Character Association And Component Analysis In American Cotton (*G. hirsutum* L.)

THESIS

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JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA, JABALPUR

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(PLANT BREEDING AND GENETICS)

By

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CERTIFICATE - I

*This is to certify that the thesis entitled **"Character Association And Component Analysis In American Cotton (G. hirsutum L.)"** submitted in partial fulfilment of the requirement for the degree of **Master of Science in Agriculture (PLANT BREEDING AND GENETICS)** of the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by Miss **JYOTI JETHLIYA,** I.D. No.AP/IN-113/01, under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.*

No part of the thesis has been submitted for any other degree or diploma (Certificate awarded etc.) or has been published/ published part has been fully acknowledged. All the assistance and help received during the course of the investigation has been duly acknowledged by her.

Place: Indore

Date: 28.06.2007

(Dr. P.D. Gaikwad)

Chairman of the Advisory Committee

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CERTIFICATE - II

*This is to certify that the thesis entitled **"Character Association And Component Analysis In American Cotton (G. hirsutum L.)"** submitted by Miss **JYOTI JETHLIYA**, I.D. No. AP/IN-113/01, to the J. N. Krishi Vishwa Vidyalaya, Jabalpur in partial fulfilment of the requirements for the degree of **Master of Science in Agriculture** in the Department of **Plant Breeding and Genetics** has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination of the same.*

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(Jyoti Jethliya)

Place: Indore

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INTRODUCTION

Cotton is one of the most important commercial crops playing a key role in economic, political and social affairs of the world. As a fibre crop, cotton belongs to family Malvaceae.

There are four main species of cotton of which two are new world cotton *viz.*, *Gossypium hirsutum* (L.), *G. barbadense* (L.) and two are old world cotton *Desi* cotton *G. arborium (L.)*, *G. herbaceum* (L.). Cotton occupies the maximum area (50%) in India and World. The area and production in 2005-06 under cotton have been reported to the 6.35 lakh ha and 15 lakh bales in Madhya Pradesh and 88.17 lakh ha and 242.50 lakh bales production in India, respectively. (Source: Annual report CICR, Coimbatore (2006-07)).

Seed cotton yield and fibre quality are very important for farming community, ginning industry and textile industry. The genetic analysis is more complex pertaining to seed cotton yield, as it is presumed to be controlled by a large number of genes and is greatly influenced by environment. The correlation coefficient analysis and path coefficient analysis provide information on the relative importance of various yield contributing characters. The yield potential of the cotton plant is influenced by such components as plant height, leaf characters, number of monopodia and number of sympodia per plant, number of bolls per plant. Quality of fibre is also an important character and it depends on fibre length and strength.

Therefore, for achieving rational improvement in yield and fibre quality, knowledge of mechanism of association and direct and indirect effects of component characters provides a basis for formulating suitable selection criteria determining the yield and fibre quality. Keeping these in view, present investigation was undertaken with the following objectives:

1. To estimate various parameters of genetic variability for kapas yield and its components and fibre quality.

2. To estimate the correlation coefficients between kapas yield and its components at genotypic and phenotypic levels.

3. To estimate the direct and indirect effects of various yield components on kapas yield to understand the cause of association between two variables.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

In this chapter the work done on following aspects of cotton breeding has been reviewed. Attempts were made to study the genetics of yield and yield components of cotton. The available literature on various aspects has been reviewed under the following heads:

2.1 Genetic variability

2.2 Heritability

2.3 Genetic advance

2.4 Correlation coefficients

2.5 Path analysis

2.1 Genetic variability:

Dedaniya and Pethani (1994) reported significant difference between 26 genotypes studied for Bartlett's index, seed cotton yield per plant, number of bolls per plant, lint yield per plant, bundle strength tenacity and fineness micronaire.

Kumar and Rajamani (1994) evaluated ten high-yielding advanced lines of *Gossypium arboreum*, together with released cultivar K10, for seed cotton yield, ginning outturn, lint index, 100-seed weight and halo length and reported highest variation in seed cotton yield and lint index.

There was a significant interaction between varieties and fibre strength parameters in ranking of varieties by Stelometer as well as by HVI, as noted by Howle *et al.* (1995).

Pandey *et al.* (1995) noticed high genotypic coefficient of variation for cotton yield per plant, indicating the importance of additive gene effects, whereas phenotypic coefficient of variation was high for boll number per plant, boll weight and ginning percentage, indicating the importance of non-additive effects.

Patel *et al.* (1996) observed high estimates of genotypic coefficient of variation for seed cotton yield per plant and bolls per plant.

Rao and Mary (1996) observed high genetic variability for boll number, boll weight, lint index and seed cotton yield while Ali *et al.* (1998) noticed low coefficients of variability for all the characters except seed cotton yield per plant and number of bolls per plant.

Jagtap and Mehetre (1998) reported high genetic coefficient of variation for bolls per plant and seed cotton yield per plant. Similarly Deshmukh *et al.* (1999) observed high genotypic coefficients of variation while studying 36 cotton genotypes for seed cotton yield per plant, bolls per plant and sympodia per plant.

Patil and Raveendra (1999) noted that high variability for seed cotton yield per plant, plant height, sympodia per plant, bolls per plant and boll weight in six F_2 populations recorded.

Satange *et al.* (2000) observed that the characters like seed cotton yield per plant, bolls per plant, plant height and sympodia per plant had high levels of genetic variation.

Dheva and Potdukhe (2002) studied six F_2 population and noted high variability for plant height and seed cotton yield per plant.

Pandey *et al.* (2002) studied high genetic variation for plant height, intermediate genetic variation for seed cotton yield per plant, ginning percentage and 2.5% span length, and low, for boll weight and earliness. The phenotypic coefficient of variation, was generally lower than the genotypic coefficient of variation. The genotypic coefficient of variation was high for seed yield per plant, but low for boll weight, earliness, ginning percentage and 2.5% span length.

Pawan Kumar (2004) reported that high genetic coefficient of variation for number of bolls per plant, seed cotton yield per plant and kapas yield per plant.

Most recently Gupta (2005) noted that high genotypic coefficient of variation in 34 cotton genotypes for kapas yield per plant, number of bolls per plant and number of sympodia per plant.

2.2 Heritability:

Moderate heritability estimates for fineness micronaire, lint yield per plant, Bartlett's index, seed cotton yield per plant and number of bolls per plant is observed by Dedaniya and Pethani (1994).

Pandey *et al.* (1995) noted high heritability estimates for cotton yield per plant, boll number per plant, boll weight and ginning percentage.

Kowsalya and Raveendra (1996) reported high heritability (>80%) for days to 50% flowering, boll weight, ginning outturn, pollen abundance, pollen stainability, selfed seed set and 2.5% span length.

Patel *et al.* (1996) observed high heritability for seed cotton yield per plant, bolls per plant, mean fibre length, 2.5% span length, fibre fineness and uniformity ratio.

Siddiqui (1996) found high estimates of heritability for seed cotton yield per plant, 2.5% span length, plant height and weight of 25 burst bolls.

Ali *et al.* (1998) noted prominent broad sense heritability estimates for number of bolls per plant, boll weight and yield of seed cotton thus suggesting that improvement for these traits can be made through selection.

Jagtap and Mehetre (1998) reported moderate to high heritability (broad-sense) for number of bolls per plant, total yield per plant, seed index, plant height and fibre length except sympodia per plant and number of seeds per boll. Similarly Deshmukh *et al.* (1999) had recorded high heritability values for number of monopodia per plant, number of sympodia per plant, number of bolls per plant and plant height except ginning outturn and fibre fineness.

High heritability for ginning percentage, 2.5% span length, seed yield per plant, boll weight and plant height showed by Pandey *et al.* (2002) while studying 32 genotypes Pawan Kumar (2004) noted that high estimates of heritability for seed cotton yield per plant, plant height and fibre length respectively.

Lastly a prominent broad sense heritability estimates for kapas yield per plant, boll number per plant, fibre strength and seed index had been noticed by Gupta (2005).

2.3 Genetic advance:

High genetic advance for fineness micronaire, lint yield per plant, Bartlett's index, seed cotton yield per plant and number of bolls per plant were noted by Dedaniya and Pethani (1994).

Patel *et al.* (1996) reported high expected genetic advance for seed cotton yield per plant and bolls per plant. Conversely mean fibre length, 2.5% span length, fibre fineness and uniformity ratio showed low to medium genetic advance.

Rao and Mary (1996) suggested to practice selection based on boll weight and boll number, because these traits had high heritability associated with greater genetic advance.

Siddiqui (1996) reported high genetic advance as a percentage of the mean for seed cotton yield per plant, 2.5% span length, plant height and weight of 25 burst bolls.

Jagtap and Mehetre (1998) observed that low genetic advance could be attributed to low genotypic coefficient variation rather than to the heritability. High heritability estimates coupled with the low genetic gain were found for days to flowering, number of loculi per boll, ginning percentage and lint index indicating that variation in these characters was due to non-additive gene effects. Number of bolls per plant, seed cotton yield per plant, boll weight, seed index, plant height and halo length had high heritability associated with high genetic gain suggesting the probable role of additive gene effects on character expression, hence there is possibility of improvement of these characters through simple selection.

High heritability coupled with high genetic advances for plant height, bolls per plant and seed cotton yield. High heritability appeared to be due to additive gene effects had been reported by Deshmukh *et al.* (1999).

Dheva and Potdukhe (2002) noted high genetic advance for cotton yield, yield component and fibre quality traits. However high heritability estimates coupled with high genetic advance for plant height and seed yield per plant and thus suggesting that both traits are governed by additive gene effects (Pandey *et al.* (2002)).

Pawan Kumar (2004) estimated that high genetic advance as a percentage of the mean for number of bolls per plant, number of monopodia per plant and kapas yield per plant. Similarly high genetic advance as a percentage of mean was highest for kapas yield per plant noted by Gupta (2005).

2.4 Correlation coefficients:

Saxena (1963) reported significant positive correlation of seed cotton yield with plant height and number of bolls collected.

Patil and Rodge (1977) reported that height of the plant, monopodial branches and 100 seed weight were negatively correlated with yield. However, number of sympodial branches and bolls per plant were positively and significantly correlated with the yield of hybrid cotton variety Varalaxmi.

Waldia *et al.* (1979) observed negative relationship between boll number and number of sympodia and positive association between boll number and boll weight, boll number and number of monopodia, boll number and seeds per locule.

Singh *et al.* (1979) found strong negative association between boll number and boll weight (r= -064).

Sympodia per plant, showed positive correlation with seed cotton yield per plant as observed by Basu and Bhat (1987).

Sangwan and Yadav (1987) noticed that seed cotton yield per plant was positively correlated with monopodia per plant.

Chaudhary *et al.* (1998) found that sympodia per plant had positive correlation with seed cotton yield per plant.

The yield of seed cotton per plant was positively correlated with number of monopodia per plant. number of sympodia per plant. number of picked bolls per plant and boll size. (Giri and Nankar (1989)).

Similar result also Cheng and Zhou (1991) reported by that seed cotton yield per plant was positively correlated with sympodia per plant. boll number per plant and plant height.

However, Tomar *et al.* (1991) reported that seed cotton yield per plant was positively correlated with seed index.

Gite *et al.* (1993) observed that the seed cotton yield was mainly dependent upon number of bolls harvested.

Arshad *et al.* (1993) noted that the seed cotton yield was positively correlated with plant height and sympodia per plant.

Tyagi (1994) reported that seed cotton yield per plant was positively correlated with number of bolls per plant.

Dedaniya and Pethani (1994) noted that seed cotton yield per plant was positively correlated with number of bolls per plant; boll weight, lint yield per plant, plant height and bundle strength tenacity.

Sumathi and Natrajan (1995) found positive correlation between plant height and seed cotton yield per plant.

Sambamurthy *et al.* (1995a and 1995b) observed that seed cotton yield per plant was positively correlated with number of bolls per plant and seed index.

Amutha *et al.* (1996) noted that all characters except days to first boll bursting and seed index had significant and positive correlation with seed cotton yield at the genotypic and phenotypic levels in parents. In hybrids, the number of sympodia per plant, boll weight and plant height had positive association with seed cotton yield at both the levels. In parents, colour of the lint had a positive correlation with fibre fineness and ginning outturn at the genotypic level. It was negatively correlated with bundle strength both at genotypic and phenotypic level. The colour of lint had a negative relationship with bundle strength and 2.5% span length in the hybrids, the respective genotypic and phenotypic correlation coefficients being negative.

Rao and Mary (1996) noted that positive association between seed cotton yield and number of monopodia, number of sympodia, number of bolls per plant and plant height except fibre length and suggested that increased in any one of them will lead to increased seed cotton yield and that all of them can be improved simultaneously. No negative correlations were observed except for micronaire with fibre length.

Kudchikar and Janaboudar (1998) studied high yielding 14 cotton genotypes were associated with higher harvest index and boll number per plant.

Larik *et al.* (1999) observed highly significant correlation of seed cotton yield with bolls per plant was observed at phenotypic level. At genotypic level seed cotton yield expressed significantly positive correlation of 0.784, 0.539 and 0.503 with sympodia, bolls per plant, boll weight and lint index respectively. Bolls per plant exhibited strong positive correlation with sympodia both at genotypic level (r=0.945) and phenotypic level (r=0.568). Fibre strength displayed strong positive association with staple length (r=0.614) and ginning outturn percentage at genotypic level. Fibre fineness revealed strong positive and negative genetic correlation (r= 0.984* and r= -0.844) with fibre strength and staple length, respectively. Estimated value of phenotypic and genetic correlation were similar in direction, while in magnitude genetic correlations tended to be larger, though similar in sign, to their corresponding phenotypic correlation. They conclude that the bolls per plant and sympodia to be the most effective yield component of cotton.

Ambamurthy (1999) noted number of boll per plant, plant height, number of monopodia, sympodia and seeds per boll had positive correlation with seed cotton yield, while ginning percentage showed significant negative association with seed cotton yield.

Manimaran (1999) reported that seed cotton yield per plant showed positive correlation with monopodia per plant, sympodia per plant and number of bolls per plant and plant height.

Sambamurthy and Rao (1999) found positive correlation between seed cotton yield per plant and plant height.

Sultan *et al.* (1999) observed that sympodia per plant, boll number per plant, boll weight and ginning percentage showed highly significant positive correlations with fibre yield, at both the phenotypic and genotypic levels. There was an antagonistic association between boll number and boll weight.

Satange *et al.* (2000) reported that bolls per plant, sympodia per plant, seed index and boll weight had positive significant correlations with seed cotton yield per plant both at phenotypic and genotypic levels.

Girase and Mehetre (2002) noted that sympodia number, boll number, boll weight, plant height, seed index, length index and total dry matter exhibited significant positive association with seed cotton yield.

Kaushik *et al.* (2003) observed that seed cotton yield per plant was positively correlated with monopodia per plant, number of bolls per plant and plant height.

Thind (2004) studied seven cultivars of *Gossypium*. The period of fibre elongation was recorded more in long than in short staple cultivars.

Pawan Kumar (2004) reported that number of sympodia per plant and number of boll per plant showed highly significant positive correlations with seed cotton yield.

Gupta (2005) noted that seed cotton yield per plant was positively and significantly correlated with plant height, sympodia per plant and number of bolls per plant.

2.5 Path analysis:

Butany *et al.* (1968) observed that the boll number has no direct contribution to yield, but contributes mostly through sympodia. Number of sympodia and boll weight were the characters, which had direct contribution to yield.

Singh *et al.* (1979) stated that despite the negative correlation between boll weight and boll number, both characters had strong direct effects on yield.

Tyagi (1994) found that boll number had direct effect on yield followed by plant height.

Waldia *et al.* (1979) reported that bolls per plant, boll weight and seed locule had exhibited positive direct effects on yield.

Tikka *et al.* (1980) stated that only boll number per plant had direct effect on yield and selection for that character could be used in the improvement of seed cotton yield.

