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## Manisha R Rathod

Department of Agricultural  
Botany, Vasant Rao Naik  
Marathwada Krishi Vidyapeeth,  
Parbhani, Maharashtra, India

## AB Jadhav

UPRS (Upland Paddy Research  
Scheme), Vasant Rao Naik  
Marathwada Krishi Vidyapeeth,  
Parbhani, Maharashtra, India

## SB Borgaonkar

UPRS (Upland Paddy Research  
Scheme), Vasant Rao Naik  
Marathwada Krishi Vidyapeeth,  
Parbhani, Maharashtra, India

## Physiological analysis of promising rice (*Oryza sativa* L.) genotypes for yield and yield contributing traits

Manisha R Rathod, AB Jadhav and SB Borgaonkar

### Abstract

An experiment was conducted to study physiological functions, yield and yield contributing traits in rice genotypes to obtain the variation in yield and morpho-physiological parameters of rice genotypes at research farm Upland Paddy Research Scheme (UPRS), VNMKV, Parbhani during *Kharif 2021*. The experimental plot was laid out in a randomized block design with twelve rice genotypes and 3 replications. The rice genotypes showed significant variations in morpho-physiological parameters, yield attributes and biochemical traits. Among the twelve rice genotypes, PBNR 14-07 followed by PBNR 14-11 recorded maximum plant height, number of tillers, number of panicles, number of spikelets, 1000 grain weight, grain yield per hectare, and harvest index, while minimum values varied among genotypes. There was no significant variation in panicle length among the rice genotypes. Maximum panicle length was recorded in genotype PBNR 14-07 followed by PBNR 14-11 and minimum panicle length was recorded in genotype PBNR 15-10. Highest chlorophyll content, Protein content, and carbohydrate content were recorded in PBNR 14-07 followed by PBNR 14-11.

**Keywords:** Rice, morpho-physiological parameters, yield and yield attributes

### 1. Introduction

Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. This is the staple food of the people living in the eastern and southern parts of the country, particularly in the areas having over 150 cm annual rainfall. India is the world's second-largest producer of rice, and the largest exporter of rice in the world. In India, rice is grown on an area of 437.8 lakh hectares with a production of 118.4 million tons with productivity of 2705 kg/ha. (Annual Report, Ministry of Agriculture, Government of India 2020-21). The area under rice during 2020-2021 in Maharashtra is 1665 million hectares with a production of 34.76 million tons and productivity of 2087.4 kg/ha (Department of Agriculture, Maharashtra state).

Productivity of rice in India is less than 50 percent of that of China and world. Moreover, highest productivity of Egypt (9.80 t/ha) is 4 times higher than our national productivity. Average productivity of Maharashtra (2.98 t/ha) is more than average productivity of India (2.71 t/ha) in 2020-21. Marathwada region is having very low average productivity (1330 kg/ha in 2020-21). Low productivity in Marathwada might be attributed to rainfed cultivation (only 20% irrigation in Maharashtra in comparison to 58% of India), inadequate nutrient and crop production management and unavailability of suitable genotypes with better grain quality. West Bengal, Uttar Pradesh and Punjab are top three rice producing states.

Upland rice is cultivated in rainfed fields that are prepared and seeded when dry. Upland rice ecosystems are frequently rather diversified, with fields that are level, gently sloping or steep at elevations up to 2000 meters and with annual rainfall varying from 1000 to 4500 mm. Only 15% of all upland rice is grown on fertile soils, which can range from being extremely fertile to being extremely weathered, infertile and acidic. They nevertheless produce grains that are needed locally and are well adapted to their habitats.

Information on physiological characters plays a vital role in rice breeding. It is essential to know the physiological behaviour of modern rice genotypes for definite breeding objectives to improve those genotypes. Identifying promising physiological traits associated with quality and yield plays an important role in varietal development programmes. Development of rice varieties with high yielding ability is one of the most fundamental approaches for dealing with the expected increase in the world demand. Little information is available on the physiological characteristics of rice varieties and hence the present work would give an account of the growth and yield performance of some rice genotypes and better orientation towards physiochemical traits and grain yield.

