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INTERRELATIONSHIP BETWEEN YIELD AND YIELD COMPONENTS IN RICE (*ORYZA SATIVA* L.)

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Abstract

Interrelationship between yield and yield components was studied in two rice cultivars, Basmati-370 and Basmati Pak and their true breeding mutant lines viz EF-29-1, EF-4-23-1, EF-4-73-1, and EF-27-73-1, DM-16-5-2 and EF-2-11. These varieties/mutant lines were grown at two population densities (22 x 15 cm and 22 x 30 cm). Correlation coefficients were worked out between various yield components. Panicle length showed a positive and significant correlation with number of grains per panicle and panicle weight. A highly significant correlation was observed between number of branches per panicle, number of grains per panicle and panicle weight. Thousand grain weight was negatively correlated with all the yield components studied. It was also found that change in the planting density did not show any influence on the interrelationship of various traits.

Introduction

Success of a mutation breeding programme depends upon the efficiency of induction of mutations and efficiency of selection of beneficial mutants. A great deal of breeder's time and efforts are devoted to the selection of promising mutants. Among the principal objectives of mutation breeding in rice, improvement in grain yield has attracted maximum attention of the rice workers. Since grain yield in rice is dependent upon, apart from other factors, panicle length, number of branches per panicle, number of grains per panicle and panicle weight, the knowledge of relationship among these and other yield factors will be useful in designing an effective selection programme for yield improvement in rice. Selection for these traits after the modification of plant architecture through the use of induced mutations offer possibilities of developing more efficient system leading to the increased grain yield potential (Futsuhara, et al., 1967; Reddy et al., 1975; Ram, 1974; Rutger et al., 1976). Hence, it seems imperative for a rice breeder to pay greater attention to determine the relationship between yield and yield components so that the selection of high yielding mutants in early generations is facilitated.

The interrelationship between yield and yield attributing traits has been the sub-

Table 1. Mean values for yield and yield components of Basmati-370 Basmati Pak and their mutants under two population densities.

Varieties	Plant spacing	Panicle length (cm)	Number of branches panicle	Number of grains per panicle	Number of fertile grains per panicle	Panicle weight (g)	1000-grain weight (g)	Grain yield per plant (g)
Basmati-370	I	30.86	12.20	155.33	142.27	3.18	20.26	21.27
	II	31.85	12.24	162.16	148.97	3.39	20.66	39.44
Ef-29-1	I	30.74	9.44	130.02	116.60	2.50	20.70	17.25
	II	30.61	10.50	151.06	131.24	2.81	20.06	36.78
Ef-4-23-1	I	30.31	9.10	98.09	67.66	1.78	23.00	12.50
	II	30.14	9.43	105.85	80.15	2.07	27.93	24.86
Ef-4-73-1	I	28.47	9.13	100.92	82.12	2.11	23.70	15.75
	II	29.81	10.20	115.63	95.97	2.28	23.36	30.09
Ef-27-73-1	I	28.93	9.98	114.81	97.58	2.35	21.46	16.84
	II	29.83	10.46	124.61	107.90	2.50	21.46	31.53
DM-16-5-2	I	29.02	10.93	138.55	129.53	2.58	18.8	17.71
	II	28.40	11.24	130.04	119.44	2.42	19.03	32.61
Basmati Pak	I	27.22	9.57	90.67	84.06	2.09	23.83	18.72
	II	27.39	9.87	94.39	88.16	2.10	23.53	34.15
Ef-2-11	I	30.77	10.54	138.07	123.24	3.10	24.13	20.04
	II	30.70	11.33	154.45	135.94	3.25	23.83	37.56
LSD 5%	I	0.6643	0.7299	3.3565	7.5255	0.2299	1.1864	3.7941
	II	0.5232	0.6002	1.6667	3.4539	0.2280	0.8840	1.3121
LSD 1%	I	0.9220	1.0131	4.6584	10.4445	0.3191	1.6466	5.2657
	II	0.7261	0.8330	2.3131	4.7936	0.3165	1.2268	1.8210

I = (22 x 15 cm)
II = (22 x 30 cm)

Table 2. Correlation coefficients among different yield components under two population densities.

Characters	Plant spacing	Number of branches per panicle	Number of grains per panicle	1000-grain weight	Grain yield per plant	Panicle weight	Number of fertile grains per panicle
Panicle length	I	0.3675	0.6764	-0.2217	0.1305	0.5467	0.4939
	II	0.4983	0.7680*	-0.1045	0.3326	0.7452*	0.6218
Number of branches	I	–	0.8542**	-0.5280	0.7717*	0.8468**	0.8659**
per panicle	II	–	0.8402**	-0.4530	0.7819*	0.8701**	0.9170**
Number of grains per	I	–	–	-0.5998	0.6682	0.9159**	0.9656**
pancile	II	–	–	-0.4312	0.7553*	0.9501**	0.9689**
1000-grain weight	I	–	–	–	-0.1626	-0.2936	-0.6045
	II	–	–	–	-0.2528	-0.2166	-0.4805
Crain yield per plant	I	–	–	–	–	0.8662**	0.7953*
	II	–	–	–	–	0.8328*	0.8670**
Panicle weight	I	–	–	–	–	–	0.9280**
	II	–	–	–	–	–	0.9489**
Number of fertile	I	–	–	–	–	–	–
grains per panicle	II	–	–	–	–	–	–

I = (22 x 15 cm) * Significant at 5%

II = (22 x 30 cm) ** Significant at 1%

ject of investigation by several workers (Sarathe et al., 1969; Swamy, 1970; Gupta & Padalia, 1971; Majid & Shafi, 1971; Talwar & Goud, 1976; Brar & Saini, 1976 and Saini & Gagneja, 1975). While most of the correlation studies in rice have been confined to commercial cultivars or F_2 progenies (Khaleque et al., 1977; Chaudhary et al., 1976; Shastry et al., 1967; and Chang & Tagumpay, 1970), very little information is available on induced mutations regarding the interrelationship of various yield components. Such studies are highly desirable in rice breeding programme aiming at yield improvement as it helps in identifying a genetic marker. The present study was therefore undertaken to find out the relationship between yield and various yield components in the true-breeding mutant strains resulting from the mutagenic treatment of two Basmati cultivars.

