

Original Research Article

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## Identification of Pre-harvest Sprouting Tolerant Rice Genotypes for Lowland Ecology

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### ABSTRACT

#### Keywords

Pre-harvest sprouting, Lowland, Vivipary, Rice

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Pre-harvest sprouting (PHS) of rice greatly reduces the quality and economic value of grain, and PHS tolerance is one of the most important traits in rice breeding for lowland ecology. Pre-harvest sprouting (PHS) was evaluated using thirty four lowland rice genotypes in the field condition. The genotypes Dinesh, Saraswati, Hanseswari, Tulasi and Golak found highly tolerant to PHS. The most susceptible genotypes to PHS were Dubraj, Uday, Dhartri, Lunishree, Panke, Amulya, Utkalprava, Moti, Naveen and Biraj.

### Introduction

The phenomenon of germination of mature cereal grains in the ear or panicle, usually during wet season shortly before harvest, is termed as pre-harvest sprouting (PHS) or vivipary. PHS occurs in many cereal crops such as wheat, barley, maize, and rice in most region of the world. Yield loss and quality deterioration of rice have been frequently reported in low land ecosystem due to the adverse weather conditions that cause the viviparous germination or Pre-harvest sprouting (PHS) with lodging. PHS not only causes reduction of grain yield, but also affects the quality of grains, resulting into significant economic losses (Cho *et al.*, 1987;

Rho, 1990). Effective screening method for viviparous germination of rice has been developed by Young Cheoul *et al.*, (2000). Yan *et al.*, (2014) showed that storage of food reserve in endosperm not only provides nutrients at the disposa of embryo, but also acts as a mechanical barrier for its growth. Mohapatra and Kariali (2016) elucidated the pathway for ethylene production in germinating rice seeds and suggested management of viviparous germination for climate resilient cultivation. Therefore, the cultivation of varieties with low viviparous is one of the prior considerations to minimize yield loss in low land genotypes. In eastern India, lowland rice varieties are cultivated where the water stands in the field at the time

of harvest. So the mature panicles get contact with water and the seeds are prone to viviparous germination.

### Materials and Methods

The present study was conducted to identify the pre-harvest sprouting tolerant genotypes. Thirty four popular lowland rice genotypes were used in the experiment during wet season 2012 in the experimental farm of NRRI, Cuttack located at 20°25' N latitude and 86° 58' E longitude. The Seeds of thirty four genotypes were sown in nursery bed on 26<sup>th</sup> June 2012. Twenty five days-old healthy seedlings were transplanted in well puddle plots of 3m x 4m size on 27<sup>th</sup> July 2012 in randomized complete block design with three replications. The plant density was maintained at 33 plants m<sup>2</sup> with spacing of 20 x 15 cm line to plant basis. Fertilizer was applied @ 90:60:60 of N: P: K kg ha<sup>-1</sup>. The entire dose of P & K along with 30 kg of N was applied as basal dose, while the rest of the 60 kg of N was applied in two split doses, one 25 days after planting and the other at flowering stage of the crop. Appropriate cultural practices like weeding, raking and need based plant protection measures were undertaken in order to raise a healthy crop. The plants were tagged at the time of 50% flowering (anthesis) individually. Thirty days after anthesis (DAA), panicles were immersed in a polythene bag (20 X 15 cm) filled with water (IL) by bending without causing much strain to the plant. The mouth of the polythene

bag was loosely tied to keep the panicles inside the water with proper aeration. The germination count was taken 12 days after the above mentioned procedure. The emergence of coleoptiles was counted as germinated seed. The germination percentages of the seeds on the panicle were recorded by counting the number of germinated and ungerminated filled seeds on panicle. Seeds were considered germinated when the hull over the embryo ruptured. Three replications were taken for this study and each replication was taken with ten panicles from different hills. Experiment was conducted under normal temperature range prevailing at harvesting period of the season. The average temperature during test period was 29 °C.

### Results and Discussion

The analysis of the data was done using statistical software SAS 9.2. The analysis showed that intensity of preharvest sprouting varied among different genotypes. Most of the genotypes had intensity of PHS higher than 90%, except five genotypes i.e. Dinesh, Saraswati, Hanseswari, Tulasi and Golak had highest intensity of PHS tolerance (Table 2, Fig. 1 and 2). PHS were highly significant and influenced by genotype (Table 1). In Table 2, the genotypes with different letters are statistically significant at 5% level of significance. The viviparous percentage varied from 0% to 99% for the tested rice genotypes.

**Table.1** ANOVA of the 34 lowland rice genotypes

Source	df	SS	MSS
Variety	33	174572.09	5290.06 **
Error	68	22.88	0.3365
Total	101	174594.97	

\*\* Significant at 1% probability level

**Table.2** Pre-harvest sprouting (viviparous) germination % of 34 lowland rice genotypes

Variety	Pre-harvest sprouting (%)
Dubraj	98.27 a
Dinesh	0.00 n
Uday	98.77 a
Nalini	10.50 j
Saraswati	0.00 n
Dhartri	98.27 a
Navin	98.67 a
Dhusara	0.00 n
CR1014	91.60 b
Ketakijoha	30.10 i
Lunishree	90.03 d
Panke	98.63 a
FR13A	69.80 fg
Khanish	50.33 h
Neeraja	2.03 m
Hanseswari	0.00 n
Moti	91.23 bc
Amulya	99.03 a
Utkalprava	98.80 a
Savitri	4.43 k
Purnendu	90.17 d
Durga	89.93 d
Biraj	98.97 a
Tulasi	0.00 n
Panidhan	68.93 fg
Pooja	90.30 cd
Gayatri	79.33 e
Sarala	90.37 cd
Sonamani	70.10 f
Golak	0.00 n
Samalai	79.93 e
Bhagirathi	3.17 l
Ambica	4.27 k
Sudhir	90.27 cd
C.V.	0.99

Values in a column with same letter(s) are not statistically different at 0.05 level of significance by DMRT

**Fig.1** Photograph showing Vivipary and non vivipary germination in three low land genotypes Left (Utkalprava), Middle (Saraswati), Right (Udya)



**Fig.2** Photograph showing Vivipary and non vivipary germination in two low land genotypes Left (FR13A), Right (Saraswati)



The genotypes Dinesh, Saraswati, Hanseswari, Tulasi and Golak shows 0% pre-harvest sprouting. Other genotypes which showed below 5% of pre-harvest sprouting were Neeraja, Bhagirathi, Ambica and Savitri (2.03%-4.43% PHP), while genotype Nalini shows 10.50% PHP. Some genotypes showing intermediate PHP viz. Ketekijoha, FR13A, Kanish, Panidhan, Gayatri, Sonamani and Samalai. (30 % – 80 % PHP). The

genotypes highly prone to vivipary were Pooja, Sarala, Sudhir, Biraj, Dharitri, Naveen, CR1014, Lunishri, Panke Moti, Amulya, Durga, Utkalprabha and Purnendu (> 85 % PHP). In the present study, many lowland genotypes exhibited viviparous germination. The identified genotype will be useful for breeders for breeding program for lowland ecosystem.

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