Ananda Chaudhary and Hanumantharao (1987) found that monopodia, sympodia per plant and boll weight were related with seed cotton yield through direct effects.

Chaudhary *et al.* (1998) reported that boll number and boll weight had positive direct effect on seed cotton yield per plant.

Singh *et al.* (1990) noted that boll number and boll weight had the strongest direct effect on seed cotton yield per plant.

Tomar and Singh (1991) found that boll number had a considerable positive direct effect on seed cotton yield per plant.

Dedaniya and Pethani (1994) observed on the basis of path analysis that the high correlation between lint yield and seed cotton yield was a product of boll weight and bolls per plant.

Tyagi (1994) reported that boll number and boll weight had highest direct effects on seed cotton yield per plant.

Sumathi and Natrajan (1995) observed that boll number was the main character in regards to influencing the seed cotton yield directly.

Rao and Mary (1996) reported that boll number and boll weight were the principle yield attributes, having the highest direct effects. The characters seed per boll and seed index contributed to yield indirectly through boll weight. The fibre characters on yield were of minor significance.

Valarmathi (1996) noted positive direct effect on seed cotton yield with boll number and sympodia per plant.

Amutha *et al.* (1996) observed that in cotton hybrid number of bolls per plant was the most important characters, which influenced the yield directly or indirectly.

Manimaran (1999) reported that monopodia, boll number, boll weight had directly effect on seed cotton yield per plant.

Larik *et al.* (1999) observed that the character boll number pronounced direct and indirect effects on seed cotton yield as compared to other variable.

Sultan *et al.* (1999) observed on the basis of the basis of path coefficient analysis that boll number, boll weight and ginning percentage had strong direct effects on fibre yield.

Girase and Mehetre (2002) indicated that sympodia number, boll weight, plant height, seed index, length index and total dry matter directly and positively contributed towards the seed yield.

Pawan Kumar (2004) stated that boll number and boll weight and plant height had highest direct effects on seed cotton yield per plant.

Gupta (2005) observed positive direct effect on seed cotton yield, number of monopodia, number of boll per plant and sympodia per plant respectively.

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

This chapter comprises the methods employed and materials used during the course of investigation entitled "Character association and component analysis in American cotton (*G. hirsutum* L.)". The details of materials used and methodologies adopted in the present study have been described under different sub headings:

3.1 Experimental site

The present investigation was carried out in All India Co-ordinated Cotton Improvement Project, College of Agriculture, Indore (M.P.) during *kharif* 2006-07. The topography of the field was uniform with gentle slope.

3.2 Location and climate

Indore is situated in Malwa Plateau in Western part of Madhya Pradesh at the latitude of 22.43° N and longitude of 75.66° E with an altitude of 555.5 meter above mean sea level. This region has sub tropical, semi arid climate with an average rainfall of 941 mm and the precipitation is received mostly during mid June to mid September. The southwest monsoon is responsible for the major part of the precipitation with occasional showers in winter. The average maximum temperature of the city ranges between 45°C to 23°C and the minimum between 29°C and 4°C during summer and winter, respectively.

3.3 Meteorological data

The meteorological conditions prevailed during the crop growth, showing maximum-minimum temperature, average relative humidity and rainfall have been presented in Table 3.1. The data were obtained from the Observatory of College of Agriculture, Indore.

The rainfall during the season was 1105.8 mm which is above average and its distribution was also normal which was favourable for the normal growth and development of the crop.

Table 3.1 Meteorological conditions prevailed during crop growth period

Month	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Number of rainy days	RH (%)	Evaporation rate (mm) day
June	36.5	25.8	40.8	7.0	78.6	7.0
July	28.7	23.8	360.4	14	88.9	2.4
Aug	26.8	22.3	429.4	17	92.7	2.3
Sept	29.8	22.5	244.4	11	93.1	2.3
Oct	30.0	18.6	14.0	3.	89.9	3.3
Nov	29.3	14.0	13.0	1	89.2	2.7
Dec	26.6	11.02	0	0	93.1	2.6
Jan	25.2	9.4	3.8	1	92.9	3.2
Total			**1105.8**	**54**		

3.4 Experimental material

The experimental material comprised 21 genotypes of American cotton. The list of genotypes have been presented in Table 3.2.

Table 3.2 List of cotton genotypes

SN	Genotype	SN	Genotype
1	AKH 2017	11	P 6263
2	CNDTS 51	12	CCH 4436
3	SCS 651	13	PH 1024
4	GSHV 151	14	RAH 216
5	NH 627	15	TSH 2005
6	BS 77	16	ARBH 818
7	H 1259	17	GJHV 360
8	IH 09	18	ERB 548
9	NDLH 1863	19	ZC (LRA, Sahana)
10	AKH 20.7.2	20	Vikram
		21	IH 63

These genotypes were grown in completely randomized block design, replicated 3 times. The row to row and plant to plant distance of 60 cm × 60 cm was maintained. Gross plot size was 14.40 m^2 and net plot size was 11.52 m^2. All recommended package of practices were followed during the crop growth period.

3.5 Observations recorded

The data was recorded on five plants of each genotype, selected randomly from each of three replications for following observations:-

1. **Flower initiation:** Flower initiation was measured in days from the sowing date to 1^{st} opening of flower.
2. **Plant height (cm):** Plant height was measured in cm from the base of plant to the tip of the stem at the time of first picking.
3. **Number of sympodia per plant:** Number of branches (bearing fruits directly) per plant was counted at the time of first picking.
4. **Number of monopodia per plant:** The number of primary branches (without bearing fruit directly) was counted at the time of first picking.
5. **Number of bolls per plant:** The number of bolls per plant was recorded before each picking.
6. **Number of seeds per boll:** Seeds from the well developed three bolls of each selected plant were counted and the average number of seeds per boll was obtained.
7. **Seed cotton per boll:** The weight of each boll after picking was recorded in gram.
8. **Ginning percentage:** The ginning percentage was obtained by using following formula:

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

9. **Seed index:** Seed index was obtained from the ginned cotton of randomly selected single plant, from each of three replications

and weighed in gm. Hundred seeds were randomly selected from the bulk of fine plants/replications.

10. **Seed cotton yield per plant (g):** Seed cotton yield of five competitive plants per replication was recorded after each picking and averaged.

11. **Fibre length (mm):** Lint collected from each of the five selected plants from the plot and it was sent to CIRCOT, Nagpur and 2.5 per cent span length has recorded from Digital fibrograph instrument.

12. **Fibre strength:** Fibre strength is expressed in breaking load in pound and is tested for the yarn of a particular count on a lea tester of one lea made of 120 yard of yarn. Since strength of fibres co-related with breaking load strength index is calculated through fibre strength of bundle against strength tester. Strength index is equal to the breaking load of bundle (lbs) divided by its weight in mg.

Statistical analysis:

1. Analysis of variance and covariance

The average data for each character recorded on five plants were subject to analysis of variance and covariance for RBD by the standard procedures (Panse and Sukhatme, 1954). Genetic variation and correlation coefficient will be worked out as per the standard process appeared in Dabholkar (1992), and the skeleton of ANOVA (Table 3.3), which was used for each trait is as follows:

Table 3.3: ANOVA for Randomized Completely Block Design

Sources of variation	d.f.	MSS	F (Calculated)
Replications	(r-1)	M_r	M_r/M_e
Genotypes	(g-1)	M_g	M_g/M_e
Error	(r-1)(g-1)	M_e	

Where r= replication, g= genotype, e= error, m=mean.

Conclusion regarding the replication and treatments differences were made through F-test and the significance of differences between entries for various characters was tested and identified using critical differences at 0.01 and 0.05 per cent.

2. Estimation of phenotypic and genotypic coefficients of variation:

The phenotypic (PCV) and genotypic (GCV) coefficients of variation were calculated in percentage by the formulae given by Burton (1952).

$$\text{PCV\%} = \frac{\text{Phenotypic standard deviation}}{\text{Grand mean}} \times 100$$

$$\text{GCV \%} = \frac{\text{Genotypic standard deviation}}{\text{Grand mean}} \times 100$$

3. Estimation of heritability and genetic advance:

Estimation of heritability provides help to breeder in selection. In this investigation broad sense heritability (h^2b) was calculated by following formula:

$$h^2_b = \frac{\text{Genotypic variance}\left(\sigma^2{}_g\right)}{\text{Phenotypic variance}\left(\sigma^2 p\right)} \times 100$$

Where,

$$\text{Genotypic variance } \sigma^2_g = \frac{\text{Mg} - \text{Me}}{r}$$

$$\text{Phenotypic variance } \sigma^2_p = \frac{\text{Total variance}}{r}$$

4. Genetic advance:

Genetic advance was calculated by the formula given by Robinson *et al.* (1949) from straight selection.

$G(S) = kh^2\sigma p$

Where,

K = selection of differential in standard deviation units which is 2.06 for 5% selection intensity.

h^2 = heritability in broad sense in fraction

σ_p = phenotypic standard deviation

5. Estimation of correlations:

The estimates of correlation coefficients at genotypic, phenotypic and environmental levels among the observed traits were calculated by following formulae.

$$r_p = \frac{\text{Covariance x, y (p)}}{\sqrt{\text{Variance x (p)} \times \text{Variance y (p)}}}$$

$$r_g = \frac{\text{Covariance x, y (g)}}{\sqrt{\text{Variance x (g)} \times \text{Variance y (g)}}}$$

$$r_e = \frac{\text{Covariance x, y (e)}}{\sqrt{\text{Variance x (e)} \times \text{Variance y (e)}}}$$

Where,

r_p = phenotypic correlation

r_g = genotypic correlation

r_e = environmental correlation

Significance of correlation coefficients were tested against 't' values at n-2 degrees of freedom as given by Fisher and Yates (1938).

6. Path coefficient analysis

The correlation coefficient analysis and path coefficient analysis provide knowledge on the relative importance of yield components. The direct and indirect effects of component characters to the total correlation coefficients with seed cotton yield/plant was estimated through path coefficient analysis given by Wright (1921, 1934) and elaborated by Dewey and Lu (1959).

For estimation of various direct and indirect effects, the following sets of simultaneous equation were formed and solved.

$Y_{1y} = P_{1y} + Y_{12}\,P_{2y} + Y_{13}\,P_{3y} + \ldots\ldots\ Y_1/\,P_{1y}$

$Y_{2y} = P_{2y} + Y_{12}\,P_{2y} + Y_{23}\,P_{3y} + \ldots\ldots\ Y_2/\,P_{1y}$

$Y_{ly} = P_{l1}\,P_{ly} + Y_{12}\,P_{2y} + Y_{23}\,P_{2y} + \ldots\ldots\ P_{1y}$

Where,

Y_{1y} to Y_{ly} = Coefficients of correlation between causal factor 1 to I and dependent character.

Y_{l2} to $Y_{l-1,l}$ = Correlation among causal factors themselves, and

P_{1y} to P_{Ly} = Direct effects of characters 1 to I on character Y.

Residual effect, which measures the contribution of the characters not considered in the causal scheme, was obtained as:

Residual effect (PRY) = $\sqrt{1-R^2}$

Where,

$$R^2 = \sum_{iy} P_{iy}^2 + \sum_{\substack{i+j \\ i>j}} P_{iy} P_{jy} R_{ij}$$

RESULTS

CHAPTER IV

RESULTS

The experimental results obtained in the present investigation have been described under the following heads:

4.1 Analysis of variance

4.2 mean and range

4.3 Coefficient of variation

4.4 Heritability

4.5 Genetic advance

4.6 Character association and component analysis

4.6.1 Correlation coefficient

4.6.2 Path coefficient

4.1 Analysis of variance:

The analysis of variance for randomized block design in respect of twelve characters *viz.,* fibre length, fibre strength, flower initiation, ginning percentage , number of bolls per plant, number of monopodia per plant,

Table 4.1: Analysis of variance showing mean sum of square for different characters in cotton

S.No.	Source of variation	Replications	Genotype	Error
	Degree of freedom	2	20	40
	Characters	Mean sum of squares		
1	Flower initiation(days)	2.21	42.5**	2.62
2	Plant height (cm)	1.01	113.6**	4.37
3	No. of sympodia per plant	8.72	25.8*	6.19
4	No. of monopodia per plant	0.057	0.096**	0.027
5	No. of bolls per plant	0.11	8.19**	0.31
6	No. of seeds per boll	0.30	12.3**	0.46
7	Seed cotton yield per boll(gm)	0.005	0.11**	0.009
8	Ginning percentage	0.25	8.37**	0.27
9	Seed index(gm)	0.23	3.39**	0.11
10	Cotton yield per Plant(gm)	0.37	52.5**	2.88
11	Fibre length(mm)	0.07	8.55**	0.08
12	Fibre strength(gramtexta)	0.06	3.61**	0.05

** Highly significant at 0.1% * Significant at 0.5%

number of seeds per boll, number of sympodia per plant, seed cotton yield per plant, seed cotton yield per boll, **seed index**, and plant height was carried out separately and the mean sum of square root for various characteristics has been presented in Table 4.1. Highly significant differences were obtained for all the twelve characters under study.

4.2 Mean and range:

The estimates of mean and range for all the twelve characters have been shown in Table 4.2. The mean data for all the characters have been given in Appendix .

The table showed a wide range of variation among the genotypes. The variation was almost uniform on both sides of mean indicating normal distribution of population.

4.2.1 Flower initiation (days):

Flower initiation (days) of 21 genotypes ranged in between 44 to 58 days and the mean of these being 48.3 days. Eight entries exhibited significantly early flowering in between the range of 45.0 to 46.7 days and the mean flowering of 48.7 days. Three out of eight entries were found earliest *Viz.*, PKH207, CCH4436 and ZC(LRA sahana) each taking 45 days. (Table 4.2 and Appendix table-1)

4.2.2 Plant height(cm):

A wide range of variation for height in between 49.4 to 75.4 cm have been recorded in 21 genotypes. The mean value for height being 61.4cm. Three entries *Viz.*, RB548(49.4cm), NH627 (52.2cm) and NDLH-1863 (53.4cm) found significantly dwarfer per shorter in height as against mean height of 61.4 cm. Vikram was found tallest recording 75.4 height in cm. (Table 4.2 and Appendix table-1)

4.2.3 Number of sympodia per plant::

The number of sympodia ranged from 11.8 to 17.6 as against average of 14.4 branches per plant. None of the genotype was found better (significantly) than the mean value of 14.4 branches per plant. However, Vikram had produced highest sympodia per plant Viz., 17.6 per plant. (Table4.2 and appendix table 1)

Table 4.2: Variability parameters for different characters in cotton

Character	Mean	Range		PCV %	GCV %	Heritability (broad sense)	Genetic advance	Genetic advance over mean
		Minimum	Maximum					
Flower initiation	49.3	45.0	58.0	8.10	7.40	83%	6.87	13.94
Plant height (cm)	61.4	49.4	74.0	10.41	9.84	89%	11.75	19.14
No. of sympodia per plant	14.4	11.8	17.6	18.41	6.37	52%	0.65	4.51
No. of monopodia per plant	1.28	1.00	1.60	17.62	11.86	45%	0.21	16.41
No. of bolls per plant	9.5	5.4	12.9	18.00	17.01	89%	3.16	33.26
No. of seeds per boll	19.7	15.7	22.9	10.71	10.13	69%	3.88	19.70
Seed cotton per Boll (g)	2.46	2.04	2.83	8.33	7.33	77%	0.33	13.41
Ginning percentage	35.5	31.8	38.0	4.85	4.62	91%	3.22	9.07
Seed index (g)	8.43	6.89	11.32	13.01	12.42	71%	2.06	24.44
Total yield per plant (g)	23.4	13.9	31.6	18.83	17.38	63%	7.74	33.08
Fibre length (mm)	25.2	20.1	27.6	6.76	6.67	97%	3.41	13.53
Fibre strength (mm)	19.8	17.6	21.5	5.61	5.49	95%	2.20	11.11

