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Studies of aromatic rice based on genetical parameters utilizing induced mutants

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Abstract
Genetical studies on eight hybrids involving four induced mutants of local aromatic cultivars were made to gain information on recombination breeding and heterosis breeding. The hybrids IET-14142 x Pusa Basmati I for plant height, IET-14142 x Basmati-370 for panicles number, test weight and dry matter production, IET-13541 x Pusa Basmati I for primary branches per panicle, IET-13541 x Basmati-370 for spikelet number per plant, grain number per plant, dry matter production and grain yield per plant, 21-6-1 x Basmati-370 for spikelet number plant and 21-6-1 x Pusa Basmati-I for grain number plant , IET-14143 x Basmati 370 for grain length and IET-14143 x Basmati-370 for test weight and grain number plant would be effective for recombination breeding. The hybrid IET-14143 x Basmati-370 for panicle weight and spikelet number plant, IET-14142 x Pusa Basmati I for dry matter production plant, IET-13541 x Pusa Basmati I for panicle weight and secondary branches per plant, 21-6-1 x Basmati-370 for secondary branches per plant and grain yield per plant, 21-6-1 x Basmati 370 for dry matter production per plant would be promising for heterosis breeding. Although, the future breeding programme always should be based on their estimates in particular environment.

Keywords: aromatic rice, heterosis breeding, induced mutants, recombination breeding

Introduction
Aromatic rice has the greater importance in the national and international rice market because of its premium quality and good smell. Several varieties are being cultivated in different regions of India including the basmati varieties. Non-basmati varieties like are also cultivated along with others in the different regions of India including West Bengal. These are also much superior and having with great demand because of its several quality traits like aroma and kernel characters [1, 2]. Tulaipanja and Gobindabhog are of two such scented verities of West Bengal. Some mutants were isolated from such two non-basmati varieties. These induced mutants are marked with their characteristic aroma and good yield. These are hybridized with the basmati varieties to analyze its genetical potentialities. The analysis based on various genetical parameters is very much important to formulate the breeding strategy of aromatic rice. The idea on combining power can be used to identify the effective cross combinations for recombination breeding. Studies on using multiple genetic parameters like specific combining ability, heterosis as well as per se performance can be focused for the identification of hybrids for heterosis breeding. Considering all the above aspects, an investigation was carried out to obtain some basic information needed in formulating breeding programme of aromatic rice involving induced mutants of aromatic rice.

Materials and Methods
Eight hybrid combinations generated from two basmati verities viz., Basmati-370 and Pusa basmati-I and four gamma ray induced mutants IET-14143 and IET-14142 of local traditional aromatic cultivar Tulaipanja [3] and IET-13541 and 21-6-1 of Gobindabhiog [4] were sown in the earthen pots to generate seedlings. The seedlings of about one month old were then transplanted in the field following randomized block design with standard spacing replicated thrice. The plants were grown by adopting normal standard agricultural practices. Observations were made on various morphological and physiological traits from the whole population including the parents for statistical analysis on genetical parameters required for the present studies..

Results and Discussion
The parents and cross combinations with desirable combining ability effects for different morphological characters is very much useful for breeding programme of aromatic rice. Recombination breeding makes use of fixable additive gene action. To get effective recombinants in segregating generations, the parents of hybrids should possess superior combining ability for the morphological characters to be improved. In addition to it, the SCA effects, should not be significant because selection of superior recombinants will be hindered by significant SCA effects. Hence, it is desirable to select only those hybrids having non-significant SCA effects with parents possessing significant GCA effects [5]. On the basis of above mentioned consideration, out of all the hybrids of aromatic rice evaluated, seven hybrids may be useful in recombination breeding for their respective morphological and physiological characters (Table-1).

The hybrids IET-13541 x Basmati-370 for spikelet number per plant, grain number per plant, dry matter production and grain yield per plant, IET-14142 x Basmati-370 for panicle number, test weight and dry matter production, IET-14143 x Basmati-370 for test weight and grain yield per plant, 21-6-1x Basmati-370 for spikelet number per plant and grain number plant, IET-14143 x Basmati 370 for grain length, IET-14142 x Pusa Basmati I for plant height, IET-13541 x Pusa Basmati I for number of primary branches per plant and 21-6-1 x Pusa Basmati I for number of grains per plant would be expected to produce effective recombinants of aromatic rice. Several characters of these crosses showed additive type of gene action, which is fixable in nature [6]. So, it is expected to get transgressive segregants in the progeny of these cross combinations for the improvement of these traits.

Evaluation of hybrids for heterosis breeding based on three criterion like significant SCA effects, significant heterobeltiosis and high per se performance in desirable direction are important for heterosis breeding. In this context, two hybrids each for days to flowering, panicle weight and dry matter production, three hybrids for number of secondary branches per panicle and one hybrid each for spikelet number panicle, grain breadth and grain yield per plant would be promising for heterosis breeding (Table-2). However, commercial exploitation of the heterotic hybrids would be biologically feasible, if sterility system is incorporated in a parent, preferentially having no restorer gene(s), while the corresponding fertility restoration system have to be incorporated in the other parent of the hybrid, if it does not so have.

