International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 5, No. 4, p. 48-54, 2014

RESEARCH PAPER OPEN ACCESS

Yield performance of newly developed test crossed hybrid rice variety

Md. Saikat Hossain Bhuiyan[1*], Afruz Zahan[2], Hasina Khatun[2], Mosud Iqbal[2], Farzana Alam[2], Md. Rezaul Manir[2]

[1]*Bangladesh Institute of Nuclear Agriculture (BINA), Bangladesh*

[2]*Bangladesh Rice Research Institute (BRRI), Bangladesh*

Article published on October 18, 2014

Key words: Rice, Test crossed hybrids, yield and yield contributing characters.

Abstract

This study aimed to determine the adaptability and performance of different hybrid rice varieties and to identify the best hybrid rice variety in terms of yield and recommend it to rice farmers. Based on the findings of the study, the different hybrid rice varieties evaluated had significant effects on plant height at maturity, number of days to maturity, number of tillers, number of productive tillers, number of filled and unfilled grains, length of panicle and yield. RGBU010A X SL8R is therefore recommended as planting material among hybrid rice varieties because it produced favorable yield, produced more productive tillers and filled grains, produced longer panicles, heavy seeds, high harvest index and are accepted by consumers. In the absence of this variety, RGBU02A X SL8R, RGBU003A X SL8R and RGBU0132A X SL8R may also be used as planting material.

* **Corresponding Author:** Md. Saikat Hossain Bhuiyan ✉ saikat.ag88@gmail.com

Introduction

Rice, the second most widely-grown cereal crop after wheat and gifted with rich genetic repositories, is the staple food for more than half of the global human population. More than one hundred thousand landraces and improved cultivar collections available in the rice germplasm world wide largely contribute to the rich genetic diversity of rice. The world population is projected to increase from 6.13 billion in 2001 to 7.21 billion in 2015 and 8.27 billion in 2030, indicating a corresponding increase in rice demand from 680 million tons in 2015 to 771 million tons in 2030 (Badawi, 2004). The current levels of rice production do not meet future demand. Since 2000, annual withdrawals from rice stocks have been necessary to bridge the gap between rice production and demand. The challenge of overcoming hunger, poverty and malnutrition in rice-consuming countries while maintaining productivity and protecting the environment will require coordinated efforts. In addition, rice research plays a major role in the efficient utilization of cultivated area, improved rice varieties, and the minimization of losses during milling. The major focus of rice research in the next decade must emphasize on the development of high-yielding and early-maturing varieties in order to ensure sustainable production of rice (Swain, 2005). The rice plants that we see in the farmer's fields today are all inbred rice varieties. Normally, each rice flower contains both male and female organs. This allows the plant to reproduce itself through self-pollination. A hybrid rice variety, also referred to as the F1, is the product of crossing two rice plants with superior qualities. These superior qualities of both parents are passed on to the seed and results in a phenomenon called 'hybrid vigor' or 'heterosis'. Hybrid rice is a product of pollination- that is two kinds of seeds are sown and grown side by side and pollination is done by natural and artificial means. Hybrids are generally more vigorous and larger in size than the parent stock. The young seedlings produce long roots and broad leaves that enable them to take up more nutrients thus, produce more grains. Zhende (1988) stated that hybrid rice has high tillering capacity. During vegetative growth, hybrid rice accumulates more dry matter in the early and middle growth stages which results in more spikelets per panicle. They have bigger panicles and more spikelets per panicle. These factors result in higher yields usually 15% or more than ordinary rice, also called inbred (Philrice, 2002). Only 3.8 metric ton of paddy produced from inbreds every hectare per harvest season. IRRI (1988) made mentioned that hybrid rice yield 20-30% more than the conventional varieties with adequate management. It has contributed to national food self-sufficiency in the short run and provides a long-run perspective for Asia to feed itself as population pressures on arable land increase. There are other hybrids at present which give an average yield of 5.7 tons/ha during the wet season (Vanzi, 2003). Several hybrid varieties had been developed and released up to the present. Different varieties perform differently in a particular environment. A recent study (Janaiah and Hossain, 2000) indicated that although farmers got about 16% yield advantage in the cultivation of hybrids compared to the popularly grown inbred varieties, the yield gains were not stable. It is for this reason that this study was conceptualized to find out which among the numerous hybrid rice varieties is best adopted in Bangladesh in order for the farmers to know the right hybrid rice to grow.

