
WELCOME TO
MY PRESENTATION

ADDITIVE MAIN EFFECTS AND MULTIPLICATIVE INTERACTION ANALYSIS IN UPLAND COTTON (*Gossypium hirsutum* L.)

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Presentation outline

1. Introduction
2. Materials and Methods
3. Results and Discussion
4. Conclusion
5. Recommendation

INTRODUCTION

Cotton production in Bangladesh

1. Area under cotton production = 4,27,000 ha

2. Harvested area was = 50,000 ha (2016)

3. Current production = 1,50,000 bales

4. Requirement of row cotton = 60 lakh bales (2016)

5. 2nd largest apparel producer of the world

6. 2nd largest cotton consumer of the world

7. 2nd largest cotton importer of the world

Objectives

1. Response of cotton genotypes at elevated climatic changes during growth and development stages

2. Study of adaptation and genotype x environment interaction in cotton genotypes grown at different environments in the country

3. Identification of cotton genotypes which have high seed cotton yield and stable performance across the different environments of our country

4. Study of relationships, similarities and dissimilarities of seed cotton yield with different stability parameters to quantify GxE interaction effect

5. Identification of stable genotype/genotypes by determining G x E interaction effects obtained by AMMI analysis of seed cotton yield over the environments

MATERIALS AND METHODS

List of the genotypes of American upland cotton

Sl. No.	Genotypes	Sl. No.	Genotypes
01	JA-08/A	11	BC-088
02	JA-08/B	12	BC-0303
03	JA-08/C	13	BC-0406
04	JA-08/D	14	BC-051
05	JA-08/E	15	BC-0342
06	JA-08/9	16	BC-037
07	JA-0541	17	BC-0188
08	JA-0510	18	CB-9
09	JA-054	19	CB-10
10	JA-0526	20	CB-11

List of the experiments:

Expt. No.	Name of the experiments	Period of completion
I	Evaluation of 20 cotton genotypes	Cropping season (2010-2011)
II	Selection of stable and high seed cotton yielding lines.	Cropping season (2011-2012)
III	Assessment of quality traits in cotton	Cropping season (2013-2014)

Experimental sites

Experiment I:	Cotton Research, Training and Seed Multiplication Farms under Jessore, Dinajpur and Cotton Research Center, Mahiganj, Rangpur
Experiment II:	Cotton Research, Training and Seed Multiplication Farms under Jessore, Dinajpur and Cotton Research Center, Mahiganj, Rangpur
Experiment III:	Cotton Research, Training and Seed Multiplication Farms under Jessore, Dinajpur and Cotton Research Center, Mahiganj, Rangpur.

Fig. Pictorial view of seed sowing in the research field at CRTSM Farm, Jagodishpur, Jessore

Fig Pictorial view of seed sowing in the research field at CRTSM Farm, Sadarpur, Dinajpur

Fig Pictorial view of seed sowing in the research field at CRC, Mahigonj, Rangpur

Fig Pictorial view of application of cowdung at the experimental plot

Fig Application of fungicide by napsack sprayer at seedling stage

Fig Application of inter-row cultivator for weed control and fertilizer Management

Fig Spraying of chemical insecticide by power spray

Characters to be studied

a. Yield and yield contributing characters

Sl. No.	Characters	Sl. No.	Characters
01	No. of vegetative branches/plant	07	Single boll weight (g)
02	No. of primary fruiting branches /plant	08	No. of bolls /plant
03	No. of secondary fruiting branches /plant	09	No. of un-burst bolls /plant
04	N.F.B/Plant	10	Plant height at harvest(cm)
05	Days to 1st flowering (50%)	11	Plant population at harvest
06	Days to 1st boll split (50%)	12	Seed cotton yield (kg/ha)

b. Ginning and lint characters

Sl. No.	Characters	Sl. No.	Characters
01	GOT (%)	06	50% span length (Inch.)
02	Lint yield (kg/ha)	07	2.5% span length (Inch.)
03	Seed index (g)	08	Micronaire value
04	Lint index (g)	09	Pressly strength index (PSI)
05	Fuzz grade	-	-

GOT = Ginning Out Turn

RESULTS AND DISCUSSION

Table 4.1 Mean performances of different characters in 20 genotypes of cotton at three locations

Genotypes	VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW (g)	UBB/P	PH (cm)	S/B	SCY (kg ha^{-1})
JA-08/A	1.93	14.47	11.20	6.23	53	103	33.5	4.74	1.4	106.37	27.9	3012
JA-08/B	1.60	13.43	9.53	6.00	50	105	26.7	5.03	1.8	96.60	24.6	2641
JA-08/C	1.87	14.67	8.13	6.23	51	106	31.5	6.17	1.4	101.73	29.9	3329
JA-08/D	4.27	26.00	21.33	7.13	51	109	33.2	4.93	1.4	108.73	28.2	3430
JA-08/E	1.80	15.40	8.07	6.40	53	107	31.0	5.51	1.6	94.33	28.1	3226
JA-0541	1.47	17.37	9.50	6.07	49	108	28.2	5.46	1.5	110.07	25.5	2711
JA-08/9	1.40	17.23	6.53	5.27	48	102	31.7	4.17	2.3	91.80	26.8	2904
JA-054	1.53	14.93	9.03	5.73	51	105	24.9	5.80	1.6	101.33	26,0	2810
JA-0526	2.33	19.07	13.53	6.23	52	104	30.0	5.27	1.6	108.33	35.0	2703
JA-0510	1.97	15.10	9.00	5.93	50	104	25.0	4.75	1.0	102.13	26.3	2799
BC-088	2.30	21.97	13.50	6.33	50	106	29.0	4.95	1.5	131.20	25.0	2703
BC-0303	2.57	20.17	12.17	6.40	53	109	33.0	4.49	1.2	116.47	22,9	2580
BC-0406	3.20	22.50	16.23	6.53	51	107	37.9	4.47	1.8	130.93	27.4	3089
BC-051	2.03	16.60	13.23	6.33	47	104	34.5	4.33	1.6	118.73	25.6	2969
BC-0342	2.77	20.10	16.57	7.03	51	106	29.9	5.40	1.2	130.00	27.1	2973
BC-037	2.67	21.87	13.47	6.40	56	109	32.4	4.99	1.9	128.80	23.0	2466
BC-0188	2.13	22.17	15.13	6.73	53	107	32.7	4.36	1.5	131.27	26.5	2758
CB-9	3.17	21.20	14.73	7.73	56	115	25.6	5.97	1,5	104.70	23.3	2389
CB-10	2.63	23.33	15.50	6.57	50	116	33.4	5.07	1.7	118.67	27.0	3205
CB-11	0.67	16.13	6.63	6.27	50	105	26.9	5.34	1.5	119.73	23.3	2483
CV (%)	12.36	14.70	9.56	6.82	7.17	11.24	9.98	7.53	15.67	15.69	8.22	18.94
LSD	0.97	5.27	3.16	0.85	0.98	0.65	4.83	0.64	0.47	10.22	2.05	504.68

VB/P =Vegetative branches plant $^{-1}$ MSN/P =Main stem node plant $^{-1}$, · PFB/P= Primary fruiting branches plant $^{-1}$,SFB/P =Secondary fruiting branches plant $^{-1}$,DFF =Days to 1st flowering (50%), DFBS= Days to 1st boll splitting (50%), B/P= Bolls plant^{-1} Un-burst bolls plant^{-1} ·BW = Boll weight (g) , PH =Plant height (cm), S/B =Seeds boll^{-1}, SCY= Seed cotton yield (kg ha^{-1})

Table 4.2 Genetic parameters of different characters in 20 genotypes of cotton at three locations

Characters		VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW (g)	UBB/P	PH(cm)	S/B	SCY (kg ha^{-1})
Mean range	Min.	0.67	13.43	6.63	5.27	47	102	24.9	4.17	1.0	91.80	23	2466
	Max.	4.27	26.00	21.33	7.33	56	116	37.9	5.97	2.3	131.27	29.9	3430
GCV(%)		7.93	24.21	17.36	9.47	34.97	65.94	26.94	6.40	2.49	60.92	44.50	205.43
PCV(%)		8.36	26.42	23.54	10.73	39.05	80.45	28.60	7.30	2.96	72.45	49.48	330.12
h^2b (%)		78.35	61.27	82,63	85.45	84.96	87.40	90.36	96.45	85.35	97.46	96.48	83.58
GA		34.62	25.49	26.36	46,49	58.39	49.58	59.46	10.32	46.64	39.56	24.59	48.54
GAM(%)		21.50	7.35	35.30	9.94	23.60	32.46	39.57	48.39	17.48	9.42	60.35	30.73

GCV=Genotypic coefficient of variation, PCV=Phenotypic coefficient of variation, h^2b= Heritability in broad sense, GA=Genetic advance and GAM=Genetic advance as % of mean

VB/P =Vegetative branches plant $^{-1}$ MSN/P =Main stem node plant $^{-1}$, , PFB/P= Primary fruiting branches plant $^{-1}$,SFB/P =Secondary fruiting branches plant $^{-1}$,DFF =Days to 1st flowering (50%), DFBS= Days to 1st boll splitting (50%), B/P= Bolls plant^{-1} Un-burst bolls plant^{-1} ,BW = Boll weight (g) , PH =Plant height (cm), S/B =Seeds boll^{-1} , SCY= Seed cotton yield (kg ha^{-1})

Table 4.3 Genotypic (r_g) and phenotypic (r_p) correlation coefficients in all possible pair characters of cotton at three locations

	r	VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW	UBB/P	PH	S/B	SCY
VB/P	r_g	1.00	-0.240	0.763 **	0.281	-0.563*	0.094	-0. 783**	0.438	-0.820**	0.095	0.275	-0850.**
	r_p	1.00	-0.221	0. 710**	0.259	-0.529*	0.087	-0730**	0.320	-0.794 **	0.088	0.251	-0801**.
PFB/P	r_g		1.00	-0.009	0.105	0.220	-0.489	0.390	0.390	0.007	0382.	0.117	0.474
	r_p		1.00	-0.003	0.096	0.187	-0.453	0.299	0. 354	0.006	0.321	0.111	0.457
SFB/P	r_g			1.00	0.304	-0.132	0.094	0.190	0.667.**	0.109	0.311	0.680**	0.889**
	r_p			1.00	0.295	-0.123	0.092	0.153	0.651.**	0.099	0.275	0.653.**	0.875**
MSN/P	r_g				1.00	0.774**	0.874**	0.136	0.082	0.472	0.768**	0.099	0.843**
	r_p				1.00	0.583*	0.827**	0.119	0.079	0.459	0.717**	0.093	0818.**
DFF	r_g					1.00	0.651**	0.765**	0.212	-0.009	0.348	0.231	0775. **
	r_p					1.00	0.650**	0732.**	0.200	-0.008	0.333	0.202	0.749**
DFBS	r_g						1.00	-0.107	0.357	0.273	0.110	0.200	0.273
	r_p						1.00	-0.100	0.355	0.272	0.101	0.197	0.259
B/P	rg							1.00	-0. 684**	0.795**	0.280	0.239	0.786**
	r_p							1.00	-0 666.**	0.784**	0.276	0.224	0.779**
BW	r_g								1.00	0.240	0.163	0.793**	0.689**
	r_p								1.00	0.236	0.154	0.768**	0.675**
UBB/P	r_g									1.00	0.300	0.107	-0.681**
	r_p									1.00	0.289	0.097	-0.664**
PH	r_g										1.00	0.361	0.351
	r_p										1.00	0.358	0.334
S/B	r_g											1.00	0.693.**
	r_p											1.00	0.678**
SCY	r_g												1.00
	r_p												1.00

* and ** indicate significant at 5% and 1% levels of probability, respectively.

