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Adaptability of Bt and NBt Cotton Hybrids in Different Locations in Central and Southern India

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ABSTRACT

Keywords

Stability, Cotton, Adaptability, $G \times E$ interaction

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Cotton has a proud place among the crops from earliest times. Apart from seed cotton the cotton seed oil also has very good quality and vitamin E. Among 24 Bt and their counterparties non-Bt hybrids evaluated JKCH-2245 non-Bt, K-5038 Bt, KDCHH-441 Bt, NCEN-2R non-Bt, Dhruva Bt and JKCH-99 Bt hybrids were identified as stable yielders for south and central India.

Introduction

Cotton, white gold rules the world of textile moreover it is unchallenged as a natural textile fibre, despite the advent of a multitude of other fibres. It is an important fibre and food crop of nearly 100 countries with China, India, United States, Pakistan and Brazil being five of the largest producers of cotton. Since the discovery of the Mohen-jodaro relics the history of cotton and cotton manufacture came to be treated as beginning from times of the ancient Indus valley civilization, which flourished in India about 5000 years ago.

Gossypium hirsutum, *G. barbadense*, *G. arboreum* and *G. herbaceum* are grown in

varied agro-climate in northern, central and southern India from 9° N latitude to 31° N latitude. *G. hirsutum* is the principal cultivated cotton and accounts for about 90 per cent of the world cotton production. *G. barbadense* accounts for about eight per cent of the world cotton production. The estimated area under cotton during 2008 to 2009 in India was 93.73 lakh ha with production and productivity of 290 lakh bales and 526 kg lint per ha, respectively (Sharma *et al.*, 2009). In the year of 2008 in Karnataka, cotton was grown over an area of 3.5 lakh ha with 8.9 lakh bales production. India has 20 per cent of total cotton growing area of the world and contributes over 12 per cent to total production.

In India, cotton is cultivated in diverse situations ranging from irrigated situation characterized by intensive management to assured rainfed situation where moisture is not a constraint to dry rainfed situation characterized by low rainfall (less than 500 mm) accompanied by high temperature and high intensity.

To achieve the target of increasing cotton production at national level, it is essential that productivity of cotton increases in all these situations. In this regard the adaptability of genotypes in different environment is very important. Thereby the present investigation to identify Bt and non Bt hybrids in South and Central India was taken up.

Materials and Methods

To analyze the data over three environments the stability model proposed by Eberhart and Russell (1966) was adopted. This model involves the estimation of three parameters which are defined by a mathematical formula.

$$Y_{ij} = \mu_i + \beta_i I_j + S_{ij}$$

Where, Y_{ij} = Mean of the i^{th} variety at the j^{th} environment, μ_i = Mean of i^{th} variety over all environments, β_i = The regression coefficient that measures the response of i^{th} variety to varying environments, S_{ij} = The deviation from regression of the i^{th} variety at the j^{th} environment and I_j = The environmental index obtained by subtracting the grand mean from the mean of all varieties at the j^{th} environment.

These parameters were calculated as follows

Environmental index

$$I_j = \frac{\sum_i Y_{ij}}{t} - \frac{\sum_i \sum_j Y_{ij}}{t \cdot s}$$

Where,

t = Number of varieties, s = Number of environments, with $\sum_j I_j = 0$

The regression coefficient for each variety (b_i)

$$b_i = \frac{\sum_j Y_{ij} I_j}{\sum_j I_j^2}$$

Deviation from regression

$$S^2 d_i = \frac{\sum_j \delta_{ij}^2}{s - 2} - \frac{S^2_e}{r}$$

Where, S^2_e/r = Mean square for (estimate of) pooled error

Predicted performance of the genotypes

$$Y_{ij} = \bar{X}_i + b_i I_j$$

Where, $\bar{X}_i$ is the estimate of μ_i ,

In this model the variance due to environments and genotype $\times$ environment are partitioned into environment (linear), genotype $\times$ environment (linear) and deviation from the regression coefficient.

Genotype-environment interaction

The magnitude of GE interaction was assessed for each character and each genotype. This was worked out as per the procedure suggested by Eberhart and Russell (1966).

The analysis of variance for stability as per this model is algebraically represented as below.

Where, n = number of environments, r = number of replications, g = number of genotypes, CF = Correction factor.

To test the significance of pooled deviation mean square against the pooled error mean square.

$$F = \frac{MS_3}{MS_4}$$

If pooled deviation mean square is found significant then it would be the appropriate denominator to test the significance of all components including genotypes, genotype $\times$ environment (linear). Otherwise pooled error mean square is appropriate denominator.

To test the significance of the differences among the means of genotypes.

$$F = \frac{MS_1}{MS_3}$$

To test that the genotypes do not differ for their regression on environmental index

$$F = \frac{MS_2}{MS_3}$$

Further, 't' test is used to test the significance of deviation of 'b_i' from unity

$$t = \frac{|1 - b_i|}{S.E(b_i)}$$

Where,

$$SE(b_i) = \frac{\sqrt{\frac{\sum_j \delta_{ij}^2}{n-2}}}{\sum_j I_{2j}}$$

Where, δ_{ij}^2 is the deviation of ith variety in jth environment from regression

To test individual deviation from linear regression

$$F = \text{Pooled error mean square} \left(\frac{\sum_j \delta_{ij}^2}{(n-2)} \right) /$$

A joint consideration of three parameters, that is

The mean performance of the genotype over environments (location), X_i

Regression coefficient b_i and

The deviation from linear regression $S^2 d_i$, are used to define stability of genotype (variety).

The estimate of deviation from regression suggests the degree of reliance that should be put to linear regression in interpretation of data. If these values are significantly deviating from zero, the expected phenotype cannot be predicted satisfactorily. When deviations are non-significant, the conclusions, may be drawn by joint consideration of mean yield and regression values (Finlay and Wilkinson, 1963 and Eberhart and Russell, 1966) as below.

Regression value of unity is interpreted as average stability since the average slope over all varieties on the environment index will be unity.

Results and Discussion

The detailed ANOVA for stability (Table 13) revealed significant differences among the genotypes with respect to yield, twenty boll weight, ginning outturn, seed index, oil content at 1 per cent level and monopodial branches at 5 per cent level. But, there was no significant difference in sympodia, bolls per plant, fuzz per cent, hull per cent and kernel per cent. Variance due to environment was significant for all traits at 1 per cent level. $G \times E$ interaction was found significant for yield, plant height, bolls per plant, oil percentage, fuzz per cent at 1 per cent level and monopodia and seed index showed significance at 5 per cent level. Remaining characters viz., sympodia, 20 boll weight, hull per cent and kernel per cent and ginning outturn (%) recorded non-significant $G \times E$ interaction. $G \times E$ (linear) was found

significant for sympodial branches, bolls per plant, ginning outturn per cent, fuzz per cent, hull per cent and kernel per cent at 1 per cent level. Besides, significant pooled deviations show that performance of genotypes fluctuated from the linear path of response to environment for all characters except ginning outturn per cent.

Genetic adaptability studies through stability parameters (mean performance, bi and S^2_{di}) for different traits has been presented in Table 29.

Stability analysis

Genotype $\times$ environmental interactions are of major importance to plant breeders in developing improved varieties. These interactions are usually present in any biological experiment, reducing the progress from selections (Comstock and Moll, 1963). Selection of genotypes that interact less with the environments in which they are grown is known to reduce genotype $\times$ environment interactions (Allard and Bradshaw, 1964) and aids the breeder in developing stable genotypes.

The present study comprising 24 Bt hybrids and their non-Bt counterpart hybrids were evaluated across three locations *viz.*, Dharwad, Bagalkot and Nagpur for 12 quantitative traits to know the prevalence of $G \times E$ interactions and stability of performance of hybrids across locations for the characters presented in Table 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. The results revealed significant differences among the hybrids for different traits studied in each of the environments and after testing for homogeneity of errors across environments, the data was considered for pooling, which is a prerequisite for two way analysis.

In the two-way analysis of variance (Table pooled analysis) presented in Table 14. The

mean square due to genotype $\times$ environmental interactions was found significant for seed cotton yield (kg/ha), plant height, number of bolls per plant, oil per cent, fuzz content, monopodial branches and ginning outturn which exhibited significance at 1 and 5 per cent suggesting differential response of the genotypes to varying environments and mean squares due to environment was also observed to be significant for all the traits justifying the selection of sites for the present investigation. A review of past work indicated considerable $G \times E$ interaction operating in cotton (Bhatade and Bhale, 1983; Dani, 1999; Blanche *et al.*, 2006; Reddy and Reddy, 2007; El-Kadi *et al.*, 2007; Vannirajan, 2007 and Saini *et al.*, 2008).

Further, the analysis of variance for stability (Eberhart and Russell, 1964) also revealed significant differences among the hybrids for seed cotton yield (kg/ha), 20-boll weight, ginning outturn, seed index, oil content and monopodial branches. The additive environmental variance was found to be of considerable magnitude as indicated by the significance of variance due to environment (linear) for all the characters except kernel content. The mean squares due to pooled deviation was found significant for all the characters except seed cotton yield (kg/ha), thus implying that there is no simple relationship existing between genotypes and the environments and therefore, it is rather difficult to predict the performance of the genotypes across environments.

Bhatade and Bhale (1983), Deshpande and Bhale (1983), Blanche *et al.*, (2006), Elkadi *et al.*, (2007), Saini *et al.*, (2008), Reddy and Reddy (2007), for oil content, obtained significance for genotype $\times$ environment (linear). But, found significance for pooled deviation which indicated that part of variation in the performance of genotypes is predictable (Eberhart and Russell, 1964).

The more pronounced linearity for the character oil content could largely be explained by differences in regression slopes. This obviously means that fairly accurate prediction of the genotypic performance of genotypes is possible for oil content.

The mean performance of genotypes in the present study varied with the environment in response to change in environments. As the genotypes did not respond uniformly, the mean performance of genotypes *i.e.*, population mean or site mean (Eberhart and Russell, 1964) varied across environments. A single parameter based on site mean, the "Environment index" was introduced which is the deviation of site mean from overall grand mean. Once the significant genotype $\times$ environment interaction is observed for a given trait, the next task would be to identify the stable genotype, which interacts moderately with the environments giving a near consistent performance across environments.

The regression coefficient and deviation from regression of each variety presented in Table 15.

Finlay and Wilkinson (1963) suggested that a genotype is considered as stable, if it had high mean and unit regression coefficient ($b_i = 1$). However, the model is based only on linear regression which could simply be regarded as a measure of response of a particular genotype. Eberhart and Russell (1964) suggested both linear and non-linear (S^2d_i) components of genotype $\times$ environmental interactions.

According to this model, the genotype is considered as ideal and stable when it possesses high or low mean (depending on the character) with regression coefficient around unity ($b_i = 1$) and deviation from regression coefficient (S^2d_i) being non-significant.

A stable genotype is one with a regression slope near to unity, insignificant deviation from regression line and having higher mean value for the trait.

Patel *et al.*, (1999) observed 64 *Gossypium hirsutum* hybrids and their 20 parents for yield at three locations. Hybrids from four crosses possessed average stability and gave high yield. All parents gave lower yields, but showed greater stability than the hybrids. Similar results were observed by (Eberhart and Russell, 1964), Deshpande and Bhale (1983), Bhatade and Bhale (1983) and Ansingkar and Bhale (1984), El-Okkia *et al.*, (1982), El-Dayim *et al.*, (1982), Rao *et al.*, (1989), Bhatade *et al.*, (1995), Basu (1996), Baloch *et al.*, (1994), Opondo and Ombakho (1997), Wondima (2000), Stoilova and Dechev (2002), El-Feki *et al.*, (2002), Anandan *et al.*, (2003), Badra (2003), Nanjundan *et al.*, (2004), Nirania (2004), Anandan *et al.*, (2005), Pund and Dev (2006), Xing Chao *et al.*, (2007) and Saini *et al.*, (2008).

So far many Bt hybrids have been released and identification of location specific and well adapted Bt hybrids is the pressing need. Thereby this investigation was planned and executed. The results are presented in Table 16.

K-5038 Bt (1820.33 kg/ha), NCEN-2R NBt (1763.33 kg/ha), JKCH-2245 NBt (1665.33 kg/ha), KDCHH-441 Bt (1651 kg/ha), Dhruva Bt (1643 kg/ha) and JKCH-99 Bt (1577.33 kg/ha) hybrids were found suitable for cultivation at all the three locations indicating their wider adaptability based on stability parameter. On an average, seed cotton yield of all these hybrids was significantly higher than check. The deviation from regression coefficient was also insignificant for these hybrids and regression coefficient of all these hybrids did not significantly deviate from 1.

