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A discriminant function for selection for yield in *Eleusine coracana* Gaertn *

by

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Synopsis: Multiple Correlation Coefficient, Multiple Regression Coefficient and Discriminant Function were worked out for fifteen distinct varieties of finger millet taking into consideration three characters, viz., number of ear bearing tillers, number of fingers and weight of straw per plant which had been shown to be highly correlated with grain yield in previous work. The multiple regression and the multiple correlation coefficients indicate that these three components are collectively responsible for a major portion of the variation caused in ultimate grain yield. A prediction formula has been fitted up for grain yield so that, given the values for the three components, prediction of yield can be made with considerable accuracy.

The number of ear bearing tillers exerts the maximum influence upon the grain yield followed by weight of straw, the contribution of number of fingers being relatively small. Based on this, the former two components have been formulated as selection indices for yield of grain in *Eleusine coracana*.

Introduction: In breeding for increasing the yield in finger millet, the breeder is faced with the problem of arriving at a suitable index to be employed in the selection following the hybridisation. Advances in genetics, plant breeding and biometry have shown that formulation of a selection index utilising Fisher's (1936) concept of discriminant function is an important measure for efficient selection of breeding material. This function shows the extent to which each of the other characters is genetically related to yield; and in addition, if such samples are scored by means of this function the sum total of the linear function gives a value highly correlated with its genotypic yield potentialities. The investigations, reported herein, were undertaken with a view to finding out the range of phenotypic and genotypic variation for six characters in *ragi* and finally to arrive at a discriminant function.

Materials and Methods: From the varietal collection maintained by the Millet Specialist, Agricultural College and Research Institute, Coimbatore, fifteen varieties of *ragi* of medium duration (names and description of the varieties are presented in the table) varying markedly in their morphological characters, were selected for the study. The experimental design chosen was "Randomised

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TABLE.

Description of the important characteristics of ragi varieties used in the studies.

Particulars	EC.364	MS.9271	EC.1320	EC.2985	EC.3854	EC.4354	EC.4597	EC.4608	EC.4624	CO.5	MS.8069	EC.321	EC.545	EC.926	CO.2
1. Name	Sovil *Ragi*	Purna (Aruna x Co. 1)	Pori urundai -keram	Perum *Ragi*	(Local)	Extracted from EC.1540 x EC.3517	(Local)	(Local)	(Local)	(Strain)	Marua *Ragi*	Pala *Ragi*	Gidda *Ragi*	(Local)	(Strain)
2. Place	Kollegal	Mandya	Palur	Palur	Radhapuram	—	Malabar	East Africa	East Africa	Coimbatore	Bihar	Kurnool	Cuddapah	Kurnool	Coimbatore
3. Habit	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Sub-erect	Erect	Bushy	Erect
4. Height*	Medium	Short	Short	Short	Short	Medium	Medium	Medium	Medium	Short	Short	Medium	Tall	Short	Short
5. No. of tillers @	Low	Medium	High	Medim	High	Low	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium
6. Pigmentation nodes and inflorescence	Purple	Purple	Deep purple	Purple	Purple	Green throughout	Purple	Purple	Purple	Purple	Green throughout	Green throughout	Green throughout	Green throughout	Green throughout
7. Earhead type	Open	Top-curved	In-curved	In-curved	In-curved	In-curved	In-curved	In-curved	In-curved	In-curved	In-curved	Fisty	Fisty	Fisty	Fisty
8. Length of the primary ear**	Long	Medium	Short	Short	Short	Medium	Short	Short	Short	Short	Short	Short	Very short	Short	Short
9. No. of fingers*@	Low	Medium	Medium	Low	High	Medium	Medium	Medium	Low	Medium	Medium	Low	Medium	High	Medium
10. Duration (in days)	115	110–115	115–120	115–118	115	112–118	115–120	120	115–120	115	110–120	115–125	120–140	115	115
11. Special, if any	Slightly gappy earhead	—	—	—	—	White earhead and grains	—	Reniform seeds	Globular seeds	—	—	—	Thin straw (lodges)	Sterility and gappiness present	—

* Height - tall: over 90 cm; Medium: 75 to 90 cm; short: below 75 cm.

@ Tillers - high: over 5; medium: 3 to 5; low: below 3.

** Length of the primary ear - long: over 13 cm; Medium: 9 to 12 cm; short: below 9 cm.

*@ No. of fingers - high: over 40; medium: between 30 and 40; low: below 30.

Block Design". The experiment consisted of fifteen varieties replicated five times. The dimension of each plot was 10' × 10'. One month old seedlings were transplanted in lines adopting a spacing 9" × 9". The crop was grown irrigated. The experiment was laid out in the Millet Breeding Station, Coimbatore, during 1961. "Three Digit Random Numbers" (Fisher and Yates, 1948) were used for random earmarking of plants. In total, 450 plants (6 plants per plot × 5 replications × 15 varieties) were studied. The data on the yield of grain and straw, and other characters were gathered.