VB/P =Vegetative branches plant $^{-1}$ MSN/P =Main stem node plant $^{-1}$, · PFB/P= Primary fruiting branches plant $^{-1}$,SFB/P =Secondary fruiting branches plant $^{-1}$,DFF =Days to 1st flowering (50%), DFBS= Days to 1st boll splitting (50%), B/P= Bolls plant^{-1} Un-burst bolls plant^{-1} ,BW = Boll weight (g) , PH =Plant height (cm), S/B =Seeds boll^{-1} , SCY= Seed cotton yield (kg ha^{-1})

Table 4.4 Path analysis at genotypic level of different characters in cotton

Characters	VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW	UBB/P	PH	S/B	r_g with SCY
VB/P	**-0.754**	-0.410	0.280	0.525	0.209	-0.518	-0.362	-0.127	0.423	0.306	-0.422	-0.850**
PFB/P	-0.375	**0.149**	0.097	0.130	0.102	0.138	0.321	0.030	-0.220	-0.198	0.300	0.474
SFB/P	-0.643	0.172	**1.384**	0.277	-0.407	-0.768	0.409	-0.087	-0.557	0.626	0.503	0.889**
MSN/P	0.256	0.062	0.202	**0.163**	-0.145	-0.100	0.107	0.008	0.048	0.137	0.105	0.843**
DFF	-0.479	0.270	0.020	-0.286	**0.597**	0.518	0.291	0.135	-0.593	0.041	0.261	0.775 **
DFBS	-0.175	0.048	0.105	-0.229	0.200	**0.328**	0.261	-0.194	-0.251	0.056	0.124	0.273
B/P	-0.267	0.129	0.154	0.038	0.303	-0.389	**1.526**	-0.472	-0.150	0.171	-0.257	0.786**
BW	-0.365	0.208	0.122	-0.338	0.050	-0.487	-0.673	**1.568**	-0.290	0.243	0.651	0.689**
UBB/P	0.052	0.073	-0.104	0.111	-0.278	0.168	0.129	-0.205	**-0.872**	0.106	0.139	-0.681**
PH	-0.189	0.155	0.004	0.216	-0.316	0.107	-0.152	0.070	0.144	**0.104**	0.218	0.351
S/B	-0.156	0.263	0.105	-0.587	0.120	-0.456	-0.731	0.198	-0.149	0.104	**1.982**	0.693.**

Residual effect= 0.153

VB/P: Vegetative branches/plant, **PFB/P:** Primary fruiting branches/plant, **SFB/P:** Secondary fruiting branches/plant, **MSN/P:** Main stem node/plant, **DFF:** Days to 1st flowering, **DFBS:** Days to 1st boll split, **B/P:** Bolls/plant, **BW:** Boll weight, **UBB/P:** Unbrust bolls/plant, **PH:** Plant height, **S/B:** Seeds/boll, **SCY:** Seed cotton yield

Table 4.5 Construction of selection indices in cotton

Index selection	Expected genetic worth	Relative efficiency over straight selection (%)
$I_1=0.582\ x_1$	13.56	100.00
$I_2=0.309\ x_2$	7.32	53.98
$I_3=0.281\ x_3$	9.30	68.58
$I_4=0.284\ x_4$	10.61	78.24
$I_5=0.841x_5$	11.48	84.66
$I_{12}=0.481\ x_1+0.459\ x_2$	14.34	105.75
$I_{13}=0.252\ x_1+0.480\ x_3$	14.87	109.66
$I_{14}=0.376\ x_1+0.978\ x_4$	14.95	110.25
$I_{15}=0.597x_1+0.093\ x_5$	15.00	110.62
$I_{23}=0.457\ x_2+0.273\ x_3$	14.68	108.26
$I_{24}=0.715x_2+0.783x_4$	15.12	111.50
$I_{25}=0.712\ x_2+0.189\ x_5$	14.19	104.65
$I_{34}=0.378\ x_3+0.268\ x_4$	14.57	107.45
$I_{35}=0.935x_3+0.837x_5$	15.58	114.90
$I_{45}=.982\ x_4+0.579\ x_5$	16.09	118.66
$I_{123}=0.357\ x_1+ 0.582\ x_2 +0.631\ x_3$	17.45	128.69
$I_{124}=0.890\ x_1+0.368\ x_2+0.231\ x_4$	17.85	131.64

Table 4.5 Construction of selection indices in cotton (cont'd)

Index selection	Expected genetic worth	Relative efficiency over straight selection (%)
$I_{125}=0.376\ x_1+0.794\ x_2+0.257x_5$	17.93	132.23
$I_{134}=0.598\ x_1+1.471x_3+0.683\ x_4$	18.22	134.37
$I_{135}=0.523\ x_1+1.023\ x_3+0.886\ x_5$	18.69	151.62
$I_{145}=0.099x_1+0.685\ x_4+0.780\ x_5$	19.54	144.10
$I_{234}=0.680\ x_2+0.572\ x_3+0.780\ x_4$	18.83	138.86
$I_{235}=0.571x_2+0.569\ x_3+\ 0.271\ x_5$	17.98	132.60
$I_{245}=0.532\ x_2+0.893\ x_4+0.951\ x_5$	18.74	138.20
$I_{345}=0.580\ x_3+0.589\ x_4+0.436\ x_5$	19.78	145.87
$I_{1234}=0.562\ x_1+0.537x_2+0.458\ x_3+0.762\ x_4$	19.85	146.39
$I_{1235}=0.379x_1+0.678\ x_2+0.365\ x_3+0.386\ x_5$	20.79	153.32
$I_{1245}=0.589\ x_1+0.379\ x_2+0.893x_4+0.725\ x_5$	20.98	154.72
$I_{2345}=0.572\ x_2+0.785\ x_3+0.470\ x_4+0376\ x_5$	20.97	154.65
$I_{12345}=0.673\ \ x_1+0.786\ \ x_2+0.575\ \ x_3+0.689\ x_4+0.358\ \ x_5$	21.36	157.22

x_1= Seed cotton yield, x_2=Days to 1st flowering, x_3=Bolls plant^{-1}, x_4=Boll weight and x_5= Seeds boll^{-1}.

Table 4.6 Insect scouting method in cotton field

Insects	Scouting method
Bollworm	Randomly selected individual plants and examined carefully for presence of eggs or small (less than 1/2 inch long) larvae. Concentrate scouting primarily on the terminal area and the upper 8 to 12 inches of the plant. Eggs were usually deposited in the terminal bud or on the upper surface of newly expanded leaves, but also be sure to check for presence on eggs on outer square bracts.
Jassid	Jassid was scouted by randomly selecting expanded leaves. It attacks at the lower surface of leaves.
Aphids	When scouting for aphids, it was important to note any additional stress factors that might be affecting the crop and to be aware of predators, parasites, and pathogens that might be affecting the aphid population. Scouted by randomly selecting fully expanded leaves.
Whitefly	Scout for whiteflies by examining plant terminals and undersides of upper leaves for presence of adult and/or immature. Recorded counts as percent of terminals infested.
Thrips	Primarily a pest of seedling cotton, 4th leaf stage or younger: Examined whole seedlings for presence of thrips, concentrating on undersides of leaves and in terminal area.
Plant bug	Adult plant bugs were best quantified by using a 15 inch diameter sweep net. It needed to take several 25 sweep samples per field and recorded results as average number of plant bugs per 100 sweeps.

Table 4.7 Insect infestation in twenty cotton genotypes

Genotypes	NIP	NLP	NILP	ILPP	NBP	NIBP	IBPP
JA-08/A	4	145.35	3.7	2.55	33.5	1.8	5.37
JA-08/B	5	140.67	2.8	1.99	26.7	1.5	5.62
JA-08/C	3	145.90	4.9	3.36	31.5	2.0	6.35
JA-08/D	2	152.64	0.0	0.00	33.2	0.0	0.00
JA-08/E	2	148.78	7.3	4.91	31.0	2.2	7.00
JA-0541	5	139.98	6.1	4.36	28.2	2.8	9.93
JA-08/9	5	140.00	8.0	5.71	31.7	5.3	16.72
JA-054	5	142.56	5.0	3.51	24.9	3.8	15.20
JA-0526	5	135.06	11.2	8.29	30.0	5.2	17.33
JA-0510	5	137.48	10.5	7.64	25.0	5.8	23.20
BC-088	5	150.35	8.3	5.52	29.0	1.9	6.55
BC-0303	5	144.58	12.6	8.71	33.0	8.1	24.55
BC-0406	5	132.57	8.7	6.56	37.9	2.6	6.86
BC-051	5	147.94	9.4	6.35	34.5	4.7	13.62
BC-0342	5	150.37	8.2	5.45	29.9	3.8	12.71
BC-037	5	143.54	10.5	7.32	32.4	6.8	20.73
BC-0188	5	139.83	6.1	4.36	32.7	4.3	13.15
CB-9	5	149.79	7.6	5.07	25.6	2.9	11.60
CB-10	5	146.22	8.0	5.47	33.4	4.5	13.47
CB-11	5	138.45	5.9	4.26	26.9	1.8	6.69
CV (%)	2.41	12.65	7.94	2.90	9.98	13.38	2.57
LSD	0.67	15.87	3.89	4.00	4.83	2.45	9.46

NIP=Number of insect species visited the plots, **NLP =** Number of leaves plant$^{-1,}$ **NILP=** Number of infested leaves plant^{-1} **ILPP=** Infested leaves plant^{-1} (%), **NBP=** Number of bolls plant^{-1} **NIBP=**Number of infested bolls plant^{-1} **IBPP**= Infested bolls plant^{-1} (%)

Table 4.8 Mean performances of different characters in three locations over 3 years

Characters	Dinajpur				Rangpur				Jessore			
	2010-11	2011-12	2012-13	Mean	2010-11	2011-12	2012-13	Mean	2010-11	2011-12	2012-13	Mean
VB/P	1.56	1.58	1.40	1.51	1.97	2.02	2.34	2.11	2.89	2.93	3.25	3.02
PFB/P	12.58	11.49	13.73	12.6	15.00	15.30	16.31	15.54	16.94	17.86	18.16	17.32
SFB/P	5.88	7.25	6.42	6.52	10.84	8.17	9.25	9.42	17.40	16.38	16.92	16.90
MSN/P	5.34	6.02	5.49	5.62	6.93	5.87	6.00	6.27	7.71	7.10	7.45	7.42
DFF	50.33	52.00	49.67	50.67	55.00	54.33	56.67	55.33	59.00	60.12	62.67	60.60
DFBS	112.33	115.00	114.67	114.00	119.00	120.33	118.00	119.11	120.67	121.00	120.00	120.56
B/P	25.54	26.90	25.18	25.87	27.48	28.05	29.26	28.26	34.62	35.74	33.59	34.65
BW	5.30	5.27	5.83	5.47	5.04	5.91	5.00	5.32	5.87	6.01	5.99	5.96
UBB/P	2.63	1.98	2.50	2.37	1.57	1.80	1.92	1.76	0.78	1.00	1.01	0.93
PH	98.35	100.00	97.52	98.62	110.48	115.50	120.61	115.53	125.48	122.22	124.57	121.08
S/B	27.40	28.00	28.25	27.88	28.28	27.95	27.91	28.05	29.27	30.03	29.88	29.73
SCY	2728	2907	2841	2825	3000	3157	2999	3052	3367	3209	3138	3238