Table.1 Mean performance of Bt and non-Bt hybrids across three environments for oil content (%)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	20.43	21.75	-6.07	5.85	12.69	19.20	18.10	6.08	8.17	1.97	20.35	20.70	-1.69	-1.93	-0.24	19.99	20.18	-0.94	3.74	4.72
K-5038	21.73	21.31	1.97	12.59	10.41	19.25	16.65	15.62	8.45	-6.20	21.55	18.75	14.93	3.86	-9.64	20.84	18.90	10.26	8.15	-1.92
KDCHH-441	20.67	18.71	10.48	7.10	-3.06	18.25	17.10	6.73	2.82	-3.66	19.45	17.75	9.58	-6.27	-14.46	19.46	17.85	9.02	0.99	-7.37
JK-Indra	20.83	21.20	-1.75	7.93	9.84	18.85	18.65	1.07	6.20	5.07	21.40	21.75	-1.61	3.13	4.82	20.36	20.53	-0.83	5.66	6.54
RCH-2	19.30	19.71	-2.08	0.00	2.12	17.75	17.10	3.80	0.00	-3.66	20.75	17.60	17.90	0.00	-15.18	19.27	18.14	6.23	0.00	-5.86
JK-Ishwar	21.74	20.45	6.31	12.64	5.96	18.00	17.15	4.96	1.41	-3.38	21.50	21.25	1.18	3.61	2.41	20.41	19.62	4.03	5.92	1.82
JKCH-1947	15.16	18.56	-18.32	-21.45	-3.83	15.80	17.10	-7.60	-10.99	-3.66	14.60	18.00	-18.89	-29.64	-13.25	15.19	17.89	-15.09	-21.17	-7.16
JKCH-22	15.01	19.77	-24.08	-22.23	2.44	16.85	19.15	-12.01	-5.07	7.89	13.95	16.75	-16.72	-32.77	-19.28	15.27	18.56	-17.73	-20.76	-3.68
Ankur-651	18.46	18.94	-2.53	-4.35	-1.87	17.95	17.85	0.56	1.13	0.56	17.00	17.12	-0.70	-18.07	-17.49	17.80	17.97	-0.95	-7.63	-6.75
JKCH-1050	17.46	12.40	40.81	-9.53	-35.75	17.00	17.45	-2.58	-4.23	-1.69	10.90	14.05	-22.42	-47.47	-32.29	15.12	14.63	3.35	-21.54	-24.08
PCH-2270	18.12	20.76	-12.72	-6.11	7.56	17.50	16.75	4.48	-1.41	-5.63	18.35	21.15	-13.24	-11.57	1.93	17.99	19.55	-7.98	-6.64	1.45
NCEN-3R	20.81	20.83	-0.10	7.82	7.93	16.62	16.40	1.34	-6.37	-7.61	20.40	21.30	-4.23	-1.69	2.65	19.28	19.51	-1.18	0.05	1.25
KDCHH-9810	20.36	19.61	3.82	5.49	1.61	18.25	17.00	7.35	2.82	-4.23	21.55	19.60	9.95	3.86	-5.54	20.05	18.74	6.99	4.05	-2.75
NCEN-2R	20.35	20.72	-1.79	5.44	7.36	17.25	17.35	-0.58	-2.82	-2.25	21.02	19.75	6.43	1.30	-4.82	19.54	19.27	1.40	1.40	0.00
JKCH-266	20.10	14.52	38.43	4.15	-24.77	18.45	15.00	23.00	3.94	-15.49	14.50	19.20	-24.48	-30.12	-7.47	17.68	16.24	8.87	-8.25	-15.72
Dhruva	21.94	22.35	-1.83	13.68	15.80	17.95	17.00	5.59	1.13	-4.23	22.75	21.55	5.57	9.64	3.86	20.88	20.30	2.86	8.35	5.35
K-5316	21.34	22.50	-5.16	10.57	16.58	18.00	18.00	0.00	1.41	1.41	20.55	22.20	-7.43	-0.96	6.99	19.96	20.90	-4.50	3.58	8.46
KDCHH-9632	21.40	20.90	2.39	10.88	8.29	17.10	16.60	3.01	-3.66	-6.48	20.70	20.25	2.22	-0.24	-2.41	19.73	19.25	2.49	2.39	-0.10
JK-Varun	15.75	18.92	-16.75	-18.39	-1.97	14.73	17.50	-15.83	-17.01	-1.41	15.50	16.45	-5.78	-25.30	-20.72	15.33	17.62	-13.00	-20.45	-8.56
PCH-2171	17.51	19.46	-10.02	-9.27	0.83	17.55	17.65	-0.57	-1.13	-0.56	16.20	19.80	-18.18	-21.93	-4.58	17.09	18.97	-9.91	-11.31	-1.56
JK-Durga	16.78	14.56	15.25	-13.06	-24.56	15.00	16.00	-6.25	-15.49	-9.86	16.55	16.75	-1.19	-20.24	-19.28	16.11	15.77	2.16	-16.40	-18.16
JKCH-99	20.60	19.75	4.30	6.74	2.33	17.95	17.85	0.56	1.13	0.56	20.50	18.25	12.33	-1.20	-12.05	19.68	18.62	5.69	2.13	-3.37
JKCH-1945	17.81	19.16	-7.05	-7.72	-0.73	16.10	16.70	-3.59	-9.30	-5.92	13.75	19.20	-28.39	-33.73	-7.47	15.89	18.35	-13.41	-17.54	-4.77
JK-Gowri	21.25	21.31	-0.28	10.10	10.41	17.00	17.80	-4.49	-4.23	0.28	19.75	20.15	-1.99	-4.82	-2.89	19.33	19.75	-2.13	0.31	2.49
Mean	19.37	19.51				17.43	17.25				18.48	19.14				18.43	18.63			
SEm±	0.86					0.64					0.68					0.30				
CD at 5%	2.47					1.82					1.94					0.83				
CD at 1%	3.29					2.43					2.59					1.09				

Table.2 Mean performance of Bt and non-Bt hybrids across three environments for kernel content (%)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	63.93	63.95	-0.03	-11.58	-11.55	62.80	63.70	-1.41	1.45	2.91	54.20	54.15	0.09	-7.43	-7.51	60.31	60.60	-0.48	-6.13	-5.68
K-5038	61.10	64.30	-4.98	-15.49	-11.07	62.05	62.05	0.00	0.24	0.24	63.45	56.95	11.41	8.37	-2.73	62.20	61.10	1.80	-3.19	-4.90
KDCHH-441	69.70	64.15	8.65	-3.60	-11.27	62.60	64.55	-3.02	1.13	4.28	56.10	52.45	6.96	-4.18	-10.42	62.80	60.38	4.01	-2.26	-6.02
JK-Indra	84.35	60.95	38.39	16.67	-15.70	55.30	59.70	-7.37	-10.66	-3.55	60.15	53.95	11.49	2.73	-7.86	66.60	58.20	14.43	3.66	-9.42
RCH-2	72.30	66.60	8.56	0.00	-7.88	61.90	63.90	-3.13	0.00	3.23	58.55	59.00	-0.76	0.00	0.77	64.25	63.17	1.71	0.00	-1.68
JK-Ishwar	73.60	71.00	3.66	1.80	-1.80	66.70	61.45	8.54	7.75	-0.73	55.60	48.20	15.35	-5.04	-17.68	65.30	60.22	8.44	1.63	-6.27
JKCH-1947	50.90	67.35	-24.42	-29.60	-6.85	66.25	64.15	3.27	7.03	3.63	57.85	56.05	3.21	-1.20	-4.27	58.33	62.52	-6.70	-9.21	-2.69
JKCH-22	71.90	68.30	5.27	-0.55	-5.53	60.40	66.55	-9.24	-2.42	7.51	56.55	57.35	-1.39	-3.42	-2.05	62.95	64.07	-1.75	-2.02	-0.28
Ankur-651	56.50	58.25	-3.00	-21.85	-19.43	66.15	56.20	17.70	6.87	-9.21	62.10	51.90	19.65	6.06	-11.36	61.58	55.45	11.06	-4.16	-13.70
JKCH-1050	66.10	63.55	4.01	-8.58	-12.10	62.75	63.60	-1.34	1.37	2.75	55.40	55.95	-0.98	-5.38	-4.44	61.42	61.03	0.64	-4.40	-5.01
PCH-2270	67.35	65.15	3.38	-6.85	-9.89	63.25	57.55	9.90	2.18	-7.03	59.60	55.60	7.19	1.79	-5.04	63.40	59.43	6.68	-1.32	-7.50
NCEN-3R	63.55	62.75	1.27	-12.10	-13.21	56.65	62.80	-9.79	-8.48	1.45	63.00	58.45	7.78	7.60	-0.17	61.07	61.33	-0.42	-4.95	-4.54
KDCHH-9810	59.90	59.60	0.50	-17.15	-17.57	58.95	54.65	7.87	-4.77	-11.71	55.80	55.40	0.72	-4.70	-5.38	58.22	56.55	2.95	-9.39	-11.98
NCEN-2R	67.45	66.60	1.28	-6.71	-7.88	55.00	63.35	-13.18	-11.15	2.34	61.60	56.70	8.64	5.21	-3.16	61.35	62.22	-1.40	-4.51	-3.16
JKCH-266	54.95	56.80	-3.26	-24.00	-21.44	58.10	62.25	-6.67	-6.14	0.57	62.75	59.15	6.09	7.17	1.02	58.60	59.40	-1.35	-8.79	-7.55
Dhruva	56.75	56.45	0.53	-21.51	-21.92	61.95	59.70	3.77	0.08	-3.55	54.20	55.30	-1.99	-7.43	-5.55	57.63	57.15	0.84	-10.30	-11.05
K-5316	75.55	70.30	7.47	4.50	-2.77	63.30	63.30	0.00	2.26	2.26	54.75	54.15	1.11	-6.49	-7.51	64.53	62.58	3.12	0.44	-2.60
KDCHH-9632	62.10	60.17	3.21	-14.11	-16.78	59.40	65.95	-9.93	-4.04	6.54	60.75	51.65	17.62	3.76	-11.78	60.75	59.26	2.51	-5.45	-7.77
JK-Varun	67.00	67.45	-0.67	-7.33	-6.71	59.75	56.30	6.13	-3.47	-9.05	52.30	58.25	-10.21	-10.67	-0.51	59.68	60.67	-1.63	-7.11	-5.57
PCH-2171	70.70	66.15	6.88	-2.21	-8.51	63.95	60.95	4.92	3.31	-1.53	51.60	47.80	7.95	-11.87	-18.36	62.08	58.30	6.48	-3.38	-9.26
JK-Durga	68.35	66.90	2.17	-5.46	-7.47	58.50	60.40	-3.15	-5.49	-2.42	58.80	75.55	-22.17	0.43	29.04	61.88	67.62	-8.49	-3.69	5.25
JKCH-99	65.35	61.30	6.61	-9.61	-15.21	64.10	61.80	3.72	3.55	-0.16	63.75	65.45	-2.60	8.88	11.78	64.40	62.85	2.47	0.23	-2.18
JKCH-1945	61.80	60.05	2.91	-14.52	-16.94	66.95	62.35	7.38	8.16	0.73	50.05	57.05	-12.27	-14.52	-2.56	59.60	59.82	-0.37	-7.24	-6.89
JK-Gowri	61.55	57.30	7.42	-14.87	-20.75	62.20	59.20	5.07	0.48	-4.36	54.80	56.25	-2.58	-6.40	-3.93	59.52	57.58	3.37	-7.36	-10.38
Mean	65.53	63.56				61.62	61.52				57.65	56.36				61.60	60.48			
SEm _d	3.78					2.25					3.36					1.30				
CD at 5%	10.76					6.41					9.55					3.60				
CD at 1%	14.36					8.59					12.73					4.70				