4.2.4 Number of monopodia per plant:

This character ranged from 1.00 to 1.6 while the average value for monopodia per plant was 1.28 for the character. It was observed nine out of twenty one genotype *viz.*, RB 548, TSH 2005, NDLH 1863, BS 77, RAH 216, GJHV 360, GSHV 151, PH 1024 and IH 63 had been more to have significantly more monopodia per plant to mean value of 1.28. Two entries TSH 2005 and RB548 (1.6 per plant) had possessed, the highest number of monopodia per plant. (Table 4.2 and appendix table 1)

4.2.5 Number of bolls per plant:

While studying 21 genotypes, the number of bolls per plant were found from minimum 5.4 to maximum 12.9 and their mean value being 9.5 per plant. Seven entries per genotype viz. ARBH 818 (12.9), RB 548 (1.5), Vikram (11.3), RAH 216 (11.0), GJHV 360 (10.9), PH 1024 (10.7) and CCH 4436 (10.7), each has recorded significantly higher boll number per plant than higher boll no. per plant as the mean value. (Table 4.2 & Appendix Table 1)

4.2.6 Number of seeds per boll:

The range of this character varied from 15.7 to 22.9 with 19.7 as a mean value in 21 genotypes were studied. Seven genotypes viz., NH 627 (22.9), H 1259 (22.3), ARBH 818 (22.0) Vikram (21.8), RAH 216 (21.6), CCH 4436 (21.3) and BS77 (21.2), all have been recorded (significantly). Higher per more number of seeds per boll in comparison to mean value of 19.7. (Table 4.2 and appendix table 1)

4.2.7 Seed cotton yield per boll:

21 genotype studies for seed cotton yield per boll varied from 2.04 to 2.83, the mean value for this trait was 2.46 g, only three entries *viz.* P 6263 (2.83), NDLH (2.71) and CND 1651(2.6) recorded significantly more seed yield per boll (g) than that of 2.46 g per boll. (Table4.2 and appendix table 2)

4.2.8 Ginning percentage:

The range for ginning percentage varied from 31.82 to 38.0%,the mean value for this character was observed as 35.55%. Seven entries *viz.*,

AKH 2017 (38.00), RB 548 (37.4), GSHV 151 (37.4.), SCS 651 (36.7), TSH 2005 (36.6), CCH 4436 (36.6), and P6263 (36.5%, each have had superior ginning % to the average value being 35.55%. (Table 4.2 and appendix table 2)

4.2.9 Seed index:

The variation for hundred seed in gms varied from 6.89 to 11.32 g and the mean value for this character being 8.43 gm. There were six entries *viz.*, CNDTS 51 (11.32 g), GSHV 151 (9.92 g) , ZC (LRA Sahana) (9.65), P 6263 (9.41 g), BS 77 (9.17) and TSH 2005 (9.15) gave (significantly) more seed index to the average seed index in gram. The rest of fifteen genotypes however had recorded seed index below the average seed index in gram. (Table 4.2 and appendix table 2)

4.2.10 Seed cotton yield per plant:

A wide range of seed cotton yield verities was found from 13.9 to 31.6 g per plant with average yield per plant of 23.4 g . Found out of 21 genotypes i.e. ARBH 818 (31.6 g), Vikram (29.2 g), PH 1024 (27.8 g), GJHV 360 (27.2 g) significantly recorded better yield than the mean yield of 23.4 g per plant. (Table 4.2 and appendix table 2)

4.2.11 Fibre length:

Fibre length (mm) of 21 genotypes varied from 20.1 to 27.6 mm with average length of 26.2 mm. Nine entries out of 21 *viz.*, GJHV 360 (27.6 mm), CCH 4436 (27.2 mm), GSHV 151 (26.8 mm), TSH 2005 (26.5 mm), CNDTS 51 (26.5 mm), ARBH 818 (26.4 mm), P 6263 (26.0 mm), AKH 2017 (25.9 mm) and NH627 (25.7 mm) all had been found recording better over the average fibre length mm of 26.2. (Table 4.2 and appendix table 2)

4.2.12 Fibre strength:

The character study have ranged from 12.6 to 21.5 (in gram texta), its average was found as 19.8 (gram texta). Nine verities per entries *viz.* Vikram (21.5), CNDT 51 (21.3), TSH 2007 (21.2), ARBH 818 (21.2), BS77 (20.9), ZC (LRA Sahara) (20.6), AKH 2472 (20.4), AKH 2017 (20.3) and

PB 263 (20.2) were all these having better fibre strength to their mean value 19.8 (in gram texta) The rest of the twelve strains were found to recorded fibre length significantly below mean value (19.8). (Table 4.2 and appendix table 2)

Based on the performance of 21 genotypes as studied for twelve characters, at least two genotypes *viz.,* Vikram (for tallness, sympodia per plant, number of bolls, number of seeds per boll, seed cotton yield and fibre strength) and ARBH 818 (number of seed per boll, seed cotton yield per boll, fibre length and fibre strength) can be chosen and used as parents (for transferring desirable economical traits) for future varietal improvement work on cotton.

4.3 Coefficient of variation:

Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were worked out and presented in Table 4.2.

Estimates of phenotypic coefficient of variation were high for total yield per Plant (18.83%), followed by number of sympodia per plant (18.41%), number bolls per plant (18.00%), number of monopodia per plant (17.62%), seed index (13.01%), number of seeds per boll (10.71%), plant height (10.41%), seed cotton per boll (8.33%), flower initiation (8.10%), fibre length (6.76%) and fibre strength (5.61%). The lowest phenotypic coefficient of variation was recorded for ginning percentage (4.85%).

Estimate of genotypic coefficient of variation were the highest for total yield per plant (17.38%) followed by number of bolls per plant (17.01%), seed index (12.43%), number of monopodia per plant (11.86%), number of seeds per boll (10.13%), plant height (9.84%), flower initiation (7.40%), seed cotton boll (7.33%), fibre length (6.67%), number of sympodia per plant (6.37%) and fibre strength (5.49%). While, the lowest genotypic coefficient of variation was recorded for ginning percentage (4.62%).

The difference between phenotypic coefficient of variation (PCV %) and genotypic coefficient variation (GCV %) for characters *viz.,* fibre length, fibre strength, ginning percentage, plant height, number of seeds per boll, seed index and flower initiation relatively low. The remaining five characters *viz.*, number of sympodia per plant, number of monopodia per plant, total yield per plant, seed cotton per boll and number of boll per plant exhibited high to medium differences between phenotypic and genotypic coefficient of variation. (Table 4.2).

4.4 Heritability:

The heritability estimates indicate the extent of environmental influence on the expression of particular trait, and this information is very helpful in initial selection. The heritability estimates obtained in the present investigation have been for twelve characters are shown in Table 4.2.

However, the estimates of heritability were highest for fibre length (0.97), fibre strength (0.95) and ginning percentage (0.91) and lowest for number of monopodia per plant (0.45) whereas, remaining characters showed moderate range of heritability.

4.5 Genetic advance as percentage of mean:

The estimate of expected genetic advances as percentage of mean showed in Table 4.2, was highest for number of bolls per plant (33.26%) followed by total yield per plant (33.08%), seed index (24.44%). Whereas it was lowest for number of sympodia per plant (4.51%). Remaining characters *viz.*, number of seeds per boll (19.70%), plant height (19.14%), number of monopodia per plant (16.41%), flower initiation (13.94%), fibre length (13.53%), seed cotton per boll (13.41%), fibre strength (11.11%) and ginning percentage (9.07%) had moderate range of genetic advance as percentage of mean.

4.6 Character association and component analysis

4.6.1 Correlation coefficient:

Estimates of phenotypic, genotypic and environmental correlation coefficients between total yield and its contributing characters and among themselves were worked out and are presented in Table 4.3, 4.4 and 4.5, respectively and those obtained at phenotypic line have been discussed hereunder:

(a) Correlation with total yield per plant:

The character such as number of bolls per plant (0.90), number of seeds per boll (0.33), seed cotton per boll (0.31), number of sympodia per plant (0.23), number of monopodia per plant (0.07), plant height (0.05) and flower initiation (0.01), had non significant positive correlation with total yield per plant, while non significant and negative values were recorded with ginning percentage (-0.21) and seed index (-0.16).

(b) Phenotypic correlation with other yield contributing characters:

Flower initiation had significant positive correlation with monopodia per plant (0.73), seed cotton per boll (0.25), and positive non significant correlation with fibre length (0.14), seed index (0.04), ginning percentage (0.01). Flower initiation had significant negative correlation with number of seeds per boll (-0.54), plant height (-0.34) and negative but non significant correlation with fibre strength (-0.17), number of sympodia per plant (-0.20) and number of bolls per plant (-0.07).

Plant height had significant positive correlation with sympodia per plant (0.40), fibre strength (0.32) and positive but non significant correlation with seed cotton per boll (0.23), seed index (0.18), fibre length (0.11) and ginning percentage (0.04). Plant height had significant negative results with monopodia per plant (-0.30). The rest of traits showed non significant correlation.

Number of sympodia per plant showed positive and significant correlation with plant height (0.40) and ginning percentage (0.31).

Number of monopodia per plant exhibited negative and significant correlation with seed cotton per boll (0.31) and flower initiation (0.73) and negative but highly significant correlation with number of seeds per boll (-0.38) and number of monopodia per plant (-0.38).

Number of bolls per plant showed positive and significant correlation with total yield per plant (0.90) and number of seeds per boll (0.46) and negative but significant correlation with seed index (-0.28).

Number of seeds per boll had positive and significant correlation with total yield per plant (0.33) and negative but significant correlation with seed cotton per boll (-0.28), fibre length (0.25) and seed index (0.25).

Seed cotton yield per boll showed positive and significant correlation with total yield per plant (0.31), seed index (0.25), flower initiation (0.25) and negative but significant correlation with seed cotton per boll (0.28).

Ginning percentage showed positive and significant correlation with number of sympodia per plant (0.31) and positive but non significant correlation with seed cotton per boll (0.09), plant height (0.04), fibre length (0.03) and flower initiation (0.01).

Seed index exhibited positive and significant correlation with fibre strength (0.46), fibre length (0.42), seed cotton per boll (0.35) and negative but significant correlation with number of bolls per plant (0.28) and number of seeds per boll (0.25).

Fibre length exhibited positive and significant correlation with seed index (0.42) and fibre strength (0.41) and negative but significant correlation with number of seed per boll (0.25).

Fibre strength showed positive and significant correlation with seed index (0.46) fibre length (0.41) and plant height (0.32).

Genotypic correlation with other yield contributing characters:

Flower initiation exhibited strong and positive correlation with seed cotton per boll (0.27) and positive but non significant correlation with fibre length (0.14), number of monopodia per plant (0.06), seed index (0.04) and ginning percentage (0.02).

Table 4.3: Phenotypic correlation coefficients among the characters

Characters	Flower initiation	Plant height (cm)	No. of sympodia per plant	No. of monopodia per plant	No. of bolls per plant	No. of seeds per boll	Seed cotton per Boll (g)	Ginning percentage	Seed index (g)	Total yield per plant (g)	Fibre length (mm)
Plant height (cm)	-0.34**										
No. of sympodia per plant	-0.20	0.40**									
No. of monopodia per plant	0.73**	-0.30*	-0.06								
No. of bolls per plant	-0.07	-0.07	0.21	0.05							
No. of seeds per boll	-0.54**	-0.03	0.11	-0.38**	0.46**						
Seed cotton per Boll (g)	0.25*	0.23	0.05	0.14	-0.13	-0.28*					
Ginning percentage	0.01	0.04	0.31*	-0.07	-0.23	-0.18	0.09				
Seed index (g)	0.04	0.18	-0.12	0.01	-0.28*	-0.25*	0.25*	-0.06			
Total yield per plant (g)	0.01	0.05	0.23	0.07	0.90**	0.33**	0.31*	-0.21	-0.16		
Fibre length (mm)	0.14	0.11	-0.03	0.04	0.09	-0.25*	0.13	0.03	0.42**	0.13	
Fibre strength (mm)	-0.17	0.32*	-0.06	-0.15	-0.06	0.15	0.06	-0.18	0.46**	-0.02	0.41**

**Highly significant at 0.1%, * significant at 0.5%

Table 4.4: Genotypic correlation coefficients among the characters

Characters	Flower initiation	Plant height (cm)	No. of sympodia per plant	No. of monopodia per plant	No. of bolls per plant	No. of seeds per boll	Seed cotton per Boll (g)	Ginning percentage	Seed index (g)	Total yield per plant (g)	Fibre length (mm)
Plant height (cm)	-0.40**										
No. of sympodia per plant	-0.77**	0.88**									
No. of monopodia per plant	0.06	-0.43**	-0.88**								
No. of bolls per plant	-0.10	-0.11	0.39**	0.05							
No. of seeds per boll	-0.59**	-0.01	0.41**	-0.49**	0.55**						
Seed cotton per Boll (g)	0.27*	0.29*	0.24	0.30*	-0.16	-0.37**					
Ginning percentage	0.02	0.05	0.84**	-0.10	-0.27*	-0.19	0.12				
Seed index (g)	0.04	0.20	-0.45**	-0.04	-0.33**	-0.27*	0.26*	-0.06			
Total yield per plant (g)	-0.02	0.04	0.51**	0.13	0.91**	0.40**	0.25*	-0.24	-0.22		
Fibre length (mm)	0.14	0.13	0.03	0.05	0.10	-0.27*	0.16	0.04	0.46**	0.16	
Fibre strength (mm)	-0.23	0.34**	-0.16	-0.27*	-0.05	0.16	0.06	-0.20	0.49**	-0.01	0.42**

**Highly significant at 0.1%, * significant at 0.5%

Plant height exhibited strong and positive correlation with number of sympodia per plant (0.88), fibre strength (0.34), seed cotton per boll (0.29), seed index (0.20), fibre length (0.13) and total yield per plant (0.04).

Number of sympodia per plant had strong and positive correlation with number of bolls per plant (0.39), number of seeds per boll (0.41), ginning percentage (0.84), total yield per plant (0.51), seed cotton per boll (0.24) and fibre length (0.03).

Number of monopodia per plant exhibited, strong and positive correlation with seed cotton per boll (0.30), flower initiation (0.06), number of bolls per plant (0.05), total yield per plant (0.13) and fibre length (0.05).

Number of bolls per plant had strong positive correlation with number of sympodia per plant (0.39), number of monopodia (0.05), number of seeds per boll (0.55), total yield per plant (0.91) and fibre length (0.10).

Number of seeds per boll had strong and positive correlation with number of sympodia per plant (0.41), number of bolls per plant (0.55), total yield per plant (0.40) and fibre strength (0.16).

Seed cotton per boll showed positive correlation with flower initiation (0.27), plant height (0.29), number of sympodia per plant (0.24), number of monopodia (0.30), ginning percentage (0.12), seed index (0.26), total yield per plant (0.25), fibre length (0.16) and fibre strength (0.06).

Ginning percentage showed strong and positive correlation with flower initiation (0.02), plant height (0.05), number of sympodia (0.84), seed cotton per boll (0.12) and fibre length (0.04).

Seed index had strong and positive correlation with flower initiation (0.04), plant height (0.20), seed cotton per boll (0.26), fibre length (0.46) and fibre strength (0.49).

Fibre length showed strong and positive correlation with flower initiation (0.14), plant height (0.13), number of sympodia (0.03) number of monopodia (0.05), number of bolls per plant (0.10), seed cotton per boll (0.16), ginning percentage (0.04), seed index (0.46), total yield per plant (0.16) and fibre strength (0.42).

Fibre strength showed strong and positive correlation with plant height (0.34), number of seeds per boll (0.16), seed cotton per boll (0.06), seed index (0.49) and fibre length (0.42).