Table 1: Effective hybrids for recombination breeding

Character	Good combining mutant	GCA effect of mutant	Good combining variety	GCA effect of variety	Possible cross combination	SCA effect of hybrid	Effective crosses for recombination breeding
Plant height	IET-14143 IET-14142	(-)** (-)**	Pusa Basmati-I	(-)**	IET-14143 x Pusa Basmati-I IET-14142 x Pusa Basmati-I	(-)** (+)	IET-14142 x Pusa Basmati-I
Days to flowering	IET-13541 21-6-1	(-)** (-)**	Basmati-370	(-)**	IET-13541 x Basmati-370 21-6-1 x Basmati-370	(-)** (+)**	
Panicle number per plant	IET-14142	(+)**	Basmati-370	(+)**	IET-14142 x Basmati-370	(+)	IET-14142 x Basmati-370
Panicle weight	IET-14143 IET-13541	(+)** (+)**	Basmati-370	(+)**	IET-14143 x Basmati-370 IET-13541 x Basmati-370	(+)** (-)**	
Primary branches per panicle	IET-13541	(+)**	Pusa Basmati –I	(+)**	IET-13541 x Pusa Basmati –I	(+)	IET-13541 x Pusa Basmati -I
Secondary branches per panicle	IET-13541	(+)**	Basmati-370 Pusa Basmati –I	(+)** (+)**	IET-13541 x Basmati-370 IET-13541 x Pusa Basmati –I	(+)** (+)**	
Spikelet number per plant	IET-13541 21-6-1	(+)** (+)**	Basmati-370	(+)**	IET-13541 x Basmati-370 21-6-1 x Basmati-370	(-) (+)	IET-13541 x Basmati-370 21-6-1 x Basmati-370
Grain number per plant	IET-13541 21-6-1	(+)** (+)**	Basmati-370 Pusa Basmati –I	(+)** (+)**	IET-13541 x Basmati-370 IET-13541 x Pusa Basmati –I 21-6-1 x Basmati-370 21-6-1 x Pusa Basmati -I	(-) (+)** (+) (+)	IET-13541 x Basmati-370 21-6-1 x Basmati-370 21-6-1 x Pusa Basmati -I
Grain length	IET-14143 IET-14142	(+)** (+)**	Basmati-370	0.13**	IET-14143 x Basmati-370 IET-14142 x Basmati-370	(+) (-)*	IET-14143 x Basmati-370
Grain breadth	IET-14142 21-6-1	(-)** (-)**	Basmati-370 Pusa Basmati –I	(-)** (-)**	IET-14142 x Basmati-370 IET-14142 x Pusa Basmati –I 21-6-1 x Basmati -370 21-6-1 x Pusa Basmati -I	(-)** (+)* (+)** (-)**	
Grain length/breadth ratio	IET-14143 IET-14142	(+)** (+)**	Basmati-370 Pusa Basmati –I	(+)** (+)**	IET-14143 x Basmati-370 IET-14143 x	(+)** (+) (-)**	

					Pusa Basmati –I IET-14142 x Basmati-370 IET-14142 x Pusa Basmati –I	(+)**	
Test weight	IET-14143 IET-14142	(+)** (+)**	Basmati-370	(+)** (+)**	IET-14143 x Basmati-370 IET-14142 x Basmati-370	(+)** (-)**	
Dry matter production	IET-14142 IET-13541	(+)** (+)**	Basmati-370	(+)**	IET-14142 x Basmati-370 IET-13541 x Basmati-370	(-) (-)	IET-14142 x Basmati-370 IET-13541 x Basmati-370
Harvest index	IET-14143 IET-13541	(+)** (+)**	Pusa Basmati –I	(+)**	IET-14143 x Pusa Basmati –I IET-13541 x Pusa Basmati –I	(-) (+)**	
Grain yield per plant	IET-14143 IET-13541	(+)** (+)**	Basmati-370	(+)**	IET-14143 x Basmati-370 IET-13541 x Basmati-370	(+) (-)	IET-14143 x Basmati-370 IET-13541 x Basmati-370

Table 2: Effective hybrids for heterosis breeding

Characters	Hybrids	SCA effects	Better parent heterosis
Days to flowering	IET-13541 x Basmati-370 21-6-1 x Pusa Basmati -I	(-)** (-)*	(-)** (-)**
Panicle weight	IET-14143 x Basmati-370 IET-13541 x Pusa Basmati-I	(+)** (+)**	(+)** (+)**
Secondary branches per panicle	IET-14143 x Basmati-370 IET-13541 x Pusa Basmati-I 21-6-1 x Basmati-370	(+)** (+)** (+)**	(+)** (+)* (+)**
Spikelet number per plant	IET-14143 x Basmati-370	(+)**	(+)*
Grain breadth	IET-14142 x Basmati-370	(-)**	(-)**
Dry matter production	IET-14142 x Pusa Basmati –I IET-13541 x Basmati-370	(+)** (+)**	(+)** (+)**
Grain yield per plant	21-6-1 x Basmati-370	(+)**	(+)**

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