Table.3 Mean performance of Bt and non-Bt hybrids across three environments for hull content (%)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	36.05	36.05	0.00	30.14	30.14	37.20	36.30	2.48	-2.36	-4.72	45.80	45.85	-0.11	10.49	10.62	39.68	39.40	0.71	10.99	10.21
K-5038	38.90	34.70	12.10	40.43	25.27	37.95	37.95	0.00	-0.39	-0.39	36.55	43.05	-15.10	-11.82	3.86	37.80	38.57	-2.00	5.73	7.89
KDCHH-441	30.30	35.85	-15.48	9.39	29.42	37.40	35.40	5.65	-1.84	-7.09	43.90	47.55	-7.68	5.91	14.72	37.20	39.60	-6.06	4.06	10.77
JK-Indra	15.65	39.05	-59.92	-43.50	40.97	44.70	40.30	10.92	17.32	5.77	39.85	46.05	-13.46	-3.86	11.10	33.40	41.80	-20.10	-6.57	16.92
RCH-2	27.70	33.40	-17.07	0.00	20.58	38.10	36.10	5.54	0.00	-5.25	41.45	41.00	1.10	0.00	-1.09	35.75	36.83	-2.93	0.00	3.02
JK-Ishwar	26.40	29.00	-8.97	-4.69	4.69	33.30	38.55	-13.62	-12.60	1.18	44.40	51.80	-14.29	7.12	24.97	34.70	39.78	-12.77	-2.94	11.27
JKCH-1947	49.00	32.65	50.08	76.90	17.87	33.75	35.85	-5.86	-11.42	-5.91	42.15	43.95	-4.10	1.69	6.03	41.63	37.48	11.07	16.45	4.84
JKCH-22	28.10	31.70	-11.36	1.44	14.44	39.60	33.45	18.39	3.94	-12.20	43.45	42.65	1.88	4.83	2.90	37.05	35.93	3.12	3.64	0.50
Ankur-651	43.50	41.75	4.19	57.04	50.72	33.85	43.80	-22.72	-11.15	14.96	37.90	48.10	-21.21	-8.56	16.04	38.42	44.55	-13.76	7.47	24.62
JKCH-1050	33.90	36.45	-7.00	22.38	31.59	37.25	36.20	2.90	-2.23	-4.99	44.60	44.05	1.25	7.60	6.27	38.58	38.90	-0.82	7.92	8.81
PCH-2270	32.65	34.85	-6.31	17.87	25.81	35.75	42.45	-15.78	-6.17	11.42	40.40	44.40	-9.01	-2.53	7.12	36.27	40.57	-10.60	1.45	13.48
NCEN-3R	36.45	37.25	-2.15	31.59	34.48	43.35	37.15	16.69	13.78	-2.49	37.00	41.55	-10.95	-10.74	0.24	38.93	38.65	0.72	8.90	8.11
KDCHH-9810	40.10	40.40	-0.74	44.77	45.85	41.05	43.35	-5.31	7.74	13.78	44.20	44.60	-0.90	6.63	7.60	41.78	42.78	-2.34	16.87	19.66
NCEN-2R	32.55	33.40	-2.54	17.51	20.58	45.00	36.65	22.78	18.11	-3.81	38.40	43.30	-11.32	-7.36	4.46	48.65	37.78	28.77	36.08	5.68
JKCH-266	45.05	43.20	4.28	62.64	55.96	41.90	37.75	10.99	9.97	-0.92	37.25	40.85	-8.81	-10.13	-1.45	41.40	40.60	1.97	15.80	13.57
Dhruva	43.25	43.55	-0.69	56.14	57.22	38.05	40.30	-5.58	-0.13	5.77	45.80	44.70	2.46	10.49	7.84	42.37	42.85	-1.12	18.52	19.86
K-5316	24.45	29.70	-17.68	-11.73	7.22	36.70	36.70	0.00	-3.67	-3.67	45.25	45.85	-1.31	9.17	10.62	35.47	37.42	-5.21	-0.78	4.67
KDCHH-9632	37.90	39.85	-4.89	36.82	43.86	40.80	34.05	19.82	7.09	-10.63	39.25	48.35	-18.82	-5.31	16.65	39.32	40.75	-3.51	9.99	13.99
JK-Varun	33.00	32.55	1.38	19.13	17.51	40.25	43.70	-7.89	5.64	14.70	47.70	41.75	14.25	15.08	0.72	40.32	39.33	2.52	12.78	10.01
PCH-2171	29.30	33.85	-13.44	5.78	22.20	36.05	39.05	-7.68	-5.38	2.49	48.40	52.20	-7.28	16.77	25.93	37.92	41.70	-9.06	6.07	16.64
JK-Durga	31.65	33.10	-4.38	14.26	19.49	41.50	39.60	4.80	8.92	3.94	41.20	24.45	68.51	-0.60	-41.01	38.12	32.38	17.73	6.63	-9.43
JKCH-99	34.65	38.70	-10.47	25.09	39.71	35.90	38.20	-6.02	-5.77	0.26	36.25	34.55	4.92	-12.55	-16.65	35.60	37.15	-4.17	-0.42	3.92
JKCH-1945	38.20	39.95	-4.38	37.91	44.22	43.05	37.65	14.34	12.99	-1.18	49.95	42.95	16.30	20.51	3.62	43.73	40.18	8.84	22.32	12.39
JK-Gowri	38.45	42.70	-9.95	38.81	54.15	37.80	40.80	-7.35	-0.79	7.09	45.20	43.75	3.31	9.05	5.55	40.48	42.42	-4.57	13.23	18.66
Mean	34.46	36.40	-5.22	24.40	31.41	38.76	38.39	1.56	1.73	0.76	42.35	43.64	-1.26	2.17	5.28	38.94	39.48	-0.98	8.92	10.43
SEm ₁	3.82					2.24					3.36					1.31				
CD at 5%	10.89					6.40					9.55					3.62				
CD at 1%	14.53					8.54					12.74					4.78				

Table.4 Mean performance of Bt and non-Bt hybrids across three environments for ginning outturn (%)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	36.70	36.10	1.66	-0.81	-2.43	37.00	37.25	-0.67	2.07	2.76	37.00	37.25	-0.67	2.07	2.76	36.90	36.87	0.08	1.10	1.01
K-5038	37.00	35.20	5.11	0.00	-4.86	37.70	37.00	1.89	4.00	2.07	37.70	37.50	0.53	4.00	3.45	37.47	36.57	2.46	2.66	0.19
KDCHH-441	37.70	42.20	-10.66	1.89	14.05	37.70	39.35	-4.19	4.00	8.55	37.70	39.50	-4.56	4.00	8.97	37.70	40.35	-6.57	3.29	10.55
JK-Indra	32.90	38.90	-15.42	-11.08	5.14	39.95	40.30	-0.87	10.21	11.17	39.95	40.30	-0.87	10.21	11.17	37.60	39.83	-5.60	3.01	9.12
RCH-2	37.00	36.40	1.65	0.00	-1.62	36.25	36.60	-0.96	0.00	0.97	36.25	36.60	-0.96	0.00	0.97	36.50	36.53	-0.08	0.00	0.08
JK-Ishwar	35.00	34.60	1.16	-5.41	-6.49	36.20	37.50	-3.47	-0.14	3.45	36.20	37.50	-3.47	-0.14	3.45	35.80	36.53	-2.00	-1.92	0.08
JKCH-1947	37.60	35.80	5.03	1.62	-3.24	40.50	37.20	8.87	11.72	2.62	40.30	37.20	8.33	11.17	2.62	39.45	36.73	7.41	8.08	0.63
JKCH-22	40.20	36.40	10.44	8.65	-1.62	42.85	36.80	16.44	18.21	1.52	42.25	36.80	14.81	16.55	1.52	41.75	36.67	13.85	14.38	0.47
Ankur-651	36.10	34.35	5.09	-2.43	-7.16	38.40	39.00	-1.54	5.93	7.59	38.40	38.80	-1.03	5.93	7.03	37.63	37.38	0.67	3.10	2.41
JKCH-1050	34.70	34.00	2.06	-6.22	-8.11	37.35	42.25	-11.60	3.03	16.55	37.25	42.25	-11.83	2.76	16.55	36.47	39.36	-7.34	-0.08	7.84
PCH-2270	37.00	29.15	26.93	0.00	-21.22	35.20	35.05	0.43	-2.90	-3.31	35.00	35.05	-0.14	-3.45	-3.31	35.73	33.08	8.01	-2.11	-9.37
NCEN-3R	32.20	35.00	-8.00	-12.97	-5.41	37.15	39.10	-4.99	2.48	7.86	37.15	39.10	-4.99	2.48	7.86	35.50	37.73	-5.91	-2.74	3.37
KDCHH-9810	36.00	35.70	0.84	-2.70	-3.51	37.00	37.40	-1.07	2.07	3.17	37.40	37.40	0.00	3.17	3.17	36.80	36.83	-0.08	0.82	0.90
NCEN-2R	35.30	36.50	-3.29	-4.59	-1.35	35.15	36.50	-3.70	-3.03	0.69	35.15	36.75	-4.35	-3.03	1.38	35.20	36.50	-3.56	-3.56	0.00
JKCH-266	38.80	40.60	-4.43	4.86	9.73	38.50	41.50	-7.23	6.21	14.48	38.80	43.10	-9.98	7.03	18.90	38.70	41.73	-7.26	6.03	14.33
Dhruva	37.65	33.75	11.56	1.76	-8.78	36.00	37.65	-4.38	-0.69	3.86	36.15	37.65	-3.98	-0.28	3.86	36.60	36.18	1.16	0.27	-0.88
K-5316	35.70	33.00	8.18	-3.51	-10.81	36.45	35.80	1.82	0.55	-1.24	36.40	35.80	1.68	0.41	-1.24	36.20	34.87	3.81	-0.82	-4.47
KDCHH-9632	37.25	36.20	2.90	0.68	-2.16	39.70	40.20	-1.24	9.52	10.90	39.70	40.20	-1.24	9.52	10.90	38.88	38.87	0.03	6.52	6.49
JK-Varun	42.30	38.50	9.87	14.32	4.05	40.55	40.05	1.25	11.86	10.48	43.50	40.05	8.61	20.00	10.48	42.11	39.53	6.53	15.37	8.30
PCH-2171	34.40	26.00	32.31	-7.03	-29.73	36.50	34.50	5.80	0.69	-4.83	36.50	34.60	5.49	0.69	-4.55	35.80	31.70	12.93	-1.92	-13.15
JK-Durga	37.00	37.00	0.00	0.00	0.00	34.00	36.55	-6.98	-6.21	0.83	34.60	32.45	6.63	-4.55	-10.48	34.46	36.70	-6.10	-5.59	0.55
JKCH-99	36.00	35.55	1.27	-2.70	-3.92	37.00	35.00	5.71	2.07	-3.45	37.00	35.00	5.71	2.07	-3.45	36.67	35.18	4.24	0.47	-3.62
JKCH-1945	40.00	36.00	11.11	8.11	-2.70	40.00	37.05	7.96	10.34	2.21	43.25	37.75	14.57	19.31	4.14	40.00	36.93	8.31	9.59	1.18
JK-Gowri	35.00	34.70	0.86	-5.41	-6.22	35.70	36.00	-0.83	-1.52	-0.69	35.55	36.45	-2.47	-1.93	0.55	35.75	35.71	0.11	-2.05	-2.16
Mean	36.65	35.48				37.62	37.73				37.88	37.71				37.32	37.02			
SE _{em} ±	1.28					1.35					1.38					0.54				
CD at 5%	3.64					3.86					3.92					1.50				
CD at 1%	4.86					5.25					5.24					1.98				