Red marked figures = Mean value

VB/P: Vegetative branches/plant, **PFB/P:** Primary fruiting branches/plant, **SFB/P:** Secondary fruiting branches/plant, **MSN/P:** Main stem node/plant, **DFF:** Days to 1st flowering, **DFBS:** Days to 1st boll split, **B/P:** Bolls/plant, **BW:** Boll weight, **UBB/P:** Unbrust bolls/plant, **PH:** Plant height, **S/B:** Seeds/boll, **SCY:** Seed cotton yield

Table 4.9 Mean performances of different genotypes for seed cotton yield (kg ha^{-1}) over locations and years

Genotypes	Dinajpur				Rangpur				Jessore			
	2010-11	2011-12	2012-13	Mean	2010-11	2011-12	2012-13	Mean	2010-11	2011-12	2012-13	Mean
JA-08/A	2882	2930	3074	2962	3009	2857	2897	2921	2957	3139	3058	3051
JA-08/B	2340	2258	2510	2369	2368	2517	2249	2378	2739	2615	2753	2702
JA-08/C	3230	3374	3120	3241	3074	3228	3291	3197	3438	3540	3303	3427
JA-08/D	3430	3348	3273	3350	3408	3378	3325	3370	3481	3550	3665	3565
JA-08/E	3136	3359	3007	3167	3212	3286	3184	3227	3349	3250	3098	3232
JA-0541	2610	2520	2548	2559	2865	2585	2437	2629	2790	2682	2858	2776
JA-08/9	2835	2762	2806	2801	2758	2891	2787	2812	3051	2912	2845	2936
JA-054	2065	2138	2367	2190	2407	2297	2015	2239	2342	2137	2480	2319
JA-0526	2634	2761	2538	2644	2630	2879	2676	2728	2765	2850	2864	2826
JA-0510	2824	2745	2684	2751	2768	2777	2936	2827	2803	3048	2752	2867
BC-088	1938	2063	2158	2053	2204	2157	2378	2246	2433	2361	2562	2452
BC-0303	2853	2769	2899	2840	2905	2831	2876	2870	2989	3029	3000	3006
BC-0406	3076	3155	2958	3063	3001	3138	3056	3065	3259	2904	3127	3096
BC-051	2865	2927	2890	2894	3125	3089	2951	3055	3138	3106	3028	3090
BC-0342	2906	2866	2748	2840	2992	2867	2971	2943	3031	2858	3190	3026
BC-037	2347	2230	2331	2302	2457	2400	2275	2377	2582	2449	2468	2499
BC-0188	2717	2672	2590	2659	2685	2853	2579	2705	2657	2767	2906	2776
CB-9	2356	2224	2407	2329	2258	2471	2560	2429	2339	2480	2571	2463
CB-10	3056	3162	3048	3088	3107	3200	3166	3157	3137	3381	3229	3249
CB-11	2354	2427	2404	2305	2265	2467	2550	2427	2363	2661	2656	2560
CV (%)	13.63	14.00	11.58		15.33	14.56	17.61		14.90	10.89	16.48	
LSD	328.45	300.46	410.37		380.09	299.68	412.67		306.63	317.56	358.62	

Red marked figures = Mean value

Table 4.10 Combined analysis (MS) of different characters over locations and years

SOV	df	VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW	UBB/P	PH	S/B	SCY	VE (%) for SCY
R	2	75.78	165.35	124.56	35.78	9.45	36.95	13.59	7.78	3.45	103.43	32.53	756.89	6.55
G	19	312.37	738.72	659.70	99.56	25.65	395.05	341.60	88.56	12.57	1256.89	97.56	3276.90	28.36
Y	2	87.62	549.06	327.62	76.34	29.76	65.32	154.76	35.65	9.56	948.25	65.98	1567.76	13.57
E	8	268.56	672.58	765.39	45.21	12.37	154.78	99.48	68.89	10.87	1034.89	45.69	927.54	8.03
G x Y	38	587.50	957.10	562.67	89.70	34.23	104.39	165.78	100.87	18.53	846.78	56.78	1457.17	12.61
G x E	152	549.53	687.39	870.00	25.77	25.12	298.53	209.90	60.64	21.25	1365.79	73.67	2156.57	18.66
Y x E	16	375.78	472.90	412,00	35.69	11.37	35.71	76.52	65.36	14.80	421.56	45.32	764.70	6.62
GxYxE	304	121.47	54.87	26.56	25.05	16.59	39.65	5-.53	30.74	11.69	97.6.87	37.80	548.41	4.75
Residual	540	85.34	35.13	36.85	13.59	9.83	24.68	20.37	42.50	8.46	45.76	22.42	98.27	0.85

Red marked figures = Non-significant, **Blue marked figures =** Significant at 5% level of probability and **Black marked figures =** Significant at 1% level of probability.

VB/P: Vegetative branches/plant, **PFB/P:** Primary fruiting branches/plant, **SFB/P:** Secondary fruiting branches/plant, **MSN/P:** Main stem node/plant, **DFF:** Days to 1st flowering, **DFBS:** Days to 1st boll split, **B/P:** Bolls/plant, **BW:** Boll weight, **UBB/P:** Unbrust bolls/plant, **PH:** Plant height, **S/B:** Seeds/boll, **SCY:** Seed cotton yield, **VE:** Variation explained

Table 4.11 AMMI analysis of variance of seed cotton yield and yield contributing characters

SOV	df	VB/P	PFB/P	SFB/P	MSN/P	DFF	DFBS	B/P	BW	UBB/P	PH	S/B	SCY
G	19	45.36	154.50	65.50	37.40	55.69	76.87	41.52	38.55	56.08	366.78	999.41	1209.52
Y	2	14.87	67.47	44.23	16.08	24.61	65.39	30.65	24.69	36.31	296.40	391.35	929.57
E	8	41.79	35.79	60.69	21.69	36.68	70.10	37.89	39.67	45.37	300.01	710.30	1747.87
G x Y	38	132.50	263.56	125.96	28.55	134.33	126.59	52.40	68.45	60.22	592.79	368.52	18943.80
G x E	152	96.45	121.84	101.37	68.39	114.51	105.48	48.92	61.82	55.87	890.31	490.58	1034.95
Y x E	16	34.73	37,86	53.52	14.56	26.76	38.91	29.58	51.66	38.91	128.54	234.61	793.12
G x Y x E	304	21.09	56.90	28.61	19.56	22.69	36.98	31.39	40.38	18.46	96.45	124.56	529.68
IPCA 1	45	12.78	35.76	25.59	17.50	18.56	30.25	27.45	36.79	13.52	70.65	25.67	156.42
IPCA 2	43	10.46	27.87	17.36	14.97	15.30	17.47	23.90	35.71	10.30	64.78	28.40	136.90
IPCA 3	41	7.66	18.50	15.75	12.59	13.95	13.60	19.76	30.10	7.20	57.14	`23.69	121.67
IPCA 4	39	4.69	14.76	11.83	10.32	9.54	9.93	15.67	26.83	4.85	49.76	19.53	105.38
Remainder	405	23.59	45.32	25.87	46.78	30.45	26.45	32.57	97.35	13.76	205.39	61,35	198.54
Av. error	709	15.65	21.78	26.72	26.83	27.78	31.03	39.16	111.20	25.83	199.90	49.66	202.36

Blue marked figures = Significant at 5% level of probability and **Black marked figures =** Significant at 1% level of probability

SOV: Source of variation, **G:** Genotypes, **Y:** Year, **E:** Environment, **VB/P:** Vegetative branches/plant, **PFB/P:** Primary fruiting branches/plant, **SFB/P:** Secondary fruiting branches/plant, **MSN/P:** Main stem node/plant, **DFF:** Days to 1st flowering, **DFBS:** Days to 1st boll split, **B/P:** Bolls/plant, **BW:** Boll weight, **UBB/P:** Unbrust bolls/plant, **PH:** Plant height, **S/B:** Seeds/boll, **SCY:** Seed cotton yield

Table 4.12 AMMI and regression analysis on vegetative branches plant^{-1}

Genotypes	VB/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	s^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	1.93	0.895	0.337	0.58	1.49**	0.44	3.95	8	0.149	1.68
JA-08/B	1.60	0.237	0.351	0..24	0.69	1.12	2.80	5	0.968	2.88
JA-08/C	1.87	-0.318	0.586	0.95	0.34	1.16	4.36	7	1.045	3.25
JA-08/D	4.27	-0.306	-0.171	0.56	1.05	1.67	3.58	20	0.423	2.53
JA-08/E	1.80	0.394	-0.019	0.52	1.14**	1.04	2.49	6	1.070	1..88
JA-0541	1.47	0.500	0.260	0.17	0.95	1.77	2.85	3	1.341	2.58
JA-08/9	1.40	-0.328	0.216	0.19	-1.49**	1.16	2.76	2	-0.867	1.53
JA-054	1.53	1.504	0.002	0.10	0.10	0.36	0.81	4	0.246	-1.93
JA-0526	2.33	0.088	0.021	-0.53	1.72	1.29	0.90	13	0.257	-1.50
JA-0510	1.97	-0.637	0.401	0.50	-1.06	2.53	2.26	9	1.057	0.03
BC-088	2.30	0.320	0.025	0.36	1.05	0.79	1.69	12	-0.255	0.28
BC-0303	2.57	-0.186	-0.278	-2.56	1.76**	2.57	0.08	14	-1.248	-0.25
BC-0406	3.20	-0.808	-0.042	-087	--0.89	0.47	2.22	19	2.019	1.83
BC-051	2.03	-0.164	-0.1802	-0.88	0.98	0,82	1.60	10	1.313	1.28
BC-0342	2.77	-0.867	-0.251	-0.95	0.97	1.76	2.44	17	0.338	-3.03
BC-037	2.67	0.908	0.146	0.52	-1.34**	0.39	2.19	16	0.869	3.76
BC-0188	2.13	-0.917	-0.347	-0.18	-1.05	1.06	0.90	11	-0.128	0.75
CB-9	3.17	0.357	-0.935	-0.47	0.95	1.61	1.61	18	-0.467	1.60
CB-10	2.63	0.303	-0.415	0..79	1.21**	1.43	3.20	15		
CB-11	0.67	-1.346	-0.302	-0.48	0.63	0.75	2.40	1		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

VB/P: Vegetative branches/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.13 AMMI and regression analysis on primary fruiting branches plant^{-1}

