Research Article

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Evaluation of irrigated rice genotypes for agronomical traits under western terai region of Nepal

Abstract

An experiment was conducted at National Wheat Research Program (NWRP) Bhairahawa during wet season of 2016 to study the performance of different rice genotypes for yield and yield attributing characters. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The twenty four rice genotypes including three released varieties as check were investigated in Coordinated Varietal Trial (CVT). The various agronomical data such as days to heading, days to maturity, plant height (cm), panicle length (cm), effective tilllers^{-2}, 1000 grain weight (g), filled grain panicle^{-1} and grain yield (kg ha^{-1}) was recorded. The analysis of variance revealed that minimum days to heading (101) was noted in GSR102 while maximum (129 days) was recorded in Mansuli. Significant variation in thousand grain weight was observed in rice genotypes. Maximum 1000 grain weight of 27 gram was recorded in GSR221 while lowest 1000 grain weight of 16 gram was observed in NR 2157-66-2-3-1-1-1. Similarly, significantly highest grain yield (3890 kg ha^{-1}) was recorded in GSR221 genotype which was found at par with IR94391-131-353-19-B-1-1-1-3 (3880 kg ha^{-1}). Hence, based on the findings of this study, it was concluded that genotypes; GSR221, IR94391-131-353-19-B-1-1-1-3, NR2158-13-1-2-4-5, GSR102, GSR336, IR05N421 and GSR132 produced maximum grain yield and were found most suitable for the agro climatic conditions of western Terai of Nepal.

Keywords: irrigated rice, agronomic traits, genotypes, yield

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Introduction

Rice (*Oryza sativa* L., 2n=2x=24) is the major staple food crop in Nepal and ranks first in position in terms of production and productivity thus has great contribution to livelihood of majority of people.[1] As the most important staple food of Nepalese people, rice supplies about 40% of the food calorie intake and contributes nearly 20% to the agricultural gross domestic product (AGDP) and almost 7% to GDP.[2] It is grown in 1.36 million hectare and producing 4.3 million tons with productivity of 3.15 tha^{-1},[3] in which Rupandehi District shares 3911 tons of production during 2016-17.[4] Rice in Nepal carries special cultural, religious and traditional values in the society. In Nepalese society, rice forms and integral part of one's life right from the birth rites to the death rites. In the Karnali province, famous Jumli marshi rice (*Oryza sativa* var. *japonica*); known for its strong resistance to cold and its ability to grown at elevations up to 3,000 metres, is grown in the Jumla District of western Nepal.

Rice is the essential and basic food in Nepal. Area under rice cultivation has been decreasing due to human interference and encroachment for increasing urbanization and industrial expansion. As there is no further scope for bringing more area under rice cultivation, the only viable strategy is to increase the productivity of rice. Hence, to meet the ever growing national demands of food grain and to increase production of rice, the research in varietal development, evaluation, application of modern tools in plant breeding, development of hybrid rice technology, soil and nutrient management, weed management and integrated pest/disease control would receive major priority in Nepal.

Grain yield of rice is a quantitative polygenic character and highly influenced by environment. Extent and significance of association of yield with yield components should be considered, while determining the selection criteria of germplasm on the basis of available genetic variation.[5] The success of breeding program also depends upon the amount of genetic variability present in the population and extent to which the desirable traits are heritable.[6] Different morphological traits play an important role for higher rice production with new plant type characteristics associated with the crop yield.[7,8] Phonological characteristics of rice also associated with the yield potential of the different rice varieties for the selection of the best varieties that further involved in rice breeding program.[9] Thousands rice cultivars have been evolved through selection from the cultivated material many centuries ago, which are well adapted to the local environments. Many of those rice cultivars having good quality characteristics and higher yield potential under biotic and abiotic stress environments. Keeping in view with the above facts, present investigation was carried out at National Wheat Research Program, Bhairahawa with the objectives to evaluate different rice genotypes for yield and yield attributes and find out suitable high yielding rice genotypes at western Terai region condition.

