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Research Article

Evaluation of Drought Tolerant Rice Genotype in Mid Hills of Nepal

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Abstract

Field experiment was conducted in IAAS, Lamjung campus Agronomy farm from 25/06/2015– 04/11/2015. The main purpose of the experiment was to study the performance of pipeline varieties of rice and to compare their performance with released variety (Radha-4).Randomized complete block design with three replication and eight treatment with seven new genotypes and local check (Radha-4) was used. The phenological and growth parameters i.e. heading days, maturity days, plant height, and panicle length and yield and yield attributing characters i.e. effective tillers, total grain, sterility %, test weight, grain yield, and straw yield were studied during the trial period. Thus on basis of growth yield and yield attributing characters genotype IR-88965-39-1-6-4 gave the highest grain yield with satisfactory straw yield. The result obtained must be further presented for mother and baby trial for further refinement.

Keywords: Varieties, Replication, Treatment, Genotypes, Phonological characters, Yield and Yield attributing characters.

Introduction

Rice (*Oryza sativa* L.) is monocot, annual, semi aquatic cereal crop and a member of family Poaceae. It is most important cereal and staple food crops of Nepal and fulfills about 50% of calorie requirement of the Nepalese people. It is cultivated under varied agro-climatic zones in Nepal from Terai (100-300 masl), valleys and foothills (300-1000 masl) to the high mountains up to 3050 masl (highest rice cultivated area of the world) (www.wikipedia.com).

Out of 75 districts in Nepal rice is cultivated in 73 districts except Manang and Mustang of trans-Himalayan region. Rice in Nepal is a number one crop both in Area (1.48 million ha) and production (5 million metric ton) with productivity of 3.39t/ha. In 2009/10 share of agriculture and forestry for national Gross Domestic Product (GDP) was 33.03% of which the share of rice was 20.75%. Likewise out of total cultivation area of 3.091 million ha, rice cultivation occupies 47.91% in Nepal (FAO, 2014a &b). According to the CBS report of 2013/14, the area, production and productivity of rice is 16453 ha, 47115MT and 2.864 t/ha in Lamjung (CBS, 2015).

In Nepal about 51% of rice area is under rainfed lowland and upland & about 49% is under fully or partially irrigated (Adhikari, 2013). The average yield of rice is very low in Nepal. This indicates that there is a considerable yield gap between attainable yields and actual yields in farmers' field. The productivity of rice can be increased by generating improved rice technologies including high yielding drought tolerant rice varieties. The degree or extent to which plant is adapted to arid or drought condition is called drought tolerant. Till the date released variety for drought condition in Nepal are Sukhadhan-1, Sukhadhan-2, Sukhadhan-3, Sukhadhan-4, Sukhadhan-5, Sukhadhan-6 and Tarahara-1 (NARC, 2014).

Methodology

The field selected was in Sundarbazar, Lamjung as our research site which is located at 730 masl in mid-hill region of Nepal. The land was rainfed low land and soil was sandy loam. For nursery raising of seedling nursery land was prepared on 25th of June 2015, 12 beds were prepared. The size of each bed was 1m×1m=1m^2. Preparatory tillage was done by using tractor and puddling was done manually on 30th July. The selected genotypes were IR-87751-20-4-4-2, IR-87754-42-1-4-4, IR-87759-12-2-1-1, IR-87760-15-2-3-4, IR-87761-51-1-1-4, IR-88965-39-1-6-4, IR-64 and Radha-4 as Local check. The experiment was conducted under Randomized Block Design (RCBD) with 8 treatments and 3 replications. The size of Gross plot was 3m×2m =6 m^2 and net plot was 2.2×2 = 4.4m^2.The space between the plot was 0.5m and the space between block was also .5m. Row to row and plant to plant distance was 20 cm × 20cm. The seed rate was 50 kg/ha. The recommended dose of fertilizer for rice at rainfed condition is 60:30:30 kg NPK/ha. Half dose of nitrogen and full dose of phosphorus as well as potash was applied at the time of transplantation in main field. The remaining half dose of nitrogen was applied at 2 split doses at 30 and 45 Days after Sowing (DAS) during the period of 1st & 2nd weeding. Transplanting was done on 31st of July 2015. 2-3 seedlings were planted per hill. Manual weeding was done twice on 1st of September and 16th of September 2015. Plants were harvested manually by using sickle on 4th of November and threshing was done on 5th of November using manual thresher. The pre-harvest parameters observed are no. of tillers/ hill (n=10), no of effective tillers/hill (n=10), no. of ineffective tillers/hill (n=10), Plant height (n=10), Flag leaf

area (n=10) and the post-harvest parameter observed are Panicle length and weight, no. of grains/panicle (n=10), Grain yield (kg/net plot), Straw yield (kg/ net plot) and Test weight (1000 grain).