The general aim of the study was to determine the adaptability and performance of different hybrid rice varieties specifically this is to identify the best hybrid rice variety in terms of yield.

Materials and methods

Experimental Site and duration

The experiment was carried out at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur during December 2012 to July 2013. The experimental site is located at the centre of Madhupur Tract (24°09' N latitude and 90°26' E longitude) having an elevation of 8.2m from sea level (Anonymous, 1989).

Plant materials

Thirteen crosses were included in the experiment

.The seed of thirteen crosses were synthesized by the Department of Genetics and Plant Breeding, Bangabandhu Sheikh mujibur Rahman Agriculture University and the crossed materials are:
RGBU002 A x SL8 R, RGBU002 A x Mitali R, RGBU003 A x SL8 R, RGBU005 A x LP70 R
RGBU006 A x SL8 R, RGBU009 A x Mitali R, RGBU010 A x SL8 R, RGBU010 A x LP70 R
RGBU012 A x LP70 R, RGBU013 A x SL8 R, RGBU013 A x Gold R, RGBU014 A x SL8 R
RGBU014 A x Gold R.

Experimental Design
A total area of 1072 sq. m. was utilized for the study. A Randomized Complete Block Design (RCBD) involving thirteen varieties with three replications was followed. The total area was divided into three equal blocks representing replication. Each block was divided into 13 plots, in which the13 varieties were planted.

Preparation of main field
The experimental plot was at a lower elevation with high water holding capacity. The land was prepared thoroughly by 3-4 times ploughing and cross ploughing followed by laddering to attain a good puddle. Weeds and stubbles were removed and land was finally prepared by addition of basal dose of fertilizers recommended by Anon. (2005).

Fertilizer Application
Urea, TSP, MP, Sulphate and Gypsum @ 270, 130, 120, 70, 10 kg/ha respectively were used in the experiment. Total TSP, MP, and Zinc Sulphate were applied in final land preparation. Total urea was applied in three installments at 15 days after transplanting (DAT), 35 DAT & 55 DAT respectively.

Transplanting of seedling
Healthy seedlings of 45 days old were transplanted in separate strips of the experimental field. In each strip 20 x 20 cm spacing between plant to plant and row to row, respectively were maintained.

Intercultural operation
Necessary intercultural operation was taken during cropping period for proper growth and development of the plants. Weeding, during first two top dressing of urea, was done to break the soil crust, to keep the plots free from weed and to incorporate the urea fertilizer into the soil for reducing the loss of urea through denitrification. Irrigation with regular interval was given to maintain 5-7cm water up to hard dough stage of rice.

Plant protection measures
Proper control measures were taken against rice stem borer during tillering and heading stage of rice. Furadan 5G @ lg per square meter were applied at active tillering stage and panicle initiation stage of rice for controlling the stem borer. Lani rate and furadan was applied to protect from rat and rice bug respectively. During maturation period a big net was use to cover the hole field to protect the rice from birds.

Data collection
Data on yield contributing characters were collected from 5 randomly selected hills of each genotype on individual plant basis. Yield of 13 crossed was measured and then grain weight was also adjusted to 14% moisture content.

All the data gathered were statistically analyzed using the Randomized Complete Block Design. The Duncan's Multiple Range Test was used to compare significance of difference of treatment means (Gomez and Gomez, 1984).

Results and discussions
This chapter comprises the presentation and discussion of the findings obtain from the study .the data pertaining to thirteen cross progenies were computed and statistically analyzed and the results thus obtained are discussed below.

Plant Height (cm)
Plant height may not have significant role to play in the expression of hybrid vigor by the hybrids (Dwivedi, 1985). At maturity, the height of plants

among the varieties tested revealed highly significant differences. RGBU010A X SL8R was significantly the tallest among the thirteen varieties with a height of 114.0 cm which was statistically identical with RGBU012A X LP70R and RGBU009A X Mitali R and significantly different with the other varieties followed by RGBU014A X SL8R, RGBU002A X SL8R and RGBU005A X LP70R. The shortest variety was observed in BRRIdhan-29 with a mean of 95.21 cm. The significant variation in plant height could be attributed to their genetic variability.