Path coefficient analysis:

Seed yield is a complex character which is influenced by several plant characters. Path coefficient analysis can provide a more realistic picture of the relationship between kapas yield per plant and other plant characters. Estimates of phenotypic and genotypic path coefficient were worked out and presented in Table 4.5 and 4.6 and those obtained at genotypic levels have been presented below:

Genotypic path coefficient analysis:

Study of genotypic correlation and path analysis (Table 4.5) revealed the correlation between total yield per plant and flower initiation negative with total yield (-0.02). The direct contribution of flower initiation was also negative (-0.115) the indirect contribution through plant height and number of bolls per plant was also negative. The negative correlation reduced through indirect positive contribution of number of sympodia per plant, number of monopodia per plant, number of seeds per boll, seed cotton per boll and fibre strength.

The correlation between kapas yield per plant and plant height was positive with kapas yield (0.04). The direct contribution of plant height was also positive (0.024) and appreciable. The indirect plant height contribution through flower initiation and seed cotton per boll was also positive. The positive correlation reduced through indirect negative contribution of number of sympodia per plant, number of monopodia per plant, number of bolls per plant, seed index and fibre strength.

Table 4.5: Genotypic path analysis (direct and indirect effects) of the characters on total yield per plant.

Characters	**Flower initiation**	**Plant height (cm)**	**No. of sympodia per plant**	**No. of monopodia per plant**	**No. of bolls per plant**	**No. of seeds per boll**	**Seed cotton per Boll (g)**	**Ginning percentage**	**Seed index (g)**	**Fibre length (mm)**	**Fibre strength (mm)**	**Correlation co-efficient**
Flower initiation	**-0.115**	-0.010	0.011	0.059	-0.101	0.022	0.110	0.00	0.00	0.00	0.001	-0.02
Plant height (cm)	0.046	**0.024**	-0.013	-0.024	-0.107	0.00	0.118	0.00	-0.001	0.00	-0.001	0.04
No. of sympodia per plant	0.088	0.021	**-0.015**	-0.048	0.387	-0.015	0.100	-0.009	0.002	0.00	0.001	0.51**
No. of monopodia per plant	-0.123	-0.011	0.013	**0.055**	0.052	0.018	0.122	0.001	0.00	0.00	0.001	0.13
No. of bolls per plant	0.012	-0.003	-0.006	0.003	**0.988**	-0.020	-0.065	0.003	0.001	0.00	0.00	0.91**
No. of seeds per boll	0.069	0.00	-0.006	-0.027	0.547	**-0.037**	-0.150	0.002	0.001	0.00	-0.001	0.40**
Seed cotton per Boll (g)	-0.031	0.007	-0.004	0.016	-0.157	0.013	**0.410**	-0.001	-0.001	0.00	0.00	0.25*
Ginning percentage	-0.003	0.001	-0.013	-0.005	-0.269	0.007	0.049	**-0.011**	0.00	0.00	0.001	-0.24
Seed index (g)	-0.005	0.005	0.007	-0.002	-0.331	0.010	0.105	0.001	**-0.004**	-0.001	-0.002	-0.22
Fibre length (mm)	-0.017	0.003	0.00	0.003	0.102	0.010	0.066	0.00	-0.002	**-0.002**	-0.001	0.16
Fibre strength (mm)	0.026	0.008	0.002	-0.015	-0.044	-0.006	0.025	0.002	-0.002	-0.001	**-0.003**	-0.01

Residual = 0.002 **Note** : Diagonal values are the direct effects.

Table 4.6: Phenotypic path analysis (direct and indirect effects) of the characters on total yield per plant.

Characters	**Flower initiation**	**Plant height (cm)**	**No. of sympodia per plant**	**No. of monopodia per plant**	**No. of bolls per plant**	**No. of seeds per boll**	**Seed cotton per Boll (g)**	**Ginning percentage**	**Seed index (g)**	**Fibre length (mm)**	**Fibre strength (mm)**	**Correlation co-efficient**
Flower initiation	**-0.031**	-0.003	-0.001	-0.014	-0.073	0.012	0.111	0.00	0.00	-0.001	0.00	0.01
Plant height (cm)	0.010	**0.008**	0.002	0.006	-0.071	0.001	0.100	-0.001	0.00	-0.001	-0.001	0.05
No. of sympodia per plant	0.006	0.003	**0.005**	0.001	0.198	-0.002	0.023	-0.008	0.00	0.00	0.00	0.23
No. of monopodia per plant	-0.023	-0.002	0.00	**-0.019**	0.048	0.009	0.059	0.002	0.00	0.00	0.00	0.07
No. of bolls per plant	0.002	-0.001	0.001	-0.001	**0.961**	-0.010	-0.058	0.006	0.00	-0.001	0.00	0.90**
No. of seeds per boll	0.017	0.00	0.00	0.007	0.444	**-0.022**	-0.125	0.005	0.00	-0.001	0.00	0.33**
Seed cotton per Boll (g)	-0.008	0.002	0.00	-0.003	-0.127	0.006	**0.438**	-0.002	0.00	-0.001	0.00	0.31*
Ginning percentage	0.00	0.00	0.001	0.001	-0.227	0.004	0.040	**-0.025**	0.00	0.00	0.00	-0.21
Seed index (g)	-0.001	0.002	-0.001	0.00	-0.274	0.004	0.040	-0.025	**0.00**	0.00	0.00	-0.16
Fibre length (mm)	-0.004	0.001	0.00	-0.001	0.081	0.005	0.057	-0.001	0.00	**-0.007**	-0.001	0.13
Fibre strength (mm)	0.005	0.003	0.00	0.003	-0.058	-0.003	0.027	0.005	0.00	-0.003	**-0.002**	-0.02

Residual = 0.003 **Note** : Diagonal values are the direct effects.

The correlation between total yield per plant and number of sympodia per plant, observed to be positive and quite appreciable (0.51), but a negative direct contribution (-0.015) was exhibited by number of sympodia per plant. The indirect contribution of number of sympodia through number of monopodia per plant, number of seeds per plant ginning percentage was negative but smaller in magnitude. The positive correlation was mainly contributed by indirect effect of number of sympodia through flower intitiation, plant height, number of bolls per plant, seed cotton per boll, seed index and fibre strength.

Number of monopodia per plant displayed positive correlation (0.13) with total yield per plant. The direct contribution of number of monopodia per plant was also positive and appreciable (0.055). The indirect contribution of number of monopodia per plant through number of sympodia per plant, number of bolls per plant, number of seeds per boll, seed cotton per boll, ginning percentage and fibre strength was also positive and appreciable.

The correlation between total yield per plant and number of bolls per plant was observed to be positive and quite high (0.91). Also a highest positive direct contribution (0.988) was exhibited by number of bolls per plant on total yield per plant. Indirect contribution through flower initiation (0.012), number of monopodia per plant (0.003), ginning percentage (0.003) and seed index (0.001) showed positive correlation with kapas yield. The negative negligible correlation was mainly contributed by indirect effect of plant height (0.003), number of sympodia per plant ((0.006), number of seeds per boll (0.020) and seed cotton per boll (0.065).

Number of seeds per boll displayed strong positive (0.40) association with total yield per plant. The direct effect of number of seeds per boll was negative (-0.037) with total yield per plant. The number of seeds per boll has indirect contribution through flower initiation, number of bolls per plant, ginning percentage and seed index was positive and in sufficient quantity. The negative correlation between kapas yield per plant and number of seeds per boll reduced by indirect negative contribution of number of sympodia per plant, number of monopodia per plant, seed cotton per boll and fibre strength.

Seed cotton yield per boll displayed positive (0.25) correlation with total yield per plant. The direct contribution (0.410) with total yield per plant. Seed cotton yield per boll had positive and appreciable indirect contribution through plant height, number of monopodia per plant, number of seeds per boll also positive and negative indirect contribution through flower initiation, number of sympodia per plant, number of bolls per plant, ginning percentage and seed index are negligible.

Ginning percentage had substantial negative direct contribution (-0.24), Its association with total yield per plant was also negative (-0.011). The positive but negligible correlation was mainly contributed by indirect contribution of ginning percentage through plant height, number of seeds per boll, seed cotton per boll and fibre strength. The negative correlation was offset by negligible negative indirect effect, through flower initiation, number of sympodia per plant, number of monopodia per plant and number of bolls per plant.

Seed index displayed negative correlation with total yield (-0.22). The direct contribution of seed index was negative but very low in magnitude (-0.004). The positive correlation was offset by negligible negative indirect effect through flower initiation, number of monopodia per plant, number of bolls per plant, fibre length and fibre strength. The negligible positive correlation was mainly contributed by indirect effect of seed index through plant height, number of sympodia per plant, number of seeds per boll, seed cotton per boll (g) and ginning percentage.

Fibre length displayed positive correlation (0.16) with total yield. The direct contribution of fibre length was negative (-0.02) but negligible. The indirect contribution of fibre length through flower initiation, seed index and fibre strength was negative while plant height, number of monopodia, number of seeds per boll, number of bolls per plant, seed cotton per boll was positive and appreciable.

Fibre strength displayed positive correlation (0.16) with the total yield, found to have direct negative contribution (-0.003). The indirect contribution of flower initiation, plant height, number of sympodia per plant, seed cotton per boll and ginning percentage, was appreciably positive. The strong positive correlation between fibre strength and kapas yield was reduced by indirect negative and negligible contribution of number of monopodia per plant, number of bolls per plant, number of seeds per boll, seed index and fibre length.

Highest direct contribution was observed from number of bolls per plant (0.988), followed by number of monopodia per plant (0.055), seed cotton per boll (0.410) and plant height (0.024). Value of residual effect was quite small (0.002), indicating that character under study sufficiently account for the kapas yield.

The visual observation of the above entries had observed on the character as leaf colour, leaf shape and presence of pubescence, flower colour, pollen colour, colour and shape of boll in Table 4.7.

Table 4.7: The visual observation genotypes

S. No.	Entry	Leaf colour	Leaf shape	Presence of pubescence	Flower colour	Pollen colour	Colour & shape of boll
1	AKH 2017	Light green	Angular	+	Yellow	Yellow	LG & round
2	P 6263	Green	Angular	+	Yellow	Yellow	G & round
3	CNDTS 51	Dark green	Angular	+	Yellow	Yellow	DG & round
4	CCH 4436	Green	Angular	-	Yellow	Yellow	G & round
5	SCS 651	Green	Angular	-	Yellow	Yellow	G & round
6	PH 1024	Dark green	Angular	+	White	White	DG & round
7	GSHV 151	Purple red	Round	+	Yellow	Yellow	PR & angular
8	RAH 216	Green	Angular	+	Yellow	Yellow	G & round
9	NH 627	Green	Angular	+	Yellow	Yellow	G & round
10	TSH 2005	Light green	Angular	-	Yellow	Yellow	LG & round
11	BS 77	Green	Angular	+	Yellow	Yellow	G & angular
12	ARBH 818	Green	Angular	+	Yellow	Yellow	G & round
13	H 1259	Green	Angular	-	Yellow	Yellow	G & round
14	GJHV 360	Dark green	Angular	+	Yellow	Yellow	DG & round
15	IH 09	Green	Angular	+	Yellow	Yellow	G & round
16	ERB 548	Light green	Round		Yellow	Yellow	LG & round
17	NDLH 1863	Green	Angular	-	Yellow	Yellow	G & angular
18	ZC (LRA, Sahana)	Green	Angular	-	Yellow	Yellow	G & angular
19	AKH 20.7.2	Light green	Angular	+	Yellow	Yellow	LG & angular
20	Vikram	Light green	Angular	+	Yellow	Yellow	LG & angular
21	IH 63	Green	Angular	+	White	White	G & angular

G = Green, LG = Light green, DG= Dark green, PR. Purple red s

DISCUSSION

CHAPTER V

DISCUSSION

The discussion pertaining to different aspects of twenty one genotypes of American cotton evaluated at College of Agriculture, Indore has been interpreted and discussed in the chapter in conjunction with the findings of other workers. The discussion is furnished under the following heads:

5.1 Genetic variability
5.2 Heritability
5.3 Genetic advance
5.4 Correlation coefficient analysis
5.5 Path analysis

5.1 Genetic variability:

Genetic variability in any crop is an essential prerequisite for an efficient breeding programme. The technique to be used by a breeder in a specific case depends on the nature and magnitude of this variability. The study of genetic variability can not be studied directly, but through coefficient of variation at phenotypic and genotypic levels which play an important role to understand the extent and nature of genetic variability present in the population.

The analysis of variance for RBD revealed that estimates of mean sum of squares for all the characters were highly significant at 5% and 1% levels of significance, indicating the existence of large variation among the genotypes. Range for almost all the characters was also quite large and wide. It revealed that large variability for all the characters was present in the material.

The values of phenotypic coefficient variation were higher in magnitude than their corresponding genotypic coefficient of variation for all the twelve characters, indicating the masking influence of environmental factors in the expression of these characters.

Total yield per plant and plant height had wide range and high estimates of PCV and GCV indicating that there is a lot of scope for selecting parents for both the traits.

High phenotypic coefficient of variation (PCV%) and genotypic coefficient of variation (GCV%) were noted for the total yield per plant, number of bolls per plant, number of monopodia per plant, seed index, number of seeds per boll and plant height respectively. This indicted the presence of sufficient amount of genetic variability for these characters and can be exploited by adopting appropriate breeding procedures for the improvement of these characters.

The differences between the values of PCV and GCV were narrow. for fibre length, fibre strength , ginning percentage and plant height when indicated that phenotype was truly correspondent by their genotype for these characters. On the other hand number of sympodia per plant number of monopodia per plant exhibited wide differences between PCV and GCV. It suggested that phenotypic expression was not solely due to genotype but environment also contributed in the expression.

The remaining characters *viz.*, flower initiation, number of bolls per plant, number of seeds per boll, seed cotton yield per boll and seed index were found to be consistent in their behaviour, both at phenotypic and genotypic levels in having lowest coefficient of variation. It suggested that these characters were least influenced by the non-genetic factors and were hence quite stable.

Similar results were also reported by Patel *et al.*, (1996), Rao and Mary (1996), Ali *et al.*, (1998), Jagtap and Mehetre (1998), Deshmukh *et al.*, (1999), Patil and Raveendran (1999), Satange (2000), Dheva and Potdukhe (2002) and Pandey *et al.*, (2002) and Pawan Kumar (2004) for number of bolls per plant, number of sympodia per plant, seed cotton yield per boll and seed cotton yield per plant and plant height.

5.2 Heritability:

The degree to which the variability of a character may be transmitted to offspring is known as heritability. It provides a measure of genetic variation i.e. the variation upon which all the possibilities of changing the genetic composition of population through selection is dependent. In other words, knowledge of its magnitude gives an idea about the scope for effective genetic improvement through selection.

Heritability estimates are influenced by plant density, plot size, number of replications and other environmental factors. Thus heritability is not the property of a character alone but it is probably due to population and environmental conditions. Change in any of the components will affect the heritability estimates. The heritability estimates in broad sense were classified into low (below 50%), medium (between 50-70%) and high (above 70%) by Robinson *et al.*, (1949).

In present investigation broad sense heritability estimates were almost high for all the characters except number of monopodia per plant being low in heritability. However, number of sympodia per plant, total yield per plant and number of seeds per boll for which the heritability was medium. The characters like fibre length, fibre strength, ginning percentage, number of bolls per plant, plant height, flower initiation seed cotton per boll and seed index showed high heritability, indicating that these characters should form the basis of selection for high yield in present genotypes.

The present findings are in agreement with the findings of Pandey *et al.*, (1995), Patel *et al.*, (1996), Ali *et al.*, (1998) Deshmukh *et al.*, (1999) Pawan kumar (2004) and Gupta (2005) for seed cotton yield per plant and number of bolls per plant. It is also in agreement with the findings of Pandey *et al.*, (1995), Kowsalya and Raveendran (1996) and Pandey *et al.*, (2002) for ginning percentage. The present findings are also quite in agreement with the work of Kowsalya and Raveendran (1996), Patel *et al.*, (1996), Siddiqui (1996), Jagtap and Mehetre (1998) for fibre length, while Siddiqui (1996), Jagtap and Mehetre (1998) and Pandey *et al.*, (2002), Pawan Kumar (2004) and Gupta (2005) had reported for plant height.

