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IMPLICATIONS OF INDUCED DWARFISM ON PANICLE COMPONENTS IN RICE*

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Abstract

Two semidwarf induced mutants, DM-16-5-1 and DM-107-4 of a tall indica rice cultivar Basmati 370, were compared with the parent variety for associated changes in the yield components viz., length of the panicle axis, number and length of primary branches per panicle, number of secondary branches, number of spikelets borne on secondary branches and total number of spikelets per panicle. A marginal reduction in the panicle axis, primary branches per panicle, secondary branches per primary branch per panicle, spikelets borne on secondary branches and total number of spikelets per panicle was observed in DM-16-5-1 whereas, these characters were significantly reduced in DM-107-4. Length of primary branches per panicle was quite comparable in both the mutants as well as the parent cultivar. A significant reduction in the length of secondary branches of both the mutants as compared to Basmati 370 was noticed. The pattern of change in the mutants as compared to the parent variety have been discussed.

Introduction

Artificial mutagenesis is being used effectively to supplement or compliment sources of natural origin for practical plant breeding purposes. Induced macromutations usually offer unique materials for studies in crop plant evolution and plant breeding (Caldecott *et al.*, 1964; Siddiq & Swaminathan, 1968; Gustafsson, 1969; Brock, 1971). The possible effect of a major gene mutation on other plant characters is of considerable importance while evaluating a certain macromutation. In most of the breeding programmes using induced mutations, reduction in plant height is a common breeding objective. Any major change at plant height loci is expected to bring in phenotypic modifications in a group of sequential plant characters (Swaminathan, 1966). The object of the present studies was to compare two semi-dwarf mutants with the parent variety, a tall indica rice cultivar, for the associated changes in the panicle characters.

Materials and Methods

Basmati 370, a tall indica rice cultivar and two of its induced semidwarf mutants, DM-16-5-1 and DM-107-4 were used in this study. These mutants were derived from the

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segregating population of Basmati 370 after treatment with 25 KR of ^{60}Co gamma rays. DM-16-5-1 and DM-107-4 are 20% and 40% shorter in height respectively and are now in M_8 generation. The parent variety and the mutants were grown in rows 20 x 20 cm apart, in a randomised complete block design with 3 replications at the experimental area of NIAB, Faisalabad during 1980 growing season. At maturity five competitive plants from each entry per replication were randomly selected and data with respect to the following panicle characters viz., length of panicle axis, number of primary branches per panicle, total length of primary branches/panicle, number of secondary

Table: 1 Mean values and co-efficient of variation (C.V.) for yield components in Basmati 370 and its semidwarf mutants.

Characters	Basmati 370		DM-16-5-1		DM-170-4	
	Mean*	C.V	Mean	C.V	Mean	C.V
Length of panicle axis (cm)	22.33[b]	5.71	21.07[b]	6.45	18.14[a]	9.50
Number of primary branches per panicle	10.73[b]	8.96	10.60[b]	5.97	7.80[a]	12.07
Lenght of primary branch (cm)	12.96[b]	3.94	12.27[b]	4.81	12.28[b]	4.38
Number of secondary branches/primary branch	2.96[b]	8.31	2.86[b]	10.38	2.38[a]	9.76
Length of secondary branch (cm)	3.13[b]	3.83	2.96[a]	4.16	2.89[a]	4.49
Spikelets borne on secondary branches	100.53[b]	11.61	94.20[b]	16.26	53.33[a]	14.48
Total spikelets/panicle	168.33[b]	11.70	162.13[b]	10.83	104.60[a]	13.88

*Figures followed by the same letter are not significantly different at 5% level.

