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Performance evaluation of fourteen rice (*Oryza sativa* L.) varieties at Gazipur eastern Uttar Pradesh

CP Singh and SP GiriDOI: <https://doi.org/10.22271/chemi.2021.v9.i1d.11564>**Abstract**

Crop genotypes play a dominant role in crop production systems. They affect crop productivity by their higher yield potentials, resistance against insect pest and diseases under different climatic conditions. A field experiment was conducted at Zonal Agricultural Research Sub Station, (ANDUAT) Ghazipur, during 2018 and 2019 to evaluate the growth, yield and yield attributing characteristics of 14 rice varieties collected from Crop Research Station, Masodha, Ayodhya namely; NDR- 2107-7-1, NDR-2108-6-1-3-1, NDR- 2109-9-9-5-1, NDR- 2106-14-1, NDR -2110-7-1, NDR- 2111-13-1-6, NDR- 2112-20-1, NDR-2026, NDR -2103, NDR-2113-24-1, NDR-2114-13-1 and three check varieties viz. NDR 2064, NDR 2065 and NDR 359. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replicates. The plot size of the experiment was 10 m x 10 m². Parameters on, growth parameter viz. plant height, and number of tiller/m²; yield contributing characters such as effective tillers/m², panicle length, number of grains panicle/panicle, sterility %/panicle, thousand grain weight and grain yield were recorded. The genotypes of NDR 2012-20-1 (57.15 q/ha) followed by NDR 2111-13-1-6 (56.17 q/ha) have high yield stability, while the genotypes of NDR 2026 (48.89 q/ha) followed by NDR 2114-13-1 (49.75 q/ha) have low yield stability. Hence, NDR 2012-20-1 and NDR 2111-13-6-1 could be recommended for cultivation by the farmers in Gazipur and these cultivars should be popularized in larger scale to make use of its superiority.

Keywords: Randomized complete block design, plot size, yield**Introduction**

Rice (*Oryza sativa* L.), belonging to the family Graminae, is one of the most important cereal crops and serves as the primary source of staple food for more than half of the global population (Emani *et al.* 2008) [6]. Approximately, 90% of the world's rice is grown in the Asian continent and constitutes a staple food for 2.7 billion people worldwide (Salim *et al.* 2003) [19]. Strategies are needed to increase the grain production to meet the food requirement of ever-increasing population (Zhang, 2007) [23]. It is impossible to increase rice planting area to gain higher rice production, so to increase grain yield per unit area and crop harvest frequency is the only option to get maximum returns (Ray and Foley, 2013; Peng, 2014) [13, 14, 21]. The world's rice production has doubled during the last 25 years, largely due to the use of improved technology such as high yielding varieties and better crop management practices (Byerlee 1996) [3]. It is dominantly produced and consumed in the Asia. Since the beginning of civilization, thousands of rice cultivars have been selected for increasing productivity (Singh *et al.*, 2000) [20]. Manipulation of genetic resources has contributed much towards meeting rising demands of food for ever escalating world population. In late 1960s "Green revolution" boosted yield of cereal crops including rice by the utilization of high yielding short statured varieties with high sink capacity. The impact of green revolution is diminishing due to rising demands of food commodities. The area under rice cultivation is same but population has become manifold. The options available are to enhance yield of rice on per unit area basis (Cassman *et al.*, 2003) [4, 13] and development of rice cultivars with high yielding ability which can increase production (IRRI, 1993) [11, 15]. Producing varieties having resistance against biotic and abiotic stress by using conventional and modern biotechnology can increase rice yields to meet world requirement (Khush, 2005) [12, 13]. The varieties have different physiological and morphological characteristics that contribute towards yield

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(Yang *et al.*, 2007; Yang and Hwa, 2008) [4, 21, 22]. Growth and yield characteristics of genotypes depend on genetic and environmental factors. (Alam *et al.* 2008) [1, 17] reported that among production factors varietal selection at any location has an important role. Proper crop management depends on the growth characteristics of various varieties to get maximum benefit from new genetic material.

