- 1 and CB hybrid-1.The lowest gross margin (3990 and 1516 Tk./ha) and benefit cost ratio(1.08 and1.02) were recorded from Control treatment.

Table 7. Benefit Cost Ratio of hybrid Cotton

Treatment	Seed cotton yield(kg/ha)	Gross Return (Tk/ha)	Total Variable Cost (Tk/ha)	Gross margin (Tk/ha	BCR
T_oV_1	872	52320	48330	3990	1.08
T_oV_2	937	56220	54704	1516	1.02
T_1V_1	1925	115500	59836	55664	1.93
T_1V_2	2232	133920	66211	67709	2.02
T_2V_1	2482	148920	62870	86050	2.36
T_2V_2	2788	167280	69245	98035	2.41
T_3V_1	2582	154920	65924	88996	2.34
T_3V_2	3261	195660	72299	123361	2.70
T_4V_1	3125	187500	69990	117510	2.67
T_4V_2	3483	208980	74365	134615	2.81
T_5V_1	3043	182580	72028	110552	2.53
T_5V_2	3368	202088	76403	125685	2.64

Urea = 16 Tk/kg TSP = 22 Tk/kg Price of Seed =2350 Tk/kg (Rapali-1)
MoP = 15 Tk/kg Gypsum = 12 Tk/kg Price of Seed = 1500 Tk/kg(CB Hybrid-1)
Price of Seed Cotton = 60Tk/kg

Conclusion

From the above results it can be concluded that, treatment T_4 (175:60:200:30 kg/ha NPKS) enhance the hybrid variety CB hybrid-1 and Rupali-1 to produce the highest amount of seed cotton (3125.00and 3483.60 kg/ha) and two variety cultivation indicated higher net return and BCR (Tk117510, 134615Tk/ha and 2.67, 2.81). Hence, it is recommended that @ 175:60:200:30 kg/ha NPKS fertilizer should be applied to get the higher economic return with hybrid cotton varietyCB hybrid-1 and Rupali-1.

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Development of an Integrated Management Package against Sucking and Chewing pest of Cotton

H. M. Syfullah Azad[1]

Abstract

The study was conducted at Cotton Reserch Farm, Sadarpur Dinajpur during 2017-18, to find out an environment friendly management approach of major pest in cotton field. There are four treatments viz. IPM package -1 Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera)* + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Bioneem plus- (Azadirachtin 1EC) @ 1ml/litre of water, IPM package -2. Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Biomax M 1.2EC (Abamactin 1.2EC) @ 1ml/litre of water, IPM package -3. Bio-darma (75kg/ha) Seed treatment (Cruser) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L)+ Ecomec-1.8EC @ 1ml/litre of water, Farmer practice: a) spraying of Imitaf (Imidacloprid) 1ml/litre b) Spraying of Proclaim (Emamectin Benjoate) @1gm/litre of water). IPM package-1 showed the best performance which was 3124kg /ha seed cotton and 24.8% yields increased over the control.

Introduction

Cotton is a major cash crop in 60 countries of the world. But everywhere yields are reduced by insect pests especially jassids, aphids, white flies and bollworms. Spotted bollworm is the earliest damaging pests of cotton in Bangladesh. The most destructive sucking pest of cotton pest in Bangladesh is Jassid, Aphid and White fly. Jassid is commonly known and leaf hopper which sucks sap from leaves and cause phytotoxic symptpoms known as “hopper burn” (Narayan and Shingh, 1994). Now-a-days the American bollworms have been appeared as an important pest of cotton. They destroy fruiting bodies like bolls, buds, squares, and reduce more than 50% yield. Unilateral uses of pyrethorids with long exposure make them tolerant. Therefore, efforts should make for their effective control with indispensable doses of insecticides.

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1. Senior Scientific Officer

Materials and Methods

The experiments were conducted in randomized block design following three replications. The plot dimensions were 10 m × 10 m and paths between two plots were 1m wide. Variety CB-14, date of sowing 14/07/2018, plant spacing 90cm X 45cm, The treatments were IPM package -1 Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera)* + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Bioneem plus- (Azadirachtin 1EC) @ 1ml/litre of water, IPM package -2. Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Biomax M 1.2EC (Abamactin 1.2EC) @ 1ml/litre of water, IPM package -3 Bio-darma (75kg/ha) Seed treatment (Cruser) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L)+ Ecomec-1.8EC @ 1ml/litre of water, Farmer practice: a) spraying of Imitaf (Imidacloprid) 1ml/litre b) Spraying of Proclaim (Emamectin Benjoate) @1gm/litre of water)

Application of fertilizers and other intercultural operations were done as farm standard (Urea-175kg, TSP-200kg, MOP-210kg, Zypsum-80kg, $MgSo_4$–15kg, Zinc Sulfate-15kg and Borax-15kg/ha.). Scouting was done once in a week and twice at the peak of the infestation period. For scouting 5 plants were considered from each replication by random selection. The presence of aphid was estimated on a scale of 0-4 (0 = no aphid, 1= a few aphids i.e. < 10 in total, 2 = one leaf or growing point infested, 3 = more than one leaf or growing point infested, and 4= entire plant heavily infested).

For chewing insects, the whole plants were examined and examination was started from the bottom of the plants. The upper and lower surfaces of the leaves, the joint of the stems, leaf stalk, branches, buds, flowers and bolls were carefully checked. If a bud or boll contained larvae it was cut and opened for accurate identification of the larvae. It was examined the plants with the sun from behind to avoid the glare from the leave surfaces while providing ample light to see the presence of any insects. Threshold levels for major pests were Jassid-2 nymph/plant, Aphid grade 1.5/plant and Bollworms-0.25 larva or o.50 eggs / plants. Predators especially the lady beetle was counted from the selected plants. Spraying was done at the threshold level of the pests using a knapsack sprayer having the capacity of 10 liter water. A total volume of 200 liter water was applied per hectare area.

In all circumstances, it was maintained 2-3-bar pressure with walking speed 1m/sec; keeping the nozzle 25-30 cm apart from the line in favor of the wind for effective swath and coverage as the droplets can reach to the target. Normally spraying was done in between 9.00 - 10.00 am or 2.30 -3.30 pm to avoid the hottest hours of the day for less drifting and detoxification. In case of sucking pests all treatments were sprayed at a time considering as a single unit. The amount of chemical was measured carefully by the measuring cylinder and poured to the spray tank for proper mixing. Spray log (date of spray, chemical, amount of chemical, spray volume, equipment used and time of application) was maintained. It was maintained for what actually happened in the field or was intended to happen. Weekly pest's summaries, weekly picks and yield data were recorded. All cotton weighed at the same time to avoid the hygroscopic effects. Cotton was harvested from the inner rows of the plots excluding the border rows to calculate the yield/ha. Variable cost and net return was calculated as per Tague and Shelstad (1981) and Ali and Karim (1990).

Results and Discussion

Major pest: The mean incidences of jassid 1.41 to 1.13, Aphid grades 0.41 to 0.64 and Whitefly 1.79 to 1.39 were observed. Among the treatments reduced IPM package-3 pest incidence more effectively from table1. The IPM package -3 revealed the lowest abundance of Jassid, whitefly and *Heliothis*.

Yield: Yield of seed cotton from 2485-3170 kg/ha. The highest yield (3124kg/ha) were obtained when IPM package - 1.

Benefit cost ratio: Benefit cost ratio varied from 0.31- 0.86, Percent of yield increase over the control height at 24.8. IPM package -3 showed height percent of yield increase over the control all the treatments.

Table: 1, combined effect of different management package and some important insect pests of Cotton during 2017-18.

Treatments		White fly	Jassid Nymph	Aphid grade	Pheromone trap		Seed cotton yield kg/ha
					Spodoptera Litura	*Heliothis armigera*	
T1	IPM package -1	1.52	1.20	0.41	0.02	0.01	3124
T2	IPM package -2	1.59	1.16	0.54	0.03	0.02	2850
T3	IPM package -3	1.39	1.13	0.50	0.03	0.01	3070
T4	Farmer practice	1.79	1.41	0.64	0.02	0.01	2350
	LSD(0.05)	0.24	0.13	0.10	ns	ns	460.07

Mean of 3 replications/treatment, 13 observations/season and pheromone trap observations 65 days

Table-2: Cost and return analysis of cotton production under different treatments.