However, these results were not in conformity with the findings of Deshmukh *et al.*, (1999) reported low heritability for ginning percentage while Jagtap and Mehetre (1998) had reported low heritability for number of sympodia per plant and number of seed per boll. The contradiction may be due to difference in the experimental site and the experimental materials.

5.3 Genetic advance:

Heritability estimates along with the genetic advance are more useful than heritability alone in predicting the resultant effects on selecting best individuals.

In the present investigation, expected genetic advance expressed as percentage of mean was high for number of bolls per plant (33.26%), followed by total yield per plant (33.08%), seed index (24.44%), number of seeds per boll (19.70%), plant height (19.14%), number of monopodia per plant (16.41%), flower initiation (13.94%) , fibre length (13.53%) and seed cotton per boll (13.41%). High heritability with high genetic advance were observed for number of bolls per plant, total yield per plant, seed index, number of seeds per boll, plant height, number of monopodia per plant, flower initiation, fibre length and seed cotton per boll indicated that these characters are governed by additive gene action (Panse, 1957). Hence, there are good chances of improvement of these characters through direct selection in the present material. Johnson *et al.*, (1955) also pointed out that heritability values along with genetic advance are more useful than heritability alone for selecting the best individuals.

High estimates of heritability coupled with high genetic advance as percentage of mean for different characters were also reported by several workers. Pawan Kumar (2004) and Gupta (2005) for number of bolls per plant, number of monopodia per plant and Kapas yield per plant. Rao and Mary (1996), Jagtap and Mehetre (1998), Deshmukh *et al.*, (1999) and Pandey *et al.*, (2002) for seed cotton yield per plant and plant height, Jagtap and Mehetre (1998) and Dheva and Potdukhe (2002) reported high heritability with high genetic advance as percentage of mean for seed index and fibre length.

5.4 Correlation coefficient analysis:

The complexity of the crop yield characters makes its genetic analysis quite difficult. A character presumed to be controlled by a large number of genes and is greatly influenced by environment. Therefore, for achieving rational improvement of yield and its components, knowledge concerning yield contributing characters in a crop is important to plant breeder for efficient selection.

Correlation could be estimated at phenotypic and genotypic levels. The degree of correlation between different characters was estimated at phenotypic and genotypic levels. The main features of association analysis revealed that genotypic correlation was of higher magnitudes than its respective phenotypic correlation, in general. It indicated strong inherent associations between various characters due to genetic causes.

The estimates of genotypic correlation coefficient revealed that except for flower initiations, ginning percentage, seed index and fibre strength majority of the characters *viz.*, number of sympodia per plant, number of bolls per plant, number of seeds per boll and seed cotton per boll showed positive while non significant correlation for fibre length, number of monopodia and plant height with total yield per plant thus there by indicating possibility of simultaneous improvement of these characters.

Similar results were also recorded by Cheng Zhou (1991), Arshad *et al.*, (1993), Sumathi and Natrajan (1995), Manimaran (1999), Sambamurthy and Rao (1999), Rao *et al.*, (2001), Kaushik *et al.*, (2003) and Gupta (2005) for plant height, Sangwan and Yadav (1987), Giri and Nankar (1989), Ambamurthy (1999) and Kaushik *et al.*, (2003) for number of monopodia per plant. Basu and Bhat (1987), chaudhary *et al.*, (1998), Giri and Nankar (1989), Ambamurthy (1999), Manimaran (1999), Rao *et al.*, (2001) Kaushik *et al.*, (2003), Pawan kumar (2004) and Gupta (2005) for number of sympodia per plant. Giri and Nankar (1989), Cheng Zhou (1991), Tyagi (1994), Sambamurthy *et al.*, (1995),Kudchikar and Janaboudar (1998), Manimaran (1999), Rao *et al.*, (2001) Kaushik *et al.*, (2003), Pawan Kumar (2004) and Gupta (2005) for number of bolls per plant. Rao and Mary (1996), Ambamurthy (1999), and Sultan *et al.*. (1999) have genotypic correlation coefficient for ginning percentage. Tomar *et al.*, (1991), Sambamurthy *et al.*, (1995), Satange *et al.*, (2000) and Girase and Metetre observed (2002) for seed index. and for fibre length by Rao and Mary (1996) and Thind (2004).

5.5 Path coefficient analysis:

The correlation coefficient indicates only the relationship between two variables. They don't care of the complex relationship existing among set of variables. Yield is the end product of various action and interactions of different associated component characters. The path analysis technique helps in understanding and developing deeper insight into such relationship (Kempthorne, 1957 and Turner and Stevens, 1969).

Path coefficient analysis is very useful as it provides partitioning of correlation coefficient in to direct and indirect causes and permits a critical examination of the specific forces acting to produce a given correlation and measures the relative importance of each causal factor.

In present investigation, at genotypic level, yield attributes like number of bolls per plant, seed cotton per boll, number of monopodia per plant and plant height which had positive correlation with total yield had substantial direct contribution to the total yield. In addition to this, most of the characters also had indirect contribution to total yield through these characters.

Based on above results, it can be concluded that number of bolls per plant ,seed cotton per boll, number of monopodia per plant, and plant height, directly contributed to the kapas yield.

Similar results were reported by Tyagi (1994) Girase and Mehetre (2002) and Pawan Kumar (2004) for plant height, Ananda Chaudhary and Hanumantharao (1987) and Gupta (2005) for number of monopodia per plant, Waldia *et al.*. (1979) and Rao and Mary (1996) for number of seeds per boll.

It suggested that, number of bolls per plant and seed cotton per boll number of monopodia and plant height are most important and reliable components for direct selection for yield improvement in cotton.

Ginning percentage, number of sympodia, flower initiation, number of seeds/boll, seed index, fibre length and fibre strength showed negative but negligible direct contribution but there negative direct contribution was nullified by its positive indirect contribution through number of monopodia per plant. plant height, number of bolls/plant and seed cotton/boll.

However, these results were not in conformity with the findings of Tikka *et al.*, (1980), Chaudhary *et al.*, (1998), Alam and Islam (1991), Tyagi (1994). Valamathi (1996) Manimaran (1999) Pawan Kumar (2004) and Gupta (2005) who had reported positive and direct effect of number of boll per plant on kapas yield. Ananda Chaudhary and Hanumantharao (1987) and Girase and Mehetre (2002) estimated positive and direct effect on number of sympodia per plant on kapas yield. Rao and mary (1996) and Girase and Mehetre (2002) estimated positive and direct effects of seed index on kapas yield. The contradiction may be due to difference in the experimental material and environmental conditions.

This experiment revealed that sufficient genetic variability among the genotypes for all the characters under study, the highest variation observed for plant height and total yield per plant. Two promising genotypes *Viz.,* 'Vikram' and 'ARBH818' can be exploited for future breeding for improvement of cotton.

Heritability and genetic advance for total yield per plant, number of bolls per plant, number of monopodia per plant, plant height, number of seeds per boll, seed cotton per boll, flower initiation fiber length and seed index were high which indicate the role of additive gene action for their expression and can be improved by simple selection procedure.

Correlation coefficient analysis and path analysis was concluded that selection prospects for high total yield per plant is better through number of bolls per plant, seed cotton yield per boll, number of monopodia per plant and plant height showed positive association and direct effect with total yield per plant.

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY, CONCLUSION AND SUGGESTIONS FOR FURTHER WORK

6.1 Summary:

Cotton is a premier cash crop of *Kharif* season and one of the prominent eco-industrial crops of India generating sizeable employment in India. The average productivity of cotton is lowest among cotton growing nations of the world. In order to increase the yield potential of cotton varieties, an understanding of relationship among different plant characters is of immense value. Besides, knowledge about the direct contribution of different characters to yield would be highly useful for formulating a selection criterion. Therefore, the present investigation "Character association and component analysis in American cotton (*G. hirsutum* L.) under rainfed condition" using 21 genotypes was undertaken to obtain the information on correlation and direct and indirect effects of different attributes on kapas yield (seed cotton yield) for utilization in the improvement of crop.

Twenty one genotypes were grown in Randomized complete Block Design with three replications under All India Coordinated Cotton Improvement Project at College of Agriculture, Indore (M.P.), during *kharif* 2006-2007.

The data were recorded on leaf colour, leaf shape, presence of pubescence, flower initiation (days), flower colour, pollen colour, plant height (cm), number of sympodia per plant, number of monopodia per plant, number of bolls per plant, colour and shape of bolls, number of seeds per boll, ginning percentage, seed index (g), total yield per plant (g) and fibre quality characters like fibre length (mm) and fibre strength.

The data on all the characters were subjected to statistical analysis and following results were obtained:

The analysis of variance revealed significant differences among all twenty one genotypes for each character, showing sizeable amount of variability present in the material.

The range of variation, showed that the plant height was most variable followed by total seed yield. The variation was almost uniform on both the sides, indicating normal distribution of population for mean.

The characters *viz.*, total yield per plant, number of bolls per plant, number of monopodia per plant , seed index, number of sympodia per plant and number of seeds per boll possessed high PCV and GCV indicating a lot of scope for improvement through selection. The values of PCV were slightly higher than that of GCV for each character under study. Heritability in broad sense was high for flower initiation (days), plant height (cm), number of sympodia per plant, number of bolls per plant, number of seeds per boll, ginning percentage, seed index (g), total yield per plant (g), fibre length (mm) and fibre strength except number of monopodia per plant.

Genetic advance as percentage of mean was highest for number of bolls/plant, total yield/plant followed by seed index, number of seeds/boll, plant height, number of monopodia per plant, flower initiation, fibre length, seed cotton per boll, fibre strength and ginning percentage respectively.

In general, the genotypic correlations were higher than the phenotypic correlation coefficients indicating a strong inherent association between various characters investigated.

The characters *viz.*, plant height, number of monopodia per plant, number of bolls per plant, seed cotton per boll, number of monopodia per plant and plant height showed positive correlation with total yield. These characters may be used as selection criteria for increase of total yield.

Path analysis indicated positive and direct effects of number of bolls per plant , seed cotton per boll, number of monopodia per plant and plant height, on total yield per plant. Most of the characters under study also had indirect contribution through plant height, number of monopodia per plant, number of bolls per plant and seed cotton per boll, suggesting their role in determining the yield.

6.2 Conclusion:

Studies revealed sufficient genetic variability among the genotypes for all the traits under study, At least two genotypes *Viz.*, 'Vikram' and

'ARBH818' can used in hybridization/crop improvement of cotton for in corporation of multiple economical yield traits.

Heritability and genetic advance for total yield per plant, number of bolls per plant, number of monopodia per plant, plant height, number of seeds per boll, seed cotton per boll, flower initiation, fibre length and seed index were high which indicated the role of additive gene action for their expression and can be improved by simple selection procedure.

Based on correlation and path analysis it is concluded that the selection prospects for high kapas yield per plant is better through number of bolls per plant, seed cotton per boll, number of monopodia per plant, and plant height as they exert positive direct effect as well as they show positive association with kapas yield per plant.

6.3 Suggestions for further work:

According to present findings the suggestions for the further studies are as follows:

- The genetic variability available in different characters in relation to yield should be exploited.
- Characters showing high heritability with high genetic advance may be utilized through direct selection for the improvement of kapas yield per plant.
- Vikram and ARBH818 showed promise for multiple yield traits. These two promising line along with other showing promise for various traits may be evaluated for their combining ability through various biometrical mating designs to be used as parents/donor in hybridization programme for crop improvement in cotton.
- The traits showing strong positive association and positive direct effect on seed cotton yield may be used as criteria for an improvement of yield in cotton.

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APPENDICES

APPENDIX

Table 1: Mean values of 21 genotypes of American Cotton

S. No.	Variety	Flower initiation	Plant height (cm)	No. of sympodia /plant	No. of monopodia /plant	No. of bolls /plant	No. of seeds /boll
1	AKH 2017	45.0	64.7	17.1	1.07	7.7	18.4
2	CNDTS 51	46.0	59.1	14.8	1.13	8.5	20.5
3	SCS 651	49.0	73.1	16.2	1.27	7.8	18.5
4	GSHV 151	53.0	59.5	14.1	1.40	9.8	17.3
5	NH 627	46.0	52.2	13.5	1.07	9.7	22.9
6	BS 77	50.0	60.3	12.1	1.47	9.4	21.2
7	H 1259	46.0	61.2	13.4	1.13	8.6	22.3
8	IH 09	48.0	58.8	14.1	1.13	8.8	20.3
9	NDLH 1863	54.0	53.4	14.1	1.53	9.1	16.7
10	AKH 20.7.2	47.0	61.5	15.4	1.20	9.7	18.6
11	P 6263	50.0	70.3	13.7	1.27	8.7	17.4
12	CCH 4436	45.0	67.7	16.5	1.07	10.7	21.3
13	PH 1024	52.0	61.3	16.4	1.33	10.7	19.6
14	RAH 216	53.0	60.4	15.0	1.40	11.0	21.6
15	TSH 2005	58.0	58.1	11.8	1.60	5.4	15.7
16	ARBH 818	46.7	60.6	14.1	1.20	12.9	22.0
17	GJHV 360	53.0	58.9	12.3	1.40	10.9	17.5
18	RB 548	54.0	49.4	13.5	1.60	11.5	20.3
19	ZC (LRA Sahana)	45.0	63.6	11.9	1.00	8.0	19.3
20	Vikram	47.0	74.0	17.6	1.27	11.3	21.8
21	IH 63	46.7	60.6	15.2	1.33	9.8	20.1
	Mean	**49.3**	**61.4**	**14.4**	**1.28**	**9.5**	**19.7**
	Sem±	**0.93**	**1.20**	**1.44**	**0.10**	**0.33**	**0.40**
	CD at 5 %	**2.59**	**3.33**	**3.98**	**0.27**	**0.90**	**1.10**
	CV %	**5.31**	**7.12**	**17.27**	**13.02**	**5.89**	**3.48**

Table 2: Mean values of 21 genotypes of American cotton

S. No.	Variety	Seed cotton /boll (g)	Ginning percentage	Seed index (g)	Total yield /plant (g)	Fibre length (mm)	Fibre strength
1	AKH 2017	2.32	38.0	7.72	17.8	25.9	20.3
2	CNDTS 51	2.69	36.2	11.32	22.9	26.5	21.3
3	SCS 651	2.55	36.7	8.25	19.8	25.6	18.8
4	GSHV 151	2.56	37.4	9.92	25.1	26.8	19.7
5	NH 627	2.39	36.1	7.49	23.1	25.7	19.4
6	BS 77	2.52	31.8	9.17	23.7	25.6	20.9
7	H 1259	2.43	35.7	7.61	20.9	20.1	19.5
8	IH 09	2.39	36.1	7.77	21.1	24.3	18.8
9	NDLH 1863	2.71	35.9	6.89	24.7	23.1	17.6
10	AKH 20.7.2	2.43	35.5	7.99	23.6	24.5	20.4
11	P 6263	2.83	36.5	9.41	24.7	26.0	20.2
12	CCH 4436	2.38	36.6	8.15	25.5	27.2	20.0
13	PH 1024	2.60	36.1	8.30	27.8	25.0	18.4
14	RAH 216	2.35	34.3	7.54	25.9	23.8	20.1
15	TSH 2005	2.57	36.6	9.15	13.9	26.5	21.2
16	ARBH 818	2.46	34.3	7.08	31.6	26.4	21.2
17	GJHV 360	2.49	31.8	8.91	27.2	27.6	19.8
18	RB 548	2.08	37.4	7.97	24.0	25.4	18.8
19	ZC (LRA Sahana)	2.04	33.5	9.65	16.3	24.8	20.6
20	Vikram	2.57	35.7	8.68	29.2	25.3	21.5
21	IH 63	2.33	34.3	7.96	22.8	23.1	18.3
	Mean	**2.46**	**35.5**	**8.43**	**23.4**	**25.2**	**19.8**
	Sem±	**0.06**	**0.30**	**0.18**	**0.98**	**0.17**	**0.13**
	CD at 5 %	**0.16**	**0.84**	**0.51**	**2.70**	**0.47**	**0.35**
	CV %	**3.95**	**5.47**	**3.86**	**7.25**	**3.14**	**5.16**

Fig 1 : Mean values of flower initiation in cotton genotypes.

