Journal of Experimental Biology and Agricultural Sciences, December - 2018; Volume – 6(6) page 959 – 965

Journal of Experimental Biology and Agricultural Sciences

http://www.jebas.org

ISSN No. 2320 – 8694

PERFORMANCE OF RICE HYBRIDS IN EASTERN GANGETIC ALLUVIAL ZONE OF WEST BENGAL, INDIA

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Received – October 11, 2018; Revision – November 30, 2018; Accepted – December 12, 2018
Available Online – December 15, 2018

DOI: http://dx.doi.org/10.18006/2018.6(6).959.965

KEYWORDS

Rice hybrids

HYV

Germination

Grain yield

Harvest index

ABSTRACT

A field experiment was conducted at university farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India on summer rice during 2015-2016 and 2016–2017 to observe the performance of hybrid varieties under New Alluvial Zone of West Bengal. The experiment was laid out in Randomized Block Design with three replications. Square method of transplanting (20 cm × 20 cm) was maintained for all varieties (27P22, 27P37, 27P36, 28P67, 27P31, 29P01, ArizeTej Gold, and Arize 6129) and N-P_2O_5-K_2O was applied @ 140:60:60 kg/ha for hybrids. The results of study revealed that the hybrid varieties exhibited superiority in respect of different growth parameters like plant height, LAI, aerial dry matter accumulation, number of tillers per hill etc over the control variety HYV *Satabdi* (IET 4786). Among various tested rice hybrids, maximum grain yield (7.13t/ha) and harvest index (49.65%) were recorded in 28P67. The results of study revealed that both grain and straw yield of hybrid varieties were significantly higher than the HYV *Satabdi* (control variety) which might be due to better growth parameters and yield components of hybrids.

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Peer review under responsibility of Journal of Experimental Biology and Agricultural Sciences.

Production and Hosting by Horizon Publisher India [HPI] (http://www.horizonpublisherindia.in/).

1 Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops of India and is used as a staple food for more than 60% of the total population of the country (DAC, 2010). It is rich in starch and provides more energy that's why it is called high calorie food. It accounts for about 43% of total food grain production and 55% of total cereal production in India (Singh et al., 2012). India has the world's largest acreage under rice at 43.97 million hectare and second largest producer, 104 million tonnes next only to China (Anonymous, 2018). In India, total area under rice cultivation is decreasing at rapid rate; on the other hand the demand for rice is increasing with the growing population. India's population is projected to be 1.378 billion by 2030 and in order to meet the domestic demand of increasing population the present day production of about 100 million tons of rice has to be increased to 130 million tons by the year 2030 (Viraktamath, 2011). Therefore, to fulfil the gap between demand and supply, it is required to increase the productivity of rice i.e. production per unit area in many folds. On the other hand there is a yield plateauing in high yielding rice in our country like other south-east Asian countries. Introduction of hybrid varieties with high potentiality in yield is the best alternative for increasing the rice production without increasing its cultivated area. Hybrid rice technology has also been proved to be one of the most feasible and readily adoptable approaches to meet the domestic demand. The rice hybrids, recently introduced in cultivation, on an average, give 20-30% higher yield over the common high yielding varieties (Prasad, 2012). The present study was conducted to evaluate the performance of rice hybrids as compare to popular high yielding variety of rice during monsoon or *kharif* season in new alluvial zone of West Bengal, India.

2 Materials and Methods

Field experiment was conducted to evaluate the performance of different rice hybrids during winter season of 2015-2016 and 2016- 2017 at the University Research Farm (22°56´ N latitude and 88°32´ E longitude, 9.5 m above MSL), Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India. The experiment was conducted in clay-loam soil having good irrigation and drainage facilities. The experiment was laid out in randomized block design with three replications and eight hybrid rice varieties *viz.*, 27P22, 27P37, 27P36, 28P67, 27P31, 29P01, ArizeTej Gold, and Arize 6129 while one high yielding variety (HYV) *Satabdi* (IET- 4786) used as standard check. A common spacing (20 cm × 20 cm) was maintained for all varieties, and a uniform recommended doses of N-P_2O_5-K_2O:140:60:60 kg ha^{-1} was applied for hybrids and 120:60:60 kg ha^{-1} for HYV. Nitrogen fertilizer (urea) was applied in three equal splits at an interval of 25 days, however, total amount of phosphate (Single Super Phosphate) was applied as basal and potash fertilizer (MOP) was applied in two equal splits at final puddling and at 25 days after transplanting (DAT). The different growth parameter like plant height, tiller number, leaf area index (LAI), total dry matter accumulation (DMA) were recorded.

Yield component like panicle m^{-2}, filled grains $panicle^{-1}$, test weight of seeds were recorded and calculated. The grain yield and straw yield were recorded. Harvest index (HI) for each variety was calculated from data on straw and grain yield. Statistical analysis for SEm and CD was done by using methodologies as laid down in Gomez & Gomez (1984).