Materials and methods

Experimental site and genetic materials

A field experiment comprising twenty four irrigated rice genotypes including three released varieties as check; received from National Rice Research Program (NRRP), Hardinath, Dhanusha as a Coordinated Varietal Trail (CVT) was tested in National Wheat Research Program (NWRP), Bhairahawa during the wet season of 2016. The experiment was set in the plot size of 8 m^2 which were replicated three times in the Randomized Complete Block Design (RCBD). The rice genotypes used for investigation were NR 2157-66-2-3-1-1-1, NR 2157-144-1-3-1-1, IR 80285-34-3-3-2, NR 2158-13-1-1-2-4, NR 2157-166-1-3-5-1, IR 96322-34-202-13-2-1-2, NR2158-13-1-2-4-5, NR2157-122-1-2-1-1-1, GSR102, GSR336, IR06A148, GSR126,

GSR132, IR09A135, GSR312, GSR122, GSR221, IR96321-1447-651-B-1-1-4, IR94391-131-353-19-B-1-1-1-3, IR05N421,GSR135, Sabitri (Standard Check), Makawanpur-1 and Mansuli.

Cultivation practices adapted

Land preparation was carried out by two deep repeated plough and level the land. The field were divided into sub plots and then 27 days old seedlings were transplanted at spacing of 20cm x 20cm. The plot was fertilized with 100:30:30 N: P_2O_5: K_2O kg ha^{-1}. Full dose of phosphorus, potash and half dose of nitrogen were applied as basal dose after final land preparation and remaining dose of nitrogen was applied in two equal splits (Active tillering and panicle initiation stage). All the other intercultural operations and necessary package of practice were carried out as and when required in accordance with the recommended practices.

Major observations recorded

Following biometric and yield attributing characters; heading days, maturity days, plant height, panicle length, tillers m^{-2}, filled grains per panicle, unfilled grains per panicle, 1000 grain weight and grain yield were recorded from the experiment. The weight of grain from each net plot was recorded. The data was converted and reported as grain yield ha^{-1} as kg ha^{-1}. The moisture percentage of grains of each net plot was determined by moisture meter and final grain yield was adjusted at 14 % moisture level as suggested by.[10] The thousand grain weight was expressed in gram (gm).

$$\textit{Grain yield}(kg/\ ha)\ at\ 14\ \%\ moisture$$

$$= \frac{(100-MC)*plot\ yield\,(kg)*1000\,(m^2)}{(100-14)*A}$$

Where, MC= Moisture content of grain (%) just before weighing the bulk

Y= Net plot yield (kg)

A= Net plot area (m^2)

(100-MC)/(100-14)=Conversion factor for grain yield at 14% moisture content.

1000/A= Conversion factor for actual harvested area into hectare basis.

Statistical analysis

The data recorded on various parameters were subjected to the analysis of variance (ANOVA) method to find out the variance between all tested genotypes and mean comparisons among treatment means were estimated by the least significant difference (LSD) test at 5% levels of significance. Statistical analysis software GENSTAT was applied for computing the recorded data.

Meteorological data during cropped season

The experimental site has sub tropical climate with three distinct seasons; summer, rainy and winter. The maximum and minimum mean temperature was recorded during the month of June and November respectively. Total rainfall was 1683.9 mm with highest rainfall occurred during the month of July (Figure 1).