Genotypes	PFB/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	14.47	0.726	0.958	2.53	1.82**	1.28	1.33	2	0.528	1.55
JA-08/B	13.43	0.939	0.279	2.86	1.97**	2.21	1.21	1	0.865	3.36
JA-08/C	14.67	0.168	0.186	2.38	1.07*	1.64	1.38	3	0.571	1.65
JA-08/D	26.00	0.581	0.367	1.37	1.87**	1.26	1.55	20	0.219	1.39
JA-08/E	15.40	0.698	0.342	2.78	1.37**	2.18	0.99	6	0.880	2.38
JA-0541	17.37	0.665	0.5003	2.85	1.04	1.46	0.89	10	0.503	2.73
JA-08/9	17.23	-0.956	0.284	0.79	0.83	0.89	0.16	9	-1.349	1.43
JA-054	14.93	-0.725	1.503	2.01	1.02	0.91	1.82	4	0.873	-2.34
JA-0526	19.07	-0.267	0.883	1.05	1.07*	0.60	0.54	11	-1.317	-1.18
JA-0510	15.10	-0.991	-0.363	0.80	1.54**	0.03	0.628	5	0.045	0.40
BC-088	21.97	-0.591	-0.203	0.29	1.34**	1.28	2.06	16	0.368	-1.08
BC-0303	20.17	0.836	-0.169	0.47	1.16*	2.34	0.30	13	-0.322	-1.80
BC-0406	22.50	-0.291	-0.084	0.91	0.95	2.51	0.89	18	-0.050	-1.07
BC-051	16.60	-0.286	-0.165	-1.72	0. 69	1.39	0.95	8	0.188	-2.30
BC-0342	20.10	0.256	-0.867	-1.50	0.92	1.74	0.91	12	0.457	-2.09
BC-037	21.87	0.449	0.908	0.66	1.07*	3.54	0.51	15	0.347	1.15
BC-0188	22.17	-0.183	-0.919	-1.90	0.98	1.94	0.97	17	0.662	-0.76
CB-9	21.20	-0.496	0.571	0.57	1.03	1.33	0.24	14	-0.189	-1.47
CB-10	23.33	0.151	0.303	-1.62	0.93	1.09	1.52	19		
CB-11	16.13	0.395	-1.347	-1.18	0.97	0.79	1.34	7		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

PFB/P: Primary fruiting branches/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.14 AMMI and regression analysis on secondary fruiting branches plant^{-1}

Genotypes	SFB/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	11.20	0.411	1.675	1.93	0.95	2.64	1.54	9	0.383	1.25
JA-08/B	9.53	0.176	0.201	1..27	1.63**	3.02	1.31	8	0.236	1.05
JA-08/C	8.13	0.282	1.214	2.35	1.28	1.73	1.25	4	1.078	0.38
JA-08/D	21.33	0.214	0.781	1.76	0.69	4.72	0.71	20	0.025	0.93
JA-08/E	8.07	0.652	0.321	1.45	1.05	1.08	1.35	3	-0.075	-0.60
JA-0541	9.50	0.133	0.182	1.35	0.98	1.01	0.20	7	-0.497	-0.12
JA-08/9	6.53	-0.257	1.552	-0.05	0.26	1.25	1.81	1	-1. 710	1.00
JA-054	9.03	0.346	0.952	2.24	0.16	0.39	1.03	6	0.954	-1.60
JA-0526	13.53	1.305	-0.075	0.34	0.81	0.14	2.13	14	1.151	-1.10
JA-0510	9.00	0.111	-0.423	-1.65	1.08*	0.03	0.29	15	-1.640	1.45
BC-088	13.50	0.252	-1.326	-0.79	0.73	1.52	1.57	13	-2.119	1.63
BC-0303	12.17	0.602	1..321	5.19	1.62**	0.35	1.58	10	-1.852	0.73
BC-0406	16.23	0.341	1.313	2.17	1.00	0.27	1.87	18	-0.457	-2.72
BC-051	13.23	-1.115	1.133	-1.51	1.43**	1.55	1.62	11	1.950	-1.18
BC-0342	16.57	-0.549	-1.546	-2.07	0.63	0.37	1.98	19	2.826	-0.95
BC-037	13.47	0.108	0.412	3.10	1.15*	1.13	0.25	12	1.684	1.17
BC-0188	15.13	-1.062	0.611	-1.32	0.55	1.79	1.90	16	0.131	0.85
CB-9	14.73	-1.038	-1.227	1.67	0.53	3.51	0.22	15	-0.480	-1.13
CB-10	15.50	0.172	0.118	1.50	1.63**	2.82	1.62	17		
CB-11	6.63	-1.127	-0.123	-2.95	1.77**	2.17	156	2		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

SFB/P: Secondary fruiting branches/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.15 AMMI and regression analysis on main stem nodes plant^{-1}

Genotypes	MSN/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	6.23	1.534	0. 553	1.65	0.87	0.77	2.45	6	1.226	0.33
JA-08/B	6.00	2.514	1.626	1.48	0.92	0.89	4.89	4	0.048	1.5.6
JA-08/C	6.23	3.615	2.575	3.72	0. 73	0.89	1.48	6	1.047	2.71
JA-08/D	7.13	1.350	1.784	1.82	0.86	1.28	4.72	14	2.085	0.71
JA-08/E	6.40	0.626	0.184	2.25	1.29**	1.26	1.39	9	1.761	2.64
JA-0541	6.07	2..217	1.279	1.15	1.13*	2.03	1.28	5	3.087	-1.36
JA-08/9	5.27	0.393	1.143	.181	0.89	0.79	1321	1	-3.356	1.88
JA-054	5.73	-1.015	4.100	-0/59	0.36	2.67	1.32	2	-1.206	1.45
JA-0526	6.23	2.159	-3.971	2.77	1.24**	1.03	0.13	6	-0.536	-0.53
JA-0510	5.93	-2.067	0. 214	0.56	0.51	0.72	4.24	3	2.640	1.52
BC-088	6.33	-2.175	1.175	1.29	0.91	1.76	1.92	8	2.252	0.36
BC-0303	6.40	2.113	-5.073	1.02	1.18*	1.06.	1.11	9	2.187	0.56
BC-0406	6.53	1.016	-0. 551	-2.68	1.38**	0.77	3.31	10	-0.048	-2.31
BC-051	6.33	2.079	2.665	-2.80	0.79	1.85	1.74	8	3.875	-0.51
BC-0342	7.03	0.907	0. 212	-.2707	1.19*	0.71	4.74	13	1.672	-0.97
BC-037	6.40	1.986	-4.243	0.14.	1.32**	0.96	2.44	9	0.953	1.12
BC-0188	6.73	0.842	-1.601	-10.4	1.68**	3.73	1.76	12	2.187	-.0.84
CB-9	7.73	-1.114	0.486	-2.18	0.95	0.73	2.00	15	-3.726	0.76
CB-10	6.57	-0.747	0.437	-1.01	0.55	0.61	0.77	11		
CB-11	6.27	2.494	1.374	-2.83	0.79	0.95	2.79	7		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

MSN/P: Main stem node/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.16 AMMI and regression analysis on days to 1st flowering

Genotypes	DFF	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	53	1.564	0.553	3.57	0.87	0.79	2.55	7	1.256	3.30
JA-08/B	50	2.548	1.646	4.52	0.56	0.80	4.89	4	0.028	3.27
JA-08/C	51	1.665	-2.415	3.76	0.97	0.89	2.43	5	1.057	2.73
JA-08/D	51	1.158	3.704	5.18	0.89	0.28	4.32	5	1.058	0.71
JA-08/E	53	0.726	-0.549	2.27	1.35**	1.26	1.30	7	1.752	264
JA-0541	49	5.239	-3.279	5.12	1.16*	1.20	2.82	3	3.083	3.67
JA-08/9	48	0.393	1.133	-1.83	0.79	0.79	1.32	2	-3.333	1.88
JA-054	51	-1.011	1.185	3.52	0.36	2.67	1.65	5	-1.286	1.47
JA-0526	52	-2.952	-3.082	2.75	1.24**	1.03	5.21	6	-3.526	2.38
JA-0510	50	-2.367	0.214	1.60	0.51	0.72	2.24	4	2.471	5.23
BC-088	50	-2.145	1.375	1.25	0.91	1.76	1.17	4	2.272	3.67
BC-0303	53	2.117	-2.075	1.02	1.18*	1.10	0.63	7	2.188	0.56
BC-0406	51	2.036	-0.651	3.67	1.18*	0.77	3.31	5	-0.798	-2.30
BC-051	47	4.051	2.656	-2.80	0.72	1.85	1.16	1	5.071	-5.13
BC-0342	51	2.507	0.212	-2.71	1.59**	0.71	4.74	5	1.672	-2.76
BC-037	56	2.786	-4.280	1.43	1.32**	0.96	2.49	8	-0.352	1.12
BC-0188	53	2.840	-1.201	-4.15	1.06*	3.73	2.76	7	2.182	0.84
CB-9	56	-1.115	0.786	-2.12	0.95	0.73	2.00	8	1.788	2.76
CB-10	50	-0.747	0.403	-1.09	0.95	2.14.	0.727	4		
CB-11	50	2.424	2.331	-2.89	0.71	0.95	2.79	4		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

DFF: Days to 1st flowering, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.17 AMMI and regression analysis on days to 1st boll splitting

Genotypes	DFBS	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	103	0.259	0.266	7.93	0.74	0.75	0.74	2	0.142	6.02
JA-08/B	105	0.826	0.257	9.05	1.42**	0.59	1.09	2	0.164	4.03
JA-08/C	106	0.296	0.436	10.18	0.95	056	0.75	4	0.501	4.19
JA-08/D	109	0.812	-0.520	11.87	1.58**	0.87	1.14	7	0.803	7.16
JA-08/E	107	-0.165	-1.024	8.16	1.38**	0.55	1.20	5	0.616	3.48
JA-0541	108	0.139	0.103	7.67	0.74	0.47	0.36	6	0.577	-6.64
JA-08/9	102	0.337	-0.734	6.47	1.92**	0.84	0.95	1	-1.716	2.80
JA-054	105	0.084	0.456	-5.82	0.65	0.47	0.46	2	-0.864	3.47
JA-0526	104	0.347	0.815	4.62	0.89	0.71	0.80	3	0.318	-6.40
JA-0510	104	-0.275	0.087	6.45	0.92	0.55	1.22	3	-0.518	1.36
BC-088	106	-0.704	0.849	0.93	0.57	0.88	1.34	4	0.584	-4.45
BC-0303	109	0.173	-0.654	2.38	1.25**	0.59	0.50	7	0.326	-3.83
BC-0406	107	1.381	-0.878	-5.38	0.86	0.65	1.73	5	-0.142	1.97
BC-051	104	-0.534	0.392	5.25	1.36**	0.79	0.92	3	0.343	-5.76
BC-0342	106	0.618	0.305	2.36	0.94	0.68	0.86	4	0.459	-2.10
BC-037	109	0.462	0.727	-6.19	0.59	0.59	0.93	7	-0.840	1.18
BC-0188	107	-0.815	-0.615	2.20	1.14	0.44	0.16	5	0.058	2.83
CB-9	115	-0.742	-0.543	5.48	1.44	0.57	1.25	8	-0.864	3.92
CB-10	116	0.896	-0.185	8.92	1.05	0.65	0.37	9		
CB-11	105	0.237	-0.186	-7.23	0.96	0.78	0.86	2		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