Treatments			Variable cost		Gross return			Benefit cost ratio	Yield increase over the control (%)
		Insecticide Tk.	Labour & others Tk.	Total Tk.	Yield kg/ha	Return Tk.	Net return tk.		
T1	IPM package -1	2200	9000	92200	3124	171820	79620	1.86	24.8
T2	IPM package -2	8000	9000	98000	2850	156750	58750	1.60	17.5
T3	IPM package -3	5620	9000	95620	3070	168850	73230	1.77	23.5
T4	Farmer practice	8500	9000	98500	2350	129250	30750	1.31	00

N.B- Number of spray-5, only treatment-4 No. of spray-12(6+6) , spray volume-200 water/ha

T1= IPM package -1

Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera)* + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Bioneem plus- (Azadirachtin 1EC) @ 1ml/litre of water,

T2= IPM package -2

Bio-darma (75kg/ha) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L) + Biomax M 1.2EC (Abamactin 1.2EC) @ 1ml/litre of water,

T3= IPM package -3

Bio-darma (75kg/ha) Seed treatment (Cruser) + Hand picking + Sex Pheromone trap (*Spodoptera litura* + *Heliothis armigera*) + SNPV (0.5gm/L) + HNPV (0.5gm/L)+ Ecomec-1.8EC @ 1ml/litre of water,

T4= Farmer practice

Farmer practice: a) spraying of Imitaf (Imidacloprid) 1ml/litre, b) Spraying of Proclaim (Emamectin Benjoate) @1gm/litre of water).

Cost of relevant materials/activates

Seed cotton-48Tk/Kg, Spray-2 labour/ha, Hand picking-2 labour/ha, 250Tk/ Labour/day. Bioneem plus-2200Tk/Lit, Biomax-M 1.2EC-8000Tk/ Lit, Cruiser-6500 Tk/ Kg, Imitaf-4000Tk/ Lit., Proclaim - 4500Tk/ Lit. Pheromone trap110tk/ trap

Conclusion

From the study considering yield performance and benefit cost ratio, IPM package-1 performed the better among the management approaches evaluated against major pest of cotton. These three IPM approaches could be suggested for controlling major pest of cotton in Bangladesh.

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Development of Eco-friendly Management of Sucking insects of Cotton

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Abstract

The experiment was conducted at five different Cotton Research Farm of CDB and its adjacent five locations to develop environment friendly management practice against sucking pest of cotton. It consisted of 6 treatments ,T_1- Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap, T_2 – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap, T_3- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap, T_4- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) +Yellow sticky trap, T_5 - Farmers Practice (Hemidor @ 0.3 gm/litre), T_6 -Untreated control following RCB design with three replication.The treatment included. Five spraying of each treatment were conducted based on ETL. Observation on population of sucking pests (Jassids, Aphid, Whitefly) was recorded before spraying and 24,48 and 72 hr after each spraying. Overall maximum mean reduction was recorded in T_5 - Farmers Practice (Hemidor @ 0.3 gm/litre). In case of Jassid population T_3- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap give the highest reduction rate and in white fly population T_1- Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap showed better next performance. Highest yield was found in T_5 followed by T_3. Highest BCR (2.84) observed in T_3. In environmental point of view we may consider T3 as best management practices for Jassid and T_1 for whitefly. Pest management approaches was developed to control sucking insect pests of cotton and for benefit of farming community. Use of safe botanical pesticides remained effective against sucking pests and is recommended against cotton pests, which showed less effective to natural enemies and environment friendly.

Key word: Eco-friendly, Sucking pest, cotton.

Introduction

Cotton is an important commercial crop in Bangladesh. It is a pest loving crop. Sucking pests are quite serious from seedling stage of cotton. Their heavy infestation reduces the crop yield to a great extent. The estimated loss due to sucking pests is up to 21.20% (Dhawan et al., 1988). Among the sap feeders jassid (*Amrasca biguttula)* , aphids (*Aphis gossypii)* and whitefly (*Bemisia tabaci)* are deadly pests. Climate is an important determinant of the abundance and distribution of biological species. The climate has profound effects on population of invertebrate pests like insects, mites, and others species; and affects their development, reproduction, and dispersal. Climate change is expected to have significant impacts on the distribution, phenology, and abundance of many species over the next few decades.

1.Additional Director, 2. Cotton Development Officer

Change in the global climate may, thus, affect the crop yields, incidence of pests, and economic costs of agricultural productionCotton farmers in Bangladesh depend largely on synthetic pesticides to control sucking pests. At least 5-7 chemical sprays are directed against sucking pests. Due to continuous use of synthetic insecticides, insects become resistance and hence the efficacy has become less reliable. Indiscriminate use of insecticide specially for jassid, aphid, white-fly, red cotton bug causes environmental pollution. Incremental use of toxic chemicals take place in the food chain and ecosystem through bio-magnification and cause hazards.To overcome this problem application of biochemical substances are needed. Bio-chemicals are effective and have less exposure in the environment. Azadiractin is a bio-chemicals with active ingredient of neem which is suitable to many crops. - Akondo leaf extract (50%) + Tobacco Leaf extract (50%) are botanics. This investigation have been evaluated for their effectiveness against sucking pests of cotton and their impact on natural enemies.

Materials and Methods

The experiment was conducted at five Cotton Research Farm of CDB, Sreepur, Jashore, Dinajpur, Rangpur, Bandarban and five adjacent locations of each farm comprises six treatments during the kharif season of 2017-18. The experiment was laid out in RCB design with three replications. The treatments were T_1- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap, T_2 – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap, T_3- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap, T_4- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap, T_5 - Farmers Practice (Hemidor @ 0.3 gm/litre), T_6 -Untreated control. Experimental area of each farm was 0.13 ha. In farmer's field, one bigha land was divided into 6 plot to implement treatments. Six different location serves as replication. Cotton variety CB-12 was used as a test material. All botanic used in this experiment were prepared by mixer grinder. The crop was maintained well by adapting standard agronomic practices as per recommendations. Ten plants were selected randomly from each plot. The populations of sucking pests *viz.,* jassid, aphids and whitefly were recorded from top, middle and bottom leaves of ten tagged plants per plot before spray and after 24,48 and 72 hours of spray. Effect on natural enemies i.e.coccinellids and chrysoperla were recorded and average values of these observations were subjected for statistical analysis according to CROPSTAT to assess the overall impact on pest suppression. Seed cotton yield was harvested on plot basis excluding border lines and expressed as t/ha.

Result & Discussion

Climate change will have both direct as well as indirect effects on insect populations. Temperature is the major factor in global climate change that directly affects insect development,

reproduction, and survival. The most significant consequence of rising temperatures is the change in distribution in range of crops, pests and their natural enemies. These climatic changes have impact on the population dynamics of insect and develop resistance to particular insecticide.

Average monthly rainfall of Chuadanga, Rangpur, Sayedpur is different in 2017 (Fig 1). In all location highest rainfall occur from June to September. In Chuadanga similar rainfall occur in year round. Among three locations maximum rainfall was found in sayedpur. In Rangpur and Sayedpur highest rainfall occur in August that is 500 mm and 750 mm respectively. Rainfall pattern of last 90th decade and 20th decade in Chuadanga are different from each other (Fig 3). Highest rainfall found in the month of June 112.97 mm. In 1991-96 more amounts of rains was fallen than 2012-17.

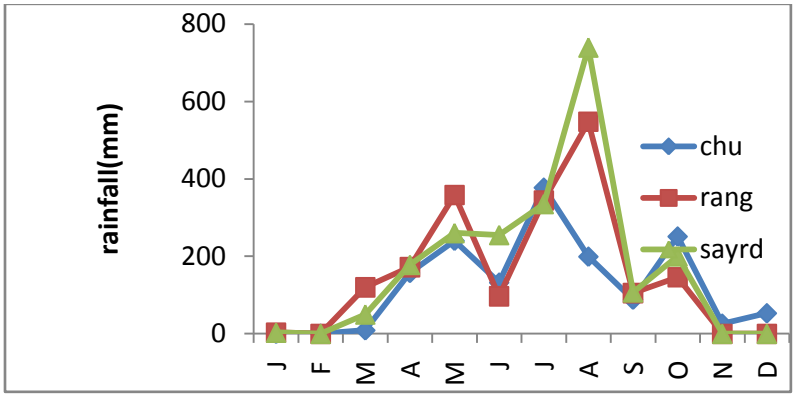
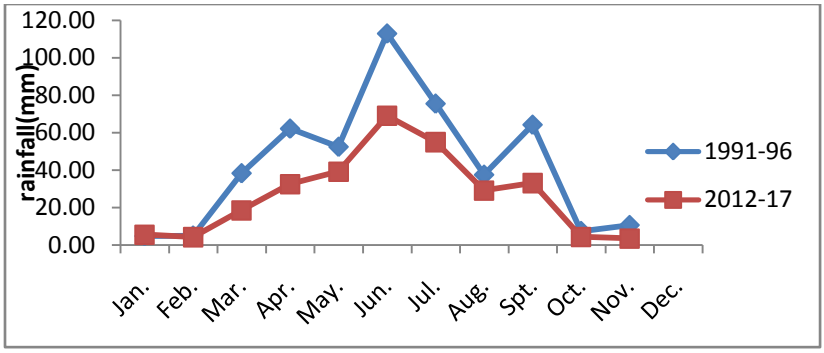


Fig 1: Average monthly rainfall 2017.