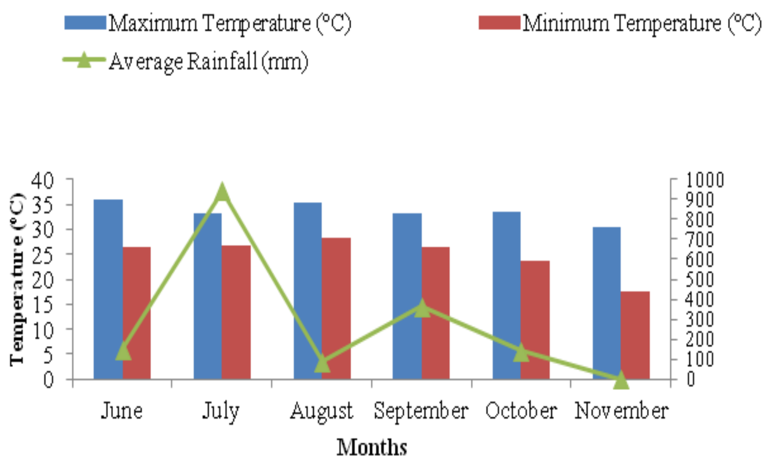

Figure 1 Meteorological data during cropped season, Bhairahawa, Rupandehi, 2016.

Results and discussion

Phonological observations

Days to heading

The findings related to days to heading are presented in Table 1. The analysis of variance revealed that all tested genotypes were significantly different with days to heading. The result showed that Mansuli variety (check) was observed as most delayed in heading in 129 days followed by Makwanpur-1 in 125 days. Whereas genotype GSR102 was found early to heading in 101 days followed by GSR126 in 105 days. This might be due to its early maturing genetic ability. These results are in line with Ashfaq et al.[11] & Hussain et al.[12] who reported that translation time, water and soil condition, planting and sowing method affects the days to panicle initiation, while Jamal et al.[13] attributed the variation of panicle initiation to genetic variability of genotype. Tahir et al.[14] also reported the same findings in rice and he concluded that variability in days to heading might be due to the genetic makeup of the exotic lines and genotypic environmental interaction.

Table 1 Phonological and biometric parameter of irrigated rice genotypes, 2016

Genotype	Days to heading (DAS)	Days to maturity (DAS)	Plant height (cm)	Panicle length (cm)
NR 2157-66-2-3-1-1-1	119	136	105	18
NR 2157-144-1-3-1-1	112	143	93	6
IR 80285-34-3-3-2	106	135	105	14
NR 2158-13-1-1-2-4	123	146	98	20
NR 2157-166-1-3-5-1	122	150	107	14
IR 96322-34-202-13-2-1-2	124	151	100	16
NR2158-13-1-2-4-5	118	144	100	14
NR2157-122-1-2-1-1-1	106	136	99	13
GSR102	101	135	102	13
GSR336	110	139	94	17
IR06A148	110	140	100	16
GSR126	105	136	95	12
GSR132	110	139	110	13
GSR135	107	135	104	14
IR05N421	111	145	109	15
IR09A135	106	133	103	17
GSR312	108	135	106	16
GSR122	106	137	97	17
GSR221	119	146	106	14
IR94391-131-353-19-B-1-1-1-3	117	142	97	12
IR96321-1447-651-B-1-1-4	119	140	107	18
Sabitri (Standard Check)	114	142	101	16
Makawanpur-1	125	145	105	17
Mansuli	129	148	126	19
F-test	*	**	ns	ns
LSD (0.05)	18	9.3	15	7.4
CV %	9	4	9	30.1

*, ** indicate significance at 5%, 1% level of P value and ns indicates non significant. DAS-Days after sowing

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Days to maturity

There was significant difference in days to maturity among tested rice genotypes (Table 1). The results showed that the maximum days to maturity (151 days) was recorded in IR 96322-34-202-13-2-1-2 genotype followed by NR 2157-166-1-3-5-1 (150 days), whereas IR09A135 genotype found earlier in maturity (133 days). Karim et al.[15] evaluated 41 aromatic rice genotypes for variability and genetic parameter analysis and highly significant mean sum of square was observed due to genotypes for days to maturity.