For successful crop production knowledge of varietal morphological and physiological characteristics is necessary. The objective of present study was to compare the growth and yield characteristics of different rice varieties under conditions of Gazipur, Eastern U.P. The findings of the experiment may be beneficial to students, researchers and farmers to manage particular varieties for higher yield targets.

Materials and Methods

The study was carried out at Zonal Agricultural Research Sub Station, (ANDUAT) Ghazipur, during 2018 and 2019. It is located at latitude 25° 35' 2.5512" N and longitude 83° 34' 37.284" E 36020'E and elevation sea level of 74 m (243ft) m.a.s.l, in Uttar Pradesh state. The study area receives average annual rainfall here is around 1076 mm 42.4 inch per year. May is the warmest month of the year. The temperature in May averages 34.1 °C | 93.4 °F. In January, the average temperature is 16.8 °C | 62.2 °F. It is the lowest average temperature of the whole year. There is a difference of 320 mm, 13 inch of precipitation between the driest and wettest months. The average temperatures vary during the year by 17.3 °C, 63.1 °F. The land was ploughed and harrowed well. The nursery was sown 2nd week of June every year. After 25 days, seeds were planted at the rate of two or three plant/hill seedlings in Randomized Complete Block Design (RCBD) in three replications with a spacing of 20 x 15 cm. The plot size was 3 x 5 m² per plot. Nitrogen (N), phosphorus (P) and potassium (K) at a rate of 120N-60P-60K kg/ ha were applied at three times as follows: One-third of N along with P and K before transplanting, 1/3 of N 20 days after transplanting, and further 1/3 of N 50 days after transplanting. To control weeds, Nomini Gold @ 0.250 litre/ha was applied after 25 days transplanting.

Data collection

The following data were collected

Days to flowering

Number of days from sowing up to the date when the tips of the panicles first emerged from the main shoots on 50% of the plant in a plot.

Days to maturity

Number of days from the date of sowing to the date when 85% of the crop stand stems, leaves, and floral bracts in a plot changed to light yellow color was recorded.

Plant height

Height of the plant in centimeter from the base of the main stem to the tip of the panicle was recorded as the average of five randomly selected plants.

Panicle length

Length of the panicle in centimeter from the node where the first panicle branch starts to the tip of the panicle as the average of five randomly selected plants.

Number of fertile tillers per m²

The average number of fertile tillers from one sqm randomly selected plants was taken.

Total grain per panicle

The average number of fertile grain per panicle was randomly selected from 5 panicle.

Sterility %

The average sterility % of per panicle was randomly selected from 5 panicle.

Thousand-grain weight

Weight in g of 1000 grains from bulked grains, which was collected at central rows of each plot and was recorded.

Grain yield per hectare

Grain yield in kg obtained from each plot was converted to quintals per hectare.

Data analysis

The data so obtain were subjected to statistical analysis after necessary transformation for final statistical analysis (Gomez and Gomez, 1983) [7].

Results and Discussion

Effects of variety on number of days to flowering

Highly significant varietal differences were observed for Days to 50% flowering in the varieties tested (Table 1 and figure 1). This result is in agreement with (Sadiqur *et al.* 2018) [8] who reported days to 50% heading of the crop was highly significantly affected by the main effect of the varieties. The days to 50% flowering ranged from 88 days for NDR- 2108-6-1-3-1 to 98 days for NDR- 2107-7-1 varieties.

Effects of variety on number of days to maturity

The candidate rice varieties exhibited highly significant differences on the number of days to maturity from sowing (Table 1). The result implies that these differences could be attributed to the agronomic characteristics and to the climate adaptability of different rice varieties to the local condition (Romualdo *et al.* 2014) [6, 10]. The number of days to maturity plays a significant role in the cropping system. Early maturing crops are timely handled, evacuate the land early for the next crops and escape from insect pest attack. (Cooper and Somrith 1997) [5] also reported that early maturity has been shown to be an important trait under stress conditions because early maturing rice can escape from the late season drought stress. The duration to maturity ranged between 117 to 127 days with the variety NDR- 2108-6-1-3-1 taking the shortest time (117 days) to mature. NDR- 2107-7-1 rice variety was taken 127 days to mature respectively.