. Fig 2: Rainfall difference in chuadanga

Rainfall distribution pattern in 1991-96 and 2012-17 in Rangpur was different from other (Fig 3). In 2012-17 more or less even rainfall occurs from the month of April to October. But in 1991-96 there was went down of rainfall in July to august. Opposite rainfall distribution pattern observed

in Sayedpur (Fig 4). In 1991-96 there was dramatic decrease of rainfall from July to August but in 2012-17 there is opposite situation.

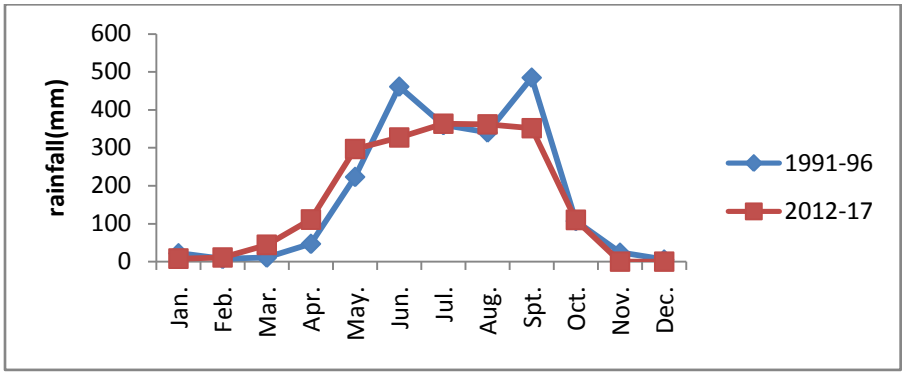


Fig 3: Rainfall difference in Rangpur.

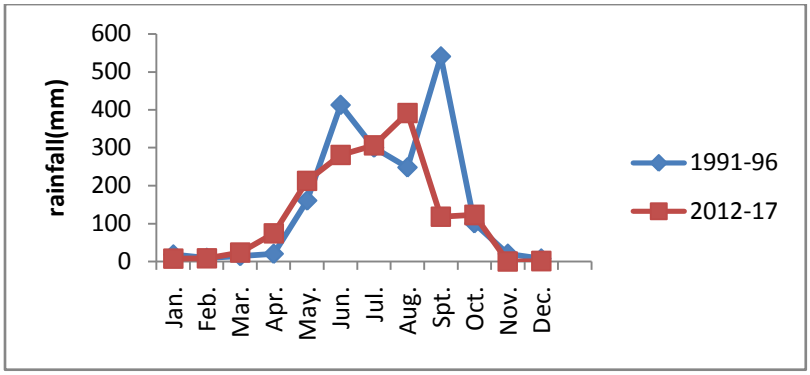


Fig 4: Rainfall difference in Sayedpur.

One of the most important climate changing factor is maximum temperature. Monthly temp. difference were observed in above two locations in 1991-95 and 2013-17 (Table 1,2).there was 1^0c temp difference from last few years to recent few year. Elevated global temperatures were found to create favourable conditions for the survival and reproduction of many insect pests such as the cotton sap-sucking pests whiteflies, thrips, aphids, mealybugs, etc. Among various sap-sucking pests the whitefly, (*B. tabaci*) B biotype causes serious yield losses to cotton (Kranthi K.R., 2014) . Higher temperatures resulted in a decline in the efficacy of insecticides such as the synthetic pyrethroids.

The jassid first appeared in 3rd week after sowing (WAS) in all the sowing dates. Its population increased gradually and maximum population reached during 5 to 7 WAS under different dates of sowing.(Dehariya S.K. *et al*, 2018) As the temperature increased the population of pest was found to increases. Patel et al. (1997) also obtained signi 沟 cant positive relationship between jassid population and maximum temperature as well as bright sunshine hours.

Table 1: Tamperature difference in Rangpur.

Month	1991-95		2013-17	
	Maxi. temp	Min. temp	Maxi. temp	Min. temp
July	29.13	24.02	29.92	24.7
August	29.63	23.78	29.88	24.54
September	28.97	21.92	29.60	24.46
October	28.08	18.96	29.23	19.08
November	25.82	13.48	26.28	12.52
December	23.05	9.48	24.20	8.9

Table 2: Tamperature difference in Chuadanga.

Month	1991-95		2013-17	
	Maxi. temp	Min. temp	Maxi. temp	Min. temp
July	29.32	24.28	29.92	24.7
August	29.88	23.32	29.92	24.54
September	29.95	23.06	29.92	24.46
October	29.58	18.8	29.92	19.08
November	27.80	12.9	29.92	12.52
December	24.28	9.02	28.82	8.9

At the end of the year there was 5% humidity difference in three locations (Fig:5,6,7). Recent monthly sunshine vary from the past.(Fig: 8,9,10)

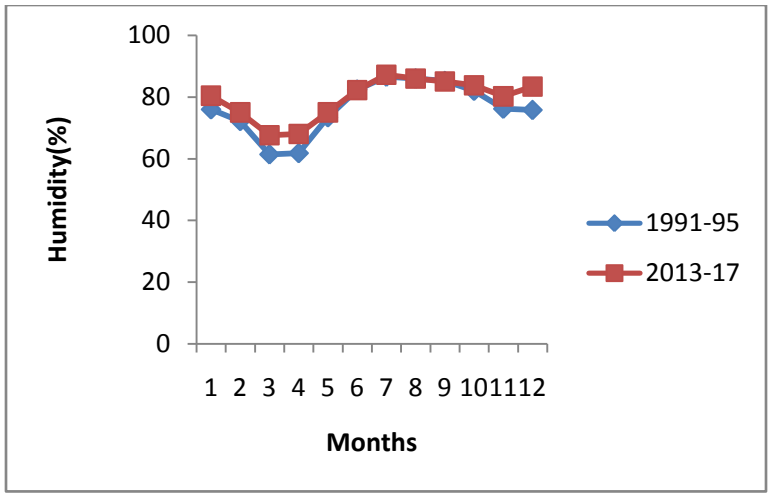


Fig 5: Humidity difference in Chuadanga.

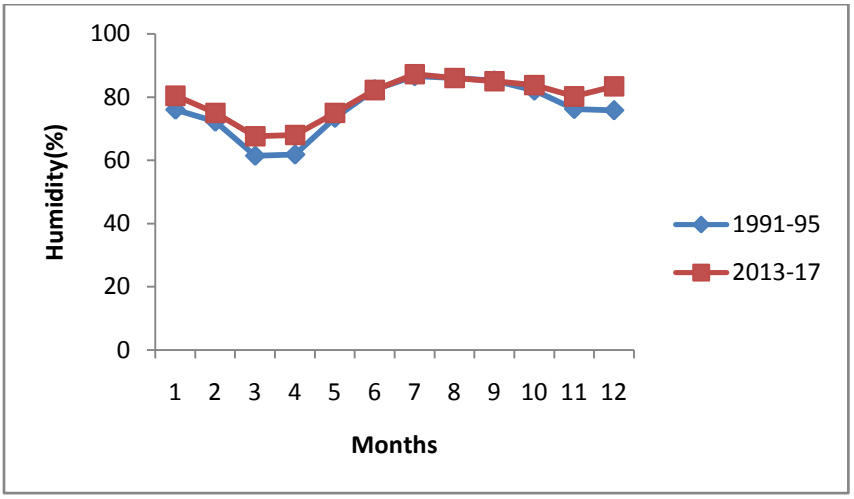


Fig 6: Humidity difference in Rangpur.