Results and Discussion

Among tested eight genotypes (Table 1), there was no significant difference observed in case of plant height with average plant height of 89.68cm. It showed that all of the genotypes were semi dwarf type. In case of panicle length the average panicle length was 29.23cm. Significant different was found for panicle length where the longest genotype was IR-87759-12-1-1 (23.93cm) where the shortest panicle was found in Radha-4 (19.46 cm). It shows that the genotypes having long panicle with dense grain setting produced good yield compared to short panicles.

There was significant difference in sterility among genotypes. It ranged from 26.4%-38.5%. The highest sterility was found in IR-87759-12-2-1-1(38.5%) and lower in IR-64 (25.2%) and remaining genotypes seemed to be statistically at par. The sterility in genotypes may be due to failure of proper pollination and insect damage (Fig. 1 &2).

Table 1: Effect of different genotype on growth and yield attributing character

Genotype	Plant ht.(cm)	Tot. till/m²	Eff. Till/m²	Panical length(cm)	Total grain/panicle	Sterity %
IR-87751-20-4-4-2	86.37^{a}	350^{a}	316.7^{a}	22.69^{ab}	121.7^{a}	32.63^{ab}
IR-87754-42-1-4-4	89.75^{a}	300^{a}	275.0^{a}	22.94^{ab}	91.33^{bcd}	26.40^{b}
IR-87759-12-2-1-1	93.35^{a}	308.3^{a}	275.0^{a}	23.93^{a}	101.3^{b}	38.50^{a}
IR-87760-15-2-3-4	91.91^{a}	306.7^{a}	281.7^{a}	23.2^{a}	80.00^{d}	28.17^{b}
IR-87761-51-1-1-4	87.25^{a}	308.3^{a}	283.3^{a}	23.38^{a}	98.67^{bc}	32.67^{ab}
IR-88965-39-1-6-4	91.03^{a}	316.7^{a}	283.3^{a}	22.87^{ab}	115.4^{a}	25.87^{b}
IR-64	85.02^{a}	366.7^{a}	241.7^{a}	21.98^{ab}	89.67^{cd}	25.20^{b}
Radha-4	92.80^{a}	308^{a}	283.3^{a}	19.46^{b}	65.00^{e}	33.60^{ab}
Grand mean	**89.69**	**320.625**	**292.5**	**22.55**	**95.87**	**30.38**
LSD	**13.3 NS**	**72.0 NS**	**72.02NS**	**3.53 ***	**10.47****	**12.83***
C.V	**5.56%**	**12.83%**	**13.06%**	**8.95**	**6.24**	**17.42**