DFBS: Days to 1st boll split, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.18 AMMI and regression analysis on bolls plant^{-1}

Genotypes	B/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	33.5	0.432	1.261	3.88	0.89	0.84	1.24	18	0.349	3.86
JA-08/B	26.7	1.817	1.332	2.36	1. 77**	1.46	2.91	4	0.718	4.60
JA-08/C	31.5	1.175	1.175	2.09	0.96	1.64	2.16	12	1.69	3.56
JA-08/D	33.2	1.249	1.799	4.38	1.06*	1.29	2.99	17	1.449	6.49
JA-08/E	31.0	1.377	1.484	2.37	1.55**	1.25	2.91	11	1.375	1.47
JA-0541	28.2	1.845	0.567	-3.55	0.81	1.36	2.18	6	-1.981	1.64
JA-08/9	31.7	1.024	2.179	1.97	0.86	1.98	2.56	13	-0.758	4.37
JA-054	24.9	0.189	1.326	1.30	0.98	0.67	1.34	1	0.783	-3.37
JA-0526	30.0	1.412	0.777	-2.96	0.75	1.18	2.90	10	-0.154	-3.85
JA-0510	25.0	1.586	1.756	-1.79	0.73	1.37	2.89	2	-0.325	3.30
BC-088	29.0	1.459	2.043	2.08	1.09*	1.02	3.37	7	-0.669	-2.71
BC-0303	33.0	0.884	1.191	-2.73	1.13*	0.84	1.78	16	-0.892	-1.07
BC-0406	37.9	1.326	0.769	3.0	1.23**	1.41	2.19	20	1.736	2.06
BC-051	34.5	0.637	0.712	0.3	1.03	0.46	0.28	19	2.130	-2.59
BC-0342	29.9	0.607	0.478	2.00	0.93	1.16	3.81	8	3.257	-4.14
BC-037	32.4	2.107	2.704	-1.65	1.32	1.96	3.74	14	1.423	3.77
BC-0188	32.7	0.157	0.184	3.61	0.87	0.56	0.24	15	-0.141	3.15
CB-9	25.6	0.750	0.204	1.89	1.16*	0.83	1.14	3	0.466	-1.78
CB-10	33.4	0.877	0.869	2.85	1.38**	0.47	1.69	18		
CB-11	26.9	0.483	1.094	-1.04	0.96	1.88	1.24	5		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

B/P: Bolls/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.19 AMMI and regression analysis on boll weight

Genotypes	BW	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	4.74	0.145	0.135	0.53	0. 76	0.63	2.29	6	1.357	1.83
JA-08/B	5.03	1.649	1.475	0.83	1.74**	1.22	2.79	11	1.128	1.81
JA-08/C	6.17	1.326	1.534	0.89	0.94	1.07	2.16	20	0.577	0.98
JA-08/D	4.93	1.435	1.645	1.48	2.87**	1.92	1.15	8	1.124	2.18
JA-08/E	5.51	0.763	1.272	0.63	1.16*	1.70	1.72	17	1.287	1.28
JA-0541	5.46	-0.923	-1.592	1.23	0.18	0.65	-0.78	16	1.271	0.95
JA-08/9	4.17	1.923	-1.265	0.55	1.21	0.75	1.11	1	2.789	1.11
JA-054	5.80	0.607	0.411	-1.07	0.97	1.21	0.11	18	-2.314	-1.54
JA-0526	5.27	1.022	1.345	0.86	0.18	1.30	1.45	13	0.815	-0.91
JA-0510	4.75	-1.761	-0.646	-0.25	1.85**	0.71	0.401	7	4.846	0.65
BC-088	4.95	0.482	-0.255	-0.58	1.75**	1.41	3.40	9	-3.087	-464.26
BC-0303	4.49	-2.173	-1.228	-1.46	0.98	1.17	2.26	5	-5.471	-1.39
BC-0406	4.47	0.672	1.257	-2.68	0.95	0.09	1.79	4	2.311	1.29
BC-051	4.33	1.735	1.382	0.67	1.14*	1.40	1.96	2	-1.973	-1.45
BC-0342	5.40	1.465	-1.456	-1.02	0.75	0.28	1.84	15	-1..385	-0.90
BC-037	4.99	1.126	0.152	0.69	1.09	0.57	1.58	10	0.249	1.51
BC-0188	4.36	1.098	1.287	0.37	0.98	1.47	1.17	3	1.747	-1.79
CB-9	5.97	0.816	1.042	0.28	1.67**	0.41	1.06	19	-1.461	-1.27
CB-10	5.07	1.513	1.831	1.29	0.54	1.41	1.66	12		
CB-11	5.34	-1.603	1.721	-1.21	0.36	2.18	1.32	14		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

BW: Boll weight, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.20 AMMI and regression analysis on unburst bolls plant^{-1}

Genotypes	UBB/P	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	1.4	-0.537	-0.240	0.28	0.98	1.04	0.83	3	0.275	0.94
JA-08/B	1.8	1.317	1.146	0.67	1.40**	1.42	1.19	7	1.204	0.97
JA-08/C	1.4	0.648	0.387	0.54	1.09*	0.81	1.90	3	1.136	0.47
JA-08/D	1.4	-0.992	-1.446	0.98	0.78	1.23	1.54	3	0.555	083
JA-08/E	1.6	-0.626	0.378	0.54	1. 09*	1.09	0.79	5	1.147	0.29
JA-0541	1.5	-0.292	1.724	-0.54	1.07*	1.04	1.84	4	-0.068	-0.16
JA-08/9	2.3	0.814	-0.697	-0.16	0.95	0.96	1.12	9	0.437	0.19
JA-054	1.6	-0.236	-0.961	-0.19	0.89	0.61	0.59	5	0.830	-0.70
JA-0526	1.6	1.536	-1.665	0.95	1.08	0.85	2.78	5	-0.422	-0.95
JA-0510	1.0	-0.591	0.551	-0.97	0.96	0.93	1.61	1	0.383	0.19
BC-088	1.5	-0.537	1.426	-0.28	1.84**	0.53	1.96	4	-0.136	-0.78
BC-0303	1.2	-1.024	-0.946	-0.53	0.81	1.28	1.69	2	0.899	-0.09
BC-0406	1.8	0.552	0.843	0.68	1.20**	1.62	1.18	7	0.345	0.84
BC-051	1.6	-1.034	1.083	-0.32	1.30**	081	1.094	5	0.678	0.11
BC-0342	1.2	-0.939	-1.083	0.08	0.81	0.51	2.08	2	0.793	-0.85
BC-037	1.9	-0.212	1.580	-0.89	1.18*	4.07	1.62	8	0.580	0.78
BC-0188	1.5	0.878	-0.753	0.33	1.63**	3.04	1.09	4	0.912	-0.04
CB-9	1.5	-0.959	-1.617	0.36	0.70	1.73	2.92	4	0.267	-0.56
CB-10	1.7	-1.621	0.952	0.73	0.57	0.59	2.57	6		
CB-11	1.5	-0.520	-0.238	0.51	0.99	0.85	0.85	4		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

UBB/P: Unbrust bolls/plant, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.21 AMMI and regression analysis on plant height

Genotypes	PH	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	106.37	3.185	2.128	5.36	0.95	1.56	1.27	8	5373	5.83
JA-08/B	96.60	2.693	1.447	3.57	0.74	1.25	2.27	3	3.658	3.49
JA-08/C	101.73	1.345	1.194	2.48	0.96	1.13	2.16	5	4.578	3.67
JA-08/D	108.73	2.426	1.475	6.49	0.97	0.54	1.15	10	7.104	6.72
JA-08/E	94.33	0.643	-1.698	2.63	1.06*	0.87	1.17	2	1.187	2.79
JA-0541	110.07	-2.163	-1.597	1.26	0.98	0.83	3.57	11	5.941	-5.28
JA-08/9	91.80	1.620	-1.786	2.56	1.24**	0.15	1.10	1	2.273	4.86
JA-054	101.33	4.102	-3.4186	-1.05	0.94	1.95	5.51	4	-2.154	-2.64
JA-0526	108.33	-1.082	1.745	1.76	0.98	2.91	2.35	9	0.918	-2.51
JA-0510	102.13	2.278	-1.676	2.56	1.68**	0.56	3.07	6	2.484	1.67
BC-088	131.20	3.242	-2.255	-3.82	1.27	1.36	4.30	19	-9.058	-4.22
BC-0303	116.47	-8.117	-1.428	-3.78	0.91	1.62	2.15	12	-5.581	-2.90
BC-0406	130.93	-4.621	5.578	1.68	0.99	0.57	1.84	18	5.111	0.87
BC-051	118.73	4.135	1.857	-1.65	1.14*	2.80	1.96	14	-1.973	-4.41
BC-0342	130.00	-1.392	-2.406	-1.52	0.77	0.75	1.95	17	-1.574	-1.76
BC-037	128.80	2.816	3.354	2.68	1.19*	0.99	1.57	16	6.049	5.35
BC-0188	131.27	-2.438	1.257	-1.35	0.98	382.94	1.27	20	-1.734	-3.10
CB-9	104.70	3.126	1.082	1.92	1.27**	0.35	1.15	7	-1.261	-2..74
CB-10	118.67	1.532	3.034	2.97	0.45	0.93	2.66	13		
CB-11	119.73	-1.203	0.719	-1.83	0.84	0.86	1.80	15		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

PH: Plant height, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.22 AMMI and regression analysis on seeds boll^{-1}

Genotypes	S/B	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	27.9	3.480	2.401	2.45	0.95	0.57	3.68	15	1.472	2.47
JA-08/B	24.6	1.295	2.654	2.67	0.89	0.82	2.41	4	3.563	2.51
JA-08/C	29.9	1.325	-1.195	3.57	0.94	1.01	2.16	18	0.572	1.65
JA-08/D	28.2	-2.416	-1.477	5.62	0.97	0.42	1.55	17	4.184	2.74
JA-08/E	28.1	0.663	-1.169	3.58	1.06*	0.57	1.22	16	1.287	2.70
JA-0541	25.5	-2.143	-1.597	-2.92	0.78	1.32	1.78	6	1.071	1.28
JA-08/9	26.8	0.699	-1.765	1,68	1.21**	1.15	1.01	11	2.278	1.89
JA-054	26.0	4.206	2.418	-3.52	0.97	0.98	1.11	8	-2.454	1.65
JA-0526	35.0	-1.682	1.545	2.22	0.91	1.92	2.34	19	0.218	1.59
JA-0510	26.3	2.279	-1.637	-2.37	1.18*	0.56	0.40	9	2.464	1.69
BC-088	25.0	3.243	-2.215	2.88	1.52**	0.36	3.45	5	-2.088	1.26
BC-0303	22.9	-2.118	-1.284	-3.31	0.84	5.62	2.12	1	-5.578	2.94
BC-0406	27.4	-6.621	6.575	-2.19	0.92	1.65	1.89	14	1.317	0.82
BC-051	25.6	4.125	3.847	3.48	1.14*	2.84	1.24	7	-.1976	4.41
BC-0342	27.1	-1.371	-2.416	1.52	0.78	0.74	1.84	12	-1.5.35	1.79
BC-037	23.0	4.826	3.372	1.76	1.19*	4.42	1.58	2	3..249	2.31
BC-0188	26.5	-2.418	1.027	-2.58	0.68	2.94	1.14	10	-1.147	3.13
CB-9	23.3	3.156	1.572	1.009	1.07*	0.35	1.03	3	-1.159	-2.04
CB-10	27.17	-1.581	3.031	4.376	0.95	1.96	3.66	13		
CB-11	23.3	-1.2.09	1.716	1.487	0.64	131	1.88	3		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