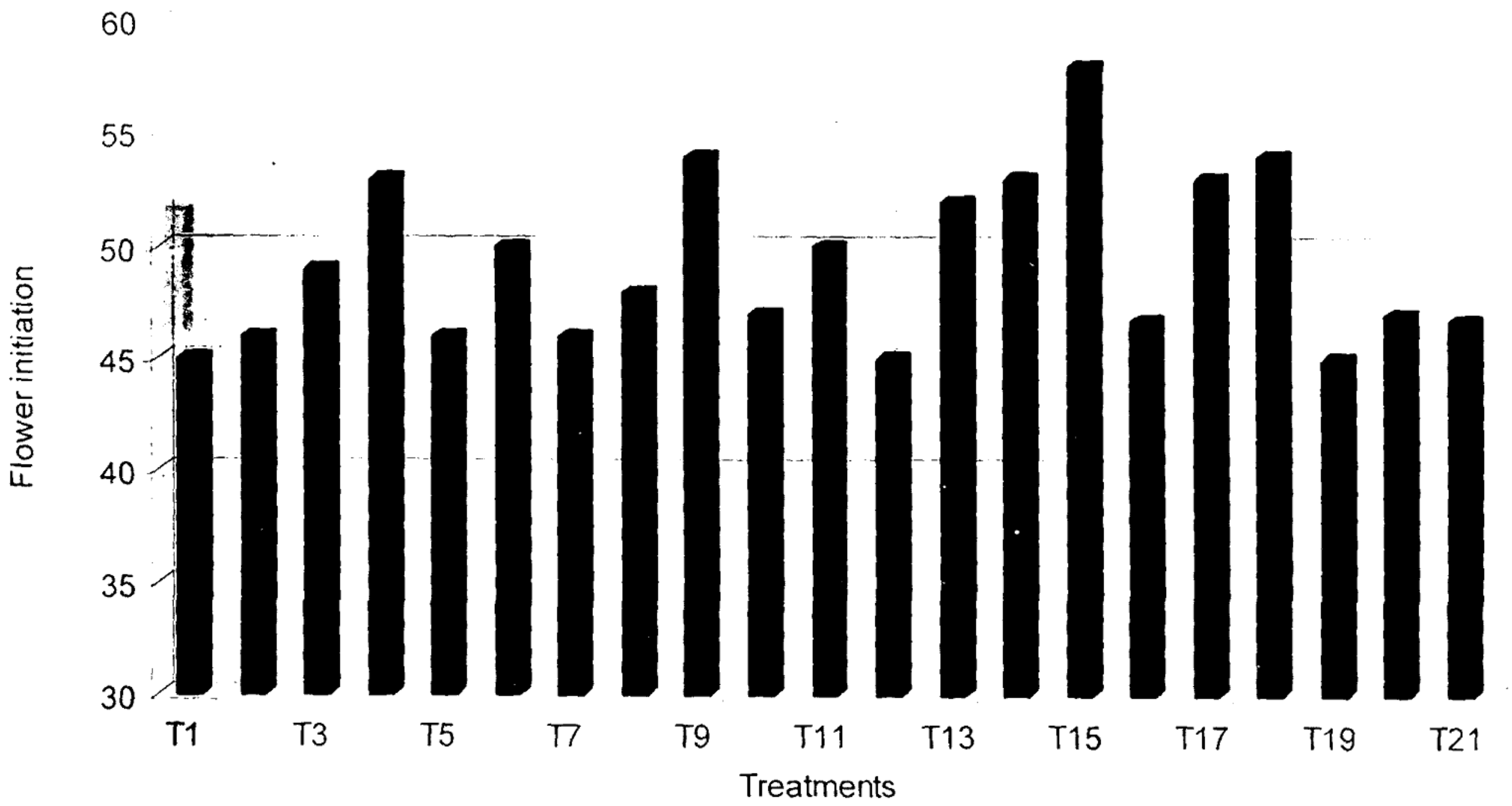


Fig 2 : Mean values of plant height (cm) in cotton genotypes.

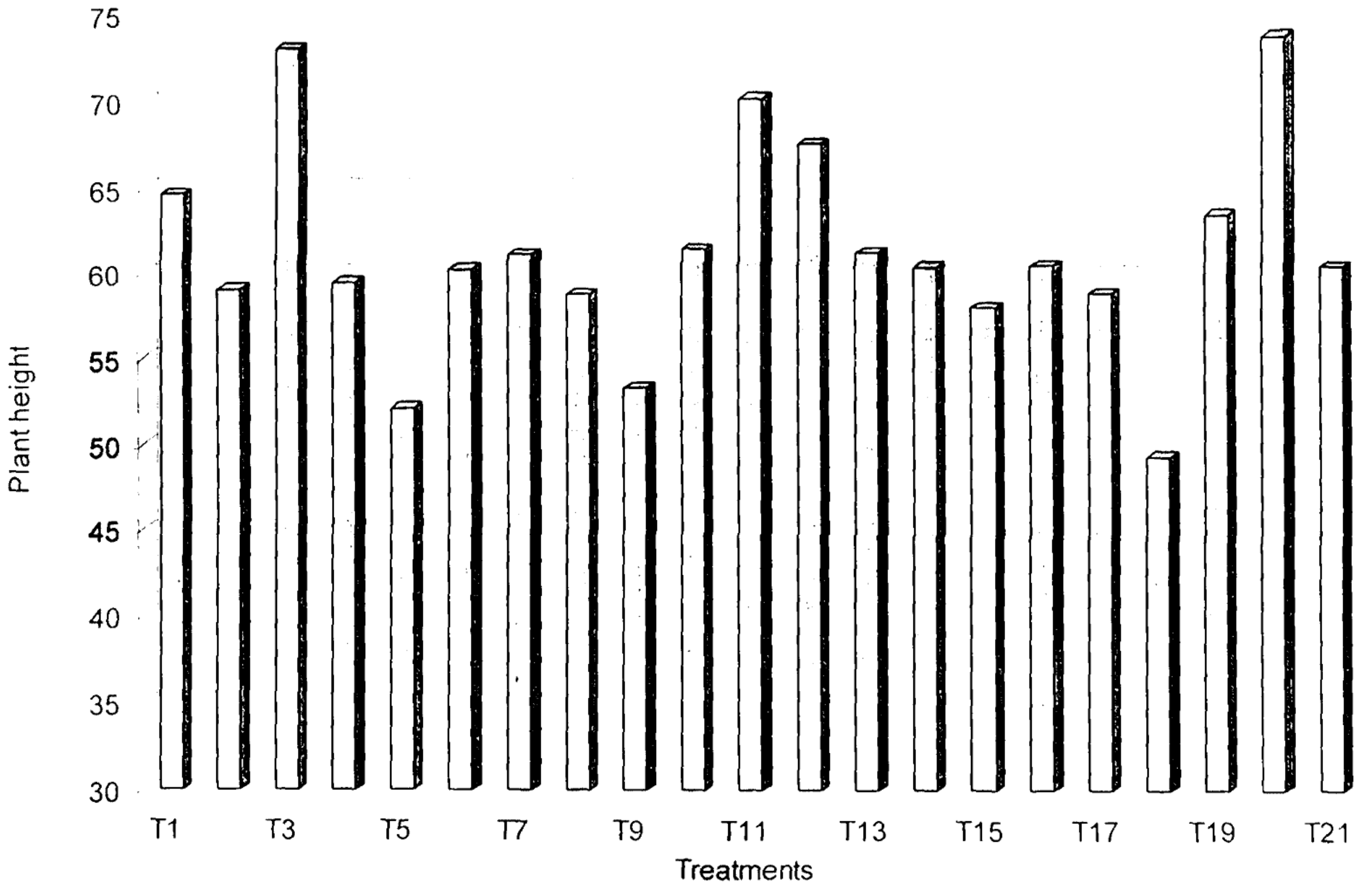


Fig 3 : Mean values of no. of sympodia per plant in cotton genotypes.

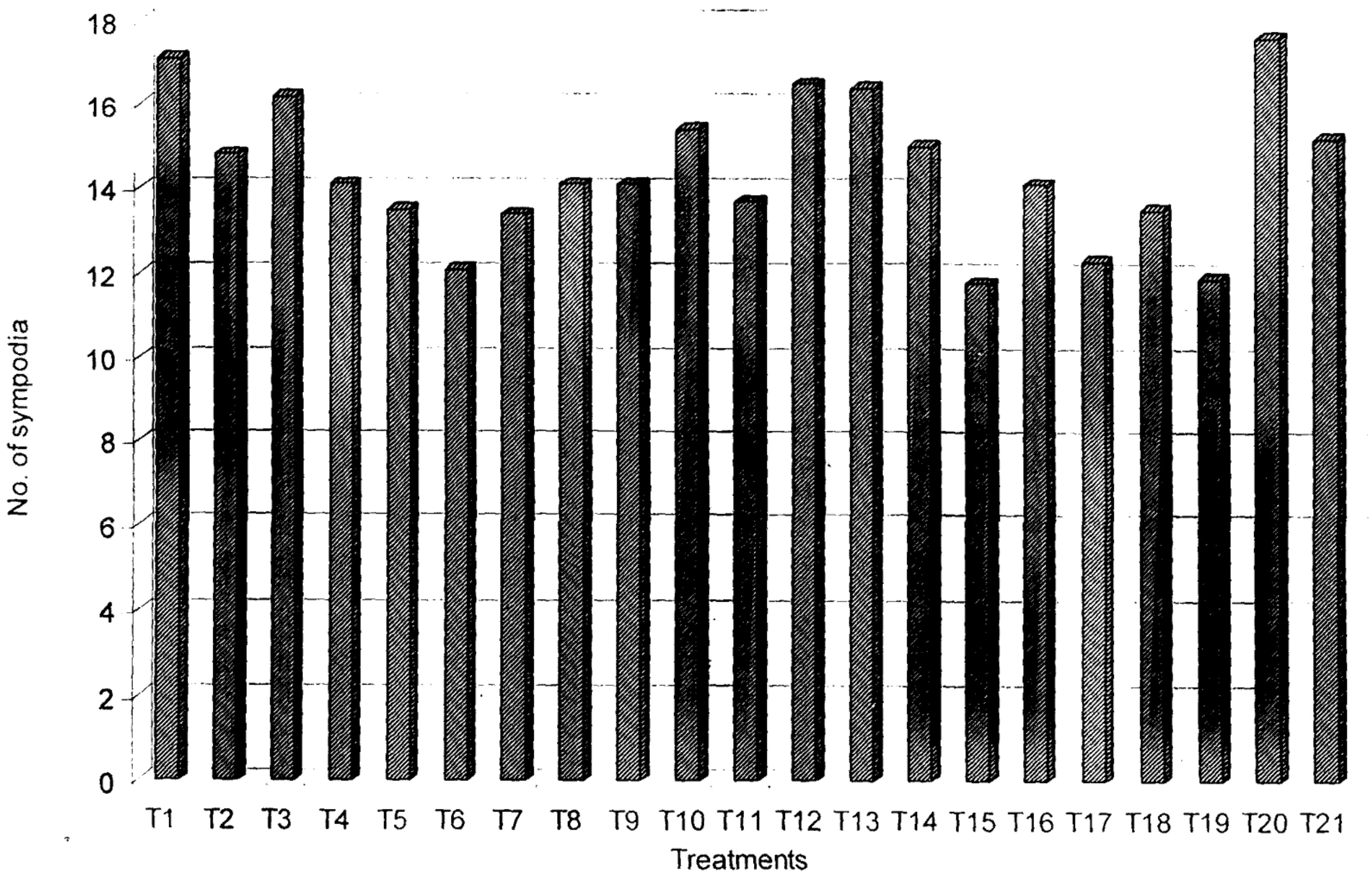


Fig 4 : Mean values of no. of monopodia per plant in cotton genotypes.

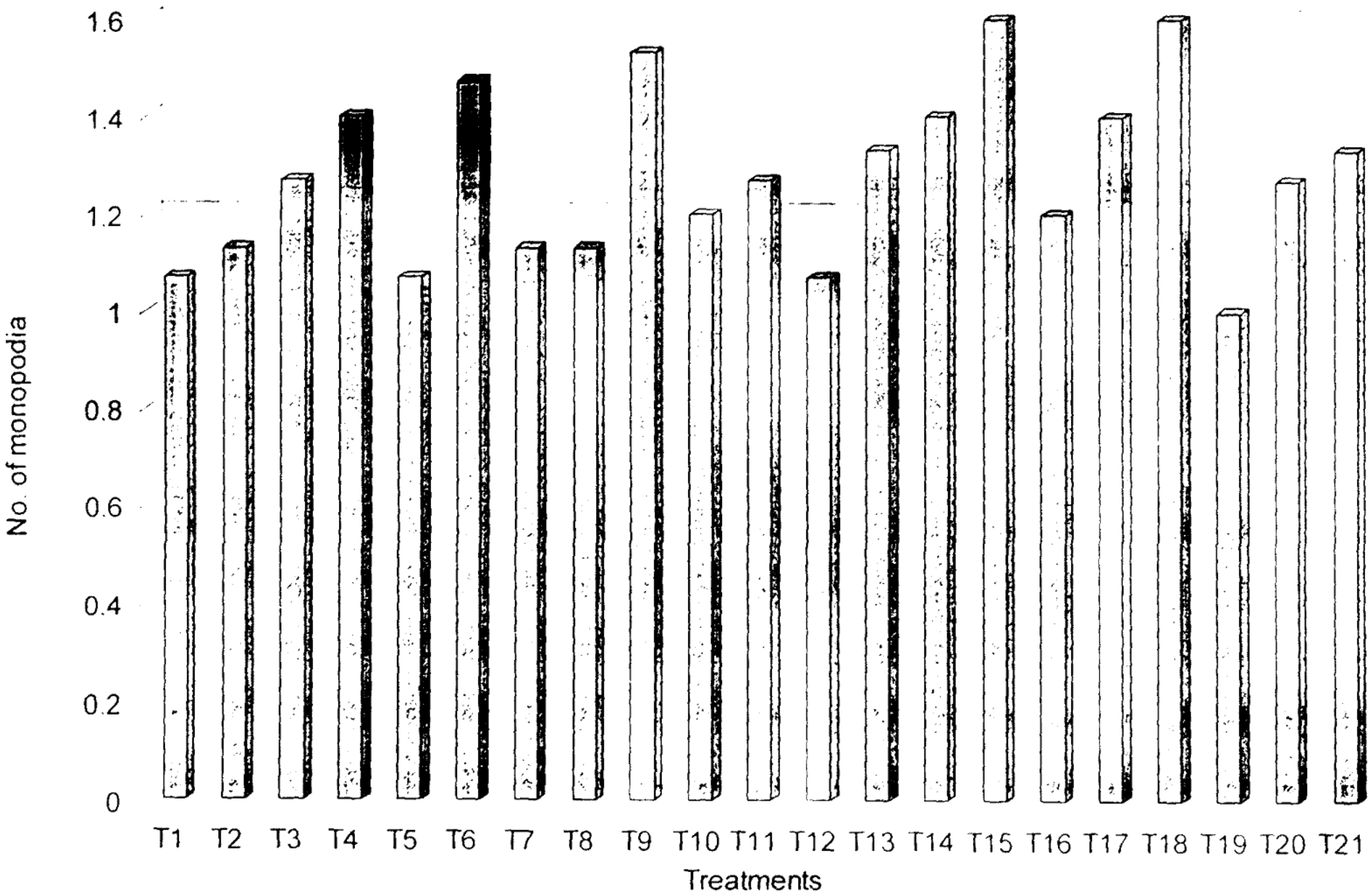


Fig 5 : Mean values of no. of bolls per plant in cotton genotypes.