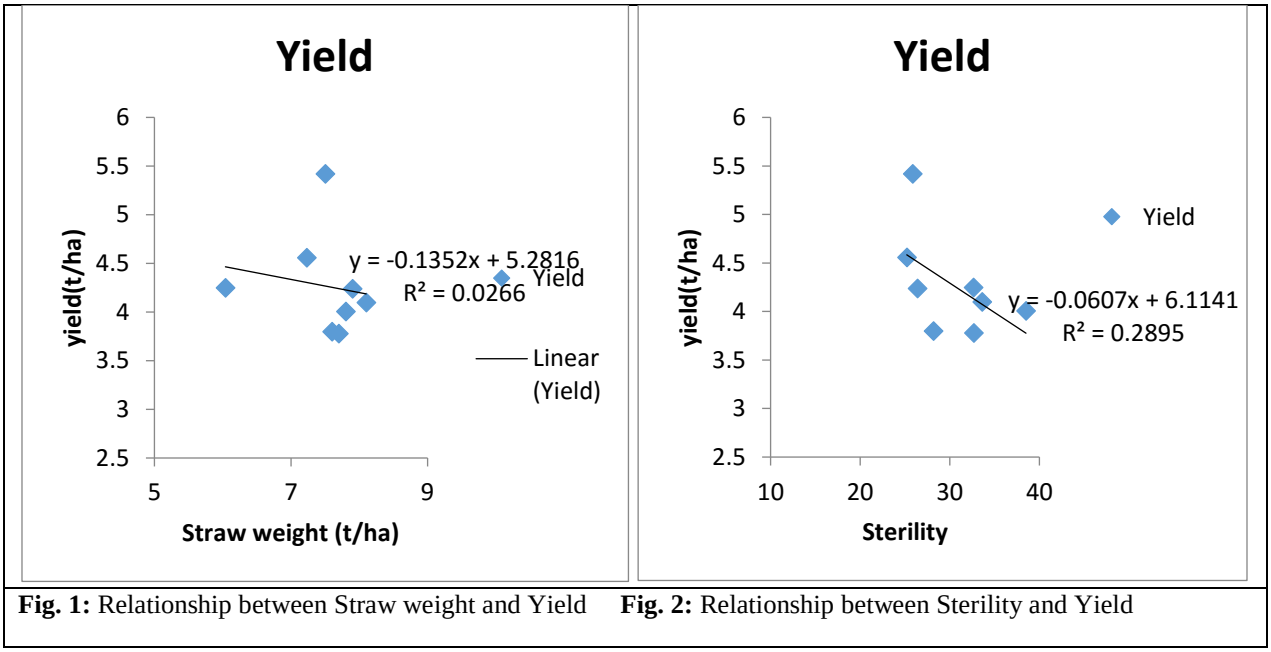

Fig. 1: Relationship between Straw weight and Yield **Fig. 2:** Relationship between Sterility and Yield

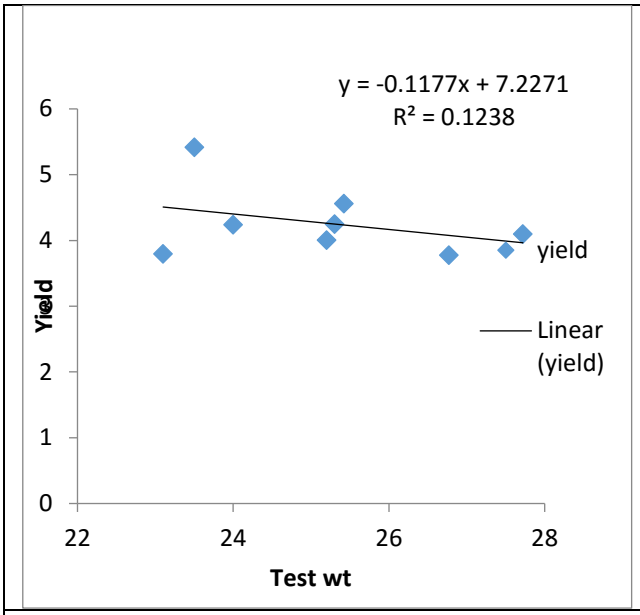

Fig. 3: Relationship between Test weight and Yield

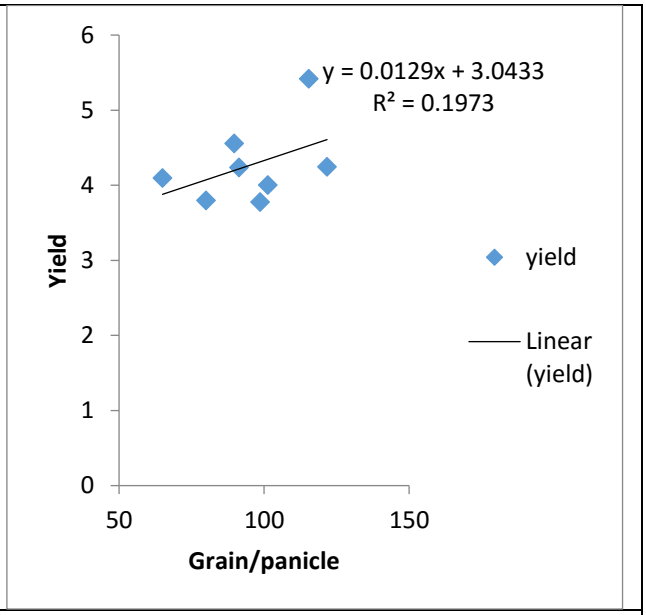

Fig. 4: Relationship between Grain/panicle and Yield

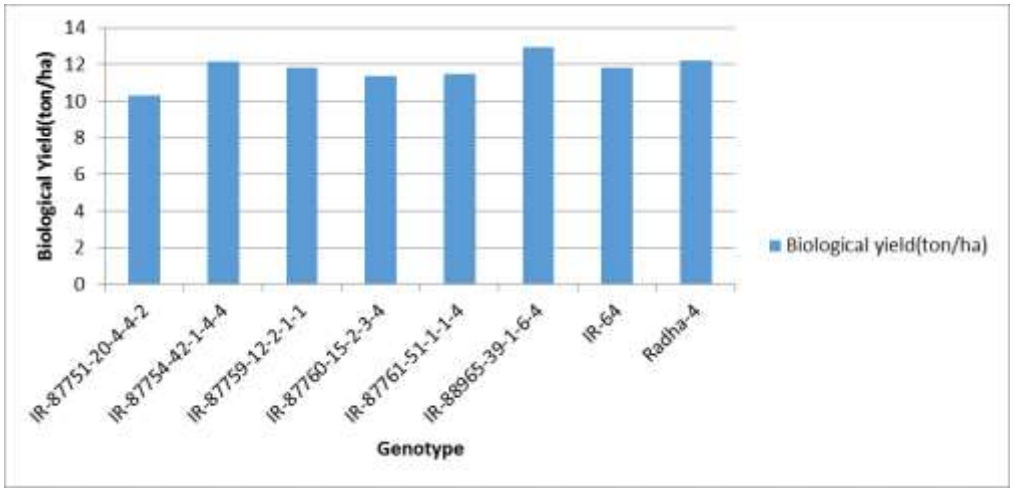

Fig. 5: Effect of Genotypes in Biological Yield (t/ha^{-1}).