Effects of variety on panicle length

There was significant difference in panicle length among varieties tested (Table 1). Opposite results were recorded by (Idris and Matin 1990) [9] who reported that panicle length influenced by variety. Although there was no significant difference in panicle length among varieties the longest panicle length was observed in varieties NDR –2110-7-1 (30.2 cm), which were obtained a panicle length of 25.6 cm (NDR- 2106-14-1) and 30.2 cm respectively.

Effects of variety on number of panicle per sqm

Significant varietal differences were observed for number of panicle per sqm in the varieties tested (Table 1). The reason of difference in number of effective tiller per sqm is the variation in the genetic makeup of the variety. Similar result was also reported by (Ramamamy *et al.* 1987) who stated that number of tillers differed due to varietal variation. Tillering ability plays a vital role in determining rice grain yield. Too few tillers result fewer panicle, but excessive tillers enhance high tiller mortality, small panicle, poor grain filling and consequent reduction in grain yield (Peng *et al.*, 1994) [13, 14, 21]. Among the various yield components productive tillers are very important as the final yield is mainly a function of the number of panicles bearing tillers per unit area (Roy *et al.*

2014)^[17]. In the result of this study, NDR- 2112-20-1 variety produced the highest number of panicle (331) per sqm followed by NDR- 2111-13-1-6 that produced 308 panicle per sqm. The lowest number of panicle per sqm (245) was recorded for NDR- 2109-9-9-5-1 which was significantly lower than 331 and 308 recorded for NDR- 2112-20-1 and NDR-2111-13-1-6 varieties, respectively (Table 1 and figure 2).

Effects of variety on grain yield

The rice varieties exhibited highly significant differences on grain yield as shown in table 1 and figure 3. The genotypes of NDR 2012-20-1 (57.15 q/ha) followed by NDR 2111-13-1-6 (56.17 q/ha) have high yield stability, while the genotypes of NDR 2026 (48.89 q/ha) followed by NDR 2114-13-1 (49.75 q/ha) have low yield stability. NDR-2026 produced the lowest grain yield (48.89 q/ha) among the varieties tested. The difference in yield was also attributed to the number of productive tillers, varietal yielding capabilities and also to the growth performance of every variety tested (Romualdo et al. 2014)^[6, 10].

Effects of variety on 1000 grain weight

The candidate rice varieties exhibited highly significant differences on 1000 grain weight (Table 1 and figure 4). Similar results were reported by (Gupta and Sharma 1991)^[8].

Thousand-grain weight, an important yield determining component, is a genetic character least influenced by environment (Ashraf *et al.* 1999)^[2, 18, 19]. The variation in thousand seed weight might be due to the differences in length and breadth of the seeds that were partly controlled by the genetic make-up of the genotypes (Sadiqur *et al.* 2018)^[8]. The highest 1000- grain weight of 28.2 g was exhibited by the variety NDR- 2112-20-1 followed by the rice variety NDR- 2111-13-1-6 which recorded 28.0 g, respectively. The lowest value in 1000 grain weight was recorded in the variety NDR- 2107-7-1 with the weight of 21.7 gm which was statistically different from all other rice varieties tested.

The results indicated significant differences among rice varieties for plant Height, number of tiller per plant, days to flowering, number of days to maturity, 1000 grain weight and grain Yield. Panicle length was not significantly affected by the candidate varieties. The highest grain yield was obtained from the variety NDR 2012-20-1 followed by NDR 2111-13-1-6. The grain yield obtained from NDR 2012-20-1 variety was greater than the all check. Using of high yielding varieties is crucial for successful crop production; therefore it is advisable to use NDR 2012-20-1 rice variety for commercial production. Further research may require evaluating rice seed quality in addition to evaluating grain yield of different rice varieties.