Table 1. Average number of effective tiller, uneffective tiller, filled grain and unfilled grain.

Name of Entry	*No. of effective tiller/plant*	*No. of un effective tiller/plant*	*No. of filled grain/panicle*	*No. of unfilled grain/panicle*
RGBU014A×SL8R	14.33d	13.33c	129.3bc	10.73e
RGBU02A×SL8R	19.67b	18.8a	128bc	26.6bc
RGBU06A×SL8R	13.87efg	13.10c	111.4d	27.63bc
RGBU03A×SL8R	17.10c	17.33ab	118.5c	15.63d
RGBU010A×SL8R	29.70a	18.18a	135.2b	8.267e
RGBU013A×SL8R	16.07cd	15.33ab	138.1b	25.73c
RGBU005A×LP70R	15.9cd	14.7bc	119.2cd	29.73b
RGBU010A×LP70R	11.57e	12.77cd	136.9b	37.10a
RGBU014A×Gold R	10.50ef	15.10b	120.4c	25.87c
RGBU002A×MitaliR	14.80d	15.70b	138.1b	9.3e
RGBU012A×LP70R	8.067f	8.00e	106.7ld	33.53ab
RGBU013A×Gold R	14.27d	14.03bc	122.6bc	35.57a
RGBU009A×MitaliR	11.07e	10.93d	136.6b	26.13bc
BRRIdhan29	14.33d	13.33c	174.85a	16.56cd

*Means of the same letter are not significantly different at 5% level DMRT.

Number of Days from Sowing to Maturity

Early maturing hybrids are desirable as they produce more yields per day and fit well in multiple cropping systems. Highly significant differences could be noted among the cultivars on the number of days from sowing to maturity. RGBU013A X GoldR being the earliest to mature that is, within 138 days, was significantly different from the other varieties. In varying number of days, the following cultivars matured after RGBU013A X GoldR had matured RGBU006A X SL8R, RGBU014A X SL8R, RGBU002A X SL8R and RGBU005A X LP70R was the latest to mature that is, within 150 to 165 days. The earlier ripening of some varieties tested was attributed to their varietal differences; others have shorter life span and attained physiological maturity stage earlier than the other varieties. Hence this result shows that the different varieties differ in their performance and adaptability to a certain environment.

Number of Effective and Uneffective Tillers per Hill

Productive tillers are an important yield component in rice. The trait number of panicle bearing tillers/ plant is believed to be closely associated with high grain yield/plant so, the hybrids with more number of panicle bearing tillers/plant to be identified. The variety or hybrid with low tillering capacity is not wanted in transplanted rice culture. The data on mean values for productive tillers/hill showed that all the hybrids except RGBU010A X LP70R produced more or less same number of productive tillers/hill. Hybrid RGBU010A X LP70 produced significantly higher (29) tillers/hill. As such, the number of the former is significantly different to the other varieties. This outcome supports what had been stated by

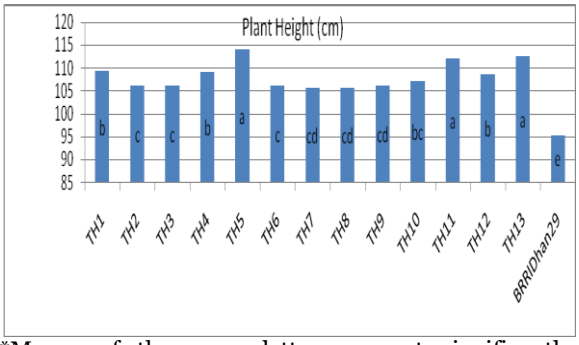
Zhende (1988) that hybrid rice has high tillering capacity. RGBU012A X LP70R produced the lowest number of productive tillers (8) together with RGBU014A X Gold R and RGBU009A X MitaliR which are next in producing the lowest number of productive tillers. The significant differences could be attributed to the fact that high yielding varieties (HYV's) have relatively high tillering capacity (De Datta, 1981).