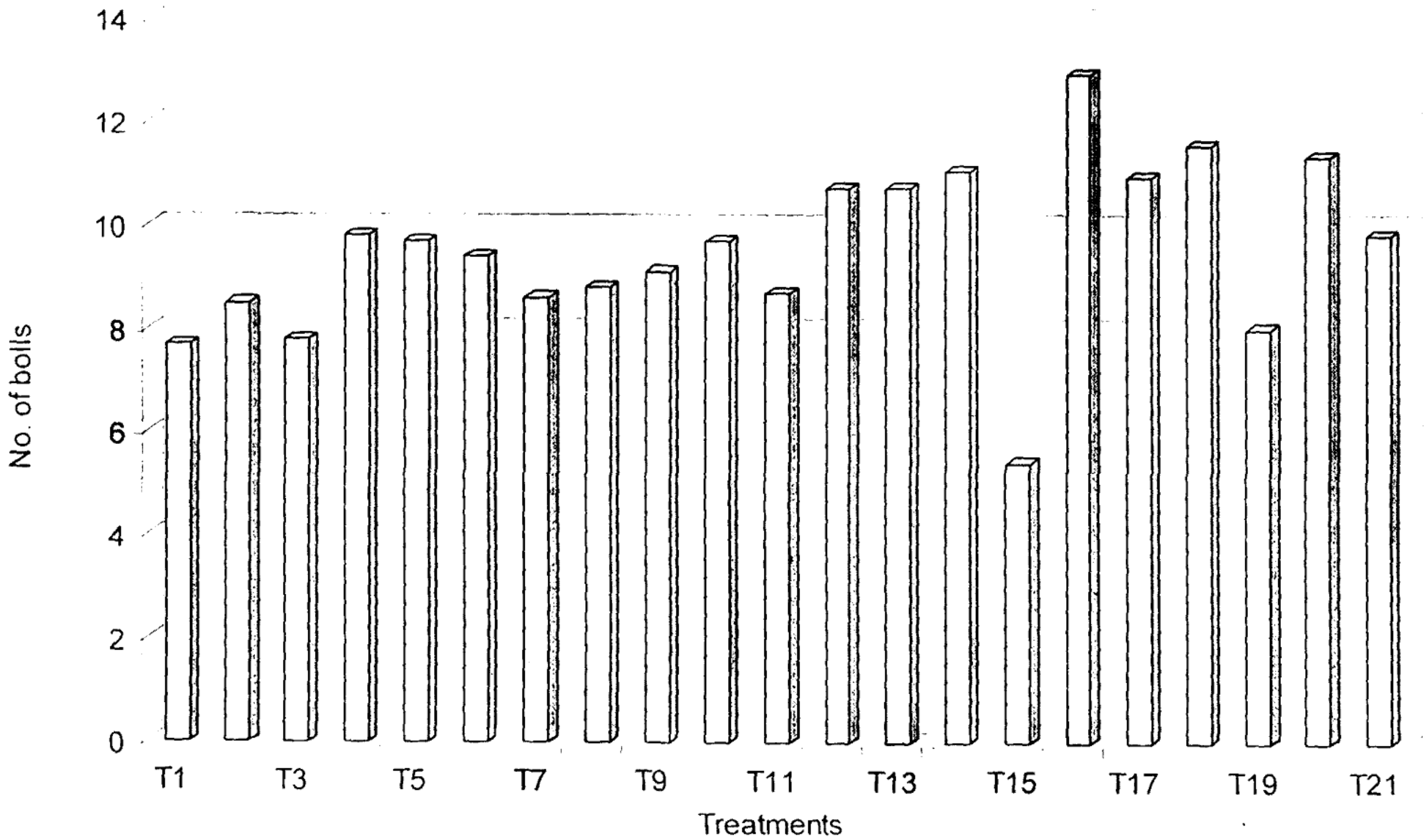


Fig 6 : Mean values of no. of seeds /boll in cotton genotypes.

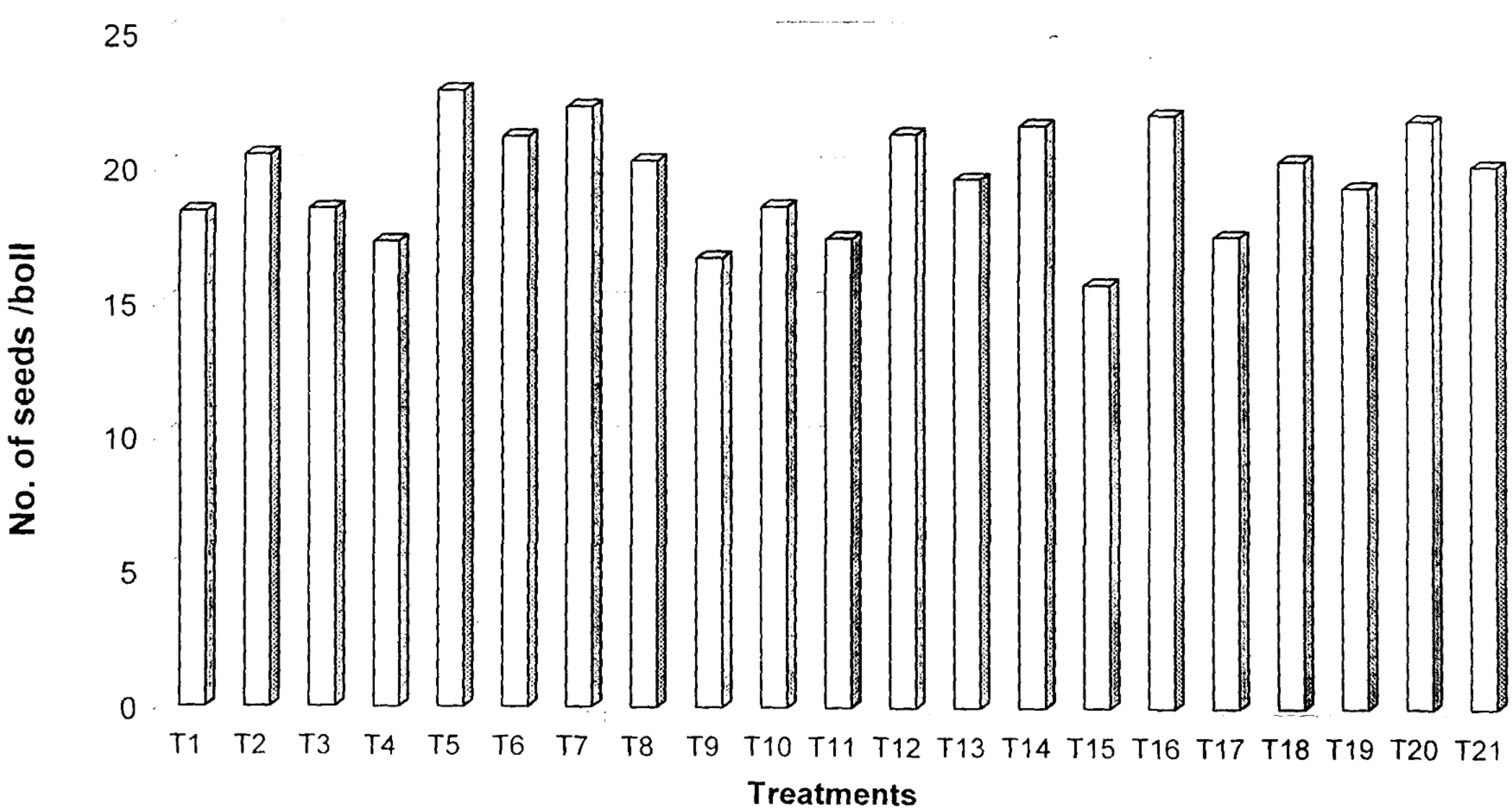


Fig 7 : Mean values of seed cotton /boll (g) in cotton genotypes.

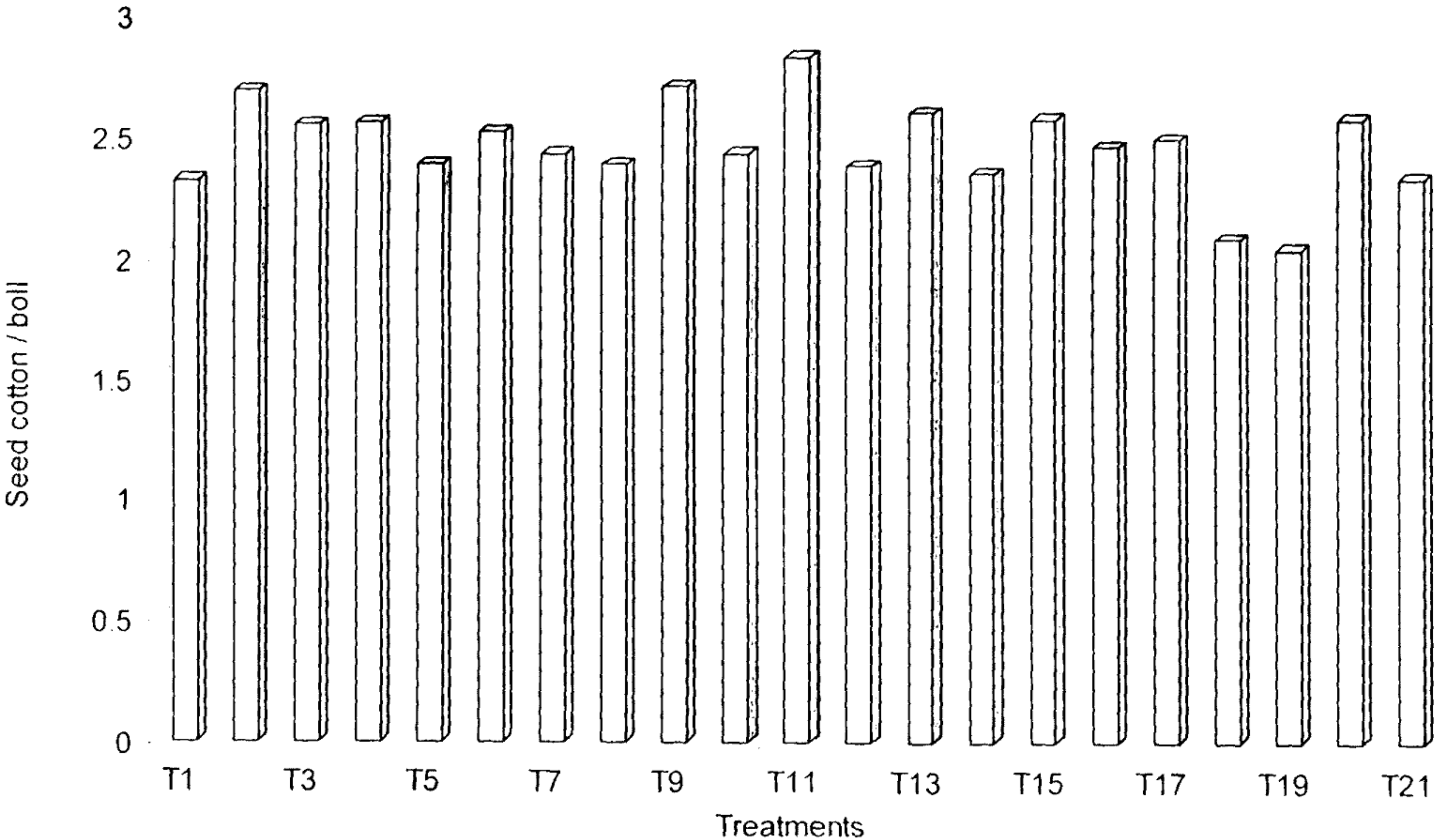


Fig 8 : Mean values of ginning percentage in cotton genotypes.

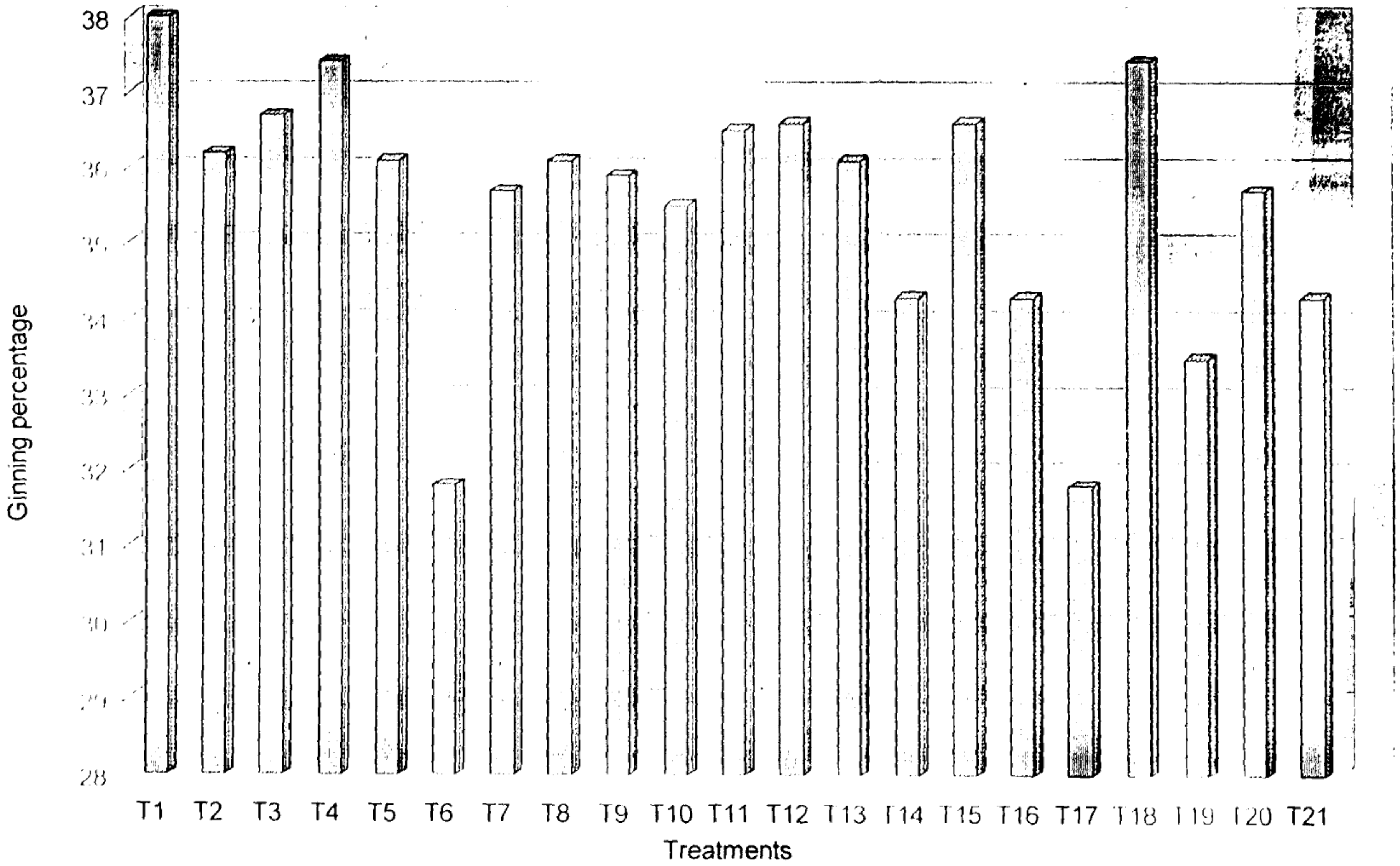


Fig 10 : Mean values of total yield /plant (g) in cotton genotypes.