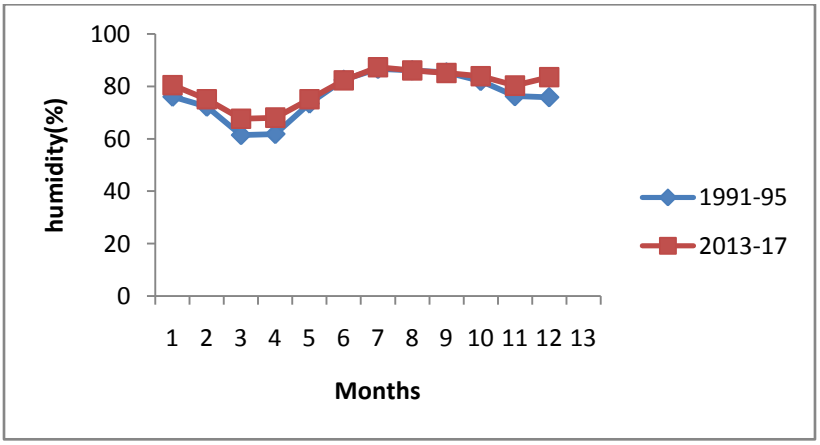


Fig 7: Humidity difference in Sayedpur

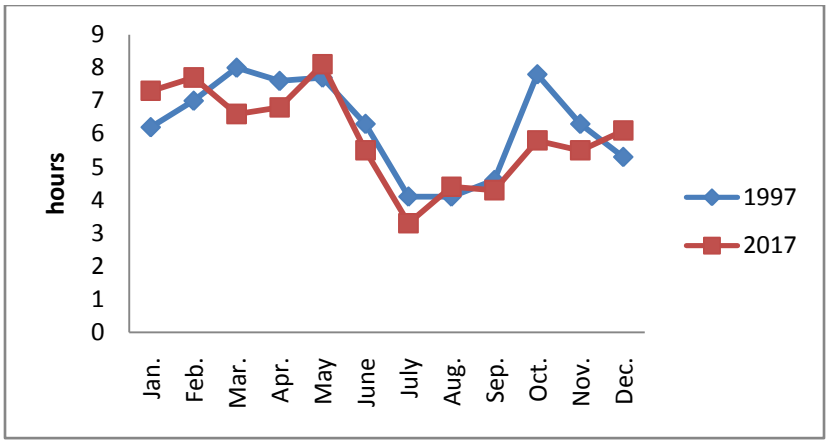


Fig 8: Sunshine difference in Chudanga

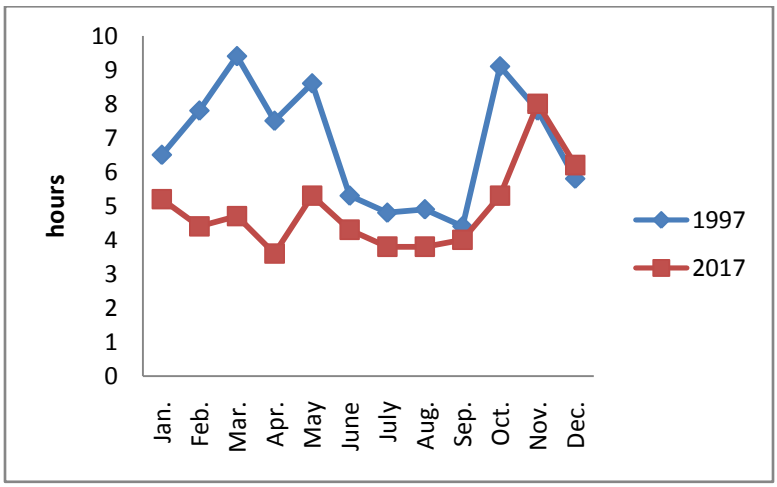


Fig 9: Sunshine difference in Rangpur

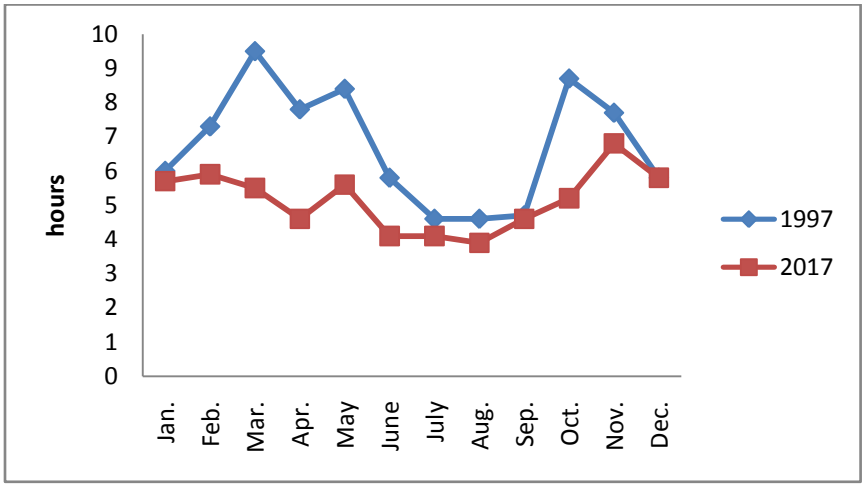


Fig 10: Sunshine difference in Sayedpur

Jassid population

Cotton Jassid (*Amrasca biguttala)* is most dominant in cotton growing areas of Bangladesh. Jassids apparently introduce a toxin that impair photosynthesis by feeding and this causes the edges of leaves to curl downwards, the leaf become yellowish and then redden. Severe 'hopper burn' leads to shedding of reproductive parts and can severely stunt young plants and reduce yields.

The effect of management practices on jassid population in five Cotton Research Farm of CDB are observed in present work (Table 3). At Sreepur farm, the season long jassid population ranges between 2.09 to 6.6 per plant. The population of jassid did not vary significantly in all the plots before imposing treatments. After 24 hours of spray, jassid population ranges between 0.97 to 1.29 per plant. After 48 hours of spray jassid population ranges between 0.97 to 1.29 and after 72 hr jassid population ranges from 0.29 to 7.8. At Jashore farm, the season long jassid population ranges between 2.15 to 6.81 per plant. After 24 hours of spray jassid population ranges between 0.72 to 7.2 per plant. After 48 hours of spray population ranges between 0.42 to 7.83 and and after 72 hr it ranges from 0.29 to 7.8..At Dinajpur farm, the season long jassid population ranges between 1.95 to 6.26 per plant. After 24 hours of spray population ranges between 1.29 to 6.48 per plant. After 48 hours of spray jassid population ranges between 0.53 to 6.41 and and after 72 hr jassid population ranges from 0.25 to 7.26. At Rangpur farm, the season long jassid population ranges between 1.91 to 6.23 per plant. The population of jassid did not vary significantly in all the plots before imposing treatments. After 24 hours of spray jassid population ranges between 1.04 to 6.58 per plant. After 48 hours of spray jassid population ranges between 0.88 to 6.75 and and after 72 hr population ranges from 0.25 to 7.26. At Bandarban farm, jassid population ranges between 2.32 to 6.51 per plant.. After 24 hours of spray jassid population ranges between 0.77 to 6.89 per plant. After 48 hours of spray jassid population ranges between 0.4 to 7.2 and and after 72 hr jassid population ranges from 1.34 to 8.24. In all research farm, the population of jassid did not vary significantly in all the plots before imposing treatments In five farms, the significantly lowest number of jassid population was found in T_3. i.e. Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap**,** and highest population obtained from T_6 (control).

There is no significant difference in case of all management practices. All the management approaches are effective against jassid population in all farms of CDB. As they are contained of botanic like bio-neem. The combination packages are mainly bsed on azadiractin, yellow sticky trap, tobacco and akondo leaf extracts. As there is no significant difference among the treatment but highest reduction occur in T_5 Farmer's practices (Hemidor) followed by T_3. As there no significant difference among the treatment in environmental aspect T_3 may eradicate cotton jassid population.