Table.5 Mean performance of Bt and non-Bt hybrids across three environments for seed index (g)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	8.10	8.40	-3.57	9.46	13.51	8.30	9.30	-10.75	-5.14	6.29	6.85	8.70	-21.26	-2.14	24.29	7.75	8.80	-11.93	0.39	13.99
K-5038	8.60	9.40	-8.51	16.22	27.03	9.15	9.25	-1.08	4.57	5.71	8.05	7.90	1.90	15.00	12.86	8.60	8.85	-2.82	11.40	14.64
KDCHH-441	8.60	8.00	7.50	16.22	8.11	9.60	9.45	1.59	9.71	8.00	7.15	8.50	-15.88	2.14	21.43	8.45	8.65	-2.31	9.46	12.05
JK-Indra	7.90	8.00	-1.25	6.76	8.11	8.95	8.90	0.56	2.29	1.71	7.10	6.55	8.40	1.43	-6.43	7.98	7.82	2.05	3.37	1.30
RCH-2	7.40	7.80	-5.13	0.00	5.41	8.75	10.30	-15.05	0.00	17.71	7.00	6.85	2.19	0.00	-2.14	7.72	8.32	-7.21	0.00	7.77
JK-Ishwar	8.40	9.10	-7.69	13.51	22.97	7.85	10.10	-22.28	-10.29	15.43	7.10	7.60	-6.58	1.43	8.57	7.78	8.93	-12.88	0.78	15.67
JKCH-1947	3.65	6.90	-47.10	-50.68	-6.76	7.25	7.95	-8.81	-17.14	-9.14	5.75	5.40	6.48	-17.86	-22.86	5.55	6.75	-17.78	-28.11	-12.56
JKCH-22	5.70	7.00	-18.57	-22.97	-5.41	7.20	8.60	-16.28	-17.71	-1.71	6.60	9.80	-32.65	-5.71	40.00	6.50	8.47	-23.26	-15.80	9.72
Ankur-651	5.50	6.00	-8.33	-25.68	-18.92	8.95	8.65	3.47	2.29	-1.14	8.55	6.20	37.90	22.14	-11.43	7.67	6.95	10.36	-0.65	-9.97
JKCH-1050	5.00	5.40	-7.41	-32.43	-27.03	8.50	7.00	21.43	-2.86	-20.00	6.75	6.65	1.50	-3.57	-5.00	6.75	6.35	6.30	-12.56	-17.75
PCH-2270	6.40	7.80	-17.95	-13.51	5.41	9.15	9.65	-5.18	4.57	10.29	7.65	7.20	6.25	9.29	2.86	7.73	8.22	-5.96	0.13	6.48
NCEN-3R	7.70	8.90	-13.48	4.05	20.27	8.30	9.90	-16.16	-5.14	13.14	8.30	8.40	-1.19	18.57	20.00	8.10	9.07	-10.69	4.92	17.49
KDCHH-9810	7.70	10.10	-23.76	4.05	36.49	9.65	9.45	2.12	10.29	8.00	7.85	8.05	-2.48	12.14	15.00	8.40	9.20	-8.70	8.81	19.17
NCEN-2R	8.60	9.20	-6.52	16.22	24.32	9.90	8.70	13.79	13.14	-0.57	6.15	6.50	-5.38	-12.14	-7.14	8.22	8.13	1.11	6.48	5.31
JKCH-266	8.40	5.90	42.37	13.51	-20.27	8.20	7.20	13.89	-6.29	-17.71	6.45	8.55	-24.56	-7.86	22.14	7.68	7.22	6.37	-0.52	-6.48
Dhruva	7.85	8.70	-9.77	6.08	17.57	8.70	10.15	-14.29	-0.57	16.00	7.30	7.80	-6.41	4.29	11.43	7.95	8.88	-10.47	2.98	15.03
K-5316	7.40	8.80	-15.91	0.00	18.92	8.15	8.50	-4.12	-6.86	-2.86	7.35	6.45	13.95	5.00	-7.86	7.63	7.92	-3.66	-1.17	2.59
KDCHH-9632	8.50	9.05	-6.08	14.86	22.30	9.90	9.50	4.21	13.14	8.57	7.65	7.35	4.08	9.29	5.00	8.68	8.63	0.58	12.44	11.79
JK-Varun	6.25	6.40	-2.34	-15.54	-13.51	6.45	8.85	-27.12	-26.29	1.14	6.15	5.85	5.13	-12.14	-16.43	6.28	7.03	-10.67	-18.65	-8.94
PCH-2171	6.50	7.10	-8.45	-12.16	-4.05	8.70	8.85	-1.69	-0.57	1.14	6.25	5.65	10.62	-10.71	-19.29	7.15	7.20	-0.69	-7.38	-6.74
JK-Durga	6.50	8.15	-20.25	-12.16	10.14	8.35	8.95	-6.70	-4.57	2.29	6.15	6.35	-3.15	-12.14	-9.29	7.00	7.82	-10.49	-9.33	1.30
JKCH-99	8.10	8.90	-8.99	9.46	20.27	10.40	11.25	-7.56	18.86	28.57	7.60	7.95	-4.40	8.57	13.57	8.70	9.37	-7.15	12.69	21.37
JKCH-1945	5.30	5.50	-3.64	-28.38	-25.68	7.50	7.80	-3.85	-14.29	-10.86	6.15	6.55	-6.11	-12.14	-6.43	6.32	6.62	-4.53	-18.13	-14.25
JK-Gowri	7.50	8.80	-14.77	1.35	18.92	9.45	9.25	2.16	8.00	5.71	5.80	7.60	-23.68	-17.14	8.57	7.58	8.55	-11.35	-1.81	10.75
Mean	7.15	7.89				8.64	9.06				6.99	7.27				7.59	8.07			
SE _{mp}	0.27					0.33					0.26					0.12				
CD at 5%	0.77					0.93					0.75					0.32				
CD at 1%	1.04					1.24					0.99					0.42				

Table.6 Mean performance of Bt and non-Bt hybrids across three environments for seed cotton yield (kg/ha)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	2700.00	1500.00	80.00	170.00	50.00	1793.00	1615.00	11.02	6.41	-4.15	2230.00	1703.00	30.95	161.43	99.65	2181.67	1665.33	31.01	85.78	41.81
K-5038	2175.00	2000.00	8.75	117.50	100.00	1920.00	1376.00	39.53	13.95	-18.34	1541.00	998.00	54.41	80.66	17.00	1820.33	1516.33	20.05	55.01	29.12
KDCHH-441	1600.00	1120.00	42.86	60.00	12.00	1801.00	1728.00	4.22	6.88	2.55	1625.00	1216.00	33.63	90.50	42.56	1651.00	1379.00	19.72	40.59	17.43
JK-Indra	2400.00	2050.00	17.07	140.00	105.00	1615.50	1589.00	1.67	-4.12	-5.70	2047.00	1213.00	68.76	139.98	42.20	2012.00	1626.00	23.74	71.33	38.46
RCH-2	1000.00	650.00	53.85	0.00	-35.00	1685.00	1222.50	37.83	0.00	-27.45	853.00	838.00	1.79	0.00	-1.76	1174.33	908.33	29.28	0.00	-22.65
JK-Ishwar	1075.00	525.00	104.76	7.50	-47.50	1793.00	1583.00	13.27	6.41	-6.05	1056.00	686.00	53.94	23.80	-19.58	1308.00	931.33	40.44	11.38	-20.69
JKCH-1947	2158.00	550.00	292.36	115.80	-45.00	1446.00	1425.00	1.47	-14.18	-15.43	836.00	733.00	14.05	-1.99	-14.07	1480.00	902.67	63.96	26.03	-23.13
JKCH-22	1575.00	1150.00	36.96	57.50	15.00	2020.00	1499.50	34.71	19.88	-11.01	1677.50	1093.00	53.48	96.66	28.14	1583.67	1421.00	11.45	34.86	21.01
Ankur-651	2025.00	1350.00	50.00	102.50	35.00	2123.00	1435.00	47.94	25.99	-14.84	1146.00	1076.00	6.51	34.35	26.14	1764.67	1287.00	37.11	50.27	9.59
JKCH-1050	1165.00	525.00	121.90	16.50	-47.50	1516.00	1515.50	0.03	-10.03	-10.06	1083.00	1076.00	0.65	26.96	26.14	1252.33	1041.00	20.30	6.64	-11.35
PCH-2270	970.00	625.00	55.20	-3.00	-37.50	1441.00	1298.00	11.02	-14.48	-22.97	2061.00	1127.00	82.87	141.62	32.12	1375.67	1131.67	21.56	17.15	-3.63
NCEN-3R	2125.00	1175.00	80.85	112.50	17.50	1752.00	985.00	77.87	3.98	-41.54	2973.00	1020.10	191.44	248.53	19.59	2283.33	1060.00	115.41	94.44	-9.74
KDCHH-9810	1950.00	1775.00	9.86	95.00	77.50	1738.00	1091.00	59.30	3.15	-35.25	1352.00	1201.00	12.57	58.50	40.80	1680.00	1355.67	23.92	43.06	15.44
NCEN-2R	1950.00	1825.00	6.85	95.00	82.50	2005.00	1703.00	17.73	18.99	1.07	1637.00	1063.00	54.00	91.91	24.62	1763.33	1631.00	8.11	50.16	38.89
JKCH-266	1550.00	1400.00	10.71	55.00	40.00	1870.00	1420.00	31.69	10.98	-15.73	1236.00	711.00	73.84	44.90	-16.65	1552.00	1177.00	31.86	32.16	0.23
Dhruva	2150.00	1450.00	48.28	115.00	45.00	2243.00	1748.00	28.32	33.12	3.74	1595.00	1236.00	29.05	86.99	44.90	1831.00	1643.00	11.44	55.92	39.91
K-5316	1950.00	870.00	124.14	95.00	-13.00	1245.00	1116.00	11.56	-26.11	-33.77	895.00	704.00	27.13	4.92	-17.47	1256.67	1003.33	25.25	7.01	-14.56
KDCHH-9632	1775.00	1600.00	10.94	77.50	60.00	1705.00	1163.00	46.60	1.19	-30.98	1728.50	634.00	172.63	102.64	-25.67	1555.33	1313.00	18.46	32.44	11.81
JK-Varun	750.00	625.00	20.00	-25.00	-37.50	2086.00	1229.00	69.73	23.80	-27.06	1268.50	817.00	55.26	48.71	-4.22	1326.33	932.00	42.31	12.94	-20.64
PCH-2171	685.00	450.00	52.22	-31.50	-55.00	1896.50	1440.00	31.70	12.55	-14.54	1671.50	1270.00	31.61	95.96	48.89	1339.17	1131.67	18.34	14.04	-3.63
JK-Durga	1600.00	1350.00	18.52	60.00	35.00	1292.00	1147.00	12.64	-23.32	-31.93	1150.00	549.00	109.47	34.82	-35.64	1299.00	1063.67	22.12	10.62	-9.42
JKCH-99	1400.00	900.00	55.56	40.00	-10.00	1691.00	1486.50	13.76	0.36	-11.78	1641.00	682.00	140.62	92.38	-20.05	1577.33	1022.83	54.21	34.32	-12.90
JKCH-1945	1250.00	1200.00	4.17	25.00	20.00	1993.00	1760.00	13.24	18.28	4.45	2327.00	934.00	149.14	172.80	9.50	1762.33	1392.33	26.57	50.07	18.56
JK-Gowri	1050.00	1000.00	5.00	5.00	0.00	1618.00	1422.00	13.78	-3.98	-15.61	1443.50	850.00	69.82	69.23	-0.35	1305.00	1156.00	12.89	11.13	-1.56
Mean	1626.17	1152.71				1762.00	1416.54				1544.73	976.25				1588.94	1237.13			
SEm _±	112.73					159.79					146.06					57.51				
CD at 5%	320.66					454.54					415.50					159.40				
CD at 1%	427.91					606.56					554.40					209.90				

Table.7 Mean performance of Bt and non-Bt hybrids across three environments for number of sympodia

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean		Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	16.50	12.95	27.41	37.50	7.92	13.30	11.70	13.68	-6.34	-17.61	13.40	14.60	-8.22	-18.79	-11.52	14.40	13.08	10.09	1.19	-8.08
K-5038	16.10	14.50	11.03	34.17	20.83	12.60	10.30	22.33	-11.27	-27.46	13.20	15.30	-13.73	-20.00	-7.27	13.97	13.37	4.49	-1.83	-6.04
KDCHH-441	14.30	12.30	16.26	19.17	2.50	14.50	13.00	11.54	2.11	-8.45	15.70	15.70	0.00	-4.85	-4.85	14.83	13.67	8.49	4.22	-3.94
JK-Indra	14.70	13.10	12.21	22.50	9.17	13.50	12.60	7.14	-4.93	-11.27	17.40	15.30	13.73	5.45	-7.27	15.20	13.67	11.19	6.82	-3.94
RCH-2	12.00	12.30	-2.44	0.00	2.50	14.20	11.50	23.48	0.00	-19.01	16.50	15.90	3.77	0.00	-3.64	14.23	13.23	7.56	0.00	-7.03
JK-Ishwar	13.20	10.15	30.05	10.00	-15.42	14.40	12.30	17.07	1.41	-13.38	14.20	15.80	-10.13	-13.94	-4.24	13.93	12.75	9.25	-2.11	-10.40
JKCH-1947	13.00	12.50	4.00	8.33	4.17	14.70	16.30	-9.82	3.52	14.79	16.00	14.60	9.59	-3.03	-11.52	14.57	14.47	0.69	2.39	1.69
JKCH-22	11.80	11.30	4.42	-1.67	-5.83	12.40	13.40	-7.46	-12.68	-5.63	15.20	17.70	-14.12	-7.88	7.27	13.13	14.13	-7.08	-7.73	-0.70
Ankur-651	15.40	16.20	-4.94	28.33	35.00	14.30	13.10	9.16	0.70	-7.75	15.90	13.70	16.06	-3.64	-16.97	15.20	14.33	6.07	6.82	0.70
JKCH-1050	14.50	12.70	14.17	20.83	5.83	14.70	14.60	0.68	3.52	2.82	13.40	10.30	30.10	-18.79	-37.58	14.20	12.53	13.33	-0.21	-11.95
PCH-2270	12.60	13.30	-5.26	5.00	10.83	13.90	13.00	6.92	-2.11	-8.45	14.90	19.80	-24.75	-9.70	20.00	13.80	15.37	-10.21	-3.02	8.01
NCEN-3R	15.10	16.10	-6.21	25.83	34.17	13.80	13.10	5.34	-2.82	-7.75	12.40	14.50	-14.48	-24.85	-12.12	13.77	14.57	-5.49	-3.23	2.39
KDCHH-9810	14.80	14.00	5.71	23.33	16.67	14.20	14.50	-2.07	0.00	2.11	17.30	11.20	54.46	4.85	-32.12	15.43	13.23	16.63	8.43	-7.03
NCEN-2R	12.50	14.50	-13.79	4.17	20.83	13.00	13.40	-2.99	-8.45	-5.63	15.40	12.60	22.22	-6.67	-23.64	13.63	13.50	0.96	-4.22	-5.13
JKCH-266	12.90	13.20	-2.27	7.50	10.00	13.70	13.20	3.79	-3.52	-7.04	14.60	14.20	2.82	-11.52	-13.94	13.73	13.53	1.48	-3.51	-4.92
Dhruva	16.20	14.80	9.46	35.00	23.33	13.20	12.90	2.33	-7.04	-9.15	13.90	14.30	-2.80	-15.76	-13.33	14.43	14.00	3.07	1.41	-1.62
K-5316	16.10	15.50	3.87	34.17	29.17	13.30	13.30	0.00	-6.34	-6.34	11.30	12.20	-7.38	-31.52	-26.06	13.57	13.67	-0.73	-4.64	-3.94
KDCHH-9632	13.60	13.20	3.03	13.33	10.00	14.00	12.30	13.82	-1.41	-13.38	17.40	21.50	-19.07	5.45	30.30	15.00	15.67	-4.28	5.41	10.12
JK-Varun	30.50	12.20	150.00	154.17	1.67	15.70	11.00	42.73	10.56	-22.54	13.00	14.70	-11.56	-21.21	-10.91	19.73	12.63	56.22	38.65	-11.24
PCH-2171	15.40	12.60	22.22	28.33	5.00	13.50	13.70	-1.46	-4.93	-3.52	11.90	15.00	-20.67	-27.88	-9.09	13.60	13.77	-1.23	-4.43	-3.23
JK-Durga	13.50	12.80	5.47	12.50	6.67	13.60	13.00	4.62	-4.23	-8.45	14.00	15.70	-10.83	-15.15	-4.85	13.70	13.83	-0.94	-3.72	-2.81
JKCH-99	15.60	15.80	-1.27	30.00	31.67	14.50	11.90	21.85	2.11	-16.20	18.50	18.30	1.09	12.12	10.91	16.20	15.33	5.68	13.84	7.73
JKCH-1945	13.60	13.20	3.03	13.33	10.00	13.90	13.70	1.46	-2.11	-3.52	15.00	14.50	3.45	-9.09	-12.12	14.17	13.80	2.68	-0.42	-3.02
JK-Gowri	12.30	12.75	-3.53	2.50	6.25	11.50	11.70	-1.71	-19.01	-17.61	14.05	14.90	-5.70	-14.85	-9.70	12.62	13.12	-3.81	-11.31	-7.80
Mean	14.84	13.41				13.77	12.90				14.77	15.10				14.46	13.80			
SEm±	0.91					0.76					1.45					0.44				
CD at 5%	2.61					2.17					4.12					1.22				
CD at 1%	3.48					2.89					5.51					1.61				