Table 2: Effect of different genotype on growth and yield attributing character

Genotype	Grain Yield (ton/ha)	Dry straw wt. (ton/ha)	Test wt (g)	Harvest index (%)	Bio. Yield(ton/ha)
IR-87751-20-4-4-2	4.25^{bc}	6.04^{b}	25.3^{a}	41.31^{b}	10.29^{b}
IR-87754-42-1-4-4	4.24^{bc}	7.9^{a}	24^{c}	34.87^{cd}	12.14^{ab}
IR-87759-12-2-1-1	4.007^{bc}	7.8^{a}	25.2^{b}	33.9^{d}	11.81^{ab}
IR-87760-15-2-3-4	3.8^{c}	7.6^{ab}	23.10^{c}	33.27^{d}	11.37^{ab}
IR-87761-51-1-1-4	3.78^{c}	7.7^{ab}	26.77^{a}	33.06^{d}	11.48^{ab}
IR-88965-39-1-6-4	5.42^{a}	7.5^{ab}	23.50^{c}	40.35^{a}	12.92^{a}
IR-64	4.56^{b}	7.23^{ab}	25.42^{b}	38.40^{bc}	11.81^{ab}
Radha-4	4.1^{bc}	8.1^{a}	27.72^{a}	33.41^{d}	12.20^{ab}
Grand mean	**4.269**	**7.84**	**25.17**	**36.32**	**11.753**
LSD	**0.69***	**1.74***	**1.147***	**3.65***	**2.32***
C.V	**9.21**	**13.26**	**2.6**	**5.74**	**11.25**

Relationship between Test weight and Yield is shown in Fig. 3 and relationship between Grain/panicle and Yield is shown in Fig 4. Table 1 shows that there was no significant difference on effective tillers per m^2. All the tested genotypes were significant at par with mean effective tillers of 293 per m^2. Regarding grain yield, significant difference was found on grain yield. Maximum grain yield was obtained from IR8895-39-1-6-6 (5.42 tha^{-1}) followed by IR 87751-20-4-2-2 (4.247 tha^{-1}) and lower yield was found in IR87761-51-1-1-4 (3.783 tha^{-1}) whereas other tested genotypes showed higher grain yield than the national grain yield which is a good result of the trial performed (Fig. 5).

Likewise, there was a significant difference between genotypes for straw yield. The higher straw yield was found in Radha-4 with8.103 t/ha which is statistically at par with IR87754-42-1-4-4 (7.903t/ha) and IR87759-12-2-1-1 (7.803t/ha) whereas lower straw yield was found in IR87751-20-4-4-2 (6.04 t/ha) The straw yield is also an important output from paddy in Nepal as many livestock rearing farmers prefer high straw and grain yielding varieties from their field.

Those genotypes that produce highest grain yield also have high value of harvest index (HI). Thus genotype IR88965-39-1-6-4 which had highest grain yield (5.42 t/ha) has maximum harvest index (42.3%) and the genotype IR87761-39-1-6-4 which had lowest grain yield (3.78 t/ha) has also has lowest harvest index (33.06) (Table 2).

Test weight (1000 grain weight) is an important yield determining component and is influenced by genetic and environmental factors. The statistical analysis showed that there were significant differences of the test weight among the tested genotypes. The higher test weight was found in Radha -4 with 27.72 gm which is a coarse rice grain genotype whereas lower test weight was found in IR-87760-15-2-3-4 with 23.1 which is a fine rice grained genotype. It is better to have low test weight which results to fine rice and more preferred by the farmers (Table 2).

Conclusion

Thus, we had analyzed the obtained data of tested drought tolerant genotypes by using MSTATC (1986). From this method genotype IR-88965-39-1-6-4 was found best among all. It had good growth as well as yield attributing traits. On comparing these genotype with local variety i.e. Radha-4, we found that the existing variety (Radha-4) can be replaced with this genotype to get highest yield in this ecological region.

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Competing Interest

We state that we have no competing interest.

Author's Contribution

All the team members carried out experiment and participated in data analysis. All authors prepared and finalized the manuscript.

Ethical Consideration

This study was approved by Institutional review committee of IAAS (Institute of Agriculture and Animal Science).

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