Table 2. Average length of normal leaf, flag leaf and panicle.

Name of Entry	*Length of normal leaf*	*Length of flag leaf*	*Length of panicles*
RGBU014A×SL8R	38.07d	24.80bc	26.43bc
RGBU02A×SL8R	39.53cd	26.73d	28.37bc
RGBU06A×SL8R	36.00e	30.80ab	25.70bc
RGBU03A×SL8R	44.33a	31.87ab	28.63bc
RGBU010A×SL8R	38.73cd	22.90c	26.97bc
RGBU013A×SL8R	33.83f	27.80c	26.20bc
RGBU005A×LP70R	42.6b	25.97cd	29.60b
RGBU010A×LP70R	39.43cd	22.40c	24.10c
RGBU014A×Gold R	36.20e	24.63bc	25.93bc
RGBU002A×MitaliR	40.37c	28.10b	27.23bc
RGBU012A×LP70R	41.20bc	33.57a	26.90bc
RGBU013A×Gold R	40.70bc	31.53ab	24.20c
RGBU009A×MitaliR	40.43c	33.67a	25.17bc
BRRIdhan29	40.30c	23.35bc	35.5a

*Means of the same letter are not significantly different at 5% level DMRT.

Likewise, as shown in Figure 4, among the thirteen crossed evaluated here, RGBU002A X Sl8R and RGBU010A X Sl8R had produced the highest number of uneffective tillers but the number did not significantly differ from each other. However, RGBU012A X LP70R produced the lowest number of productive tillers that did not significantly differ from the number of tillers produced per hill by RGBU013A X Gold R.

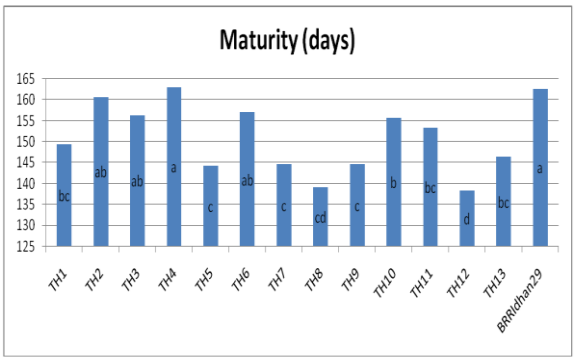


*Means of the same letter are not significantly different at 5% level DMRT.

Fig. 1. Average height of plants at maturity (cm).

Number of Filled and Unfilled Grains per Panicle:

The number of fill grains/panicle is another important as well as main yield contributing character in the rice hybrids. It directly contributes to the seed yield and maximum mean value was highly desirable for this trait. The thirteen crossed evaluated here significantly differed in terms of the produced number of filled grains per panicle. RGBU013A X SL8R and RGBU002A X Mitali R produced maximum filled grains. This number is significantly different from the number produced by the rest of the varieties. BRRIdhan-29, which is an inbreed produced the lowest number that is 98. The findings supports the idea of Fernandez (2002) that hybrid rice produces long roots and broad leaves that enable them to take up more nutrients and produce more grains.



*Means of the same letter are not significantly different at 5% level DMRT.

Fig. 2. Average Number of Days from Sowing to Maturity.

