MATERIALS AND METHODS

Investigations were carried out multilocationally at the District Seed Farm, Fulia, in the district of Nadia (West Bengal, India),State Agricultural Farm, Bankura in the district of Bankura (West Bengal, India) and in Block Seed Farm, Bishnupur in the district of 24 Parganas (West Bengal, India). The trials were conducted in two principal seasons i.e., Summer (kharif) and Winter (rabi) of 1974-76. In summer season the experiments were conducted at District Seed Farm, Fulia and State Agricultural Farm, Bankura. In rabi season the experiments were conducted at District Seed Farm, Fulia and at Block Seed Farm, Bishnupur, 24 Parganas.

Experimental materials:

14 varieties each from spp G. hirsutum L. and G. arboreum L. and six varieties belonging to G. barbadense L. were taken for study separately. The varieties belonging to G. barbadense L. were found to be very unsuitable for growing under West Bengal conditions for their late maturity and very low yield potentiality specially in the kharif season. In the rabi season, though the varieties like Andrews Sea Island and Sujata were found to be better adapted but the remaining four varieties were found to be not-adaptive. Their yield of seed cotton was so low and production of nonviable seed was so high that sufficient quantity of seeds could not be preserved for trial purposes for the subsequent seasons. Therefore, they were ultimately dropped from the study. Thus, in all, four

sets of experiments were conducted i.e., each species tried in two seasons separately.

Layout and Design :

Seeds of the above mentioned cultivars were sown in a Randomized Block Design with three replications, varieties belonging to each species were tried in the designs separately. The net plot size was 4.05mx 2.25 m with a spacing of 75 cm between rows and 45 cm between plants within a row in each year. The sowing time during kharif season at Fulia was 15th June and in Bankura it was on the 6th June. The sowing time during rabi seasons at Fulia was 15th January and at Bishnupur was 28th November. The sowing time during rabi season at Fulia had to be delayed because of low temperature during November-December which affected germination.

Recording of data :

The observations were recorded on the following plant characters from 10 randomly selected plants of each strain in each replication.

1. Yield of Kapas (seed cotton/plant (g).
2. Number of bolls.
3. Weight of crude cotton per boll (g).
4. Days of 50 per cent flowering.
5. Position of first sympodial node.
6. Number of seeds per boll.
7. Ginning percentage.

8. Plant height (cm).

9. Duration from flowering to boll maturity (days).

Due to high boll and flower shedding caused by rains and high temperature the average value of the character - duration from flowering to boll maturity could not be ascertained during kharif season.

Of the 9 characters first 8 characters were taken into consideration for correlation, path analysis and divergence during kharif season. In addition to the above stated 8 characters the ninth character in the above list i.e., duration from flowering to boll maturity was also taken into consideration for study during rabi season.

STATISTICAL PROCEDURE

Genetic Parameters :

The pooled analysis of variance and covariance for each character of the varieties belonging to each species were computed employing appropriate statistical procedures relevant to a randomized block design (Federer, 1955). The genetic variance was estimated by partitioning the variances of variety, variety x environment and error using the following expectations of mean squares in the analysis of variance (ANOVA) as proposed by Comstock and Robinson (1952).

ANOVA

Source	df	Expectation of mean squares
Variety	(V-1)	$\sigma_e^2 + R\sigma_{al}^2 + RL\sigma_a^2$
Variety x Environment	(V-1)(L-1)	$\sigma_e^2 + R\sigma_{al}^2$
Error	(R-1)(VL-1)	σ_e^2

Where, σ_a^2 = genetic variance

σ_e^2 = error variance

σ_{al}^2 = genotypexerror variance

R = number of replicates

L = number of environments

The heritability in broad sense was estimated as the ratio of the genetic and phenotypic variance (Burton and Devane, 1953)

Thus $H = \frac{\sigma_a^2}{\sigma_A^2}$

where σ_A^2 is the phenotypic variance which may be computed using the following formula:

$$\sigma_A^2 = \sigma_a^2 + \frac{\sigma_{al}^2}{L} + \frac{\sigma_e^2}{D.L}$$

The expected genetic advance due to selection was calculated as GS = (K) (σ_a) (H)

where σ_a the genetic standard deviation, H is the heritability on broad sense, K is the selection differential

(K, expressed in terms of unit normal curve, is equal to 2.06 at 5% selection intensity).

Correlation studies :

In every set of experiments, correlation studies were made to determine the degree of associations between different traits at phenotypic and genetic level by applying the formula suggested by Johnson, Robinson and Comstock (1955)

$$r_{ph} = \frac{\sigma_{ph}xy}{\sqrt{\sigma^2_{ph}x \times \sigma^2_{ph}y}} \quad , \quad r_g = \frac{\sigma_g xy}{\sqrt{\sigma^2_g x \times \sigma^2_g y}}$$

where r_{ph} and r_g represent the estimates of phenotypic and genetic correlations, $\sigma_{ph}xy$ and $\sigma_g xy$ represent phenotypic and genetic covariances between the characters x and y, and $\sigma^2_{ph}x$ and $\sigma^2_{ph}y$ denote the phenotypic variances of characters x and y, and $\sigma^2_g x$ and $\sigma^2_g y$ represent the genetic variances of the same two characters respectively.

