https://doi.org/10.29321/MAJ.10.A03411

Madras agric. J. 61 (8): 359–364, August, 1974

Relationship Between Grain and Straw Yield with Measurable Morphological Characters in Pearl Millet

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ABSTRACT

A study of the morphological features and yield components relative to the yield of grain and straw of Hybrid pearl millet (Var. HB 1) was undertaken to evolve prediction formulae for grain and straw yields. The strongest relationship exists between yield of grain and straw while plant height, productive tillers and length of the ear also make some significant contribution to the grain yield. In the case of straw, plant height seems to contribute most, followed by length and diameter of main ear and diameter of the fourth node.

INTRODUCTION

The association of the different phases of crop growth and yield components with grain yield was measured by correlation and regression co-efficients and prediction Multiple Regression Function fitted to predict the grain yield.

Ayyangar *et al.* (1935) studied the relationship of plant characters and yield and concluded that the yield of a plant could be predicted very closely when the diameter of the peduncle, length and thickness of the earhead and weight of hundred grains were known. Ramiah and Rao (1953) and Ghose *et al.* (1960) reported that height of plant, number of earbearing tillers, length of earhead, number of grains per ear and the yield of straw were major components of rice. Rajagopalan (1963) studied the relationship between yield and seven plant characters in three rice varieties and found that the grain yield, ear number and grain number, height of the plant and the yield of straw had high and positive correlation in all the three varieties.

In pearl millet, similar works have not been reported so far. Hence in the present investigation, multiple regression functions for grain and straw yields seperately have been derived, taking into account, six appropriate plant characters and yield components for each.

MATERIALS AND METHODS

The field experiment on Hybrid Bajra-1 was conducted at the Agricul-

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tural College Farm, Coimbatore during April-June 1966. Strip plot design was adopted allocating seven levels of nitrogen (0 20, 40, 60, 80, 100 and 120 kg N/ha) to the column strips and three row spacings (30, 45 and 60 cm) to the row strips. The treatments were replicated four times. A basal dressing of 5 tonnes of farm yard manure and 40 kg of P_2O_5 as super phosphate per hectare were applied. Application of nitrogen in the form of ammonium sulphate was made in two split doses, half at the sowing time and the balance 30 days after the first application. The gross and net plot areas were 7 2 MX 3.0 M and 5.4 MX 2 6 M respectively. Morphological characters were recorded following the procedure laid down by Ayyangar *et al.* (1936)

The correlation and multiple regression analyses were made using standard methods described by Goulden (1956). The simple correlations of growth characters and yield components with the yield of grain and straw and among themselves were worked out. The linear regression of yield on individual characters were also computed wherever appropriate.

Six characters from among the growth characters and the yield components studied were chosen and independent variables for fitting a multiple regression equation. The multiple regression equation was of the form

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$, where 'a' is a constant, $X_1 \ldots X_6$ are the growth and yield characters chosen and $b_1 \ldots b_6$ are the corresponding partial regression co-efficients.

Multiple correlation coefficients, which give the closeness of the correlation between observed and predicted values of Y was estimated from the formula,

$$R = \sqrt{\frac{SS \text{ of multiple regression}}{SSY}}$$

The square of the multiple correlation co-efficient (R^2), which is a measure of accuracy of prediction and also known as the co-efficient of predictability, was also estimated and expressed in percentage.

RESULTS AND DISCUSSION

Simple correlations:

The correlation matrix showing the simple correlation co-efficients between different characters are presented in Table 1.

Linear regression: Simple linear regressions of grain and straw yield on characters correlated with yield were also worked out and the linear regression equations were fitted. These are presented in Table 2.

Multiple regression function:

The simple correlation co efficients in Table 1 suggested that a multiple regression function could be more appropriate to estimate the yield of grain and straw from given values of some of the growth characters and yield components than to study their associations individually.

TABLE 1. Simple correlation matrix on yield and growth characters

	Yield of grain (Y)	Yield of straw (X 1)	No. of tillers on 40th day (X2)	Height of the plant (X 3)	Total tillers (X 4)	No. of productive tillers (X 5)	earheads (X 6)	Diameter of earheads (X 7)	Diameter of 4th node (X8)	No. of earheads per plant (X 9)	Diameter of peduncle (1X0)
Y		0.790**	0.099	0.262*	0.108	0.164	0.350**	0.151	0.193	0.141	0.161
X_1		...	0.155	0.463**	0.137	0.094	0.355**	0.249*	0.247*	0.137	0.185
X_2		...	...	0.252*	0.990**	0.918**	0.417**	0.276	0.421**	0.886	0.904**
X_3		...	...	...	0.294**	0.259**	0.486**	0.500**	0.340**	0.360**	0.358**
X_4		...	...	...	...	0.611**	0.413**	0.295**	0.308**	0.888*	0.103
X_5		...	...	...	...	...	0.095	0.228*	0.377**	0.942	0.174
X_6		...	...	...	...	...	...	0.406**	0.283**	0.430**	0.449**
X_7		...	...	...	...	...	...	...	0.874**	0.240*	0.560**
X_8		...	...	...	...	...	...	...	...	0.394**	0.481**
X_9		...	...	...	...	...	...	...	...	...	0.201
X_{10}		...	...	...	...	...	...	...	...	...	...