### Corresponding Author:

#### Manisha R Rathod

Department of Agricultural  
Botany, Vasant Rao Naik  
Marathwada Krishi Vidyapeeth,  
Parbhani, Maharashtra, India

## 2. Materials and Methods

The present investigation was undertaken to study variation in Rice Genotypes for Yield and its Yield Contributing Traits. The study was carried out at the research farm of upland Paddy Research Scheme, Vasantrao Naik Marathwada Krishi Vidyaapeeth, Parbhani during *Kharif* 2021. The experimental material consists of 10 promising rice genotypes including two checks *viz.*, Avishkar and PBNR 03-2 listed in Table 1. The experiment was laid out in a randomized block design with three replications. Field was prepared as per the

requirement. The experimental material was sown by the dibbling method. The recommended agronomical and plant protection practices were followed regularly as per needed. Observations were recorded on 5 randomly selected plants from each genotype for plant height, number of tillers, days to 50% flowering, days to maturity and yield attributes *viz.*, number of panicles per plant, panicle length, number of spikelets per panicle, 1000 grain weight, grain yield per hectare, harvest index. The data were analysed statistically for correlation studies by the Pearson method.

**Table 1:** List of promising Rice Genotypes used for the study

Sr.no	Culture	Sr.no	Culture
1	PBNR14-07	7	PBNR15-02
2	PBNR14-11	8	PBNR15-05
3	PBNR14-15	9	PBNR15-10
4	PBNR14-17	10	PBNR15-12
5	PBNR14-18	11	Avishkar (check)
6	PBNR14-21	12	PBNR 03-2 (check)

## 3. Results and Discussion

Experimental results revealed that all the genotypes perform in terms of vegetative growth. Rice genotypes showed significant variations in plant height, number of tillers per plant, days to 50% flowering, days to maturity. The plant height of rice genotypes ranged from 59.00 to 98.53 cm, genotypes PBNR 14-07 attained maximum Plant height (98.53 cm) followed by PBNR-14-11 (93.87 cm), while minimum plant height achieved by PBNR 15-10 (59.00 cm). The results for plant height were in agreement with Enamul Kabir *et al.*, (2004) [8] who have also reported significant variation in plant height at harvest among the aromatic fine rice genotypes tested. Highest number of tillers among the genotype was recorded by PBNR 14-07 (19.53 tillers plant<sup>-1</sup>) followed by PBNR 14-11 (19.0 tillers plant<sup>-1</sup>), while the lowest number of tillers observed in PBNR 14-17 (11.8 tillers plant<sup>-1</sup>). Gill *et al.*, (2006) [10] also reported similar information. This is also supported by Castaneda *et al.*, (2005) [23]. PBNR 15-05 took Minimum time for flowering and maturity. However, PBNR 14-15 and PBNR 15-10 took longer duration for flowering and maturity. Alfredo and Edwin (2006) [1] and Ashrafuzzaman *et al.*, (2009) [2] showed highly significant differences among the genotypes for days to maturity and flowering.

### 3.1 Yield and yield attributes

Perusal of the data (Table 2) revealed that the number of panicles per plant was maximum in genotype PBNR 14-07 (8.13 per plant) followed by PBNR 14-11 (7.20 per plant), while a minimum number of panicles per plant was recorded in PBNR 15-10 (5.33 per plant). Yoshida *et al.*, (1972) studied the physiological aspect of high yield in rice and reported that the number of panicles per unit area is the most important component of rice yield. There was no significant variation in panicle length among the rice genotypes. Maximum panicle length was recorded in genotype PBNR 14-07 and PBNR 14-11, while minimum panicle length was recorded in genotype PBNR 15-10. Similar results were

reported by Singh and Singh (2000) [17], Sharma (2002) [15] and Ashrafuzzaman *et al.*, (2009) [2]. The number of spikelets per panicle was highest in genotype PBNR 14-07 and PBNR 14-11. Chandrashekar *et al.*, (2001) [5] and Tahir *et al.*, (2002) [19] reported highly significant variation in the grains per panicle for different genotypes. The highest 1000 grain weight was recorded in genotype PBNR 14-07 followed by PBNR 14-1 and the lowest grain weight was recorded in genotype PBNR 14-18. More or less significant variations among the basmati genotypes have been reported by Sidhu *et al.*, (1992) [16]. PBNR 14-07 (37.25 q) recorded the highest grain yield per hectare followed by PBNR 14-11 (31.52 q) as compared to other genotypes. Biswas *et al.*, (1998) [4] also reported a similar variation in the grain yield. The highest harvest index was recorded in genotype PBNR 14-07 (43.4%) followed by PBNR 14-11 (42.6%) and the lowest harvest index was recorded in genotype PBNR 14-15 (35.6%). Similar results were also reported by Miah *et al.*, (1996) [12], Kusutani *et al.*, (2000) [11] and Chandrasekhar *et al.*, (2001) [5].