Table 1: Yield and attributing character of rice

S. No.	Strains/Varieties	Days to 50 % flowering			Days to days to maturity			Plant height cm			Panicle length			Panicle/m2			Grain yield q/ha		
		2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
1	NDR- 2107-7-1	97	98	98	126	128	127	118	120	119	26.9	27.2	27.1	276	270	273	55.40	53.80	54.60
2	NDR- 2108-6-1-3-1	87	88	88	116	118	117	124	125	125	25.8	26.1	26.0	255	249	252	54.60	53.40	54.00
3	NDR- 2109-9-9-5-1	89	88	89	118	118	118	120	119	120	27.1	27.4	27.3	241	249	245	52.50	50.60	51.55
4	NDR- 2106-14-1	91	90	91	120	120	120	118	118	118	25.6	26.1	25.9	243	253	248	51.49	50.20	50.85
5	NDR -2110-7-1	95	94	95	124	124	124	110	108	109	29.7	30.2	30.0	299	287	293	56.99	54.80	55.90
6	NDR- 2111-13-1-6	96	94	95	125	124	125	115	113	114	29.4	28.9	29.2	315	301	308	57.04	55.30	56.17
7	NDR- 2112-20-1	94	93	94	123	123	123	130	132	131	28.8	29.6	29.2	333	329	331	58.59	55.70	57.15
8	NDR-2026	89	89	89	118	119	119	113	110	112	28.4	28.1	28.3	256	263	260	49.48	48.30	48.89
9	NDR -2103	93	93	93	122	123	123	106	105	106	27.9	29.6	28.8	263	257	260	51.10	50.20	50.65
10	NDR-2113-24-1	91	90	91	120	120	120	111	110	111	26.4	26.7	26.6	254	253	254	52.61	51.55	52.08
11	NDR-2114-13-1	95	93	94	124	123	124	129	125	127	25.8	28.2	27.0	248	252	250	50.50	49.00	49.75
12	NDR- 2064(c)	97	96	97	126	126	126	121	119	120	26.7	25.6	26.2	283	266	275	55.60	55.50	55.55
13	NDR- 2065(c)	93	92	93	122	122	122	126	125	126	28.2	27.4	27.8	285	293	289	56.40	55.90	56.15
14	NDR-359(c)	91	91	91	120	121	121	108	106	107	29.1	28.9	29.0	287	283	285	52.10	55.25	53.68