Length of normal leaf, flag leaf and panicle

Increasing the leaf blade area increase the photosynthetic area as well as increase the accumulation of photosynthetic of photosynthetic products in plants where Increasing the Flag leaf area increase the photosynthetic area as well as it protect the panicle as early stage. Hybrids are generally characterized by having longer panicles indicating their efficiency in partitioning of assimilates to reproductive parts. This is one of the attributes of higher yields in hybrids. Among the crosses the height length of leaf blade was found in the cross RGBU003 A X Sl8 R (44.33) followed by RGBU005 A X LP70 R (42.06) and RGBU012 A X LP70 R (41.20), and the lowest leaf blade length was found in the cross RGBU013 A X Sl8 R (33.83) followed by RGBU014 A X Gold R (36.40), RGBU006 A X Sl8 R (36.00). Among the crosses the length of flag leaf was found in the RGBU009 A X Mitali R (33.67) followed by RGBU012 A X LP70 R (33.57) and RGBU003 A X Sl8 R (31.87) and the shortest leaf was found in the cross RGBU010 A X LP70 R (22.4) followed by RGBU010 A X Sl8 R (22.91) and RGBU014 A X Sl8 R (24.80). According to Zhende (1988) hybrid rice have bigger panicles and more spikelets per panicle and thus in the study, RGBU005A X LP70R and RGBU003A X SL8R had significantly produced the longest panicle among the hybrids used as seen in Table 1. The shortest panicle was registered by RGBU010A X LP70R (224.10cm) which is significantly different from the other varieties. The significant differences in panicle length among the hybrid rice varieties could be attributed to their genetic make-up.

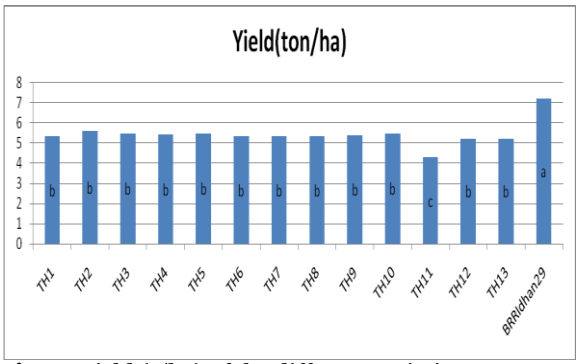


Fig. 3. Yield (t/ha) of the different varieties.

Yield per Hectare (tons)

There are no significant differences in yield per plot among the cross tested here although they were significantly differ with the check variety used here. The yield of RGBU006A X SL8R, RGBU014A X SL8R, RGBU002A X SL8R and RGBU005A X LP70R were statistically similar (Figure 3). RGBU012A X LP70R had the lowest yield.

Conclusion

Finally it can be concluded that the cross RGBU010 A X SL 8R, RGBU005 A X LP70R and RGBU014 A X Gold8R was earlier from other test cross materials although other agronomic traits were more or less similar.

References

Zhende Y, October. 1988. Proceedings of the International Symposium on Hybrid Rice. "Agronomic Management of Rice Hybrids Compared with Conventional Varieties". Changsha, Hunan, China, 27-35.

Anonymous. 1989. Annual Weather Report, Meterological station, Bangabandhu Sheikh Mujibur Rahman Agricultural University, 14-22.

Anonymous. 2013. Time and requirement of top dressing of urea according to season and variety. Adhunik Dhaner Chash, Bangladesh Rice Research Institute, 13th edition, 28.

Badawi AT. 2004. Rice-based production systems for food security and poverty alleviation in the Near East and North Africa: New Challenges and Technological Opportunities, FAO Rice Conference, Rome, Italy, 17-25.

Dwivedi JL, August. 1985. Heterosis in rice and its exploitation. In: Genetics and Rice Improvement. National Symposium held at Directorate of Rice Research, Hyderabad, India, 40-42.

Fernandez R, June. 2002. Unlad-Ani Program: Hybrid Rice Program Now in Full Swing. Philippine Star, 7.

Gomez KA, Gomez AA. 1984. Statistical procedure for agricultural research. International Rice Research Institute. *John Wiley and Sons*, New York, 139-240.

Janaiah A, Hossain M. 2000, Issues for Policy Intervention to Promote Hybrid Rice Technology in India: A Few Lessons from Recent Experiences, INDIA GRAINS **2(9),** 11-15.

PhilRice May. 2002. Hybrid Rice. "Q & A" Series, *PhilRice Maligaya,Muñoz*, Nueva Ecija. **1**, 4-6.

Swain D. 2005. Rainfed lowland and flood–prone rice a critical review on ecology and management technology for improving the productivity in Asia: Role of Water Science in Trans boundary River Basin Management, Thailand, 12-15.

Vanzi S. 2003. 2 New Rice Hybrid Varieties Introduced. Munoz Science City. Nueva Ecija posted at http://www.newsflash.org/2003/03/si/si001465htm