Maximum reduction percent (71.97%) was recorded in Neem extract after 96 hrs. of botanical pesticides application followed by (70.06%), (68.15%) and (23.33%) in Neem oil, Asafoetida and tobacco respectively. (Abdul.*et al,* 2016) It is generally observed that synthetic pesticides reduce insect infestation immediately but after development resistance against these pesticides the cotton farmer is helpless. However, biopesticides are natural substances and the insects never tolerate the efficacy of biopesticid. *Meranoplus bicolor* was found effective to control insect feeding on the flowers and at the base of immature bolls of cotton (Sivakumar, 2004). Application of Neem oil, garlic emulsion at 2% and tobacco decoction deterred the ants for 4-5 days in severely affected plots. Bio-pesticides were most effective to control sucking complex population on cotton (Ali *et al.,* 2005). Spraying biopesticides i.e. using Neem, dhatura, tobacco and eucalyptus extracts has proved to be highly beneficial in multiple dimensions. The *Azadirachta indica* produces the biodegradable and insecticidal liminoid (Praveen PM, Dhandapani N, 2001) Botanical insecticides have been found effective against mealy bug, partiazadirachtin (Isman MB).

Earlier workers also tested the plant products against jassids and found reduction in the pest population by two plant extracts neem and karanj derivatives also obtained population reduction of jassids in neem treated plots which also produced higher yield than other treatments. Some findings were reported by previous workers Dimetry et al., 1996, Sabillon and Bustamante (1995) Somsekhara, *et al.,* 1997, Singh *et al.,* 2006.

Table-3: Effect of different management practices on Jassid population at different Cotton Research Farm.

treatments	Spray-no	Sreepur				Jashore				Dinajpur				Rangpur				Bandarban			
		BS	Hours			BS	Hours			BS	Hours			BS	Hours			BS	Hours		
			24	48	72		24	48	72		24	48	72		24	48	72		24	48	72
T_1	5	2.62	1.42	1.02	0.7	2.48	1.23	0.88	0.64	2.38	1.45	0.93	0.56	2.58	1.6	1.12	0.7	2.57	1.28	0.8	1.32
T_2	5	2.4	1.55	1.12	0.77	2.42	1.5	1.00	0.71	2.42	1.43	0.99	0.75	2.61	1.5	1.01	0.67	2.31	1.19	0.89	1.32
T_3	5	2.39	1.29	.68	0.36	2.74	1.15	0.5	0.37	2.17	1.32	0.48	0.45	2.42	1.27	0.97	0.6	2.75	1.17	0.48	1.3
T_4	5	2.70	1.69	1.28	0.98	2.93	1.42	1.26	0.92	2.36	1.57	1.24	1.03	2.71	1.4	1.14	0.77	2.95	1.26	1.16	1.5
T_5	5	2.09	0.97	.54	0.29	2.15	0.83	0.42	0.24	1.95	1.29	0.53	0.25	1.91	1.04	0.88	0.6	2.32	0.77	0.4	1.34
T_6	5	6.6	6.83	7.2	7.8	6.81	7.2	7.83	8.21	6.26	6.48	6.81	7.26	6.23	6.58	6.75	6.99	6.59	6.89	7.2	8.24
SE		0.69	0.59	0.6	.60	.60	0.58	0.59	0.58	0.37	.34	0.34	0.29	0.38	0.38	0.35	0.36	0.51	0.46	0.4	0.57
LSD		1.99	1.75	1.78	1.79	1.78	1.71	1.76	1.71	1.1	1.0	1.01	0.88	1.14	1.13	1.05	1.07	1.5	1.36	7.2	1.69

Whitefly population

The effect of management practices on whitefly population were observed in this experiment (Table 4). All the treatments had less leaf infestation than untreated control. Prior to the treatment imposition uniform distribution of whitefly population was noticed and above ETL. At Sreepur farm, the season long whitefly population ranges between 5.71 to 8.46 per plant. Highest population found in T_6 and lowest population observed in T_5 i.e. Farmer's practices (Hemidor). After 24 hours of spray whitefly population ranges between 2.05 to 7.6 per plant. After 48 hours of spray whitefly population ranges between 1.42 to 8.24 and after 72 hr it ranges from 0.93 to 8.93 per plant..At Jashore farm, the season long whitefly population ranges between 5.56 to 8.02 per plant. After 24 hours of spray whitefly population ranges between 1.6 to 7.3 per plant. After 48 hours of spray whitefly population ranges between 0.42 to 7.83 and and after 72 hr population ranges from 1.37 to 7.76. At Dinajpur farm, the season long whitefly population ranges between 5.35 to 6.8 per plant. After 24 hours of spray whitefly population ranges between 1.5 to 6.22 per plant. After 48 hours of spray population ranges between 1.42 to 6.4 and and after 72 hr whitefly population ranges from 1.07 to 6.66. At Rangpur farm, the season long whitefly population ranges between 5.44 to 7.02 per plant. After 24 hours of spray whitefly population ranges between 1.77 to 6.3 per plant. After 48 hours of spray population ranges between 1.39 to 6.6 and and after 72 hr whitefly population ranges from 1.06 to 7. At Bandarban farm, the season long whitefly population ranges between 5.63 to 6.94 per plant. After 24 hours of spray whitefly population ranges between 1.71 to 7.74 per plant. After 48 hours of spray whitefly population ranges between 1.24 to 7.82 and and after 72 hr it ranges from 1.3 to 8.24. In all research farm, the population of whitefly did not vary significantly in all the plots before imposing treatments. In this farm, the significantly lowest number of whitefly population was found in T_5. i.e. Farmer's practices (Hemidor)**,** and highest population obtained from T_6 (control). In all research farm, second lowest whitefly observed in T_1 i.e. application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap. So in environmental point of view T_1 may be an option to control whitefly.
That maximum reduction percentage (59.03%) of whitefly population was recorded in Asafoetida followed by Neem oil (61.85%), Neem extract (60.20%) and the least mean reduction percentage (40.38%) of whitefly population was recorded in tobacco application during 2007.(Abdul *et al*, 2016)

The efficacy of Neem oil against thrips has also been reported by others. (Arain, 2008,Singh *et al*.2002) .Efficacy of Neem based pesticides against thrips and on the basis of cost: benefit ratio, NSKE (3%) ranked first (1:10.70) among all pesticide treatments (Khaskheli ,2007)

Table 4: Effect of different management practices on whitefly population at different Cotton Research Farm.

treatments	Spray-no	Sreepur				Jashore				Dinajpur				Rangpur				Bandarban			
		BS	Hours			BS	Hours			BS	Hours			BS	Hours			BS	Hours		
			24	48	72		24	48	72		24	48	72		24	48	72		24	48	72
T_1	5	6.02	3.37	1.89	1.39	5.63	3.23	1.72	1.21	6.09	3.99	1.83	1.1	5.93	2.27	1.63	1.06	5.83	2.14	1.52	1.32
T_2	5	5.92	2.61	2.1	1.78	5.56	2.88	1.83	1.52	5.99	2.73	1.9	1.56	6.01	2.37	1.58	1.27	5.63	2.33	1.48	1.32
T_3	5	5.71	2.45	1.9	1.5	5.58	2.34	1.79	1.37	5.95	2.42	1.8	1.24	6.17	2.12	1.72	1.18	5.82	1.99	1.6	1.30
T_4	5	5.53	2.93	2.44	1.96	5.88	2.24	2.47	1.47	5.86	2.37	1.83	1.47	6.07	2.09	2.22	1.61	6.07	2.17	2.29	1.5
T_5	5	5.86	2.05	1.42	0.93	5.83	1.6	1.37	0.9	5.35	1.5	1.42	1.07	5.44	1.77	1.39	1.16	5.92	1.71	1.24	1.34
T_6	5	8.46	7.6	8.24	8.93	8.02	7.3	7.76	8.5	6.8	6.22	6.4	6.66	7.02	6.3	6.66	7	6.94	7.74	7.82	8.24
SE		0.64	0.86	0.58	0.54	0.61	0.71	0.64	0.59	0.34	0.42	0.39	0.38	0.43	0.56	0.41	0.42	0.66	0.51	0.49	0.57
LSD		1.35	1.86	1.72	1.6	1.82	1.48	1.91	1.74	0.71	1.26	1.15	1.13	1.27	1.18	1.23	1.25	1.37	1.5	1.45	1.69