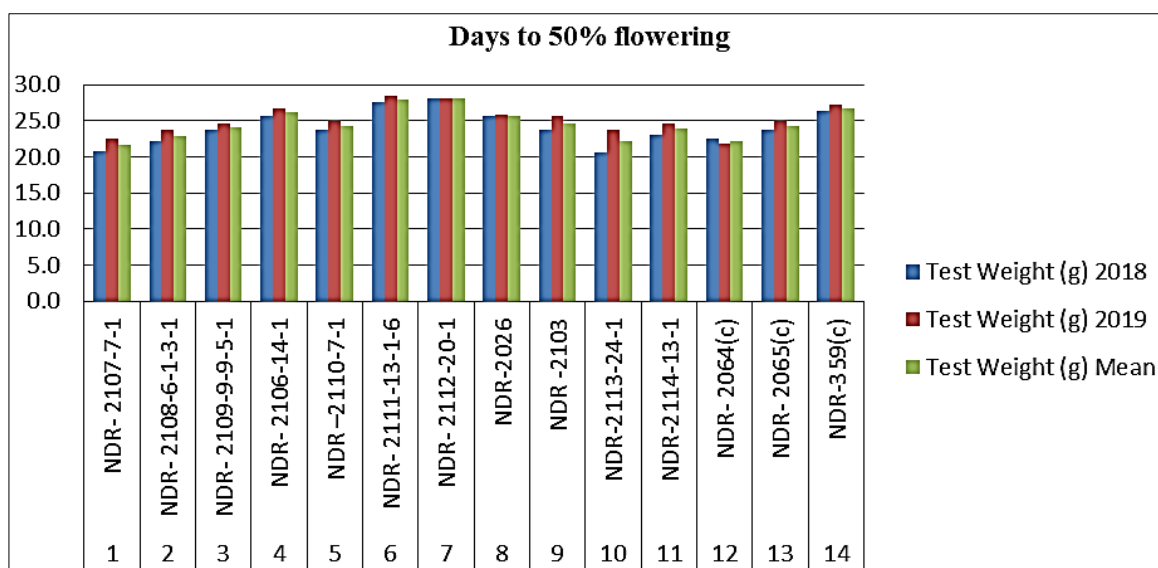


Fig 1: Days to 50% flowering

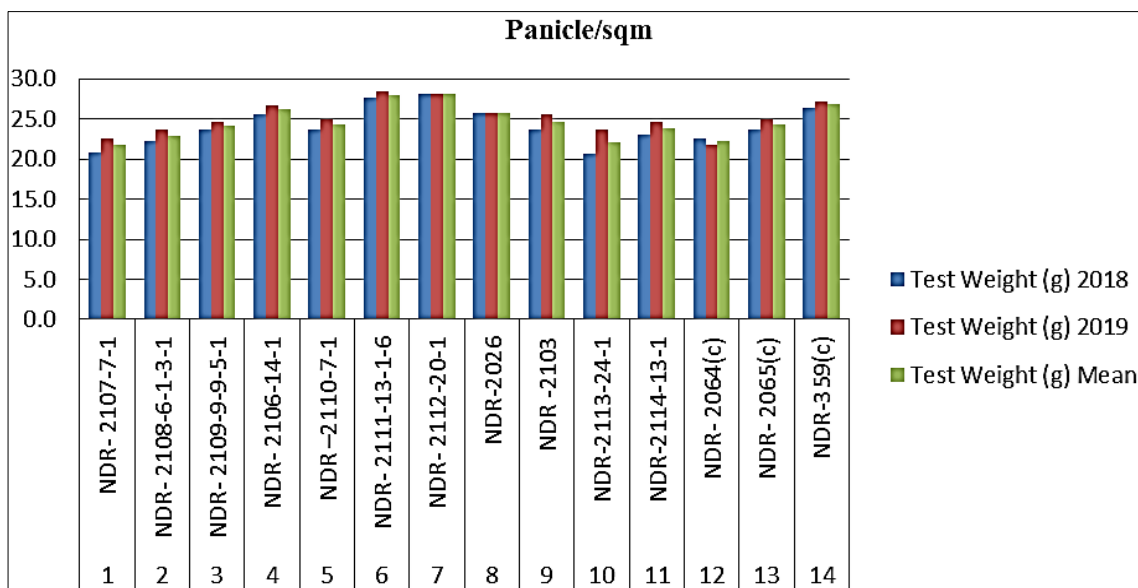


Fig 2: Panicle/sqm

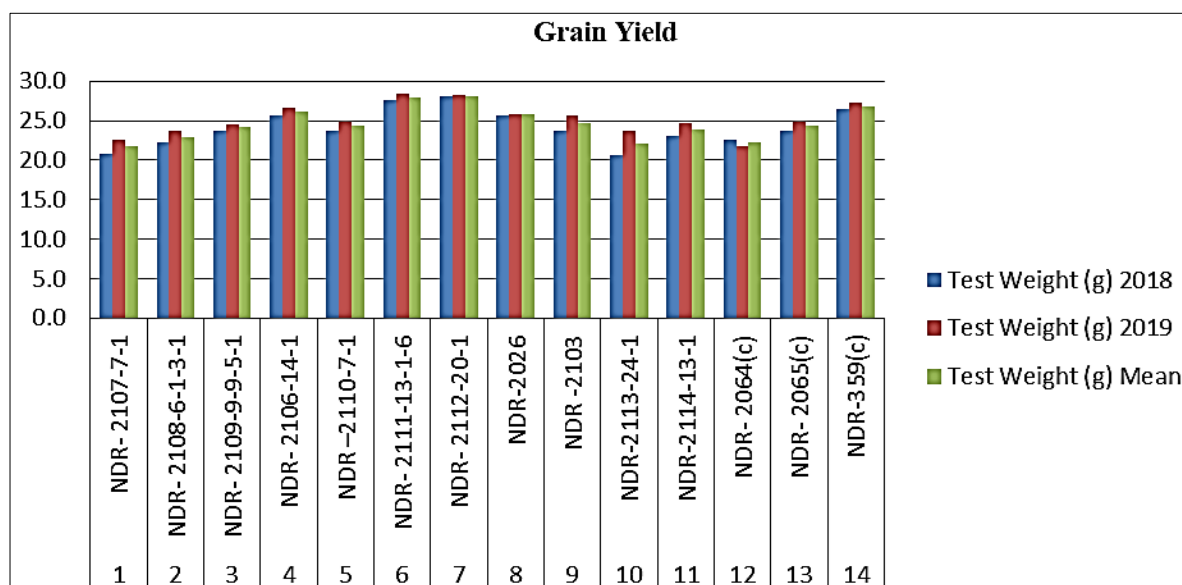


Fig 3: Grain yield q/ha

Table 2: No. of grain/panicle, sterility% and test weight of rice

S. No.	Strains/Varieties	Total grain/panicle			Sterility %			Test weight (g)		
		2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
1	NDR-2107-7-1	187	182	185	13.4	15.6	14.5	20.8	22.6	21.7
2	NDR-2108-6-1-3-1	183	178	181	12.8	14.6	13.7	22.2	23.7	23.0
3	NDR-2109-9-9-5-1	178	175	177	14.4	15.2	14.8	23.7	24.6	24.2
4	NDR-2106-14-1	172	170	171	15.2	16.1	15.7	25.6	26.7	26.2