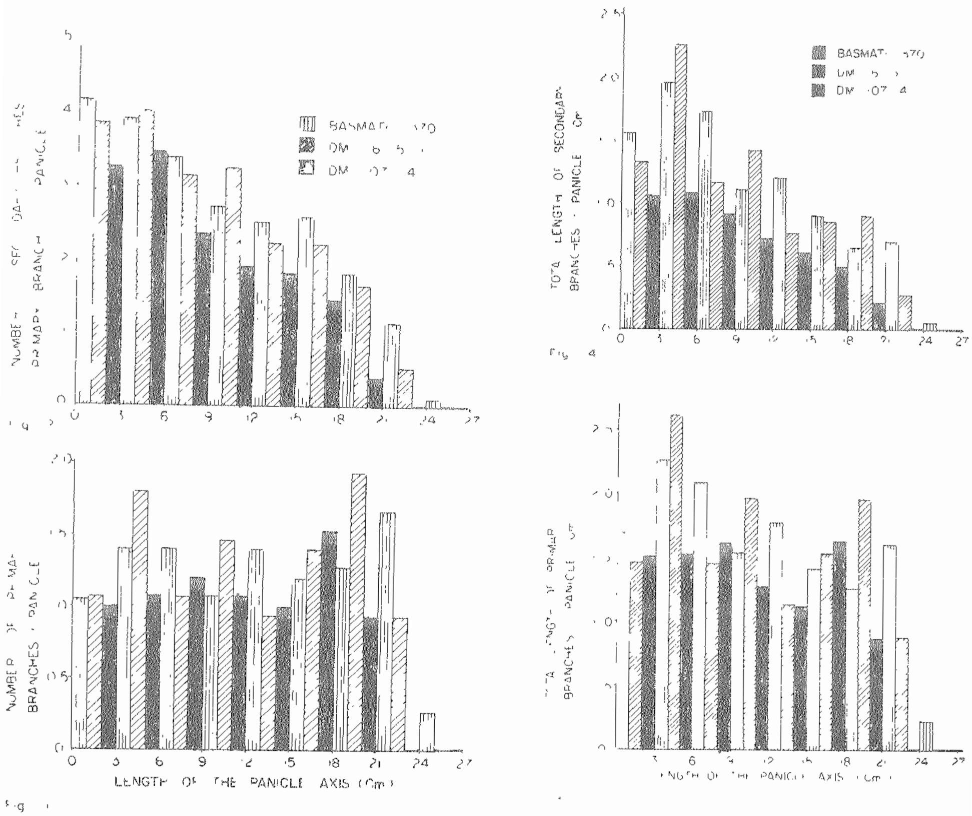

Fig. 1 & 2. Distribution of the number of primary and secondary branches along the panicle axis in Basmati - 370 and its mutants DM 16 - 5 - 1 & DM - 107 - 4.
Fig. 3 & 4. Distribution of total length of primary and secondary branches along the panicle axis in Basmati - 370 and its mutants DM - 16 - 5 - 1 and DM - 107 - 4.

branches per primary branch per panicle, total length of secondary branches/panicle, number of spikelets borne on secondary branches and total number of spikelets per panicle were recorded. The data were statistically analysed according to Duncan's Multiple Range Test.

Results and Discussion

Mean values alongwith co-efficient of variation (C.V.) of different yield components of Basmati 370 and its dwarf mutants viz., DM-16-5-1 and DM-107-4 are shown in Table 1. A marginal reduction in the length of panicle axis, number of primary branches per panicle, secondary branches per primary branch per panicle, spikelets borne on secondary branches and total spikelets per panicle was observed in DM-16-5-1 as compared to Basmati 370, whereas, these characters were significantly reduced in DM-107-4. Mean length of primary branches per panicle of both the mutants was quite comparable with the parent. A significant reduction in the length of secondary branches of both the mutants as compared to Basmati 370 was noticed (Table 1). The co-efficient of variation in DM-16-5-1 was higher as compared to parental type for all the panicle components except for number of primary branches per panicle and total spikelets per panicle whereas, an increase in the Co-efficient of variation (Table 1) for all the characters was observed in case of DM-107-4 as compared to Basmati 370.

The mode of formation of primary branches in both the mutants as well as the parent variety was identical (Fig. 1). The number of primary branches showed alternate decrease and increase in the 3 cm segments (class interval) throughout the panicle axis. The distribution pattern of the secondary branches per primary branches in Basmati 370 and both the dwarf mutants was also similar (Fig. 2). There was more concentration of the branches in the basal portion than in the upper one. The total length of primary and secondary branches was reduced in DM-16-5-1 and DM-107-4 as compared to that in Basmati 370 (Fig. 3-4). The distribution of the length of primary and secondary branches did not follow any trend. However more concentration of comparatively longer branches was observed in the lower 3-6 cm segment of the panicle axis.

All the changes observed in the panicle characters seem to be mainly due to a significant change noticed in the plant height of the mutants. The decrease in plant height of the mutants resulted in a corresponding reduction in the mean values of most of the panicle characters although the degree of change varied from one mutant to the other and from one character to the other for the same mutant. The possible basis for these modifications in panicle characters could be the pleiotropic effects of plant height loci. Rai *et al.*, (1978) advocated the possibility of plant height locus becoming active during the ontogenetic cycle of the plant development. Effect of major gene mutation on spike length/ panicle length and number of primary and secondary branches per panicle has also been reported in wheat (Swaminathan, 1966) and rice (Kawai & Narahari, 1971). In the present studies shortness of the mutants is due to reduction in the length of internodes. Both the mutants are in fairly advance generation (M_8) and breeding true for most of the visible characters. The mutants are also lodging resistant, produce more tillers and give higher grain yield as compared to Basmati 370 (Awan *et al.*, 1982).

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References

Awan, M.A., Maqbool Ahmad and A.A. Cheema. 1982. Evaluation of short stature mutants of basmati 370 for yield and grain quality characteristics. *Pak. J. Sci. Ind. Res., 25:* 67-70.

Brock, R.D. 1971. The role of induced mutations in plant improvement. *Rad. Bot., 11:* 181-196.

Caldecott, R.S., D.T. North, F.A. Ten Kao, V.S. Hiatt and N.A. Tulien. 1964. Forward mutation in *Avena* and *Triticum* polyploid series. *Rad. Bot., 6:* 753-760.

Gustafsson, A. 1969. A study of induced mutations in plants 9-34. In: *Induced mutations in plants.* IAEA, Vienna STI/PUB/231.

Kawai, T. and P. Narahari. 1971. Pattern of reduction of internode length and changes of some other characters in short culm mutations in rice. *Ind. J. Genet., 31:* 421-441.

Rai, K.N., S.L. Diwivendi and R.B. Singh. 1978. Effect of induced semi-dwarfism on panicle morphology in rice (*Oryza sativa* L.). *Cereal Res. Communication., 6:* 285-298.

Siddiq, E.A. and M.S. Swaminathan. 1968. Induced mutations in relation to the breeding and phylogenetic differentiation of *Oryza sativa.* pp 25-51. In: *Rice breeding with induced mutations.* Tech. Rep. Ser. 86, IAEA, Vienna.

Swaminathan, M.S. 1966. Mutational analysis of the hexaploid *Triticum complex. Hereditas, 2:* 418-438.