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A Selection Index for Lint Yield in Cotton *(G. arboreum L.)**

by

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Introduction: Statistical methods in plant breeding have become a precise tool in the hands of the breeder for efficient selection of new 'forms'. The application of discriminatory statistical methods for tackling the genetical and plant breeding problems has resulted in the refinement of selection techniques. These have enabled the plant breeder to handle his material with confidence and in a thoroughly scientific manner (Panse, 1942). The formulation of selection index is an advance in this direction.

Fisher (1936) developed the discriminant function technique for the formulation of selection index. Smith (1936) was the first to apply this technique to plant breeding. Since then, it is being used for the formulation

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of selection indices in the improvement of crops. A study was undertaken to formulate a selection index for lint yield in cotton *(G. arboreum* L.) by utilising the discriminant function technique and the results are presented.

Materials and Methods: A total number of 18 varieties in the species *G. arboreum* L. was included for study.

The lay out consisted of "Randomised Replicated Block Design" with 18 varieties replicated four times. Each variety was sown in one row per replication. In each row, there were ten plants spaced at one foot.[1] The crop was grown under rainfed conditions in conformity with the practices prevailing in Madras State.

The following seven characters were studied.

(i) *Plant yield:* The total quantity of seed-cotton harvested from each plant was recorded to the nearest decigram. This was ginned and the lint yield was recorded to the nearest decigram.

(ii) *Boll production per plant:* At the time of each harvest, the number of burst bolls on each plant was counted and recorded. The sum total of all such bolls at each harvest gave the total number of bolls produced per plant.

(iii) *Boll size (boll index):* The number of bolls that would yield a pound of seed-cotton (known as boll index) was calculated to serve as an indication of boll size.

(iv) *Number of seeds per boll:* The number of seeds obtained by ginning the seed cotton of each plant, divided by the number of bolls produced by that plant, gave the number of seeds per boll.

(v) *Ginning per cent:* The entire produce of seed cotton harvested from each plant was ginned and the ginning out-turn was calculated.

(vi) *Lint index:* This was calculated by dividing the weight of lint obtained in each plant by the number of seeds produced in that plant and was expressed in milligram.

(vii) *Seed index:* The weight of 100 seeds known as "Seed index" was recorded to the nearest decigram.

Fisher's discriminant function applied by Smith (1936), to plant selection in wheat, was followed in the formulation of selection index.

Results: Correlation coefficients computed for the varieties revealed the close association of three characters *viz.*, lint index, number of seeds per boll and number of bolls per plant, with lint yield (Table).

The significant values of regression coefficient, as tested by means of an analysis of variance, confirmed the influence of these three characters on lint yield. The regression equations of lint yield on each of the three components were:

(i) $y = 5{\cdot}37\,x - 0{\cdot}70$ (for lint yield on number of bolls per plant);

(ii) $y = 1{\cdot}24\,x + 1{\cdot}72$ (for lint yield on number of seeds per boll);

and

(iii) $y = 1{\cdot}56\,x - 0{\cdot}92$ (for lint yield on lint index)

The 't' value of partial regression coefficient for lint yield on each of its components was computed as 11·6851 for number of bolls per plant; 0·3650 for number of seeds per boll; and 0·2830 for lint index.

The test of significance showed that the number of bolls per plant was significant at one per cent level.

The prediction equation was fitted up as shown under:

$$ye = 1{\cdot}4992\,x_1 + 0{\cdot}1604\,x_2 + 3{\cdot}4416\,x_3 - 8{\cdot}4138$$

where x_1 is the mean lint index;

x_2 is the mean number of seeds per boll; and

x_3 is the mean number of bolls per plant.

The test of significance carried out revealed that the prediction equation was significant at one per cent level.

The multiple correlation coefficient was 0·8052 and was significant at one per cent level. The variability of lint yield on account of the three components worked out to 64·83 per cent.

The discriminant function was arrived at as:

$Z = 1\,x_1 + 7\,x_2 + 62\,x_3$ where Z is the quantitative measure of the total discriminating value representing genotypic yield; x_1 is the mean lint index; x_2 is the mean number of seeds per bolls; and x_3 is the mean number of bolls per plant.

Discussion and Conclusion: The interaction between heritable and non-heritable factors makes the yield a highly complex character, for the breeder to plan for improvement of yield. A study on the relative amounts

TABLE. *Simple Correlation Coefficients of Characters with lint yield*

S. No.	Variety	Seed cotton yield	Ginning per cent	Lint index	Seed index	No. of seeds/boll	No. of bolls/plant	Boll index
1.	K. 2	0·995†	0·410*	0·208	0·120	0·986†	0·894*	—0·333
2.	K. 5	0·995*	0·021	0·151	0·172	0·963†	0·151	—0·181
3.	K. 6	0·997†	0·422*	0·476†	—0·158	0·990†	0·900†	—0·481*
4.	9877	0·971†	0·011	0·276	0·625†	0·985†	0·765†	—0·296
5.	B. 32–48	0·995†	0·457*	0·584†	0·125	0·988†	0·903†	—0·448*
6.	5001	0·995†	0·354	0·410*	0·375*	0·983†	0·781†	—0·461*
7.	Tellapathi	0·980†	0·553†	0·451*	0·305	0·961†	0·612†	—0·502*
8.	Caro hill	0·981†	0·628†	0·670†	0·514†	0·909†	0·734†	—0·378*
9.	N. R. 5	0·976†	0·005	0·366*	0·319	0·879†	0·638†	—0·219
10.	J. Virnar	0·993†	0·483†	0·576†	0·381*	0·985†	0·821†	—0·313
11.	C. 530	0·995†	0·582†	0·587†	0·243	0·990†	0·928†	—0·538†
12.	197–3	0·998†	0·519†	0·227	0·006	0·977†	0·866†	—0·387†
13.	H. 420	0·995†	0·300	0·480†	0·286	0·958†	0·932†	—0·534†
14.	Jarila	0·994†	0·410*	0·523†	0·237	0·985†	0·927†	—0·411*
15.	231 R.	0·990†	0·019	0·470†	0·345	0·985†	0·915†	—0·478†
16.	Burma C. 19	0·997†	0·266	0·162	0·130	0·987†	0·915†	—0·418*
17.	N. M. D.	0·994†	0·406*	0·692†	0·721*	0·984†	0·849†	—0·440*
18.	Kamugan	0·979†	0·045	0·070	0·087	0·971†	0·931†	—0·045