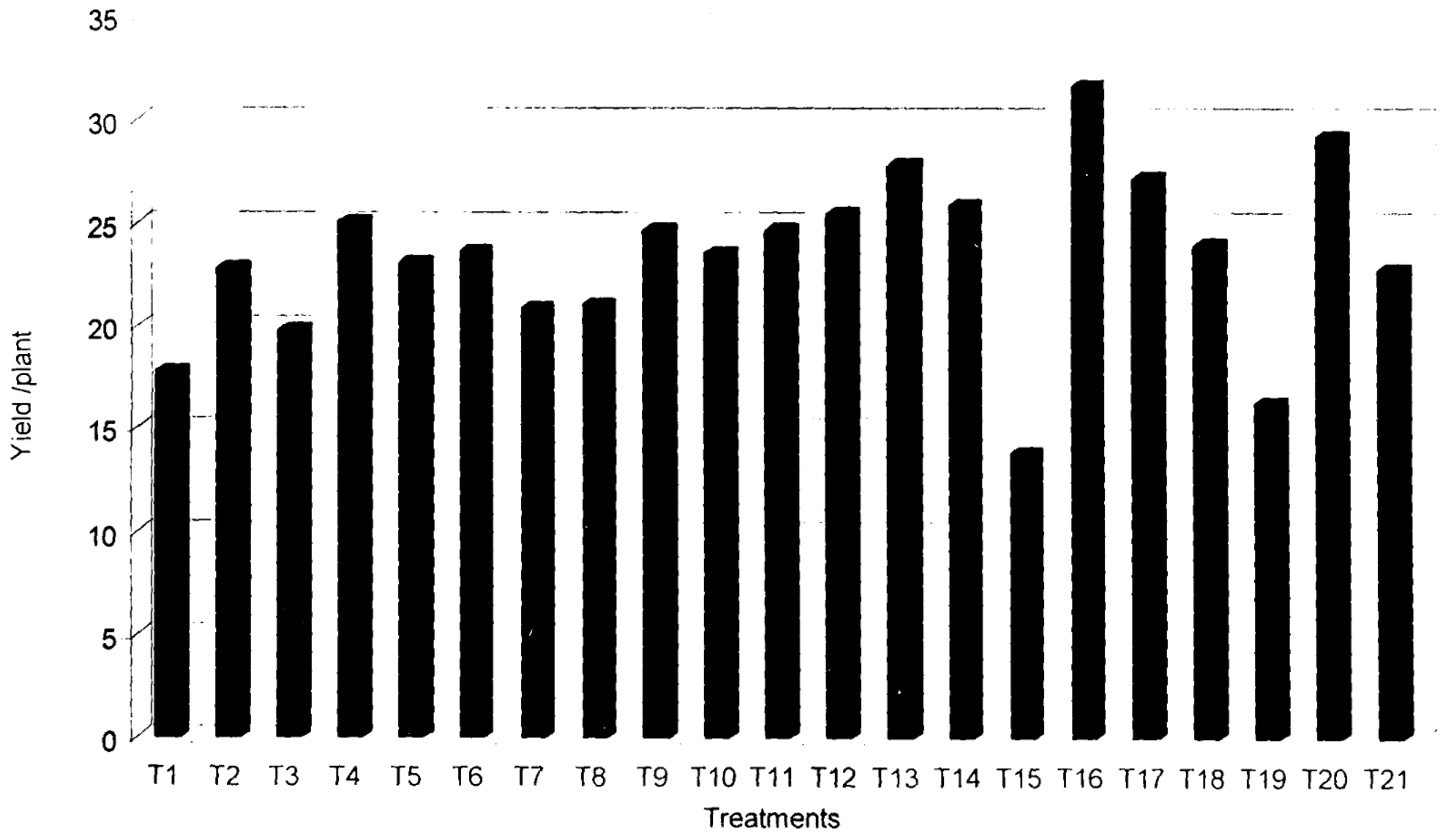


Fig 9 : Mean values of seed index (g) in cotton genotypes.

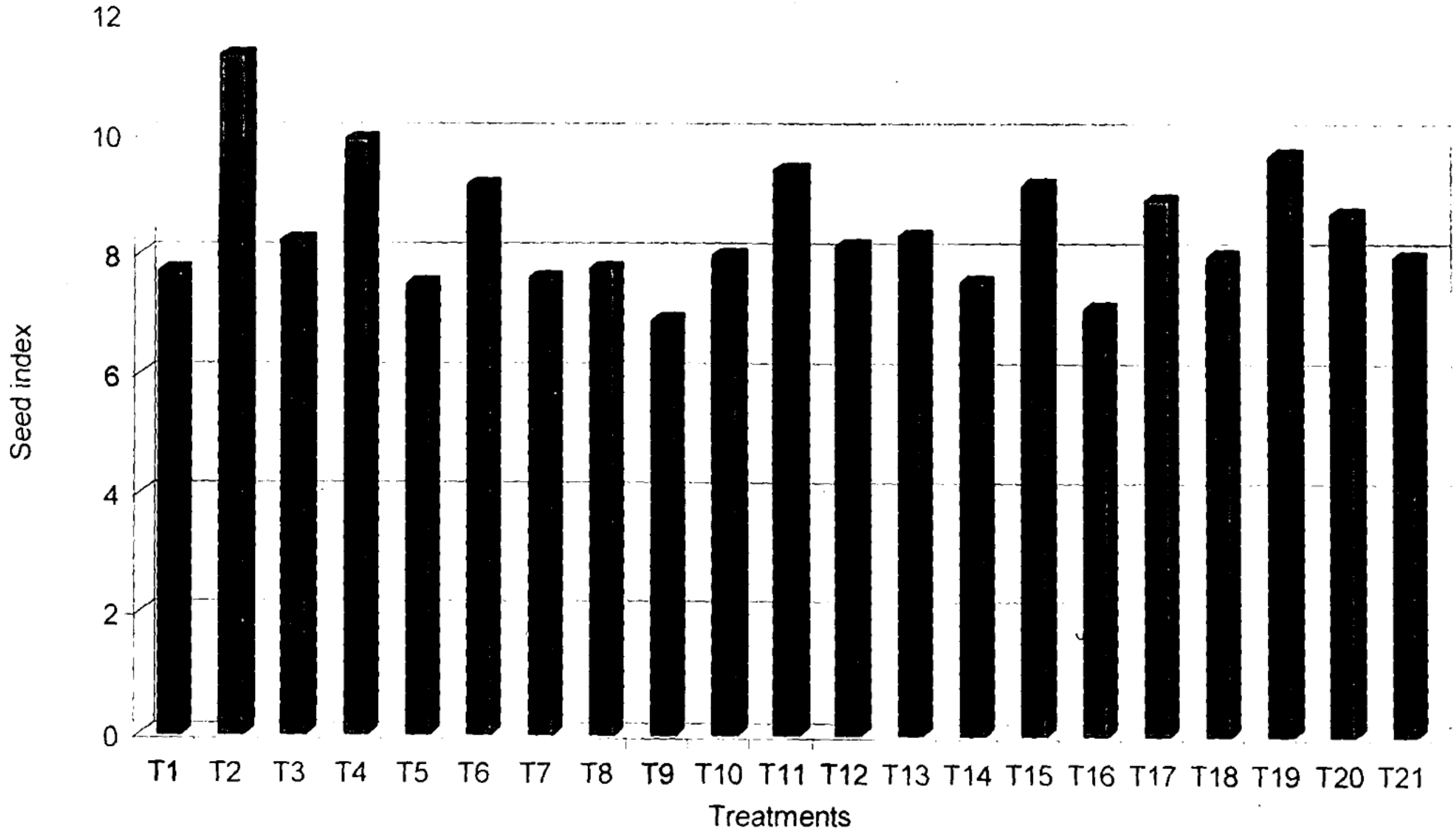


Fig 11 : Mean values of fibre length (mm) in cotton genotypes.

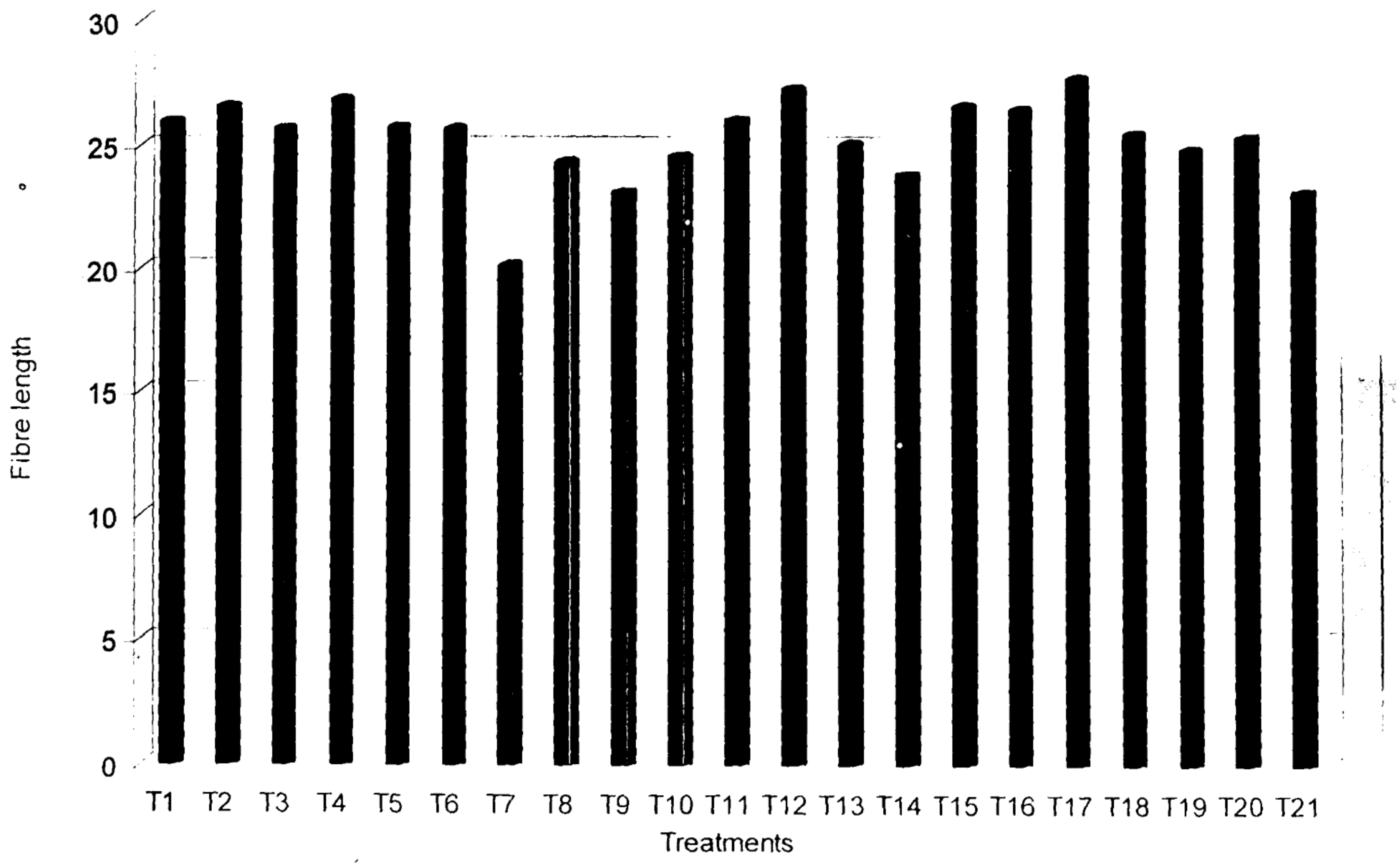
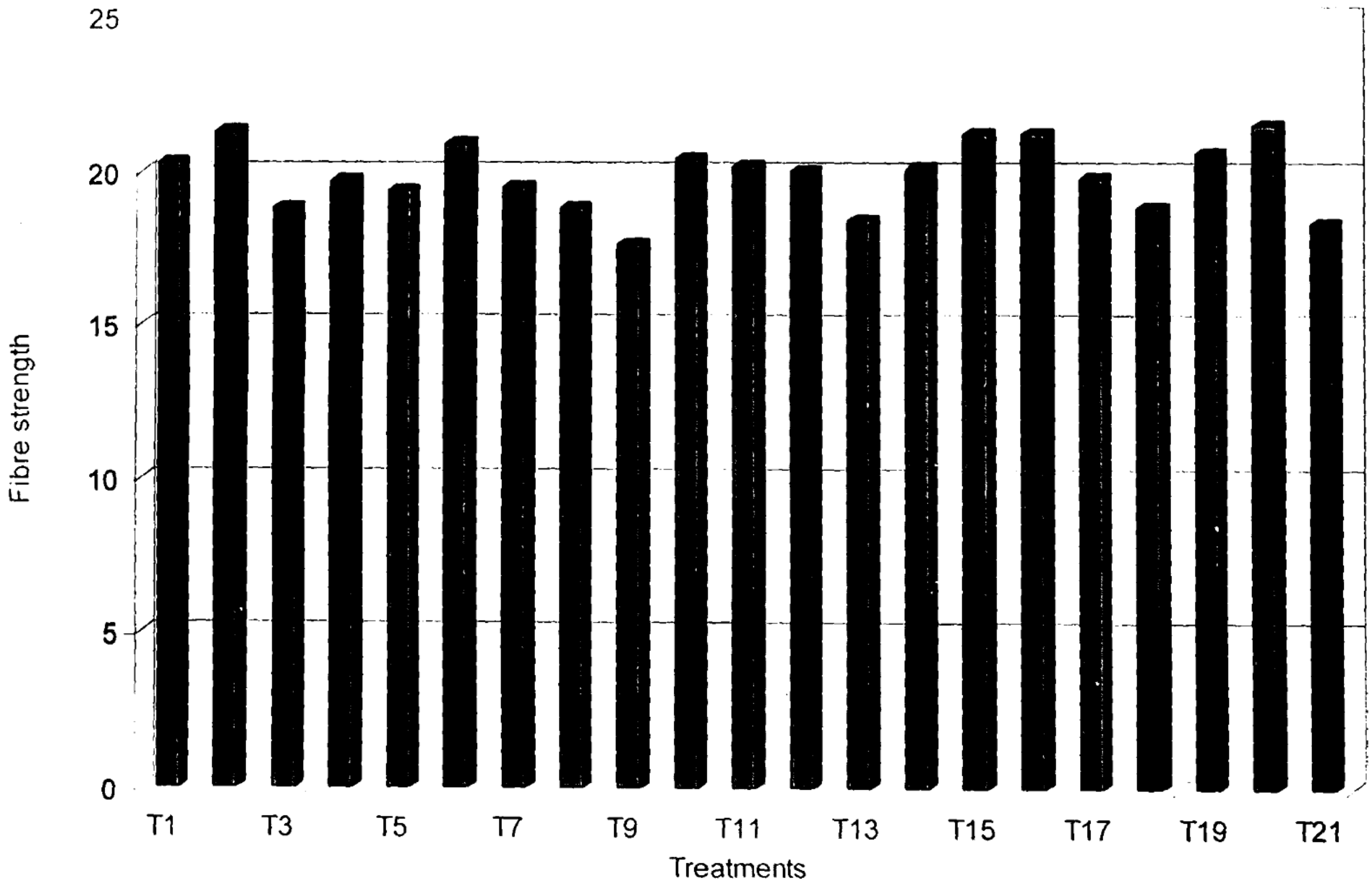


Fig 12 : Mean values of fibre strength (mm) in cotton genotypes.



VITA

The author of this thesis Jyoti Jethliya was born on 29th November, 1982 at Tarana, Distt. Ujjain (M.P.). She passed her High School Certificate examination in 1998 and Higher Secondary Examination in the year 2000 from M.P. Board of Secondary Education, Bhopal with 75% and 86% marks, respectively.

She joined College of Agriculture, Indore in 2001 and completed B.Sc. (Ag.) in the year 2005 with 1st division securing an OGPA of 7.55 out of 10 point scale.

After graduation she joined M.Sc. (Ag.) in College of Agriculture, Indore for specialization in Plant Breeding and Genetics. She has completed all the course requirement for the above said Master's degree with an OGPA of 7.41 out of 10 point scale.

She was allotted an interesting research problem of her choice for thesis work which has been duly completed by her and presented in the form of this thesis.