Biometric observations

Plant height (cm)

The effect of rice genotypes on plant height was found non significant (Table 1). However among the tested genotypes, mansuli had highest plant height of 126 cm followed by GSR132 (110 cm). The shortest plant height was observed in NR 2157-144-1-3-1-1 (93 cm). The variation in plant height of different rice genotypes might be due to different climatic requirements of various rice genotypes[16] and concluded that climatic requirements of each genotype is different. Other researchers; Prasad et al.[17] also studied genetic variability, coefficient of selection and correlation for various yield and yield contributing characteristics of rice and he observed significant correlation between grain yield and plant height. Likewise, Hussain et al.[18] reported that plant height of rice was affected by time of transplanting, soil and water condition, planting and sowing methods.

Panicle length (cm)

The data of mean panicle length are presented in Table 1. The results revealed that non significant difference among the genotypes was observed. However, the longest panicle length (20 cm) was observed in NR 2158-13-1-1-2-4 while shortest panicle was recorded in NR 2157-144-1-3-1-1 (6 cm). Similar findings were also observed by Sultana et al.[19] The variation in panicle length of different rice genotypes might be due to the variation in genetic makeup of different rice genotypes.[20] Tahir et al.[14] carried out experiment to study the genetic variability for different characters in ten rice genotypes variability for various traits and he found that these traits were under the genetic control and could be use in the selection of a desirable traits in rice.

Yield attributing characters

Effective Tillers m^{-2}

Highest number of effective tillers was obtained in GSR221 (350) followed by NR 2157-66-2-3-1-1-1 (345) and IR 80285-34-3-3-2 (345) while lowest number of effective tillers (252) was recorded in GSR312 (Table 2). Shah et al.[21] Prasad et al.[17] and Hassan et al. studied the affect of temperature, environment and genotypes and they concluded that significant heritability for yield and yield attributing traits in rice.

Table 2 Yield and yield attributes of rice genotypes, 2016

Genotype	Effective Tillers m^{-2}	Filled grain panicle^{-1}	1000 grain weight (g)	Grain yield (kg ha^{-1})
NR 2157-66-2-3-1-1-1	345	108	16	2958
NR 2157-144-1-3-1-1	270	127	17	2219
IR 80285-34-3-3-2	345	93	23	2799
NR 2158-13-1-1-2-4	276	103	23	2332
NR 2157-166-1-3-5-1	266	96	23	3030
IR 96322-34-202-13-2-1-2	247	119	21	2582
NR2158-13-1-2-4-5	336	112	24	3669
NR2157-122-1-2-1-1-1	284	108	19	2589
GSR102	307	104	24	3618
GSR336	322	123	23	3424
IR06A148	306	102	22	2571
GSR126	309	92	23	2884
GSR132	276	130	20	3230
GSR135	289	76	22	2280
IR05N421	288	96	23	3317
IR09A135	330	99	20	2547
GSR312	252	100	23	2786
GSR122	270	106	22	2457
GSR221	350	94	27	3890

Table Continued

Genotype	Effective Tillers m-2	Filled grain panicle-1	1000 grain weight (g)	Grain yield (kg ha-1)
IR94391-131-353-19-B-1-1-1-3	331	119	24	3880
IR96321-1447-651-B-1-1-4	292	106	21	2625
Sabitri (Standard Check)	292	87	22	2523
Makawanpur-1	284	103	22	3226
Mansuli	255	116	18	3138
F-test	ns	ns	**	*
LSD (0.05)	73.6	39	3	961
CV %	15.1	23	9	20
Grand Mean	297	105	22	2941

*, ** indicate significance at 5%, 1% level of P value and ns indicates non significant.

Filled grain panicle-1

Filled grains pre panicle was ranged from 76 to 130. Higher number of filled grains per panicle (130) was observed in GSR132 and lowest number of filled grains per panicle was recorded in GSR135 (76) (Table 2).