* Significant at 5% level

† Significant 1% level

of heritable and non-heritable variability exhibited by individual characters, and working out correlations between these characters are helpful in fixing the components which are less susceptible to environmental variation. For this purpose, selection indices were formulated as a reliable scientific approach to the breeding objectives, as they give due weightage to the phenotypic expression in terms of genotype by discriminating the environmental influence (Hazel and Lush 1942, and Hazel 1943).

The correlation studied revealed a high degree of relationship between lint yield and three characters *viz.*, number of bolls per plant, number of seeds per boll and lint index. The regression equation computed showed that among the three characters, the rate of contribution to lint yield was highest in the case of number of bolls per plant, and least in the case of lint index. Although, regression equation and regression lines are helpful in predicting the lint yield with reference to one of the contributing factors, they do not give any indication on the relative influence of each character of yield. They indicate only the relationship between the yield on one hand and a particular character on the other without taking into consideration the relative influence of other factors with which the character is associated (Goulden 1959). The partial regression coefficient showed that the effect of number of bolls per plant on lint yield was highly significant, indicating the usefulness of this character in selecting for lint yield.

The multiple regression function arrived at was significant at one per cent level indicating thereby, the importance of all the three characters in influencing lint yield.

The multiple correlation coefficient of 0·8052 was also significant at one per cent level. This showed the closeness between the observed and predicted values of lint yield.

Both multiple regression function and multiple correlation coefficient revealed the combined influence of the three independent characters on lint yield. This is in conformity with the findings of Panse and Khargonkar (1949) that the yield of cotton plant is the product of three factors *viz.*, number of bolls per plant, number of seeds per boll and weight of seed cotton per seed. According to Stroman (1930), the main components of total lint production are the boll number per plant and boll weight. Boll weight, in turn, is made up of number of seed per boll, lint index and seed index. Manning (1956) utilised boll per plant, seeds per boll and lint per seed in formulation of selection index for improvement of yield in *hirsutum* variety, B. P. 52.

Among the three characters influencing lint yield, the number of bolls per plant exercised the highest influence, next in order came the lint index, and the number of seeds per boll was ranked third. The three characters together were estimated to influence lint yield to the extent of 64·83 per cent. It was clear, therefore, that all other factors (both known and unknown) contributed to 35·17 per cent variation in lint yield.

Hazel add Lush (1942) indicated that when several traits affect the net worth of an organism, it is necessary to ascertain the proportion of contribution of each of the charateristics, if maximum progress from selection is to be made. Accordingly, the application of discriminant function technique in the study gave the genotypic contribution of each character to lint yield in the order of (i) number of bolls per plant, (ii) number of seeds per boll and (iii) lint index.

The discriminant function technique, as applied to varieties of *G. arboreum*, thus indicated the relative genotypic worth of the three yield components for exercising selection for yield. Emphasis on number of bolls, number of seeds per boll and lint index, in the order mentioned, would, therefore, appear to offer a more efficient basis for selection and serve as a better indicator of the genetic potentiality for lint yield than *ad hoc* selection for yield, in *G. arboreum*. Panse and Khargonkar (1949) using three factors *viz.*, number of bolls on the plant, number of seeds per boll and weight of seed cotton per seed in *G. arboreum* found that the application of discriminant function for selection of yield gives very little extra improvement as compared to simple selection on yield. On the contrary, Manning (1956) using the selection index technique for three yield components *viz.*, bolls per plant, seeds per boll and lint per seed in variety B. P. 52 *(G. hirstum)*, claimed a total improvement of 30 per cent in yield, after six generations of selection.

The study revealed that in varietal selection for lint yield in *G. arboreum*, emphasis may be laid on number of bolls per plant, number of seeds per boll and lint index; and that adoption of suitable selection index as a guide to genotypic selection may be useful in practical cotton breeding.

Summary: Notable attempts have been made recently to devise and utilise better methods in cotton breeding, of which the use of selection indices is very promising, particularly for improving the yielding ability in *G. arboreum* under rainfed conditions.

Among the seven characters studied for lint yield number of bolls per plant, number of seeds per boll and lint index showed a very close association. These three characters together were capable of influencing lint yield

to the extent of 64·83 per cent. When all the three components were considered simultaneously for their genetic worth in lint production, number of bolls per plant was seen to exert the highest influence, number of seeds per boll coming next to it and lint index being the third. It is, therefore, considered necessary to lay emphasis on the three characters in selection for lint yield in cotton *(G. arboreum)*.

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