### 3.2 Biochemical traits

SPAD values differed significantly among the rice genotypes. The highest SPAD values were recorded for genotype PBNR 14-07 followed by PBNR 14-11 and the minimum was recorded in genotype PBNR 14-18. Similar SPAD values were also reported by Mian *et al.*, (2009) [13].

The highest protein content was recorded in the grains of genotype PBNR 14-07 followed by PBNR 14-11 and minimum in the genotype PBNR 15-02. Protein content of experimental genotypes varied significantly. Dalal *et al.*, (2003) [6] studied six varieties of rice *viz.*, Gobind, Haryana, Basmati 1, IR-64, Jaya and PR-106 for their crude protein content and it ranged from 7.2 to 9.1 percent. Carbohydrate content was recorded highest in PBNR 14-07 followed by PBNR 14-11 and lowest was recorded by genotype PBNR 15-10. There was no significant variation in the carbohydrate content of experimental rice genotypes.

**Table 2:** Growth and yield attributing traits of promising rice genotypes

Genotypes	Plant height	Number of Tillers per plant	Days to 50% flowering	Days to maturity	Number of panicles per plant	Panicle length (cm)	Number of spikelets per panicle	1000 grain weight (g)	Grain yield per ha (q)	Harvest index (%)
PBNR 14-07	98.53	19.5	75.00	118	8.13	20.4	139.8	23.03	37.25	43.4
PBNR 14-11	93.86	19.0	82.33	136	7.20	20.0	137.3	22.9	31.52	42.6
PBNR 14-15	60.20	13.7	87.00	139	5.86	17.6	74.5	22.2	22.80	35.6
PBNR-14-17	72.53	11.8	81.66	136	5.60	17.8	92.5	17.8	24.17	36.4
PBNR 14-18	82.53	13.8	71.66	125	5.80	18.2	46.1	17.3	23.63	36.3
PBNR 14-21	75.80	13.9	85.00	137	5.80	18.0	54.0	22.09	23.18	36.4
PBNR 15-02	82.33	14.8	80.33	121	6.20	18.2	96.0	19.4	23.07	37.6
PBNR 15-05	82.20	13.0	67.00	109	6.40	17.6	65.6	21.2	23.51	37.4
PBNR 15-10	59.00	13.2	87.33	139	5.33	15.6	63.6	21.3	23.89	38.3
PBNR 15-12	85.60	12.6	71.66	135	6.86	17.0	97.2	20.6	23.32	38.3
AVISHKAR (check)	93.80	18.0	76.66	116	7.06	19.3	134.2	22.5	26.67	39.4
PBNR 03-2 (check)	87.60	16.5	73.66	110	7.03	18.7	105.1	22.2	25.73	39.3
C.D.	15.8	2.14	7.721	12.942	1.406	N/A	16.796	3.67	3.39	4.19
SE(m)	5.3	0.72	2.616	4.384	0.476	1.125	5.69	1.244	1.14	1.42

**Table 3:** Biochemical parameters of promising rice genotypes

Genotypes	Chlorophyll content or SPAD value	Protein content (%)	Carbohydrate content (%)
PBNR 14-07	38.3	11.2	76.0
PBNR 14-11	36.7	11.2	74.5
PBNR 14-15	25.2	8.93	73.5
PBNR-14-17	25.6	8.8	73.3
PBNR 14-18	22.1	7.6	74.0
PBNR 14-21	27.0	8.8	74.1
PBNR 15-02	27	7.3	73.6
PBNR 15-05	30.7	7.3	73.5
PBNR 15-10	26.7	8.1	71.1
PBNR 15-12	31.4	7.3	73.5
AVISHKAR (check)	36.6	9.3	74.4
PBNR 03-2 (check)	35.2	9.2	74.3
C.D.	6.16	1.664	N/A
SE(m)	2.08	0.564	2.664

#### 4. Conclusion

- Based on the above results it is concluded that the genotypes PBNR 14-07 and PBNR 14-11 had the best morpho-physiological performance. The genotype PBNR 15-10 was found to be a poorer performer in most of the parameters.
- From the study, it is concluded that higher yields were associated with plant height, number of tillers, number of panicles per plant, number of spikelets per panicle, test weight and harvest index.
- The genotypes PBNR 14-07 and PBNR 14-11 could be utilized in further breeding programme.

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