Path co-efficient analysis :

The estimates of path co-efficient were calculated according to the model proposed by Dewey and Lu (1959). They defined path co-efficient as " a standardized partial regression co-efficient and as such it measures the direct influence of one variable upon another and permits the seperation of the correlation co-efficient into components of direct and indirect effects. The use of the method requires a cause and effect situation among the variables and causal system based upon a prior ground or experimental evidence". This analysis requires solving a set of

simultaneous equations as explained hereunder

$$r_{ay} = P_{ay} + r_{ab}P_{by} + r_{ac}P_{cy}$$

$$r_{by} = r_{ab}P_{ay} + P_{by} + r_{bc}P_{cy}$$

$$r_{cy} = r_{ac}P_{ay} + r_{bc}P_{by} + P_{cy} \quad \text{.....etc.}$$

where r_{ij} is the genetic correlation co-efficient, P_{ay}, P_{by} etc. are the direct effects and $r_{ab}P_{ay}$, $r_{ac}P_{cy}$ etc. are indirect path values.

Divergence study :

The difference between the cultivars in regard to the pooled effect of all the characters under study was first tested using Wilk's criterion after routine analysis of variance for individual character as suggested by Rao (1952).

$V = - m \log_e \lambda$ when the values of p and q both are more than two, and where W_{ij} = within the population (or error) mean sum of squares or products. S_{ij} = total mean sum of square or products.

$\lambda = \frac{|W|}{|S|}$

$m = n - \frac{p + q + 1}{2}$

where $n = N_1 + N_2 \text{ ———— } N_{k-1}$

(N_1 ———— N_k denote number of plants in the population)

p = number of characters.

q = k -1 (k being the number of populations).

This value "V" is taken as X^2 and tested against pq degrees of freedom.

The second step involved transformation of original mean values of all the plant characters under study to uncorrelated means. The different functions of each character were computed using pivotal condensation technique of 8 x 8 (in case of kharif grown crops) or 9 x 9 (in case of rabi grown crops) common dispersion matrix. Deviation of one strain from another in respect of each character was then calculated, squared, and summation of all such squared deviations for the two strains in question gave a value known as D^2.

$d^2_{ij} = D^2$, when $= d_{ij} = t_{1j} - t_{2j}$ where t_{1j} and t_{2j} are transformed means of first and second strains in respect of j^{th} character.

Square root of D^2 values i.e. "D" values were accounted as the genetic distance between two strains.

The third step involved grouping the strains into different clusters on the basis of "D^2" values as suggested by Tolcher (c.f. Rao, 1952). From the different estimates partaining to Mahalanobis' D^2 values, total number of terms (N), rate of increase in D^2 values and average D^2 value the intra- and inter cluster D^2 values were calculated. Finally the relative contributions of different characters of D^2 - values were estimated.

The procedural details involved in the above calculations have been described by Rao (1952) in his book - " Advanced Statistical

Methods for Biometrical Research".

The agronomical characters relating to yield of bast fibre of cotton for both hirsutum and arboreum varieties were taken from the same trial. The agronomical characters studied in connection with bast fibre yield were :-

1. Fibre yield per plant.
2. Height of the plant.
3. Basal diameter.
4. Fibre percentage.

The fibres were extracted at the two stages of plant growth i.e., during flowering stage (100-110 days) and after the harvest of kapas (150-160 days) for judging and comparing the quality of fibre at the above two stages.

The periderm in cotton plant is very prominent and thick. It hampers the bacterial activity to separate the bast fibre from the wood. The retting of stalks as such was not sufficient to extract the bast fibre. A method was evolved and standardized to extract the fibre which is described below.

1. The plants were harvested close to the ground level.
2. All the secondary and tartiary branches were pruned.
3. The periderm at the basal portion of the stem was scrapped off by a mechanical device for facilitating microbial activity during retting.
4. Immediately after scrapping, the stalks were removed and immersed in a retting tank, drying of the stem was to be avoided.

5. The retting time of cotton stalks varied according to the temperature of the retting water. During summer months, it took 15-20 days depending upon the species and varieties (mean temperature 30-35°C). The varieties belonging to the species G. arboreum generally retted earlier.

For estimating the quality of the fibre the following traits were recorded for all the varieties in each species :-

1. Strength ; 2. Fineness ; 3. Defects ,
4. Colour ; 5. Lusture ; 6. Average reed length.

The fibre was extracted at the different stages of crop growth viz., flowering stage and boll maturity stage, in order to facilitate an effective comparison of the fibre quality at two different growth stages so that the prospect of raising cotton as dual purpose crop may be ascertained.

In addition to the above quality traits the following anatomical parameters - numerical as well as descriptive - were also estimated viz., 1) average number of fibre layers, (2) average thickness of bast bundles, (3) development of periderm, (4) nature of endodermis, (5) development of secondary phloem and xylem and (6) formation of pith.

All the above characters were studied in two different positions of the stem viz., at the bottom portion and at the middle.

To study the above features all the cultivars were grown in non replicated microplots each of 1.5 m x 1.25 m. The data were observed for five randomly selected plants in each variety.