Aphid population

In all farm, there were negligible amount of aphid were found (Table: 5). After imposing treatment there were no aphid on field. Jayakumar and Uthamasamy (1997) also reported that neem oil 3% and mahua oil 3% caused 93.3 per cent and 90 per cent larval mortality of *Myzus persicae*. Viraktamath *et al.,* (1993) also reported the effectiveness of neem seed kernel extract 4% against *Liriomyza trifolii* on tomato. Azam (1991) reported that the neem oil 1.0 and 1.25 per cent caused more than 80 per cent mortality of the larvae and pupae of *L. trifolii* and other similar findings were reported by Murthy and Prasad (1996) Wankhede *et al.,* (2007) Mishra and Shantipriya (2008)

Table 5: Effect of different management practices on Aphid population at different Cotton Research Farm.

treatments	Spray-no	Sreepur				Jashore				Dinajpur				Rangpur				Bandarban			
		BS	Hours			BS	Hours			BS	Hours			BS	Hours			BS	Hours		
			24	48	72		24	48	72		24	48	72		24	48	72		24	48	72
T_1	5	0.4	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.86	0.00	0.00	0.00
T_2	5	0.4	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.12	0.00	0.00	0.00
T_3	5	0.6	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.00	0.00
T_4	5	0.66	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.13	0.00	0.00	0.00
T_5	5	0.26	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.92	0.00	0.00	0.00
T_6	5	0.66	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.18	0.00	0.00	0.00
SE		0.16	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.53	0.00	0.00	0.00
LSD		0.49	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.15	0.00	0.00	0.00

Impact of management practices on different farmer's field are different (Table: 6). T_5 perform best among all the treatments. T_3 perform better next over control. No of jassid population ranges from 4.42 to 19.6. After 24 hr spray it ranges from 21.6 to 1.91. After 48 hours it ranges from 22.8 to 0.85 and after 72 hr spray it ranges from 24 to 0.38. Negligible amount of aphid found in early stage. No of whitefly population ranges from 16.4 to 5.52. After 24 hr spray it ranges from 18.2 to 1.12. After 48 hours it ranges from 19.2 to 0.97 and after 72 hr spray it ranges from 36.3 to 0.65.

Table 6: Effect of different management practices on Sucking pest population at different location.

treatments	Spray-no	Jassid				Aphid				Whitefly			
		BS	Hours			BS	Hours			BS	Hours		
			24	48	72		24	48	72		24	48	72
T_1	5	4.42	2.62	1.90	1.19	0.46	0.00	0.00	0.00	6.02	2.80	1.91	1.32
T_2	5	5.44	2.75	2.12	1.64	0.05	0.00	0.00	0.00	5.92	2.74	1.97	1.70
T_3	5	6.59	1.91	0.94	0.45	0.10	0.00	0.00	0.00	5.71	1.71	1.26	0.98
T_4	5	7.82	2.69	1.90	1.09	0.18	0.00	0.00	0.00	5.52	2.93	2.35	1.93
T_5	5	8.7	2.15	0.85	0.38	0.19	0.00	0.00	0.00	5.86	1.13	0.97	0.65
T_6	5	19.6	21.6	22.8	24.0	0.40	0.26	0.16	0.19	16.4	18.2	19.2	36.3
SE		2.17	2.2	2.1	2.10	0.13	0.15	0.09	0.58	0.08	1.6	1.76	9.32
LSD		4.54	4.70	4.42	4.3	0.28	0.31	0.19	1.71	0.18	3.5	3.6	19.4

Beneficial insect

Impact of management practices on natural enemies are prominent. (Table: 7).In T_5 are solely chemical spray. As a result natural enemies are disappear from treated plot. In control plot LLB and spider number are more than other treatment. There was an increasing tendency in other treatment in case of natural enemies. Use of these natural compounds in place of conventional insecticides could reduce environmental pollution, preserve non-target organisms, and avert insecticide-induced pest. (Rausell C, Martínez-Ramírez AC, García-Robles I, Real MD, 2000). The above discussion leads to conclude that priority adoption of botanical pesticides in cotton is necessary, not only to control the insect pests, but also to save the natural enemies i.e. predators etc. and to protect the environment from pollution due to synthetic pesticides.

Table 7: Impact of management practices on natural enemies.

Treatment	Spray-no	LBB				Spider			
		BS	Hours			BS	Hours		
			24	48	72		24	48	72
T_1	5	0.22	0.20	0.21	0.41	0.14	0.04	0.01	0.01
T_2	5	0.21	0.18	0.20	0.17	0.42	0.05	0.00	0.01
T_3	5	0.25	0.26	0.26	0.20	0.40	.040	0.06	0.05
T_4	5	0.29	0.28	0.28	0.70	0.10	0.08	0.02	0.05
T_5	5	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
T_6	5	0.43	0.55	0.63	0.71	0.26	0.03	0.34	0.37
SE		0.08	0.09	0.11	0.29	0.09	0.12	0.12	0.12
LSD		0.17	0.20	0.23	0.61	0.18	0.26	0.25	0.26

Yield

At Sreepur farm, the seed cotton yield ranges between 1.5 to 2.8 t/ha while the highest seed cotton yield (2.8 t/ha) obtained from T_5 i.e. farmers practice (hemidor) and lowest at T_6(control) (Fig:9). At joshore farm, the seed cotton yield ranges between 1.45 to 3.07 t/ha while the highest seed cotton yield (3.07 t/ha) obtained from T_3 i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T_6(control) (Fig:10). At Dinajpur farm, the seed cotton yield ranges between 1.06 to 2.94 t/ha while the highest seed cotton yield (2.94 t/ha) obtained from T_3 i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T_6(control) (Fig:11). At Rangpur farm, the seed cotton yield ranges between 1.18 to 3.03 t/ha while the highest seed cotton yield (3.03 t/ha) obtained from T_3 i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T_6(control) (Fig:12).. At Bandarban farm, the seed cotton yield ranges between 1.12 to 2.87 t/ha while the highest seed cotton yield (2.87 t/ha) obtained from T_5 i.e. farmers practice (hemidor) and lowest at T_6 (control) (Fig:13). At Sreepur and bandarban farm, the second highest seed cotton yield found in T_3 .

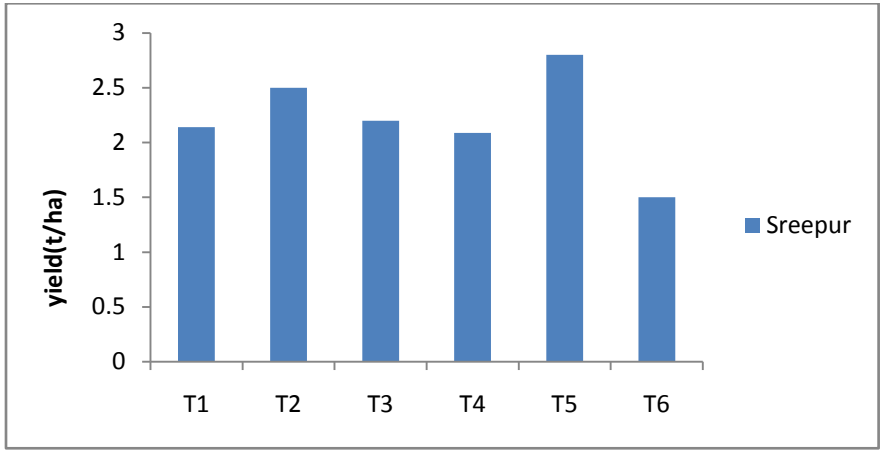


Fig 9:Effect of diff. management practices on yield of Sreepur farm

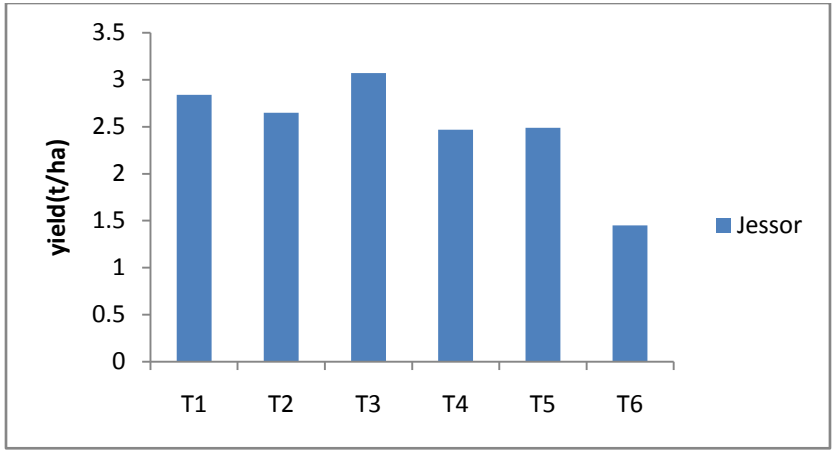


Fig 9:Effect of diff. management practices on yield of Jashore farm.