S/B: Seeds/boll, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

Table 4.23 AMMI and regression analysis on seed cotton yield (kg ha^{-1})

Genotypes	SCY	IPCA1 Score	IPCA2 Score	Phenotypic index (Pi)	bi	S^2di	ASV	Rank	SI	E. index (Ei)
JA-08/A	3012	2.185	1.328	153.68	0.91	0.39	7.29	14	2.363	18.384
JA-08/B	2641	5.659	3.413	89.65	0.94	1.22	12.29	5	1.628	181.49
JA-08/C	3329	1.345	1.194	80.39	0.84	1.02	11.60	18	0.057	281.63
JA-08/D	3430	2.436	1.475	149.16	0.97	5.42	15.15	19	2.134	114.75
JA-08/E	3226	1.643	1.169	126.39	1.06*	0.77	11.22	17	1.284	112.79
JA-0541	2711	2.155	6.532	126.80	0.88	2.32	7.18	7	5.971	157.21
JA-08/9	2904	2.623	-1.766	105.67	1.24**	3.15	21.01	11	2.789	114.89
JA-054	2810	4.186	4.181	-105.6	0.97	5.96	5.51	10	-2.354	-154.64
JA-0526	2703	-1.058	1.845	76.89	0.98*	3.92	2.35	6	0.814	-216.51
JA-0510	2799	2.271	-0.676	25.63	1.18*	2.56	20.01	9	2.480	65.64
BC-088	2703	3.242	-2.245	-382.96	1.52**	3.69	23.50	6	-4.088	-404.26
BC-0303	2580	-4.811	-1.828	-378.92	0.84	1.15	21.26	4	-5.574	-132.94
BC-0406	3089	-6.625	1.657	168.18	0.92	1.16	18.91	15	5.711	129.81
BC-051	2969	4.125	1.852	-65.79	1.01	2.84	9.64	12	-19.276	-214.41
BC-0342	2973	-3.139	-5.046	-52.00	0.78	0.71	9.84	13	-15.834	-207.79
BC-037	2466	3.892	2.352	208.61	1.19*	4.42	5.68	2	5.949	151.31
BC-0188	2758	-2.408	1.227	153.57	0.98	443.94	2.714	8	10.44	-309.13
CB-9	2389	3.112	1.072	192.14	1.27**	0.35	11.53	1	-16.41	-272.04
CB-10	3205	-1.733	3.037	297.58	0.94	1.96	3.60	16		
CB-11	2483	-1.209	4.716	-183.15	0.86	3.15	8.80	3		

* and ** indicate significant at 5% and 1% levels of probability, respectively.

SCY: Seed cotton yield, **IPCA:** Interaction principal component analysis, **bi:** Regression coefficient, **S^2di:** Deviation from regression coefficient, **ASV:** Average stability value, **SI:** Selection index, **Ei:** Environmental index

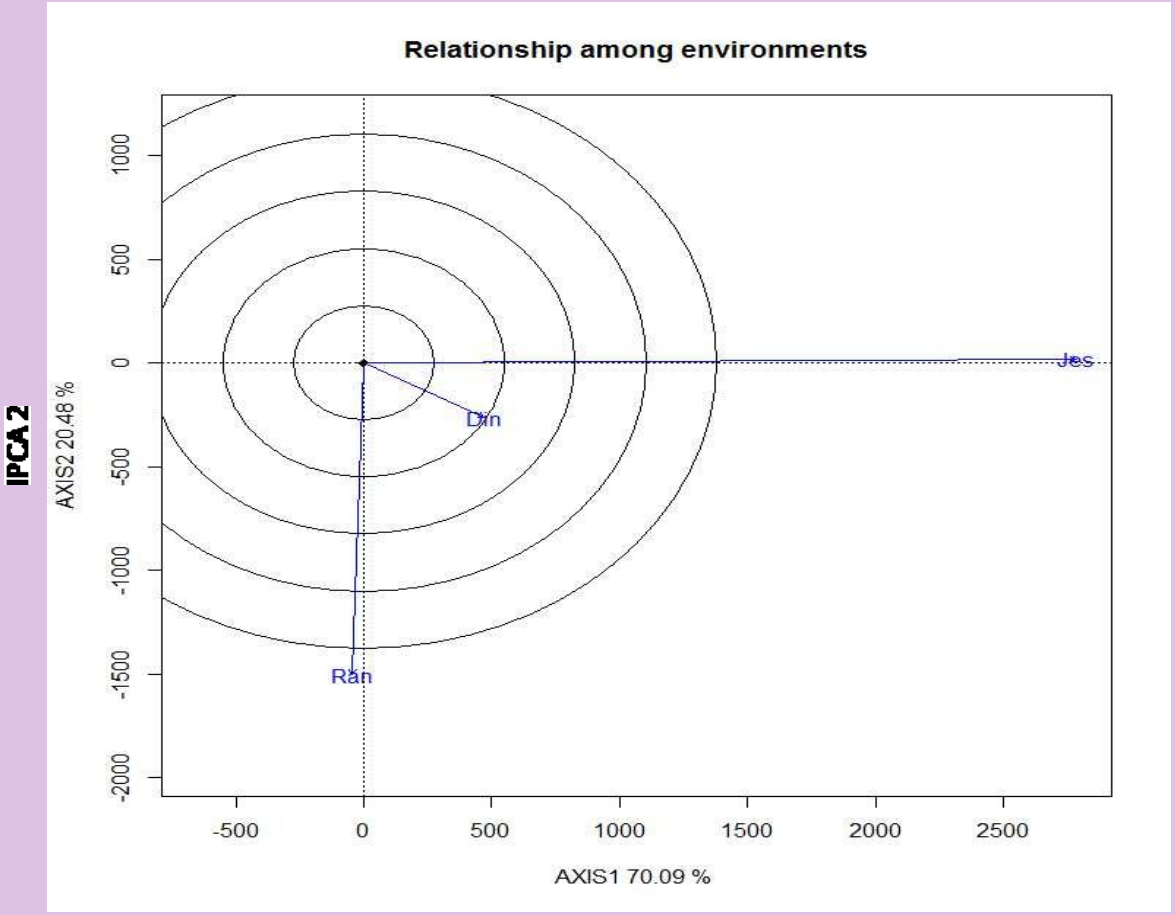

Fig. 4.1 GGE biplot analysis based environment focused sealing for comparison seed cotton yield (kg ha^{-1})

IPCA: Interaction principal component analysis through two axes, **Ordinate=** Jessore (1st quardant), **Abcissa=** Rangpur (3rd quardant), **Between Ordinate and Abcissa=** Dinajpur (4th quardant)

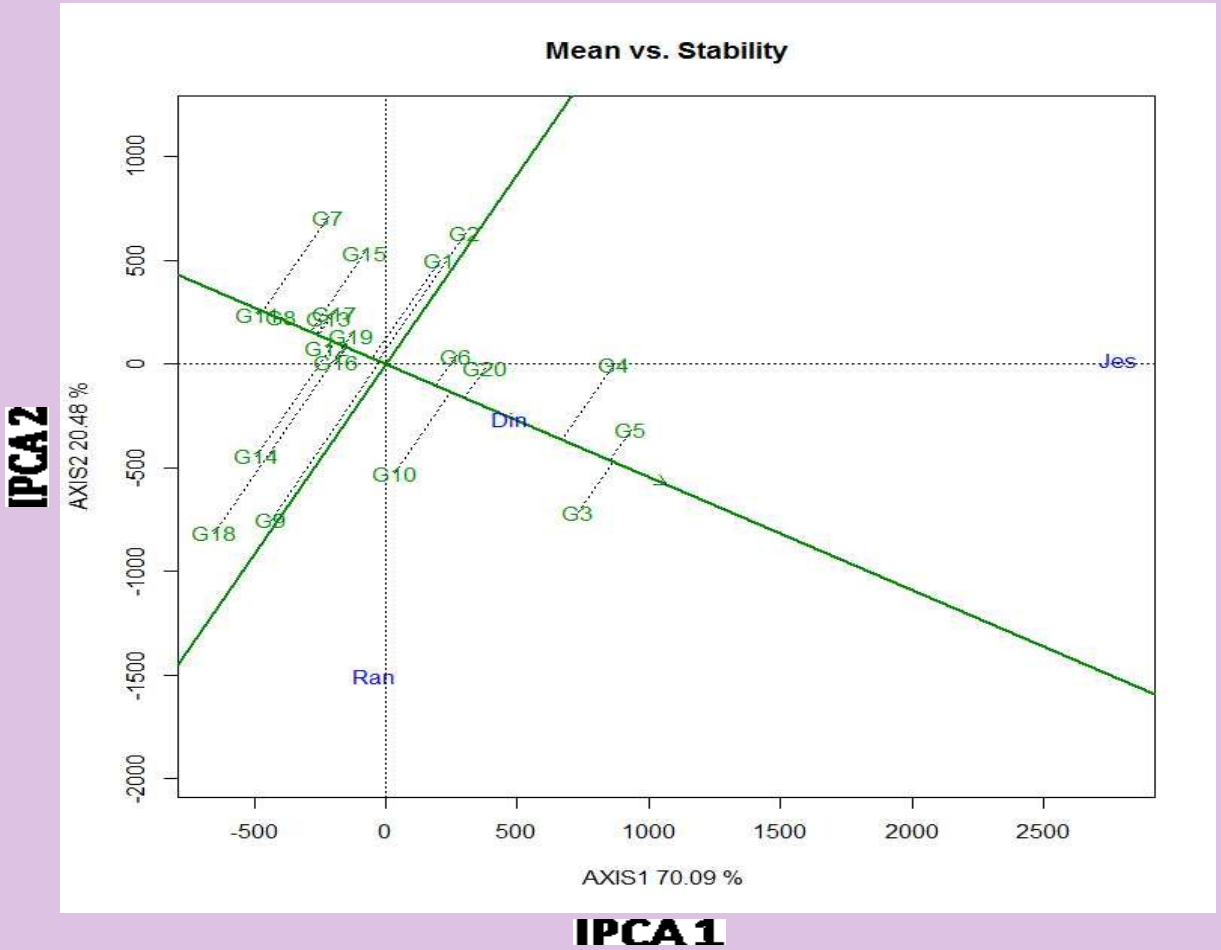

Fig. 4.2 AMMI Model for seed cotton yield (kg ha^{-1}) showing the means of genotypes and locations against their respective IPCA scores