Materials and Methods

The experimental material consisted of six true breeding early flowering and dwarf mutant strains selected from the two local, late maturing and tall Basmati cultivars viz, Basmati-370 and Basmati Pak in the M_2 generation after gamma-rays treatment. The mutants were designated EF (Early flowering) and DM(dwarf). Of these mutants EF-29-1, EF-4-23-1, EF-4-73-1, EF-27-73-1 and DM-16-5-2 are derivatives of Basmati-370 whereas, EF-2-11 is derived from Basmati Pak. EF-29-1 hereafter called Kashmir Basmati was released as commercial variety in Azad Kashmir (Awan et al., 1977). The mutants along with their parents were grown in a randomized block design at two population densities with three replications during July, 1978 at the Nuclear Institute for Agriculture and Biology, Faisalabad. Each plot consisted of four rows 4.5 meter long and 22 cm apart with a plant to plant spacing of 15 cm and 30 cm at the two planting densities. In September/October 1978, when all the mutants and parents had completed panicle emergence, 10 competitive single plants from the two central rows per replication were randomly selected and tagged. At maturity three main panicles from each plant were harvested and kept separately in paper bags along with the total panicles harvested from each tagged plant. Data with respect to grain yield per plant, panicle length, branches per panicle, number of grains per panicle, 1000-grain weight, panicle weight and number of fertile grains per panicle were recorded in the laboratory. Correlation coefficients were computed according to the procedure given by Mather (1966).

Results and Discussion

The mean values with respect to panicle length, number of branches per panicle, number of grains per panicle, panicle weight, 1000-grain weight and grain yield per plant of two Basmati cultivars and their mutant lines grown at two plant densities, are given in Table I. Significant difference among various varieties/mutant lines exist for all the yield components studied. Higher values of Basmati-370 were observed in all the characters except 1000-grain weight as compared to the mutants at both plant spacings, whereas the mean values of the early flowering mutants of Basmati-Pak were higher as compared to the parent variety. Thousand grain weight of the mutants EF-4-23-1, EF-4-73-1 and EF-27-73-1, was higher than that of Basmati-370, while DM-16-5-2 had lower value of 1000-grain weight as compared to Basmati-370. Kashmir Basmati (EF-29-1) was comparable to Basmati-370 regarding 1000-grain weight. Similarly, 1000-grain weight of Basmati-Pak and its early flowering mutant was almost identical.

Grain yield per plant seems to be greatly influenced by the planting distance. Wider spacing (22 x 30 cm) resulted in the highest grain yield per plant in all the varieties/ mutants under study. This was probably due to less plant competition and profuse tillering under wider spacing.

The values for the correlation coefficients among various yield components and yield under two spacings I (22 x 15 cm) and II (22 x 30 cm) are presented in Table 2. Planting distance did not modify the relationship of various traits. However, minor difference in the correlation coefficient between different characters at the two spacings were observed. Panicle length showed significant and positive correlation with number of grains per panicle (r =0.7680) and panicle weight (r=0.9170). Similarly a positive association was found between panicle length and number of branches per panicle, grain yield, and number of fertile grains per panicle. Saini & Gagneja (1975) also reported positive correlation between these characters. Number of branches per panicle had a positive and significant correlation with number of grains per panicle (r =0.8542), panicle weight (r =0.8701), number of fertile grains per panicle (r=0.9170) and grain yield per plant r =0.7819). The correlation between grain yield per plant, panicle weight and number of fertile grains per panicle was positive and significant. A positive and significant association was found between grain yield per plant, panicle weight and number of fertile grains per panicle. Balakrishna et al., (1973) found a positive correlation between yield and panicle weight. Similarly Eunus et al., (1976) have reported a positive association between yield and number of fertile grains per panicle. Highly significant and positive association was found between panicle weight and number of fertile grains per panicle (r =0.9489). The highest positive relationship was found between number of grains per panicle and number of fertile grains per panicle (r =0.9501) and panicle weight and number of fertile grains per panicle (r=0.9489) at both the plant densities. Correlation between 1000-grain weight and all other yield components was negative and non-significant at both the spacings. A similar association has been reported by Akram (1979) who studied inter relationship between these characters in short-culm mutants of Basmati cultivars. Chaudhry et al., (1976) have also reported a negative association between 1000-grain weight, number of fertile grains per panicle and panicle length.

A highly significant correlation of panicle weight with number of branches per panicle, number of grains per panicle and number of fertile grains per panicle indicates that these are the most important yield components influencing grain yield. Selection based on panicle weight in early generation after the induction of mutations should definitely lead for yield improvement in rice. Talwar (1976) and Talwar & Goud (1976) have reported the importance of these characters as selection indices for yield improvement in rice. A positive correlation between grain yield, panicle weight, number fertile grains per panicle, number of branches per panicle and number of grains per panicle indicates that these characters have a direct bearing on yield.

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