Table.8 Mean performance of Bt and non-Bt hybrids across three environments for bolls per plant

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	28.50	24.50	16.33	36.36	17.22	29.30	24.20	21.07	10.98	-8.33	31.90	17.00	87.65	-12.84	-53.55	28.57	23.23	22.99	4.92	-14.69
K-5038	25.50	23.00	10.87	22.01	10.05	23.40	22.80	2.63	-11.36	-13.64	31.50	30.60	2.94	-13.93	-16.39	26.30	25.97	1.27	-3.42	-4.63
KDCHH-441	32.50	25.00	30.00	55.50	19.62	28.15	27.70	1.62	6.63	4.92	37.00	33.60	10.12	1.09	-8.20	32.55	28.77	13.14	19.54	5.66
JK-Indra	22.40	20.00	12.00	7.18	-4.31	25.20	21.60	16.67	-4.55	-18.18	40.00	32.00	25.00	9.29	-12.57	28.00	25.73	8.82	2.83	-5.51
RCH-2	20.90	19.10	9.42	0.00	-8.61	26.40	26.00	1.54	0.00	-1.52	36.60	33.00	10.91	0.00	-9.84	27.23	26.77	1.72	0.00	-1.69
JK-Ishwar	31.60	15.50	103.87	51.20	-25.84	22.80	22.50	1.33	-13.64	-14.77	34.89	29.70	17.47	-4.67	-18.85	27.93	24.40	14.47	2.57	-10.39
JKCH-1947	28.50	27.00	5.56	36.36	29.19	23.50	19.30	21.76	-10.98	-26.89	28.00	25.10	11.55	-23.50	-31.42	26.17	24.30	7.70	-3.89	-10.76
JKCH-22	24.50	13.50	81.48	17.22	-35.41	26.60	22.50	18.22	0.76	-14.77	31.00	29.00	6.90	-15.30	-20.77	27.37	21.67	26.30	0.51	-20.42
Ankur-651	25.00	25.00	0.00	19.62	19.62	27.00	24.00	12.50	2.27	-9.09	34.10	27.00	26.30	-6.83	-26.23	28.70	25.33	13.30	5.40	-6.98
JKCH-1050	23.50	16.85	39.47	12.44	-19.38	26.60	20.00	33.00	0.76	-24.24	37.10	32.60	13.80	1.37	-10.93	29.07	23.15	25.57	6.76	-14.98
PCH-2270	25.00	16.00	56.25	19.62	-23.44	27.40	22.00	24.55	3.79	-16.67	38.20	32.50	17.54	4.37	-11.20	28.30	25.40	11.42	3.93	-6.72
NCEN-3R	29.70	22.00	35.00	42.11	5.26	27.80	23.30	19.31	5.30	-11.74	32.50	30.00	8.33	-11.20	-18.03	30.00	25.10	19.52	10.17	-7.82
KDCHH-9810	32.00	26.00	23.08	53.11	24.40	29.70	27.90	6.45	12.50	5.68	23.00	23.00	0.00	-37.16	-37.16	28.23	25.63	10.14	3.67	-5.88
NCEN-2R	42.00	33.40	25.75	100.96	59.81	26.10	25.90	0.77	-1.14	-1.89	35.80	35.00	2.29	-2.19	-4.37	34.57	31.50	9.75	26.96	15.68
JKCH-266	24.70	15.00	64.67	18.18	-28.23	32.50	26.50	22.64	23.11	0.38	35.00	28.50	22.81	-4.37	-22.13	27.50	26.57	3.50	0.99	-2.42
Dhruva	27.00	26.00	3.85	29.19	24.40	26.50	25.50	3.92	0.38	-3.41	31.30	31.00	0.97	-14.48	-15.30	28.17	27.60	2.07	3.45	1.36
K-5316	23.00	22.50	2.22	10.05	7.66	20.60	18.20	13.19	-21.97	-31.06	35.70	26.00	37.31	-2.46	-28.96	26.43	22.23	18.89	-2.94	-18.36
KDCHH-9632	33.50	20.80	61.06	60.29	-0.48	23.30	23.00	1.30	-11.74	-12.88	42.00	33.00	27.27	14.75	-9.84	32.83	25.70	27.74	20.57	-5.62
JK-Varun	25.50	20.00	27.50	22.01	-4.31	34.90	29.50	18.31	32.20	11.74	36.30	33.50	8.36	-0.82	-8.47	32.23	27.67	16.48	18.36	1.62
PCH-2171	23.40	18.15	28.93	11.96	-13.16	26.00	25.10	3.59	-1.52	-4.92	36.10	26.40	36.74	-1.37	-27.87	26.75	24.97	7.13	-1.76	-8.30
JK-Durga	23.40	20.00	17.00	11.96	-4.31	25.40	18.20	39.56	-3.79	-31.06	43.60	35.00	24.57	19.13	-4.37	29.67	25.53	16.22	8.96	-6.24
JKCH-99	33.20	32.50	2.15	58.85	55.50	29.80	25.50	16.86	12.88	-3.41	41.00	34.10	20.23	12.02	-6.83	34.67	30.70	12.93	27.32	12.74
JKCH-1945	26.50	19.50	35.90	26.79	-6.70	30.20	28.20	7.09	14.39	6.82	32.10	24.80	29.44	-12.30	-32.24	27.17	26.60	2.14	-0.22	-2.31
JK-Gowri	29.00	14.20	104.23	38.76	-32.06	25.60	21.30	20.19	-3.03	-19.32	37.20	31.00	20.00	1.64	-15.30	28.53	24.23	17.75	4.77	-11.02
Mean	27.53	21.48				26.86	23.78				35.08	29.73				29.04	25.78			
SE _{em}	2.38					2.37					1.85					0.90				
CD at 5%	6.78					6.76					5.26					2.50				
CD at 1%	9.05					9.01					7.02					3.30				

Table.9 Mean performance of Bt and non-Bt hybrids across three environments for twenty boll weight (g)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	65.00	65.00	0.00	-14.47	-14.47	90.50	90.00	0.56	-12.14	-12.62	68.00	66.00	3.03	-8.11	-10.81	74.50	73.67	1.13	-11.66	-12.64
K-5038	90.00	85.00	5.88	18.42	11.84	100.50	99.50	1.01	-2.43	-3.40	68.00	67.50	0.74	-8.11	-8.78	85.67	84.50	1.38	1.59	0.20
KDCHH-441	85.00	70.00	21.43	11.84	-7.89	90.50	86.00	5.23	-12.14	-16.50	73.00	73.00	0.00	-1.35	-1.35	81.33	77.83	4.50	-3.56	-7.71
JK-Indra	87.00	84.00	3.57	14.47	10.53	99.00	97.50	1.54	-3.88	-5.34	76.00	69.50	9.35	2.70	-6.08	87.33	83.67	4.37	3.56	-0.78
RCH-2	76.00	73.00	4.11	0.00	-3.95	103.00	93.00	10.75	0.00	-9.71	74.00	61.50	20.33	0.00	-16.89	84.33	75.83	11.21	0.00	-10.08
JK-Ishwar	96.00	85.00	12.94	26.32	11.84	113.00	109.50	3.20	9.71	6.31	77.00	52.50	46.67	4.05	-29.05	90.50	87.17	3.82	7.32	3.37
JKCH-1947	71.00	59.00	20.34	-6.58	-22.37	103.00	96.00	7.29	0.00	-6.80	68.50	65.50	4.58	-7.43	-11.49	80.83	73.50	9.97	-4.15	-12.84
JKCH-22	79.00	79.00	0.00	3.95	3.95	104.00	100.50	3.48	0.97	-2.43	57.50	57.00	0.88	-22.30	-22.97	80.00	79.00	1.27	-5.13	-6.32
Ankur-651	67.00	67.00	0.00	-11.84	-11.84	96.00	86.50	10.98	-6.80	-16.02	59.50	54.50	9.17	-19.59	-26.35	74.17	69.33	6.98	-12.05	-17.79
JKCH-1050	74.00	70.00	5.71	-2.63	-7.89	90.00	86.50	4.05	-12.62	-16.02	59.00	55.50	6.31	-20.27	-25.00	73.00	72.00	1.39	-13.44	-14.62
PCH-2270	78.00	74.00	5.41	2.63	-2.63	110.00	93.00	18.28	6.80	-9.71	75.50	64.00	17.97	2.03	-13.51	86.50	78.33	10.43	2.57	-7.11
NCEN-3R	98.00	77.00	27.27	28.95	1.32	108.50	95.00	14.21	5.34	-7.77	70.00	66.00	6.06	-5.41	-10.81	90.83	80.67	12.59	7.71	-4.34
KDCHH-9810	90.00	67.00	34.33	18.42	-11.84	127.00	109.00	16.51	23.30	5.83	83.00	74.50	11.41	12.16	0.68	92.33	91.17	1.27	9.49	8.11
NCEN-2R	96.00	55.00	74.55	26.32	-27.63	111.50	110.50	0.90	8.25	7.28	70.50	53.00	33.02	-4.73	-28.38	86.50	79.00	9.49	2.57	-6.32
JKCH-266	71.00	67.00	5.97	-6.58	-11.84	105.00	92.50	13.51	1.94	-10.19	67.50	62.50	8.00	-8.78	-15.54	78.17	77.00	1.52	-7.30	-8.69
Dhruva	105.20	85.00	23.76	38.42	11.84	108.00	100.50	7.46	4.85	-2.43	64.00	63.50	0.79	-13.51	-14.19	89.90	85.50	5.15	6.61	1.39
K-5316	110.00	92.00	19.57	44.74	21.05	95.00	93.00	2.15	-7.77	-9.71	70.00	69.50	0.72	-5.41	-6.08	91.67	84.83	8.06	8.70	0.59
KDCHH-9632	92.00	77.00	19.48	21.05	1.32	95.50	88.50	7.91	-7.28	-14.08	69.00	62.00	11.29	-6.76	-16.22	83.17	78.17	6.40	-1.38	-7.30
JK-Varun	64.00	51.00	25.49	-15.79	-32.89	89.00	80.50	10.56	-13.59	-21.84	62.50	55.50	12.61	-15.54	-25.00	69.00	65.17	5.88	-18.18	-22.72
PCH-2171	64.00	55.00	16.36	-15.79	-27.63	98.00	90.50	8.29	-4.85	-12.14	67.50	62.50	8.00	-8.78	-15.54	74.00	71.83	3.02	-12.25	-14.82
JK-Durga	82.00	72.00	13.89	7.89	-5.26	101.00	88.50	14.12	-1.94	-14.08	50.00	47.00	6.38	-32.43	-36.49	77.67	69.17	12.29	-7.90	-17.98
JKCH-99	82.00	60.00	36.67	7.89	-21.05	92.50	91.00	1.65	-10.19	-11.65	64.50	60.50	6.61	-12.84	-18.24	79.17	71.00	11.51	-6.12	-15.81
JKCH-1945	75.00	68.00	10.29	-1.32	-10.53	93.50	86.00	8.72	-9.22	-16.50	68.50	67.00	2.24	-7.43	-9.46	76.50	76.17	0.43	-9.28	-9.68
JK-Gowri	101.00	80.00	26.25	32.89	5.26	101.00	97.50	3.59	-1.94	-5.34	74.50	71.00	4.93	0.68	-4.05	89.83	85.17	5.47	6.52	1.00
Mean	83.26	71.54				101.04	94.21				68.23	62.54				82.37	77.90			
SEm _±	6.74					6.21					5.19					2.48				
CD at 5%	19.18					17.65					14.78					6.87				
CD at 1%	25.60					23.56					19.73					9.05				