5	NDR-2110-7-1	171	168	170	14.6	12.2	13.4	23.7	24.9	24.3
6	NDR-2111-13-1-6	199	203	201	12.8	13.2	13.0	27.6	28.4	28.0
7	NDR-2112-20-1	223	210	217	9.1	11.2	10.2	28.1	28.2	28.2
8	NDR-2026	192	189	191	16.4	17.2	16.8	25.7	25.8	25.8
9	NDR-2103	187	175	181	17.2	16.4	16.8	23.7	25.6	24.7
10	NDR-2113-24-1	152	154	153	18.2	19.6	18.9	20.6	23.7	22.2
11	NDR-2114-13-1	156	149	153	19.2	18.2	18.7	23.1	24.7	23.9
12	NDR-2064(c)	168	165	167	12.6	13.4	13.0	22.6	21.8	22.2
13	NDR-2065(c)	165	156	161	13.2	14.4	13.8	23.7	24.9	24.3
14	NDR-359(c)	201	203	202	15.6	16.4	16.0	26.4	27.2	26.8

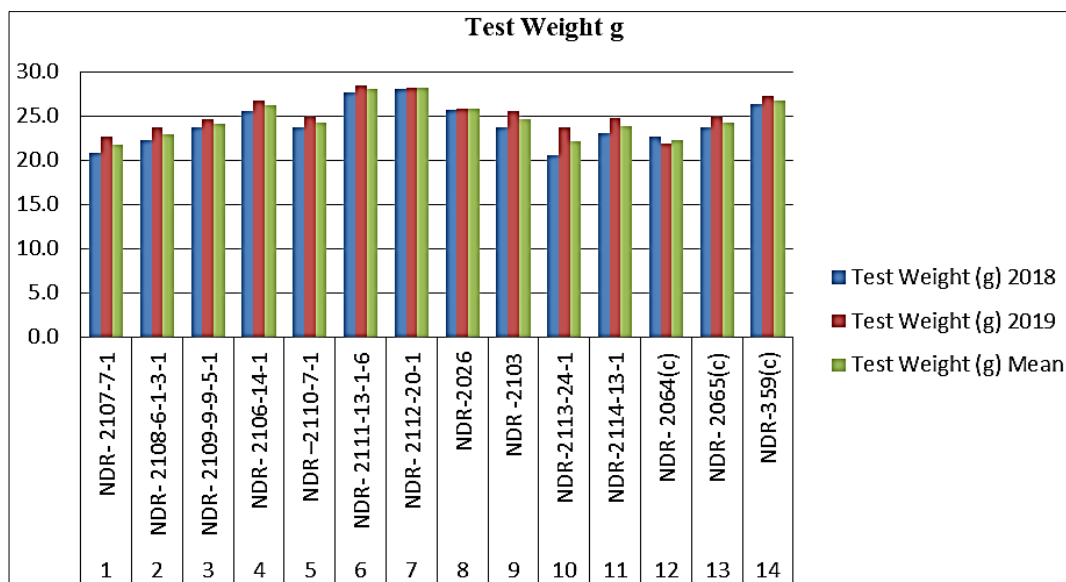


Fig 4: Test weight of rice

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