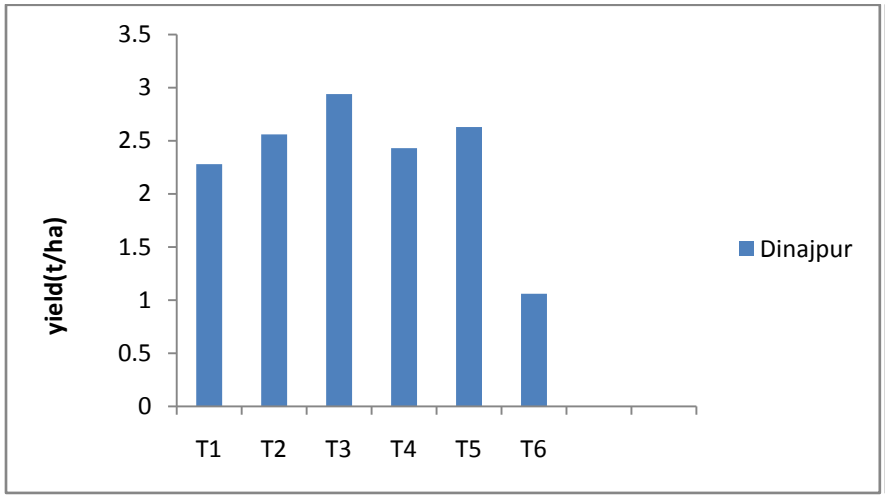


Fig 11:Effect of diff. management practices on yield of Dinajpur farm.

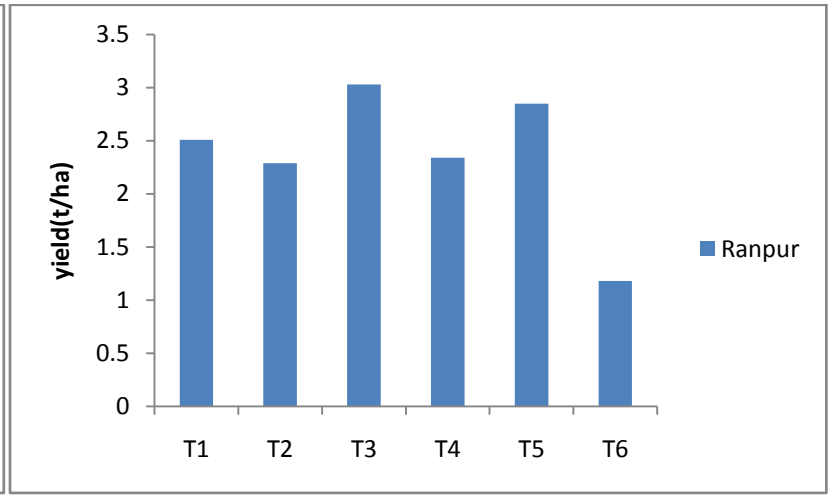


Fig 12:Effect of diff. management practices on yield of Rangpur farm.

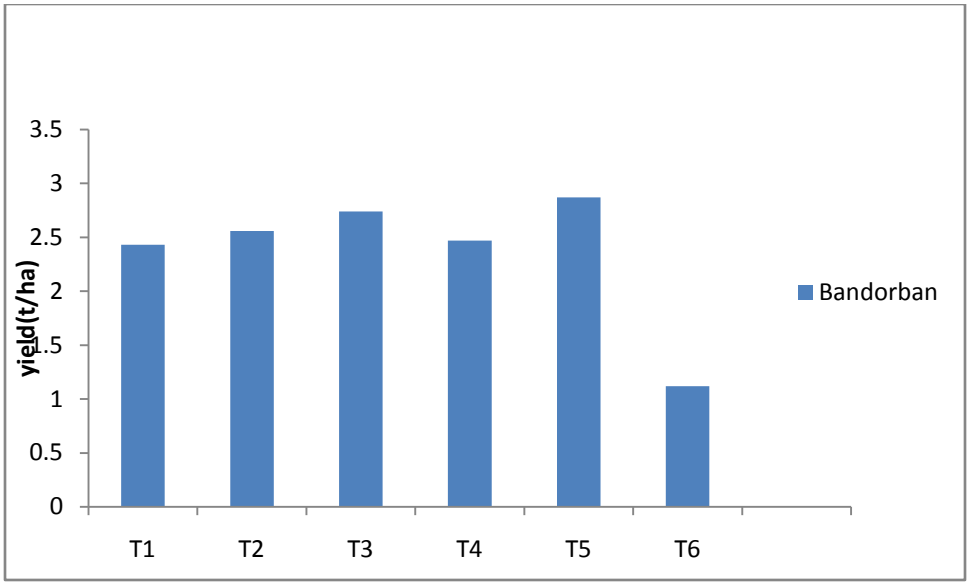


Fig 13: Effect of different management practices on yield of Bandarban farm.

Ginning out turn (GOT)

Ratio of lint and fibre is termed as GOT. Highest GOT was recorded in T_1 where100 seed weight was 11.5 (Table: 8).In control plot GOT was 38.5 and and 100 seed wt. was 12.1

Table 8: Ginning Out Turn of seed cotton under different management practices.

Treatment	Wt. of seed cotton(kg)	Wt. of lint (kg)	Wt. of seed (kg)	GOT%	100 seed wt. (gm)
T_1	1.00	0.390	0.608	39.00	11.5
T_2	1.00	0.385	0.614	38.50	12.3
T_3	1.00	0.385	0.612	38.50	11.8
T_4	1.00	0.388	0.609	38.80	12.1
T_5	1.00	0.381	0.610	38.10	11.9
T_6	1.00	0.385	0.613	38.50	12.1

Economic Analysis

Economics analysis revealed that highest gross margin of Tk 101576 and highest benefit cost ratio (2.85) was obtained from the treatment T_3 (application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap) although its variable cost Tk. 55000/ha .The lowest gross margin (Tk 21720) and lowest benefit cost ratio (1.39) were recorded from T_2 which is followed by T_6 (Table:9).

Table 9: Economic Analysis.

Treatment	Seed cotton yield(kg/ha)	Gross Return (Tk/ha)	Total Variable Cost (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	2440	136640	52500	84140	2.6
T_2	2512	140672	53000	87672	2.65
T_3	2796	156576	55000	101576	2.84
T_4	2360	132160	52000	80160	2.54
T_5	2728	152768	65000	87768	2.35
T_6	1370	76720	55000	21720	1.39

Conclusion

This research work revealed that in all farms and farmer's field overall maximum mean reduction was recorded in T_5 - Farmers Practice (Hemidor @ 0.3 gm/litre). In case of Jassid population T_3- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap give the highest reduction rate and in white fly population T_1- Application of Azadiractin(Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap showed better next performance.highest yield was found in T_5 followed by T_3. Highest BCR (2.84) observed in T_3. In environmental point of view we may consider T_3 as best management practices for Jassid and T_1 for whitefly.

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Insect Biodiversity in Cotton Fields in the Chittgong Hill Tracts

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Abstract

Insect biodiversity on upland cotton (*Gossypium hirsutum*) grown in the Chittagong Hill Tracts was studied in relation to five different cropping regimes. Most of the insect species found were pest infestations in areas with inter-planted crops. Intercropping of cotton with bottle gourd gave the lowest yield of seed cotton (961 kg/ha); the highest seed cotton yield was from cotton intercropped with rice (2126 kg/ha).

Introduction

Hillsides are one of the main resources for agricultural production in Bangladesh. In the Chittagong Hill Tracts the most popular agricultural method, practiced from ancient times, is known as Jhum (shifting) cultivation. This simple agricultural practice was developed over many generations by hill farmers, and recent attempts have failed to find any modifications that would achieve measurable improvements in the method. Seeds are sown when the wet season is just about to begin. A bamboo cage (locally known as a Thoroung) is used to carry the seeds; this is tied lightly behind the farmer's body with a rope, and is used to sow the seeds from the upper slopes to the lower parts of the hills. The farmers sow several types of seeds (rice, cotton, maize, cucumber, chilli, sesame, ginger, turmeric, coriander, etc.) at the same time, in a hole dug with a special type of tool (locally known as a Jhum Da). The seeds are sown at about 3-5 cm depth in the soil and the holes are left open, not filled in with soil. The holes are dug in a zig-zag pattern, not following any straight lines across the slope, to prevent erosion of the top soil by rain run-off.