IPCA: Interaction principal component analysis through two axes, **Green color indicate =** Distribution of 20 genotypes, **Purple color indicate =** Locations

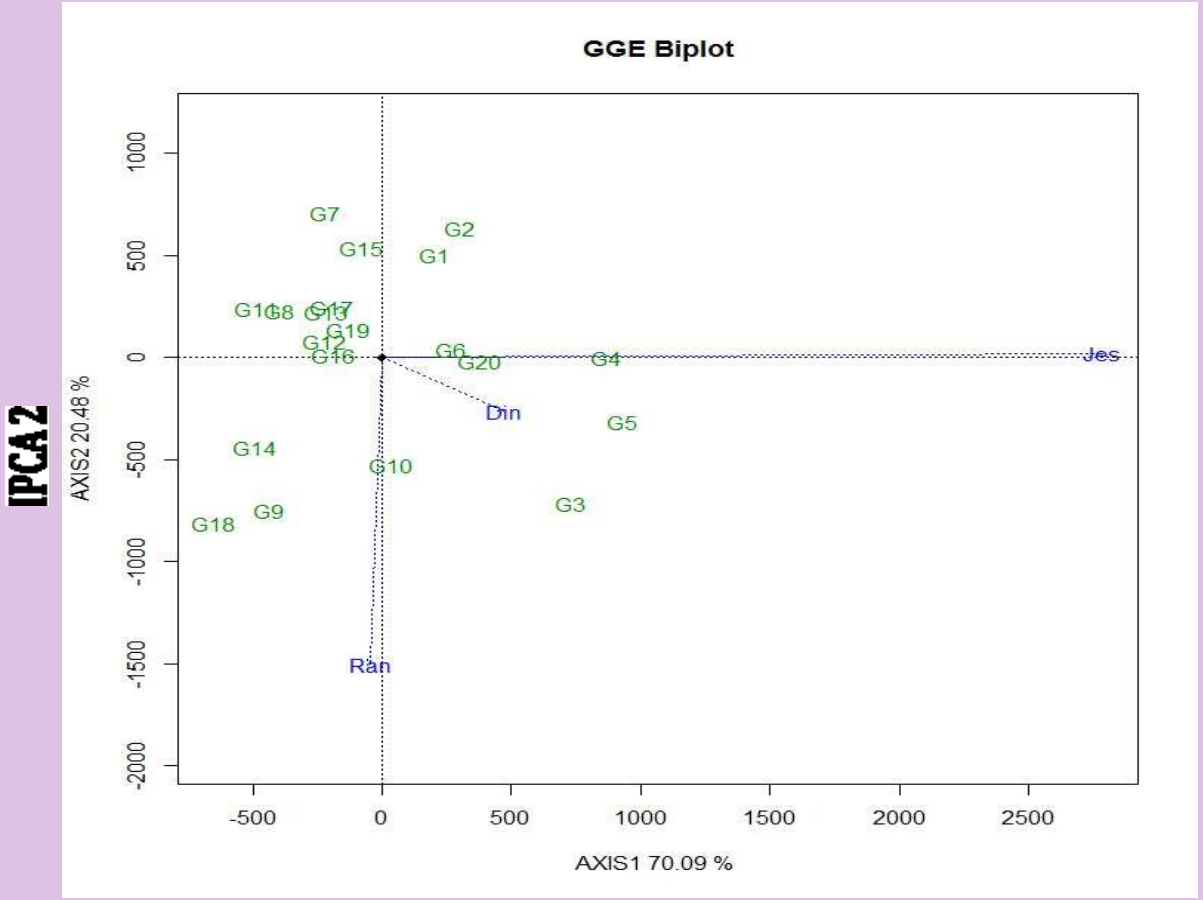

Fig. 4.3 Average tester coordinator (ATC) views of the GGE biplot based on environmental focused sealing for seed cotton yield (kg ha^{-1}) and stability of the genotypes

IPCA: Interaction principal component analysis through two axes, **Green color indicate =** Distribution of 20 genotypes , **Purple color indicate =** Locations

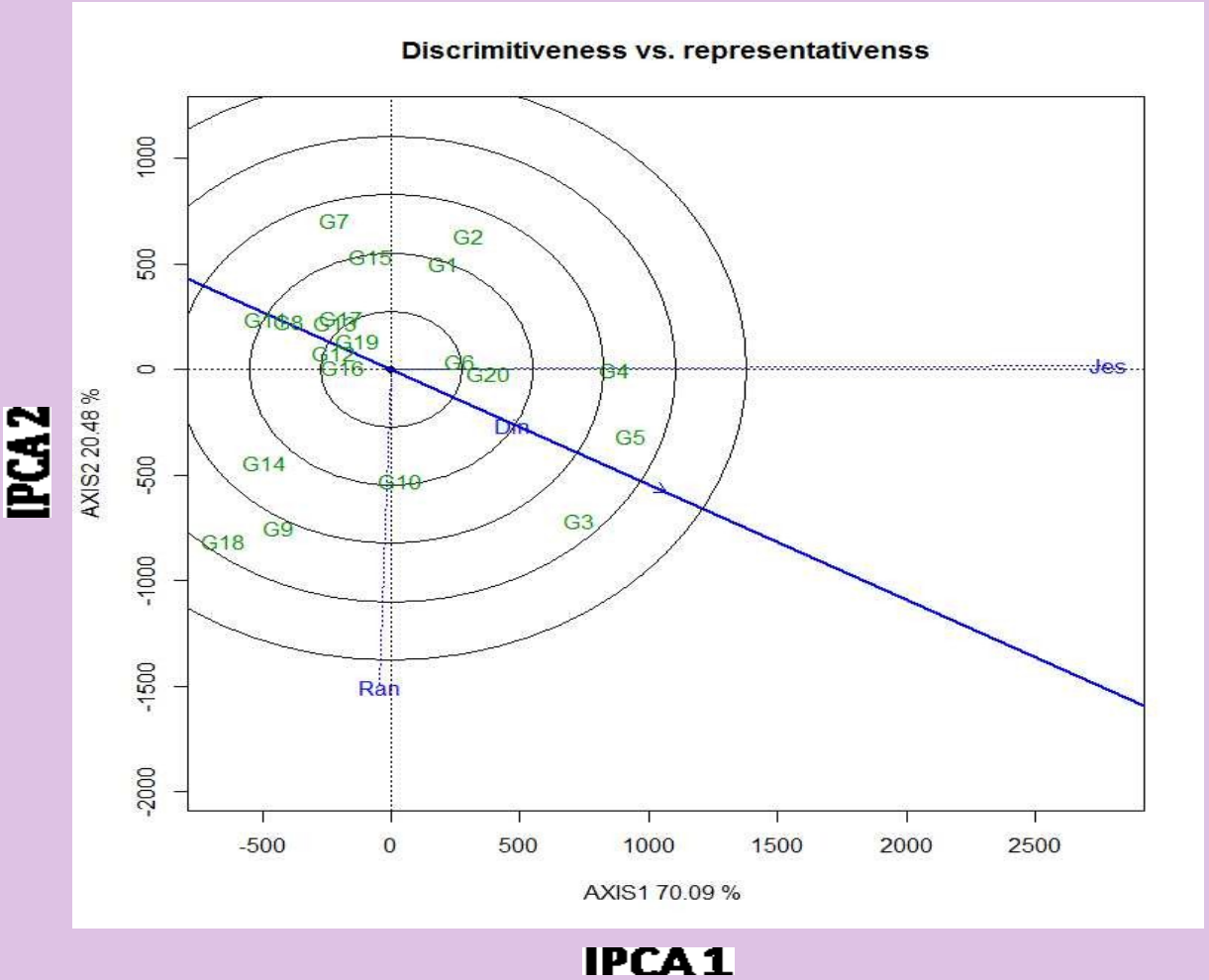

Fig. 4.4 AMMI Model for seed cotton yield (kg ha^{-1}) showing IPCA 1vs IPCA 2 scores of cotton genotypes sown across the locations

IPCA: Interaction principal component analysis through two axes, **Green color indicate =** Distribution of 20 genotypes, **Purple color indicate =** Locations, **Purple diagonal line=** Average G x E with relative distributions of the genotypes and environments.

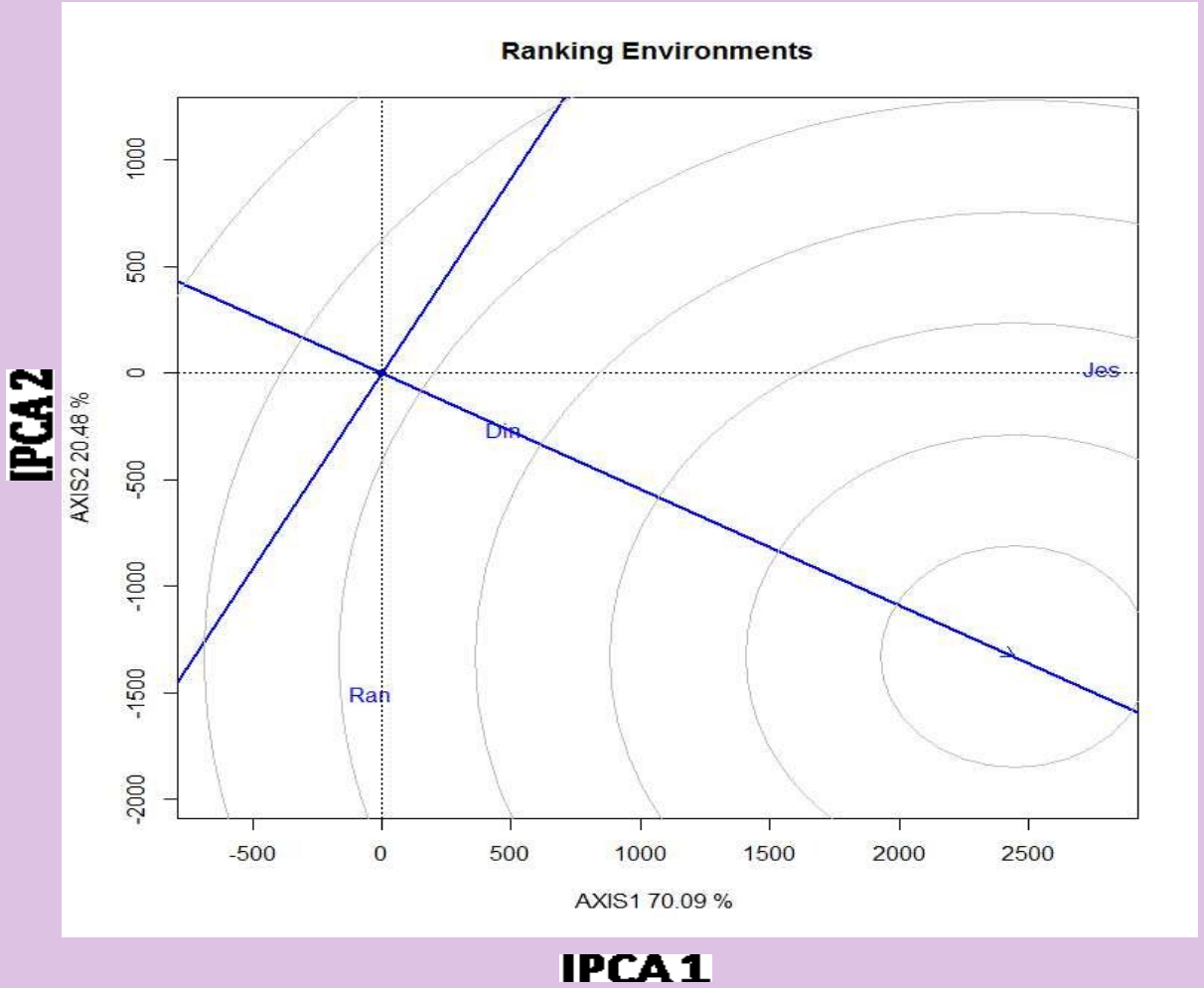

Fig. 4.5 GGE biplot analysis based on environmental means focusing comparison seed cotton yield (kg ha^{-1})