* Significant at P=0.05 level

** Significant at P=0.01 level

Six growth characters were chosen as independent variables for yield as well as straw, based on their correlation with yield of their possible relationship with yield where actual correlation is absent. The characters selected were: For grain yield - yield of straw (X1); height of plant (X2); number of productive tillers (X3); length of the main earhead (X4); diameter of the main earhead (X5) and diameter of the fourth node (X6). For straw yield - height of plant (X1); total number of tillers (X2); length of the main earhead (X3); diameter of the main earhead (X4); diameter of the fourth node (X5) and diameter of the peduncle (X6).

The multiple regression equation fitted to predict grain yield was,

$Y = 230.18 + 0.828\ X1^{**} - 0.211\ X2^{*} + 0.126\ X3^{*} + 0.168\ X4^{*} - 0.063\ X5 + 0.018\ X6.$

Similarly the prediction equation for straw yield was,

$Y = 546.73 + 0.437\ X1^{**} - 0.106\ X2 + 0\ 244\ X3^{*} - 0.348\ X4^{*} + 0.398\ X5^{*} - 0.066\ X6$

* Significant at 5 per cent level.

** Significant at 1 per cent level.

Partial regression of grain and straw yield:

As regards grain yield, only the partial regressions of grain yield on (i) yield of straw, (ii) height of plant, (iii) number of productive tillers, and (iv) length of main earheads are significant (Table 3)

This would indicated that grain yield could be predicted at least precisely without considering the other two

TABLE 2. Simple correlation coefficients between grain yield on other characters and their respective linear regression coefficients

Particulars	Simple correlation coefficient	Linear regression coefficient	Regression equation
Characters correlated with grain yield			
Straw yield	0.790**	0.219	Y = − 1.290 + 0.219 X
Height of the plant before harvest	0.262**	0.003	Y = − 0.19 + 0.003 X
Length of earheads	0.350**	0.025	Y = − 0.74 + 0.025 X
Characters correlated with straw yield			
Number of tillers on 40th day	0.463**	0.020	Y = − 13.73 + 0.020 X
Length of earheads	0.355**	0.092	Y = − 5.08 + 0.092 X
Diameter of earheads	0.249**	0.959	Y = − 4.49 + 0 959 X
Diameter of 4th node	0.247**	0.892	Y = 4.18 + 0.892 X

* Significant at P = 0.05 level

** Significant at P = 0.0 1 level

TABLE 3. Partial regression of grain and straw yield 't' Table

Partial regression of grain yield on (X)	Partial regression co-efficient (b)	Calculated 't' and level of significance
Grain yield		
X_1 Straw yield	$b_1 = +0.828$	6.627 **
X_2 Height of the plant	$b_2 = -0.211$	−2.140 *
X_3 No. of productive tillers	$b_3 = +0.133$	1.662 *
X_4 Length of earheads	$b_4 = +0.110$	1.334 *
X_5 Diameter of earheads	$b_5 = -0.063$	< 1
X_6 Diameter of the fourth node	$b_6 = +0.018$	< 1
Straw yield		
X_1 Height of the plant	$b_1 = +0.437$	+3.300 **
X_2 Total tillers per plant	$b_2 = -0.106$	< 1
X_3 Length of earheads	$b_3 = +0.244$	−1.876 *
X_4 Diameter of earheads	$b_4 = -0.348$	−1.475 *
X_5 Diameter of the fourth node	$b_5 = +0.398$	+1.847 *
X_6 Diameter of peduncle	$b_6 = -0.066$	< 1

characters namely, diameter of main earheads and of the fourth node, as by including them.

In respect of straw yield also the partial regressions on (i) height of plant, (ii) length of earhead, (iii) diameter of main earhead and (iv) diameter of the fourth node are significant. It is possible therefore to exclude the total number of tillers and diameter of peduncle without loss of precision in this estimate.

Co-efficient of predictability and multiple correlation co-efficient:

The multiple correlation co-efficient, R, which is a measure of the cor-

relation of the observed yields with those predicted and also the co-efficient of predictability, R^2, which is a measure of the precision of estimates are given below:

	R	R^2 (expressed as per cent)
Grain	0.82	67.24 per cent
Straw	0.69	47.61 per cent

It is seen that the precision of estimates is moderate but not high in grain and low in the case of straw. The lack of precision may be attributed to other agronomic factors which demonstrably have a tangible influence on yields but not to a like degree on the growth characters and yield components considered here.

In conclusion it may be stated that the study of morphological features and yield components relative to the yield of grain and straw has helped to evolve useful formulae for predicting grain and straw yields for observed values of the related plant characters including yield components.

It is note-worthy that the strongest relationship exists between the yield of grain and straw while plant height, productive tillers and length of the ear also make some tangible contribution to the grain yield.

In the case of straw, plant height seems to contribute most followed by length and diameter of main ear and diameter of the fourth node.

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