Table.10 Mean performance of Bt and non-Bt hybrids across three environments for plant height (cm)

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	91.60	96.00	-4.58	66.55	74.55	83.05	104.30	-20.37	-4.65	89.64	98.70	98.43	0.27	-20.56	78.96	91.12	91.60	-0.52	2.64	66.55
K-5038	93.00	87.30	6.53	69.09	58.73	71.80	120.40	-40.37	-17.57	118.91	119.30	100.93	18.20	-3.98	83.51	94.70	93.00	1.83	6.67	69.09
KDCHH-441	89.95	82.50	9.03	63.55	50.00	90.55	105.70	-14.33	3.96	92.18	111.00	89.87	23.51	-10.66	63.40	97.17	89.95	8.03	9.45	63.55
JK-Indra	80.90	93.30	-13.29	47.09	69.64	83.30	98.70	-15.60	-4.36	79.45	99.50	95.47	4.22	-19.92	73.58	87.90	80.90	8.65	-0.99	47.09
RCH-2	55.00	93.50	-41.18	0.00	70.00	87.10	103.00	-15.44	0.00	87.27	124.25	88.00	41.19	0.00	60.00	88.78	55.00	61.42	0.00	0.00
JK-Ishwar	78.00	94.10	-17.11	41.82	71.09	88.40	120.00	-26.33	1.49	118.18	130.35	97.30	33.97	4.91	76.91	98.92	78.00	26.82	11.42	41.82
JKCH-1947	90.60	83.40	8.63	64.73	51.64	83.30	82.05	1.52	-4.36	49.18	104.40	82.48	26.58	-15.98	49.96	92.77	90.60	2.40	4.49	64.73
JKCH-22	80.30	81.40	-1.35	46.00	48.00	83.10	90.60	-8.28	-4.59	64.73	90.80	80.77	12.42	-26.92	46.85	84.73	80.30	5.52	-4.56	46.00
Ankur-651	90.15	90.45	-0.33	63.91	64.45	87.40	118.00	-25.93	0.34	114.55	81.00	95.15	-14.87	-34.81	73.00	86.18	90.15	-4.40	-2.93	63.91
JKCH-1050	80.50	87.00	-7.47	46.36	58.18	88.20	105.50	-16.40	1.26	91.82	85.00	83.17	2.20	-31.59	51.22	84.57	80.50	5.06	-4.74	46.36
PCH-2270	69.00	85.00	-18.82	25.45	54.55	40.50	115.20	-64.84	-53.50	109.45	87.00	85.43	1.84	-29.98	55.33	65.50	69.00	-5.07	-26.22	25.45
NCEN-3R	83.60	80.00	4.50	52.00	45.45	87.90	97.00	-9.38	0.92	76.36	102.90	81.53	26.21	-17.18	48.24	91.47	83.60	9.41	3.03	52.00
KDCHH-9810	78.00	85.50	-8.77	41.82	55.45	101.55	87.25	16.39	16.59	58.64	108.10	89.82	20.35	-13.00	63.31	95.88	78.00	22.92	8.00	41.82
NCEN-2R	93.70	108.40	-13.56	70.36	97.09	107.00	137.00	-21.90	22.85	149.09	137.20	106.13	29.28	10.42	92.96	112.63	93.70	20.20	26.86	70.36
JKCH-266	75.00	97.30	-22.92	36.36	76.91	102.05	81.20	25.68	17.16	47.64	74.50	89.17	-16.45	-40.04	62.13	83.85	75.00	11.80	-5.55	36.36
Dhruva	97.40	82.30	18.35	77.09	49.64	83.00	94.80	-12.45	-4.71	72.36	97.00	91.43	6.09	-21.93	66.24	92.47	97.40	-5.06	4.16	77.09
K-5316	94.40	94.10	0.32	71.64	71.09	91.00	94.50	-3.70	4.48	71.82	105.70	92.38	14.42	-14.93	67.96	97.03	94.40	2.79	9.29	71.64
KDCHH-9632	81.50	93.30	-12.65	48.18	69.64	86.90	107.00	-18.79	-0.23	94.55	97.50	94.40	3.28	-21.53	71.64	88.63	81.50	8.75	-0.17	48.18
JK-Varun	92.45	110.00	-15.95	68.09	100.00	81.80	98.00	-16.53	-6.08	78.18	110.10	93.20	18.13	-11.39	69.45	94.78	92.45	2.52	6.76	68.09
PCH-2171	60.10	80.50	-25.34	9.27	46.36	76.00	82.50	-7.88	-12.74	50.00	90.60	78.37	15.61	-27.08	42.49	75.57	60.10	25.74	-14.88	9.27
JK-Durga	88.55	78.55	12.73	61.00	42.82	78.55	85.50	-8.13	-9.82	55.45	99.05	84.80	16.80	-20.28	54.18	88.72	88.55	0.19	-0.07	61.00
JKCH-99	90.50	92.10	-1.74	64.55	67.45	84.05	121.00	-30.54	-3.50	120.00	100.70	100.80	-0.10	-18.95	83.27	91.75	90.50	1.38	3.35	64.55
JKCH-1945	74.90	114.20	-34.41	36.18	107.64	94.00	79.00	18.99	7.92	43.64	103.00	92.37	11.51	-17.10	67.95	90.63	74.90	21.00	2.08	36.18
JK-Gowri	88.10	75.90	16.07	60.18	38.00	78.30	98.30	-20.35	-10.10	78.73	108.00	81.52	32.48	-13.08	48.22	91.47	88.10	3.83	3.03	60.18
Mean	83.22	90.25				84.95	101.10				102.74	90.54				90.30	83.22			
SEm _±	6.08					5.15					5.09					2.23				
CD at 5%	17.30					14.65					14.49					6.17				
CD at 1%	23.11					19.56					19.34					8.12				

Table.11 Mean performance of Bt and non-Bt hybrids across three environments for number of monopodials

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	2.40	3.00	-20.00	20.00	50.00	1.80	2.12	-15.09	-18.18	-3.64	2.50	2.70	-7.41	-8.09	-0.74	2.23	2.61	-14.56	-3.46	12.99
K-5038	2.40	2.25	6.67	20.00	12.50	2.10	1.50	40.00	-4.55	-31.82	2.40	2.20	9.09	-11.76	-19.12	2.30	1.98	16.16	-0.43	-14.29
KDCHH-441	3.20	3.30	-3.03	60.00	65.00	3.00	2.70	11.11	36.36	22.73	3.10	2.60	19.23	13.97	-4.41	3.10	2.87	8.01	34.20	24.24
JK-Indra	2.40	2.40	0.00	20.00	20.00	2.50	2.50	0.00	13.64	13.64	2.70	2.50	8.00	-0.74	-8.09	2.53	2.47	2.43	9.52	6.93
RCH-2	2.00	2.65	-24.53	0.00	32.50	2.20	3.50	-37.14	0.00	59.09	2.72	3.30	-17.58	0.00	21.32	2.31	3.15	-26.67	0.00	36.36
JK-Ishwar	2.90	2.40	20.83	45.00	20.00	1.80	1.60	12.50	-18.18	-27.27	1.90	3.40	-44.12	-30.15	25.00	2.20	2.47	-10.93	-4.76	6.93
JKCH-1947	2.35	2.30	2.17	17.50	15.00	1.50	1.30	15.38	-31.82	-40.91	0.70	1.70	-58.82	-74.26	-37.50	1.52	1.77	-14.12	-34.20	-23.38
JKCH-22	2.60	2.80	-7.14	30.00	40.00	1.90	2.50	-24.00	-13.64	13.64	1.90	2.80	-32.14	-30.15	2.94	2.13	2.70	-21.11	-7.79	16.88
Ankur-651	2.50	2.90	-13.79	25.00	45.00	2.10	2.40	-12.50	-4.55	9.09	2.50	2.10	19.05	-8.09	-22.79	2.37	2.47	-4.05	2.60	6.93
JKCH-1050	3.10	1.85	67.57	55.00	-7.50	1.80	1.60	12.50	-18.18	-27.27	2.50	1.20	108.33	-8.09	-55.88	2.47	1.55	59.35	6.93	-32.90
PCH-2270	2.40	2.40	0.00	20.00	20.00	1.50	2.10	-28.57	-31.82	-4.55	2.10	3.10	-32.26	-22.79	13.97	2.00	2.53	-20.95	-13.42	9.52
NCEN-3R	2.70	2.80	-3.57	35.00	40.00	1.60	2.20	-27.27	-27.27	0.00	1.80	2.40	-25.00	-33.82	-11.76	2.03	2.47	-17.81	-12.12	6.93
KDCHH-9810	2.60	3.10	-16.13	30.00	55.00	2.00	2.20	-9.09	-9.09	0.00	1.40	2.90	-51.72	-48.53	6.62	2.00	2.73	-26.74	-13.42	18.18
NCEN-2R	2.15	3.10	-30.65	7.50	55.00	2.20	2.40	-8.33	0.00	9.09	2.70	3.10	-12.90	-0.74	13.97	2.35	2.87	-18.12	1.73	24.24
JKCH-266	2.30	1.90	21.05	15.00	-5.00	1.90	2.50	-24.00	-13.64	13.64	1.90	1.60	18.75	-30.15	-41.18	2.03	2.00	1.50	-12.12	-13.42
Dhruva	2.00	2.40	-16.67	0.00	20.00	1.80	2.00	-10.00	-18.18	-9.09	2.20	3.20	-31.25	-19.12	17.65	2.00	2.53	-20.95	-13.42	9.52
K-5316	2.60	2.10	23.81	30.00	5.00	1.10	1.10	0.00	-50.00	-50.00	0.90	2.80	-67.86	-66.91	2.94	1.53	2.00	-23.50	-33.77	-13.42
KDCHH-9632	2.90	3.00	-3.33	45.00	50.00	2.10	2.20	-4.55	-4.55	0.00	3.00	3.30	-9.09	10.29	21.32	2.67	2.83	-5.65	15.58	22.51
JK-Varun	2.60	2.05	26.83	30.00	2.50	2.20	2.60	-15.38	0.00	18.18	0.70	1.30	-46.15	-74.26	-52.21	1.83	1.98	-7.58	-20.78	-14.29
PCH-2171	2.80	2.20	27.27	40.00	10.00	2.10	1.50	40.00	-4.55	-31.82	2.10	3.30	-36.36	-22.79	21.32	2.33	2.33	0.00	0.87	0.87
JK-Durga	2.85	3.15	-9.52	42.50	57.50	1.60	2.30	-30.43	-27.27	4.55	2.00	2.40	-16.67	-26.47	-11.76	2.15	2.62	-17.94	-6.93	13.42
JKCH-99	2.75	3.40	-19.12	37.50	70.00	2.80	3.00	-6.67	27.27	36.36	3.10	3.50	-11.43	13.97	28.68	2.88	3.30	-12.73	24.68	42.86
JKCH-1945	2.50	1.75	42.86	25.00	-12.50	2.30	1.50	53.33	4.55	-31.82	1.10	5.70	-80.70	-59.56	109.56	1.97	2.98	-33.89	-14.72	29.00
JK-Gowri	2.70	3.30	-18.18	35.00	65.00	2.20	2.30	-4.35	0.00	4.55	2.50	2.90	-13.79	-8.09	6.62	2.47	2.83	-12.72	6.93	22.51
Mean	2.57	2.60				2.00	2.15				2.10	2.75				2.23	2.50			
SEm±	0.19					0.25					0.18					0.08				
CD at 5%	0.55					0.71					0.50					0.23				
CD at 1%	0.73					0.98					0.67					0.30				

Table.12 Mean performance of Bt and non-Bt hybrids across three environments for fuzz percentage