1000 grain weight (gram)

Significant variation was observed in the 1000 grain weight among the different tested genotypes (Table 2). Thousand grain weight of tested genotypes ranged from 16 to 27 gram. The highest thousand grain weight was observed in GSR221 (27 gram) and lowest was obtained in NR 2157-66-2-3-1-1-1. These findings are in line with Zahid et al.[22] and he reported that variation in thousands grain weight of different rice genotypes. They also explained this kind of variation might be due to the variability in genetic makeup and different climatic requirements. Similarly, other researchers; Tahir et al.[14] reported that highly significant variation among different traits was observed and these traits were under the control of genotypic difference among the tested genotypes.

Grain yield (kg ha-1)

While comparing grain yield of tested rice genotypes over standard check variety (Sabitri), majority of genotypes were found superior over Sabitri except NR 2157-144-1-3-1-1, NR 2158-13-1-1-2-4, GSR135 and GSR122. Highest grain yield increment % was recorded in GSR221and IR94391-131-353-19-B-1-1-1-3 with the value of 54 % (Figure 2). These superior rice genotypes over standard check in terms of grain yield could be further tested as breeding materials for verification.[23–26]

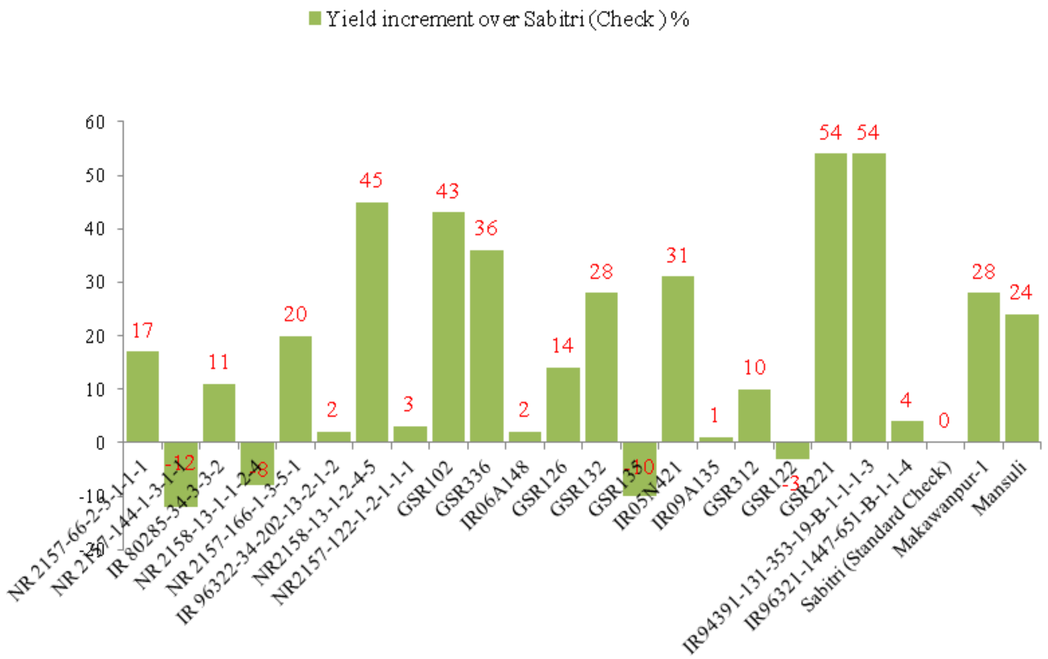

Figure 2 Percentage increment of grain yield of rice genotypes over Sabitri (Check).

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Conclusion

The evaluation of rice genotypes for a specific location/niche is the most important objective in rice breeding program. The findings of this study showed that the rice genotypes namely GSR221, IR94391-131-353-19-B-1-1-1-3, NR2158-13-1-2-4-5, GSR102, GSR336, IR05N421 and GSR132 were found high yielding rice genotypes which were promising genotypes for Bhairahawa condition of Nepal. However these findings need to be further verified on-station as well on farm before recommendation for cultivation.

Acknowledgments

None.

Conflicts of interests

Authors declare no conflict of interest exists.

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