IPCA: Interaction principal component analysis through two axes
Purple color indicate = Locations
Purple lines = Upper slopping line is more sensitive to lower slopping line

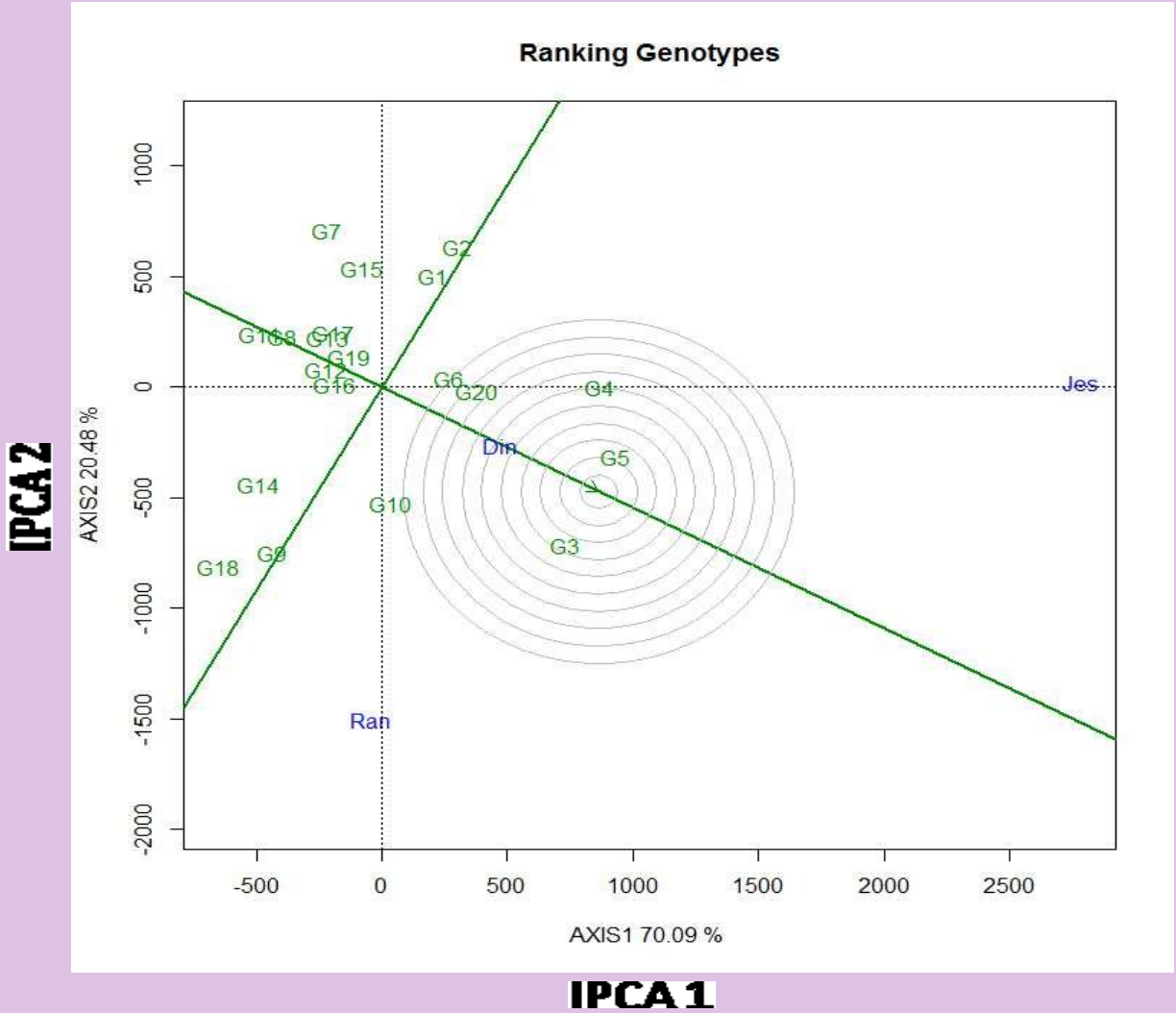

Fig. 4.6 GGE biplot of ideal location and comparison of the loca-tion with genotypes for seed cotton yield (kg ha^{-1})

IPCA: Interaction principal component analysis through two axes, **Purple color indicate =** Locations, **Purple lines=** Upper slopping line is more sensitive to lower slopping line

Table 4.24 Characteristics of cotton fibers in 20 genotypes

Genotypes	G.OT (%)	Seed index (g)	Lint index (%)	Fuzz grade	50% Span length (inch)	2.5% Span length (inch)	2.5% Span length (mm)	Presley strength (psi)	Micronaire value
JA-08/A	41.60	8.56	6.57	6	0.5	1.13	28.7	84.7	4.17
JA-08/B	42.00	10.42	7.84	7	0.58	1.14	28.96	83.87	4.28
JA-08/C	42.33	8.68	6.26	6	0.57	1.16	29.46	84.63	4.16
JA-08/D	43.05	12.26	7.59	8	0.59	1.19	30.23	85.58	4.39
JA-08/E	39.97	11.30	5.80	7	0.58	1.15	29.21	83.79	4.05
JA-0541	4118	9.57	5.43	6	0.56	1.16	29.46	84.97	4.16
JA-08/9	39.63	8.99	6.08	6	0.53	1.11	28.19	83.03	4.25
JA-054	37.13	9.25	6.12	5	0.55	1.13	28.7	84.25	4.28
JA-0526	37.31	7.78	5.58	6	0.51	1.18	29.97	84.33	4.16
JA-0510	36.48	8.71	6.8	6	0.52	1.18	29.97	84.70	4.03
BC-088	35.15	9.56	6.72	7	0.50	1.15	29.21	83.59	4.12
BC-0303	36.48	9.72	4.47	6	0.54	1.16	29.46	84.61	4.27
BC-0406	34.42	9.58	5.88	6	0.55	1.17	29.72	83.87	4.18
BC-051	34.98	9.99	5.95	6	0.57	1.15	29.21	84.34	4.14
BC-0342	35.47	9.16	4.36	5	0.58	1.13	28.7	84.58	4.12
BC-037	36.90	9.45	7.67	7	0.53	1.14	28.96	84.70	4.23
BC-0188	35.58	9.50	6.20	5	0.52	1.16	29.46	83.85	4.16
CB-9	34.68	9.26	6.88	7	0.57	1.16	29.46	82.62	4.25
CB-10	37.52	10.52	7.90	8	0.58	1.18	29.97	84.50	4.13
CB-11	33.74	9.39	6.55	8	0.53	1.10	27.94	84.18	4.02
CV (%)	7.23	8.46	7.21	6.89	6.29	6.48	6.48	8.22	5.90
LSD	2.375	1,842	1.736	0.815	0.025	0.007	0.007	0.002	0.012

G.O.T: Ginning out turn

CONCLUSION

1. Twelve characters including seed cotton yield kg ha^{-1} revealed significant variation is 20 cotton genotypes (*Gossypium hirsutum* L.).

2. The highest seed cotton yield (3430 kg ha^{-1}) was obtained from JA-08/D followed by JA-08/C (3329 kg ha^{-1}), JA-08/E (3226 kg ha^{-1}) and CB-10 (3205 kg ha^{-1}).

3. The PCV for particular character was higher than corresponding GCV, suggested environmental influence upon the phonotypic expression of the characters.

4. A total of 55 × 2 = 110 pairs of correlation coefficients were measured under each of genotypic and phenotypic levels (rg and rp).

5. In general, rg was higher than rp for a character, indicated inherent relationship between the pairs of characters.

6. Days to 1st flowering, bolls plant^{-1} and seeds boll^{-1} exhibited strong association with seed cotton yield both at genotypic and phenotypic levels.

7. The cause and effects of the characters were furnished with seed cotton yield through path analysis where the direct effect (1.982) was exerted by seeds boll^{-1} to develop relationship with seed cotton yield.

8. The genetic worth was increased with corresponding inclusion of more characters in the selection function.

9. The highest relative efficiency over direct selection for seed cotton yield was realized (157.22%) while five characters were included in the selection function.

10. The G × E was elaborated by AMMI analysis where the additive effects of the polygenes showed significant role for the expression of the characters.

11. The interactions such as Location × Year × Genotype were analyzed by multiplicative interactions.

12. The G × E was strong for a character where the location such as Jessore offered good environment for cotton genotype evaluation.

13. The Jessore is the best location and the genotype A-08/D, JA-08/C, JA-08/E and CB-10 were primarily selected to evolve new variety of cotton suitable for Bangladesh.

RECOMMENDATION

1. The selected twelve characters including seed cotton yield differentially response to three locations over three years.

2. Bolls plant^{-1}, Seeds boll^{-1} and boll weight were the more seed cotton yield enhancing characters. So breeders might exploit these three characters for improvement of cotton.

3. Jessore was the best location for cotton cultivation; therefore, the farmers' of this belt might include to PPB (Participatory Plant Breeding) or PVS (Participatory Variety Selection) methods. to find out high seed cotton yielding genotypes.

4. Though five insects such as thrips, cotton bug, bollworm, aphids and whitefly frequently visited during cropping season but JA-08/D showed complete resistant to insect attack.

5. Any of the four high seed cotton yielding genotypes JA-08/D, JA-08/C, JA-08/E and CB-10 might advance in further breeding programs with a view to develop high yielding cotton varieties.

Plate No. 1: Supervisory committee and Ph.D student were discussing about the write up on the big signboard at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 2: Phenotypic views of some promising lines.

Plate No. 3: A member of the supervisory committee was observing the bursting cotton boll at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 4: Field visit of the supervisory committee at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 5: Field visit of the supervisory committee at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 6: Field visit of the supervisory committee at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 7: Supervisor was briefing about botanical aspects of cotton to his Ph.D student at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 8: Field visit of the supervisory committee.

Plate No. 9: A moment of photo session of the supervisory committee and two Ph.D students at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 10: Ph.D student was discussing with Supervisory committee about the different aspects of cotton research at Cotton Research Farm, Jagodishpur, Jessore

Plate No. 11: Practical view of emasculation was shown by a field assistant to the Supervisory committee at Cotton Research Farm, Jagodishpur, Jessore


THANKS TO ALL