Genotypes	E ₁ : Nagpur					E ₂ : Dharwad					E ₃ : Bagalkot					Mean	Mean	Across locations		
	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean	Bt	NBt	% over NBt	% over check	% over population mean
JKCH-2245	12.45	4.90	154.08	-7.09	-63.43	11.00	11.95	-7.95	-10.93	-3.24	8.95	5.15	73.79	-42.99	-67.20	10.80	7.33	47.34	-21.85	-46.96
K-5038	7.65	11.20	-31.70	-42.91	-16.42	11.05	10.60	4.25	-10.53	-14.17	12.25	15.00	-18.33	-21.97	-4.46	10.32	12.27	-15.89	-25.33	-11.22
KDCHH-441	3.30	7.80	-57.69	-75.37	-41.79	12.05	10.75	12.09	-2.43	-12.96	13.05	14.60	-10.62	-16.88	-7.01	9.47	11.05	-14.30	-31.48	-20.04
JK-Indra	2.25	2.40	-6.25	-83.21	-82.09	8.05	8.75	-8.00	-34.82	-29.15	15.20	11.80	28.81	-3.18	-24.84	8.50	7.65	11.11	-38.49	-44.65
RCH-2	13.40	9.50	41.05	0.00	-29.10	12.35	10.90	13.30	0.00	-11.74	15.70	14.50	8.28	0.00	-7.64	13.82	11.63	18.83	0.00	-15.85
JK-Ishwar	29.80	1.45	1955.17	122.39	-89.18	11.95	10.00	19.50	-3.24	-19.03	10.20	12.05	-15.35	-35.03	-23.25	17.32	7.83	121.20	25.33	-43.34
JKCH-1947	9.30	9.40	-1.06	-30.60	-29.85	12.10	9.45	28.04	-2.02	-23.48	11.95	11.25	6.22	-23.89	-28.34	11.12	10.03	10.87	-19.54	-27.42
JKCH-22	9.75	12.75	-23.53	-27.24	-4.85	12.50	12.50	0.00	1.21	1.21	11.75	14.20	-17.25	-25.16	-9.55	11.33	13.15	-13.84	-18.02	-4.85
Ankur-651	4.30	5.90	-27.12	-67.91	-55.97	13.90	8.30	67.47	12.55	-32.79	12.00	9.85	21.83	-23.57	-37.26	10.07	8.02	25.56	-27.13	-41.97
JKCH-1050	3.70	17.40	-78.74	-72.39	29.85	9.10	9.40	-3.19	-26.32	-23.89	11.20	10.25	9.27	-28.66	-34.71	8.00	12.35	-35.22	-42.11	-10.64
PCH-2270	3.50	12.80	-72.66	-73.88	-4.48	10.40	8.90	16.85	-15.79	-27.94	14.55	13.40	8.58	-7.32	-14.65	9.48	11.70	-18.97	-31.40	-15.34
NCEN-3R	12.95	11.40	13.60	-3.36	-14.93	9.30	7.60	22.37	-24.70	-38.46	10.55	12.50	-15.60	-32.80	-20.38	10.93	10.50	4.10	-20.91	-24.02
KDCHH-9810	8.20	12.10	-32.23	-38.81	-9.70	10.75	11.70	-8.12	-12.96	-5.26	11.90	14.00	-15.00	-24.20	-10.83	10.28	12.60	-18.41	-25.62	-8.83
NCEN-2R	7.40	5.50	34.55	-44.78	-58.96	14.10	9.85	43.15	14.17	-20.24	11.00	12.95	-15.06	-29.94	-17.52	10.83	9.43	14.85	-21.64	-31.77
JKCH-266	10.85	7.25	49.66	-19.03	-45.90	9.05	9.80	-7.65	-26.72	-20.65	12.50	14.55	-14.09	-20.38	-7.32	10.80	10.53	2.56	-21.85	-23.81
Dhruva	5.55	1.80	208.33	-58.58	-86.57	12.05	10.30	16.99	-2.43	-16.60	10.10	10.60	-4.72	-35.67	-32.48	9.23	7.57	21.93	-33.21	-45.22
K-5316	5.20	3.55	46.48	-61.19	-73.51	10.60	9.00	17.78	-14.17	-27.13	11.05	12.75	-13.33	-29.62	-18.79	8.95	8.43	6.17	-35.24	-39.00
KDCHH-9632	20.65	2.35	778.72	54.10	-82.46	10.45	9.20	13.59	-15.38	-25.51	10.30	10.55	-2.37	-34.39	-32.80	13.80	7.37	87.25	-0.14	-46.67
JK-Varun	17.95	6.70	167.91	33.96	-50.00	13.45	16.55	-18.73	8.91	34.01	14.70	14.85	-1.01	-6.37	-5.41	15.39	12.70	21.18	11.36	-8.10

PCH-2171	18.30	1.50	1120.00	36.57	-88.81	12.70	11.65	9.01	2.83	-5.67	12.65	14.65	-13.65	-19.43	-6.69	14.55	9.27	56.96	5.28	-32.92
JK-Durga	12.45	10.10	23.27	-7.09	-24.63	8.85	10.95	-19.18	-28.34	-11.34	14.20	10.00	42.00	-9.55	-36.31	11.83	10.35	14.30	-14.40	-25.11
JKCH-99	1.40	11.10	-87.39	-89.55	-17.16	11.80	10.25	15.12	-4.45	-17.00	10.50	10.70	-1.87	-33.12	-31.85	7.90	10.68	-26.03	-42.84	-22.72
JKCH-1945	6.10	13.10	-53.44	-54.48	-2.24	7.80	10.10	-22.77	-36.84	-18.22	12.75	9.95	28.14	-18.79	-36.62	8.88	11.05	-19.64	-35.75	-20.04
JK-Gowri	12.40	6.05	104.96	-7.46	-54.85	13.60	12.70	7.09	10.12	2.83	14.40	9.50	51.58	-8.28	-39.49	13.47	9.42	42.99	-2.53	-31.84
Mean	9.95	7.83	176.08	-25.75	-41.57	11.21	10.46	8.79	-9.23	-15.30	12.23	12.07	5.01	-22.10	-23.12	11.13	10.12	14.37	-19.46	-26.77
SEm±	0.70					0.94					1.32					0.41				
CD at 5%	1.98					2.67					3.77					1.15				
CD at 1%	2.66					3.56					5.04					1.51				

Table.14 Analysis of variance in respect of yield and oil related traits in Bt and non-Bt cotton hybrids across three environments

Source of variation	d.f.	Seed cotton Yield (kg/ha)	Plant height (cm)	Monopodial branches	Sympodial branches	Bolls per plant	20-bolls weight (g)	GOT (%)	Seed index	Oil (%)	Fuzz (%)	Hull (%)	Kernel (%)
Genotypes	47	320147.34**	187.09	0.538*	2.08	25.42	146.87**	15.80**	2.36**	906**	14.63	21.23	21.22
Environment (e-1)	2	13166.84**	4976.47**	3.25	32.81**	905.11**	12663.70**	66.13**	39.01**	55.59**	128.49**	690.82**	687.38**
Genotypes × environment	94	167981.91	146.29**	0.32*	3.09	23.90**	85.88	4.05	0.70*	2.25**	13.01**	24.07	24.06
Environment (var × env)	96	191913.21	246.92	0.38	3.71	42.26	347.91	5.34	1.50	3.36	15.42	37.96	37.87
Environment (linear)	1	2633417.40**	9952.34**	6.52**	65.62**	1810.21**	25327.55**	132.10**	78.03**	111.18**	256.99**	1381.72**	1374.52
Genotype × environment (linear)	47	133836.20**	179.72	0.13	4.14**	19.98**	50.38	7.71**	0.48	2.33	20.21**	30.21**	30.20**
Pooled deviation	48	197914.88	110.53**	0.49**	2.00**	17.45**	118.84**	0.38	0.90**	2.12**	5.70**	17.55**	17.54**
Pooled error	141	39718.07	59.71	0.087	2.35	9.84	74.01	3.59	0.167	1.08	2.09	20.65	20.43

*, **: Significant at 5% and 1% level of probability

Table.13 Analysis of variance for different characters in Bt and non-Bt hybrids for stability across three environments

Sl. No.	Character	Mean squares due to genotype		
		E ₁	E ₂	E ₃
1.	Seed cotton yield	642891.23**	173553.02**	495774.98**
2.	Plant height	263.74**	264.84**	430.77**
3.	Monopodial branches	0.33**	0.49**	1.53**
4.	Sympodial branches	4.52**	2.67**	9.36**
5.	Bolls per plant	68.66	24.35**	53.44**
6.	20-bolls weight	360.62**	161.20**	115.45**
7.	Ginning outturn	22.01**	10.64*	15.17**
8.	Seed index	3.80**	1.92**	1.83**
9.	Oil content	10.65**	2.09**	14.39**
10.	Fuzz percentage	65.82**	6.71**	8.82**
11.	Hull content	72.65**	20.42**	45.68**
12.	Kernel content	72.62**	20.37	45.68**

*, **: Significant at 5% and 1% level of probability

Table.15 Estimates of stability parameters

Sl. No.	Genotypes	Mean	b _i	S ² di
1.	A			
	Oil percentage			
	JKCH-2245 Bt	19.99	0.62	-0.49
	JKCH-2245 NBt	20.18	1.74	-0.54
	K-5038 Bt	20.84	1.25	-0.33
	KDCHH-441 Bt	19.46	1.09	-0.40
	JK-Indra Bt	20.36	1.08	0.34
	JK-Indra NBt	20.53	1.37	0.57
	JK-Ishwar Bt	20.41	1.89	-0.02
	JK-Ishwar NBt	19.62	1.78	1.55
	PCH-2270 NBt	19.55	2.09	1.14
	NCEN-3R NBt	19.51	2.32	1.60
	KDCHH-9810 Bt	20.05	1.10	-0.10
	NCEN-2R Bt	19.54	1.69	1.52
	Dhruva Bt	20.88	2.14	2.10
	Dhruva NBt	20.30	2.65	-0.09
	K-5316 Bt	19.96	1.62	-0.51
	K-5316 NBt	20.90	2.27	0.21
	KDCHH-9632 Bt	19.73	2.12	-0.30
	JKCH-99 Bt	19.68	1.36	-0.24
	JK-Gowri NBt	19.75	1.66	-0.54
2.	Kernel percentage			
	JK-Ishwar Bt	65.30	2.40	-9.94
3.	Hull percentage			
	Ankur-651 NBt	44.55	0.85	-10.07
	Dhruva NBt	42.85	0.2	-1.11
	JKCH-1945 Bt	43.73	1.56	-10.32
4.	Ginning outturn (%)			
	KDCHH-441 NBt	40.35	-1.35	-1.67
	JK-Indra NBt	39.83	0.69	-1.78
	JKCH-1947 Bt	39.45	1.32	-1.75
	JKCH-22 Bt	41.75	1.90	-0.45
	JKCH-1050 NBt	39.36	9.25	-1.15
	JKCH-266 Bt	38.70	-0.06	-1.75
	JKCH-266 NBt	41.73	0.90	-0.84
	KDCHH-9632 Bt	38.88	1.20	-1.76
	KDCHH-9632 NBt	38.87	1.96	-1.69

Contd....

Sl. No.	Genotypes	Mean	b _i	S ² di
5.	Seed index			
	JKCH-2245 NBt	8.80	0.43	0.03
	K-5038 Bt	8.60	0.58	-0.03
	KDCHH-441 NBt	8.65	0.69	0.23
	RCH-2 NBt	8.32	1.97	-0.07
	PCH-2270 NBt	8.22	1.42	-0.08
	NCEN-3R NBt	9.07	0.84	-0.07
	KDCHH-9810 Bt	8.40	1.15	0.11
	Dhruva NBt	8.88	1.30	0.00
	KDCHH-9632 Bt	8.68	1.24	-0.01
	JK-Durga Bt	7.00	1.31	-0.07
	JK-Durga NBt	7.82	1.28	0.80**
6.	Seed cotton yield (kg/ha)			
	JKCH-2245 NBt	1665.33	0.38	17412.80
	K-5038 Bt	1820.33	1.02	43404.80
	KDCHH-441 Bt	1651.00	0.34	-17053.10
	NCEN-2R NBt	1763.33	0.08	34261.10
	Dhruva Bt	1643.00	3.14	1614.80
	JKCH-99 Bt	1577.33	0.26	2472.40
7.	Number of sympodia			
	PCH-2270 NBt	15.37	4.53	0.32
	KDCHH-9810 Bt	15.43	1.98	-1.14
	KDCHH-9632 NBt	15.67	6.04	0.42
	JK-Varun Bt	19.73	-1.43	0.16
	JKCH-99 Bt	16.20	2.50	-1.18
8.	Bolls per plant			
	KDCHH-441 NBt	32.55	0.84	7.85
	NCEN-3R NBt	30.00	0.48	-2.28
	KDCHH-9632 Bt	32.83	1.71	66.42
	JKCH-99 Bt	34.67	1.22	4.83
9.	Twenty boll weight			
	JK-Indra Bt	87.33	0.70	-33.23
	JK-Ishwar Bt	90.50	1.03	-25.78
	KDCHH-9810 Bt	91.17	1.06	-32.57
10.	Plant height (cm)			
	JKCH-2245 Bt	98.43	0.49	-27.90
	KDCHH-441 NBt	97.17	1.14	-9.80
	JK-Ishwar Bt	97.30	2.08	-20.70
	JK-Ishwar NBt	98.92	2.71	-13.40
	NCEN-2R NBt	112.63	2.19	-29.70
	K-5316 NBt	97.03	0.66	-1.10
	JKCH-99 Bt	100.80	1.68	-2.40

Contd....