Partial Regression Coefficients, Multiple Regression Function, Multiple Correlation Coefficient and Discriminant Function were worked out adopting the procedures suggested by Goulden (1959).

Results and Conclusion: Mahadevappa and Ponnaiya (1962) have made detailed investigations, in this crop, on the degree of association and influence of various attributes on yield by taking into account grain yield and six other characters viz., (i) date of earing, (ii) plant height, (iii) length of the primary ear, (iv) number of ear bearing tillers, (v) number of fingers per plant and (vi) yield of straw per plant. It was shown that among these six, only three characters, namely, number of ear bearing tillers, number of fingers per plant and weight of straw per plant had highly significant positive association with the grain yield. A suggestion was made to consider these characters for further work to arrive at a discriminant function. The present article deals with this aspect of working out discriminant function.

Multiple Regression Function: The partial regression coefficients between yield of grain on one hand and number of ear bearing tillers, number of fingers per plant and weight of straw on the other, are 0·4906, 0·1107 and 0·3314 respectively and all of them are significant even at one per cent level. This indicates that number of ear bearing tillers (x_1) and weight of straw (x_3) have got considerably more influence over yield than number of fingers (x_2). The multiple regression function fitted is: $Ye = 0{\cdot}4906\,x_1 + 0{\cdot}1107\,x_2 + 0{\cdot}3314\,x_3 + 0{\cdot}8184$, where x_1, x_2 and x_3 represent the above three characters respectively. Test of significance carried out indicated this function to be highly significant. When the values of x_1, x_2 and x_3 are given the yield can be predicted with the help of this prediction formula with considerable accuracy.

Multiple Correlation Coefficient: The multiple correlation coefficient for these three characters with yield is 0·7834. This value is highly significant. This indicates the close approximation of the predicted yield to the yield that would actually be obtained and also brings out the combined influence of the three independent attributes on the yield of grain. The percentage of variability in yield among the varieties under study accounted for by its association with the number of ear bearing tillers, number of fingers per plant is 61·37. This reveals that these three characters are responsible for most part of the variation caused in the grain yield in *ragi*.

However, the multiple regression function and the multiple correlation coefficient reveal only about the phenotypic relationship of the components to the yield. Panse (1957) has stressed the need for the differentiation of heritable and non-heritable variation in the phenotype and that selection would be more effective if based on heritable characters which show least fluctuation due to environmental influence which in turn is due to the stability of genotype. Therefore, if these three characters are taken into account in exercising selection, it may not be sound as the relative genotype contribution of each of these characters is not known. The adoption of discriminant function analysis solves this problem of apportioning the total effect by discriminating environmental effect and also by assigning relative weights to each of the yield components based on its genotype contribution. This makes discriminant function to differ from multiple regression function as otherwise both would give the same information. Goulden (1959) has pointed out that the discriminant function gives an indication of the concentration of yield genes on the yield components. Smith (1936) has explained the hypothetical premises from which the discriminant equation was derived. They are (i) that the genotype and environmental effects are additive in giving the observed magnitude of characters, (ii) that the two effects are independent and (iii) that the genotypic yield as well as the phenotypic yield follow the normal distribution. Hence this equation gives the genotypic assessment of the complex yield from its components.

Discriminant function: This is given by the relation $Z = b_1X_1 + b_2X_2 + b_3X_3$, where, Z = quantitative measure of the total discriminating value of the three characters representing genotypic yield, X_1, X_2 and X_3 = mean values of number of ear bearing tillers, number of fingers and weight of straw per plant respectively; and b_1, b_2 and b_3 = relative weights assigned denoting their genotypic contribution to yield.

Discriminant function set up for all the fifteen varieties taken together is $Z = 351\ X_1 + X_2 + 15\ X_3$. It is clear from the above formula that out of the three components which are closely associated with yield, the number of ear bearing tillers exerts the maximum contribution. Weight of straw follows the number of ear bearing tillers in its importance in exerting weight upon the grain yield; weight of straw in turn, is followed by the number of fingers per plant. Simlote (1947) suggested that the two important criteria upon which the evaluation of breeding material should be based are (i) the characters that are least affected by environmental fluctuations and (ii) those that give relatively greater weights when taken simultaneously. Although all the three characters considered here satisfy the first condition, the second condition is satisfied only by two characters viz., number of tillers and weight of straw, their respective relative weights being 351 and 15 times more than other character namely, the number of fingers.

It may, therefore, be concluded that number of ear bearing tillers and weight of straw may be utilised as selection indices for evaluating the genotype for improvement of grain yield in *Eleusine coracana*.

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