In traditional Jhum (shifting) cultivation, cotton is cultivated as a mixed crop. In the past the farmers did not use insecticides and had no idea about the use of fertilizers. Cotton is subject to attack by many insect pests, which damage different growth stages. This weakens the plants, resulting in low productivity.

Today, the indigenous method of hill agriculture, which controls soil erosion and conserves the environment, is not economically viable. However, it may be possible to combine modern farming technology with beneficial aspects of the traditional system of Jhum (shifting) cultivation, to develop a more environmentally sustainable method of hillside cultivation.

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In the last 10 years the extension of Cotton Development Board in 3 hill districts and Hill Cotton Research Station (HCRS), Bandarban have been cultivating upland cotton *(Gossypium hirsutum)*. Climatic and environmental conditions in the hills are different from the plain land, so a different insect fauna is found on hill cotton compared to that on plains-grown cotton. There is a need to develop cultural practices that will promote insect diversity on hill-grown cotton, to provide natural pest controls, but at present not enough is known about the ecology of the insects on this crop. The research program therefore needs to keep more records about the habits of the insects found on *Gossypium hirsutum* in Chittagong Hill Tracts (CHT).

Materials and Methods

The experiment was conducted at the Hill Cotton Research Station (Balaghata, Bandarban, Bangladesh) in 1st July, 2017. The experimental cotton field was situated slightly above the lower part of the hillside, where nutrient levels were not evenly distributed throughout the experimental plot. The unit plot size was 4m x 4m; spacing between rows and plants was 80cm x 50cm and a randomized complete block design with 3 replications was used. The treatments were: T_1 - cotton + single row of rice, T_2 - cotton + 10% maize, T_3 - cotton + 10% yard-long bean, T_4 - cotton + 10% sweet gourd, and T_5 - cotton + 10% bitter gourd, sown as mixed crops to attract different insects. No insecticides were applied to any of the treatments. Fertilizer and other intercultural operations were done as necessary. The Insect populations were monitored at four cotton growth stages: 1. Seedling stage (0-25 days after sowing (DAS)); 2. Vegetative stage (26-51 DAS); 3. Flowering stage (52-77 DAS); and 4. Maturation stage (78+ DAS). The targeted (pest) insect species recorded were aphid, jassid, white fly, leaf roller, Spodoptera (5 plants examined in each treatment), red cotton bug (15 plants examined in treatment), bollworm (20 plants examined in treatment), blister beetle (the whole plot examined -54 plants). The threshold levels used for the insects were: aphids at 1.5 grade/plant, jassids at 2 nymphs or adults/plant, and bollworm at 0.25/plant.

Results and Discussion

Seedling stage (0-25 DAS): On the seedling stages of cotton, the plants in all five treatments had aphid, jassid, white fly and leaf roller (Table 1A). None of the insects that attack late-stage cotton, like American bollworm, *Spodoptera* and blister beetle, were found.

Vegetative stage (26-51 DAS): Sap-sucking insects (aphid, jassid, whitefly and leaf roller) were commonly observed on the cotton plants during leaf formation and the development of branching (Table 1B). During this stage of cotton development, leaf roller began to feed on the leaves. However, although the nymphal stage of red cotton bug visited the plants during this stage, it apparently did not feed.

Flowering stage (52-77 DAS): Different colors of blister beetle like to feed on cotton flower petals; such large insects feed singly on the flowers, whereas aphids and white flies live in aggregations on the plants. There were fewer sap-sucking insects on cotton at the flowering stage than on the vegetative stage (Table 1C).

Maturation stages (78+ DAS): It is an important period of cotton research field which would like to notice to the growers or researcher where the necessary to be taken care of. When the cotton was at this stage of development, large numbers of red cotton bug were observed flying over the entire area. In contrast, bark feeder beetle were only found in small numbers; however, when a single beetle feeds on bark around the plant stem, it causes the plant to wilt and die. A single beetle can kill a mature plant.

The results in Table 2 show that the lowest seed cotton yield was produced in T_5, cotton + 10% bitter gourd (961 kg/ha). The next lowest yield was in T_2, cotton + 10% maize (1237 kg/ha), followed by T_4 (cotton + 10% sweet gourd, 1518 kg/ha) and then T_3 (cotton + 10% yard-long bean), which yielded 1536 kg/ha. The highest yield, 2126 kg/ha, was obtained from T_1 (cotton + single row of rice).

Conclusion

Observation of the biodiversity of insect pests on upland cotton *(Gossypium hirsutum)* is a new method of studying the abundance of insects on cotton in CHT. The experiment is only in its first year. To collect statistically valid data on which quality documentation (a booklet) may be based will require that the experiment be repeated.

Table 1. Insect observations made on upland cotton plants *(Gossypium hirsutum)* at different developmental stages.

A. Seedling stages (0 -25 DAS)									
Treat-ment	Aphid	Jassid	White fly	Red cotton bug	Boll-worm	Spodo-ptera	Leaf roller	Blister beetle	Bark feeder
T_1	1.40	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_2	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_3	2.20	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_4	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_5	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B.Vegetative stages (26 -51DAS)									
Treat-ment	Aphid	Jassid	White fly	Red cotton bug	Boll-worm	Spodo-ptera	Leaf roller	Blister beetle	Bark feeder
T_1	2.00	5.00	0.00	0.40 (15)	0.00	0.00	1.60	0.00	0.00
T_2	1.80	1.20	0.00	0.00	0.00	0.00	0.80	0.00	0.00
T_3	1.80	0.80	0.00	0.13 (15)	0.00	0.00	1.40	0.00	0.00
T_4	2.04	0.80	0.00	0.00	0.00	0.00	2.60	0.00	0.00
T_5	2.48	0.60	1.00	1.33 (15)	0.10 (20)	0.00	1.60	0.00	0.00
C. Flowering stages (52 - 77 DAS)									
Treat-ment	Aphid	Jassid	White fly	Red cotton bug	Boll-worm	Spodo-ptera	Leaf roller	Blister beetle	Bark feeder
T_1	0.00	0.00	0.00	0.80 (15)	0.00	0.00	0.00	0.80 (5)	0.00
T_2	0.00	1.40	0.00	0.33 (15)	0.15 (20)	0.00	0.60 (5)	0.20 (5)	0.04 (54)
T_3	0.00	1.40	0.00	0.46 (15)	0.00	0.00	1.20	0.40 (5)	0.00
T_4	0.00	0.00	0.00	0.00	0.00	0.00	1.40 (5)	0.80 (5)	0.00
T_5	0.00	0.00	0.00	0.00	0.00	0.00	2.20 (5)	0.60 (5)	0.00
D. Maturation stages (78 above DAS)									
Treat-ment	Aphid	Jassid	White fly	Red cotton bug	Boll-worm	Spodo-ptera	Leaf roller	Blister beetle	Bark feeder
T_1	0.00	0.00	0.00	0.60 (15)	0.00	0.00	0.00	0.00	0.00

T_2	0.00	0.00	0.00	0.00	0.05 (20)	0.00	3.20 (5)	0.00	0.02 (54)
T_3	0.00	0.00	0.00	0.00	1.93 (15)	0.00	0.60 (5)	0.00	0.00
T_4	0.00	0.00	0.00	0.66 (15)	0.00	0.00	0.00	0.00	0.00
T_5	0.00	0.00	0.00	0.53 (15)	0.00	0.00	3.20 (5)	0.00	0.00

Table 2. The impact of different intercrop treatments and pest insects on cotton *(Gossypium hirsutum)* plant height, cotton bolls and seed cotton yield.

Treatments	Plant height (cm)	Insect-affected bolls per plant	Matured bolls per plant	Seed cotton yield, kg/ha
T_1 – Cotton + Rice	125	3	14	2126
T_2 – Cotton + 10% maize	119	5	11	1237
T_3 - Cotton + % yard-long bean	120	2	13	1536
T_4 - Cotton + % sweet gourd	118	6	12	1518
T_5 - Cotton + bitter gourd	123	3	9	961
LSD (0.01%) CV%	14 4	4 47	8 24	1.29 0.031