Sl. No.	Genotypes	Mean	b _i	S ² di
11.	Number of monopodia			
	KDCHH-9810 NBt	2.73	1.80	-0.04
	NCEN-2R NBt	2.87	1.47	-0.01
	KDCHH-9632 Bt	2.67	1.73	0.04
	KDCHH-9632 NBt	2.83	1.82	0.15
	JK-Durga NBt	2.62	1.45	0.10
	JKCH-99 Bt	2.88	0.05	0.03
	JKCH-99 NBt	3.30	0.89	-0.01
12.	Fuzz percentage			
	RCH-2 Bt	13.82	0.62	2.79
	JKCH-22 Bt	11.33	0.66	-0.22
	JKCH-22 NBt	13.15	0.39	0.55
	KDCHH-9810 NBt	12.60	0.53	0.49
	JK-Varun Bt	15.39	-1.09	3.34
	PCH-2171 Bt	14.55	-1.82	2.32
	JK-Durga Bt	11.83	0.37	13.12
	JK-Gowri Bt	13.47	0.62	-1.04
	B			
2.	Kernel percentage			
	JK-Indra Bt	66.60	2.95	225.47**
	JK-Durga NBt	67.62	-1.29	57.68*
3.	Hull percentage			
	NCEN-2R Bt	48.65	0.64	55.62*
4.	Ginning outturn (%)			
	JK-Varun Bt	42.11	1.59	-1.73*
	JKCH-1945 Bt	40.00	1.52	10.24*
5.	Seed index			
	K-5038 NBt	8.85	0.56	0.78**
	KDCHH-441 Bt	8.45	1.25	0.40*
	JK-Ishwar NBt	8.93	1.27	0.44*
	JKCH-22 NBt	8.47	-0.21	3.79**
	KDCHH-9810 NBt	9.20	0.48	1.74**
	NCEN-2R Bt	8.22	1.87	1.47**
	KDCHH-9632 NBt	8.63	1.02	0.81**
	JK-Gowri NBt	8.55	0.80	0.33*
6.	Seed cotton yield (kg/ha)			
	JKCH-2245 Bt	2181.67	-2.18	312059.40*
	JK-Indra Bt	2012.00	-1.62	166303.20**
	JK-Indra NBt	1626.00	0.93	282994.40**
	JKCH-22 NBt	1583.67	-0.53*	-19156.50
	NCEN-3R Bt	2283.33	-3.56	69851.90**
	KDCHH-9810 Bt	1680.00	0.98	111126.80**
	NCEN-2R Bt	1631.00	2.70	81400.80**

Contd....

Sl. No.	Genotypes	Mean	b_i	$S^2 di$
7.	Dhruva NBt	1831.00	0.25	140947.00**
	JKCH-1945 NBt	1762.33	-1.33	517486.20**
8.	Bolls per plant			
	NCEN-2R Bt	31.50	0.62	25.79*
	NCEN-2R NBt	34.57	0.07	126.78**
	JK-Varun NBt	32.23	0.91	32.9*
	JKCH-99 NBt	30.70	0.60	23.37*
9.	Twenty boll weight			
	JK-Ishwar NBt	87.17	1.77	247.82*
	KDCHH-9810 NBt	92.33	1.54	650.18**
	Dhruva NBt	89.90	0.99	458.75**
	K-5316 NBt	91.67	0.62	576.49**
	PCH-2171 NBt	71.83	1.21	244.56**
10.	Plant height (cm)			
	JKCH-2245 NBt	91.12	0.50	41.82
	NCEN-2R Bt	106.13	3.02	140.90*
11.	Number of monopodia			
	JKCH-1945 NBt	2.98	2.33	10.32**
12.	Fuzz percentage			
	K-5038 NBt	12.27	1.06	4.3*
13.	JK-Ishwar Bt	17.32	-6.26*	24.76**
	JKCH-1050 NBt	12.35	-2.34	8.33*
	KDCHH-9632 Bt	13.80	-3.33*	9.92**
	JK-Varun NBt	12.70	2.69	15.63**
	C			
	Seed cotton yield (kg/ha)			
	JKCH-22 NBt	1583.67	-0.53*	-19156.50
	D			
	Fuzz percentage			
	JK-Ishwar Bt	17.32	-6.26*	24.76**
	KDCHH-9632 Bt	13.80	-3.33*	9.92**

Note:

A = High mean; $b_i \approx 1$; $S^2 di$ – NS; Remarks – Well adapted to all three environmentsB = High mean; $b_i \approx NS$; $S^2 di$ – S; Remarks – Not well adapted to all three environmentsC = High mean; $b_i \approx S$; $S^2 di$ – NS; Remarks – Not well adapted to all three environmentsD = High mean; $b_i \approx S$; $S^2 di$ – S; Remarks – Not well adapted to all three environments

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Table.16 Genotypes with differential adaptability to the three environments for seed cotton yield

Genotypes	E ₁ (Nagpur)	E ₂ (Dharwad)	E ₃ (Bagalkot)
A			
JKCH-2245 NBt	√	√	√
K-5038 Bt	√	√	√
KDCHH-441 Bt	√	√	√
NCEN-2R NBt	√	√	√
Dhruva Bt	√	√	√
JKCH-99 Bt	√	√	√

List of location specific hybrids

B	E ₁ (Nagpur)	E ₂ (Dharwad)	E ₃ (Bagalkot)
JK-Indra Bt	√		√
JK-Indra NBt	√		
NCEN-3R Bt	√		√
KDCHH-9810 Bt	√		
NCEN-2R Bt	√	√	
Dhruva NBt	√	√	
JKCH-1945 Bt	√		√
C			
JKCH-22 NBt			√

Note:

A = High mean; $b_i \approx 1$; $S^2 d_i$ – NS; Remarks – Well adapted to all three environments

B = High mean; b_i - NS; $S^2 d_i$ – S; Remarks – Not well adapted to all three environments

C = High mean; b_i – S; $S^2 d_i$ – NS; Remarks – Not well adapted to all three environments

√ = Adaptability

Genotype-environment interaction

Source of variation	D.f	SS	MS	F value
Genotype (G)	(g-1)	$\sum_i \sum_j Y_{ij}^2 - CF$	MS ₁	MS ₁ /MS ₃
Environment (E)	(n-1)	$1/n \sum_i Y_i^2 - 1/n \sum_i Y_i^2$		
G × E	(g-1) (n-1)	$\sum_i \sum_j Y_{ij}^2 - 1/n \sum_i Y_i^2$		
Environment (linear)	1	$1/g [(\sum_j Y_j - I_j)^2 \sum_i I_j^2]$		
Genotype×Environment (Linear)	(g-1)	$\sum_i [(\sum_j Y_{ij} I_j)^2 / \sum_i I_j^2] - 1/g [(\sum_j Y_j - I_j)^2 \sum_i I_j^2]$	MS ₂	MS ₂ /MS ₃
Pooled deviation	g (n-2)	$\sum_i \sum_j d_{ij}^2$	MS ₃	MS ₃ /MS ₄
Genotype 1	(n-2)	$[\sum_i Y_{ij}^2 - Y_i^2/n] - [\sum_i Y_{ij} I_j]^2 / \sum_i I_j^2$		
Genotype G	(n-2)	$[\sum_i Y_{gi}^2 - Y_g^2/n] - [\sum_i Y_{gj} I_j]^2 / \sum_i I_j^2$		
Pooled error	n(g-1) (r-1)		MS ₄	
Total	(ng – 1)	$\sum_i \sum_j Y_{ij}^2 - CF$	TSS	

The estimate of deviation from regression

Regression	Stability	Mean yield	Remarks
$b_i = 1$	Average	High	Well adapted to all the environments
$b_i = 1$	Average	Low	Poorly adapted to all environments
$b_i > 1$	Below average	High	Specifically adapted to favourable environments
$b_i < 1$	Above average	High	Specifically adapted to unfavourable environments

Hybrids like JKCH-2245 NBt (20.18%), K-5038 Bt (20.84%), KDCHH-441 Bt (19.46%), NCEN-2R NBt (19.27%), Dhruva Bt (20.88%) and JKCH-99 Bt (19.68%) also showed highly stable reaction for oil content across the three locations.

The hybrids *viz.*, JKCH-99 Bt (16.20), KDCHH-441 Bt (14.83), Dhruva Bt (14.43), K-5038 Bt (13.97), NCEN-2R NBt (13.50) and JKCH-2245 NBt (13.08) were significantly superior over experimental mean for sympodial branches per plant. Number of bolls per plant of hybrids *viz.*, JKCH-99 Bt (34.67), NCEN-2R NBt (34.57), KDCHH-441 Bt (28.77), JKCH-2245 NBt (23.23), Dhruva Bt (28.17) and K-5038 Bt (26.30) were significantly more than the population mean (27.41) and RCH-2 Bt (26.77). For twenty boll weight, NCEN-2R Bt (79.00 g), K-5038 Bt (85.67 g), Dhruva Bt (89.90 g), KDCHH-441 Bt (81.33 g), JKCH-2245 NBt (73.67 g) and JKCH-99 Bt (79.17 g) showed higher 20 boll weight.

The hybrids *viz.*, JKCH-2245 NBt (36.87%), K-5038 Bt (37.47), KDCHH-441 Bt (37.70%), NCEN-2R NBt (36.50%) and Dhruva Bt (36.60%) and JKCH-99 Bt (36.67%) showed desirable ginning outturn percentage.

With reference to seed index, JKCH-2245 NBt (8.80 g), K-5038 Bt (8.60 g), KDCHH-441 Bt (8.45 g), NCEN-2R NBt (8.13 g), Dhruva Bt (7.95 g) and JKCH-99 (8.70 g) showed significantly superior performance over population mean (7.59 g) for seed index.

Some hybrids were found suitable to a specific location. The Bt hybrid JKCH-2245 Bt was found suitable to Nagpur (2700 kg/ha) and Bagalkot (2230 kg/ha) as its seed cotton yield was significantly superior over experimental mean (1389.43 and 1260.59 kg/ha, respectively) in these locations and

over RCH-2 Bt (1000 and 800 kg/ha) at Nagpur and Bagalkot, respectively. JK-Indra (2047 kg/ha) exhibited significant superiority over average mean (1260 kg/ha) as well as RCH-2 Bt (838 kg/ha) at Bagalkot and over mean (1260 kg/ha) at Nagpur. The non-Bt hybrids JK-Indra (2050 kg/ha) and KDCHH-9810 Bt (1950.00 kg/ha) revealed significant superiority over RCH-2 Bt (1000 kg/ha) as well as experimental mean (1389 kg/ha) and these hybrids were suitable to Nagpur. The deviation from the regression coefficient was significant and regression coefficient was near to 1 for these hybrids.

At Bagalkot location, JKCH-1945 non-Bt revealed better adoption which reflected in its yield (2327 kg/ha) being higher than the experimental mean (1260 kg/ha) while Dhruva non-Bt (2150 kg/ha) was particularly adapted to Nagpur as its mean seed cotton yield (2150 kg/ha) was significantly superior to check (1000 kg/ha) and the experimental mean (1389 kg/ha).

The NCEN-3R Bt (2125 kg/ha) and KDCHH-9810 Bt (1950 kg/ha) hybrids were significantly superior to RCH-2 Bt (1000 kg/ha) and the experimental mean (838 kg/ha). The hybrids NCEN-2R Bt (1825 kg/ha) gave significantly higher yield than RCH-2 Bt (1000 kg/ha) as well as the experimental mean (1389 kg/ha) at Nagpur while, at Dharwad this hybrid (2005 kg/ha) had yield higher than RCH-2 Bt (1685 kg/ha) and the experimental mean (1589 kg/ha) proving its adaptability to both places. JK-Indra NBt (2050.00 kg/ha) was better adapted to Nagpur as its yield was better than the population mean (1389 kg/ha) and the check RCH-2 (1000 kg/ha).

All the above hybrids fitted in the condition of having significantly high mean, regression coefficient not significantly deviating from unity and deviation from regression being

significant, thus proving their adaptability to a specific location.

Among the hybrids evaluated, JKCH-2245 NBt, K-5038 Bt, KDCHH-441 Bt, NCEN-2R NBt, Dhruva Bt and JKCH-99 Bt hybrids were identified as stable hybrids for seed cotton yield based on stability parameters. These can be cultivated across the cotton cultivation zones. However, there were hybrids very much suitable for a specific location, viz., RCH-2 Bt, NCEN-3R Bt, JK-Indra Bt and Dhruva NBt which were suitable for Nagpur (Central zone) location only. JKCH-22 NBt was suitable for Bagalkot while NCEN-2R Bt was suitable for both Nagpur and Dharwad locations.

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