3 Results and Discussion

3.1 Growth attributes

Data presented in figure1 represented the required time for germination after the sowing of different rice hybrids as well as high yielding variety (HYV) of rice and it was observed that the time required for germination ranges from 5 to 6 days and that was found statistically not significant. Among the tested varieties, Arize 6129, 27P31 and 29P01 took 6 days while varieties

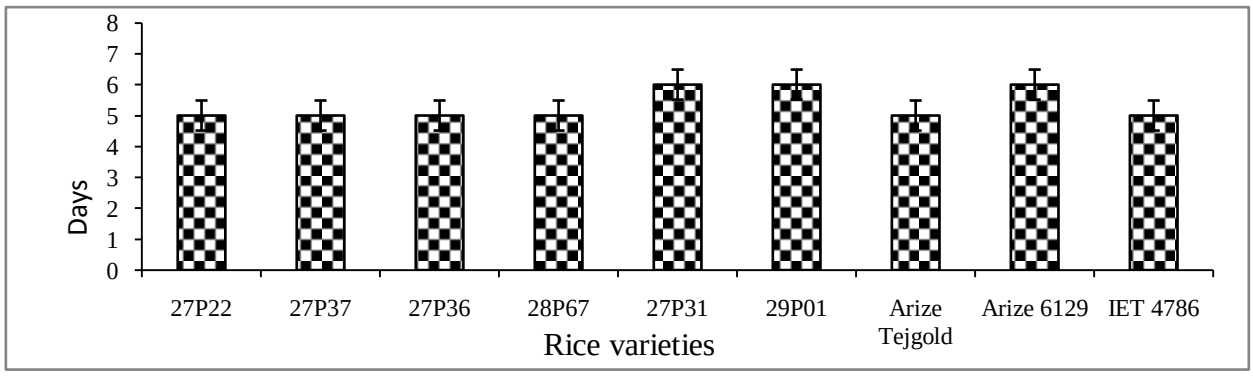

Figure 1 Days required for germination of different rice varieties

IET4786, Arize Tejgold, 27P22, 27P37, 27P36, 28P67 took only 5 days to germinate the seeds.

Regarding the time taken for panicle emergence and 50% flowering by the different rice varieties, it was recorded 53 to 60 days and 60 to 67 days respectively and significant difference had been found between the hybrids and HYV (control) for both the cases. Among the hybrids, 27P36 took significantly higher time (60 days) in panicle emergence after transplanting which was statistically at par with 27P37 (59 days), 28P67 (58 days) and 27P31 (58 days) whereas the lower data noted in rice hybrid Arize 6129. Similar trend had also been recorded in case of time for 50% flowering among the rice hybrids. However, HYV of rice, IET-4786 (Control) took significantly lowest time for panicle emergence (53 days) as well as that of 50 % flowering (60 days) (Figure 2) & (Table 3).

From the recoded data, it was observed that total duration of rice varieties varied from 120 days to 130 days. Among the tested hybrid verities, hybrid 29P01 took maximum time i.e. 130 days to mature which was significantly higher than the control followed by hybrids 27P22, 27P36 and 27P31 took 129 days which were statistically at par with 29P01. However, IET-4786 (Control) took significantly lowest time i.e. 120 days to get matured compare with other remaining varieties (Figure 3) & (Table 3).

Plant height of rice was progressively increased from

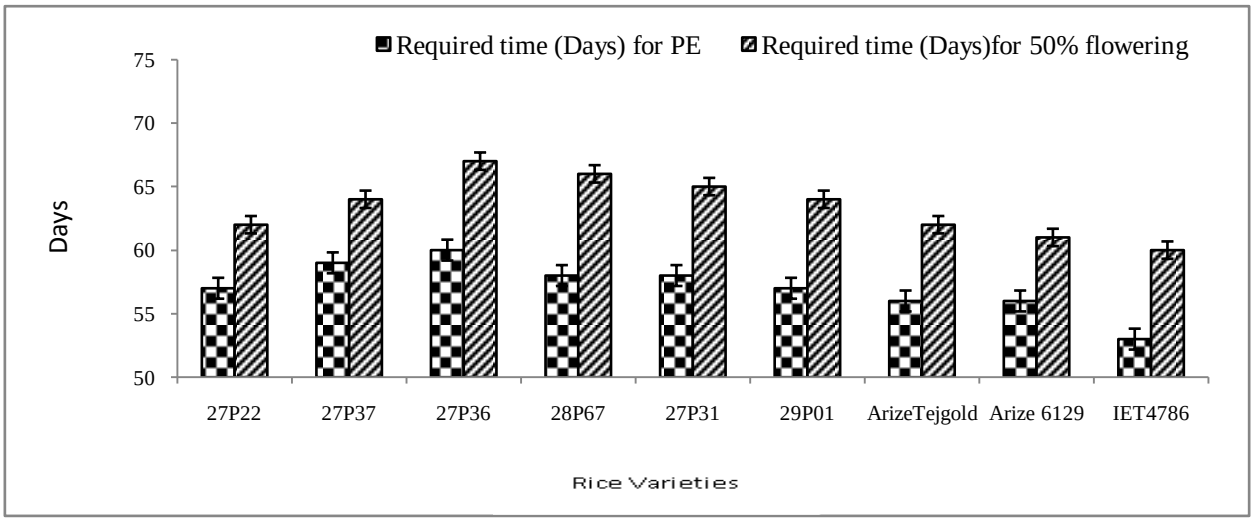

Figure 2 Days required for Panicle Emergence (PE) and 50% flowering of rice varieties

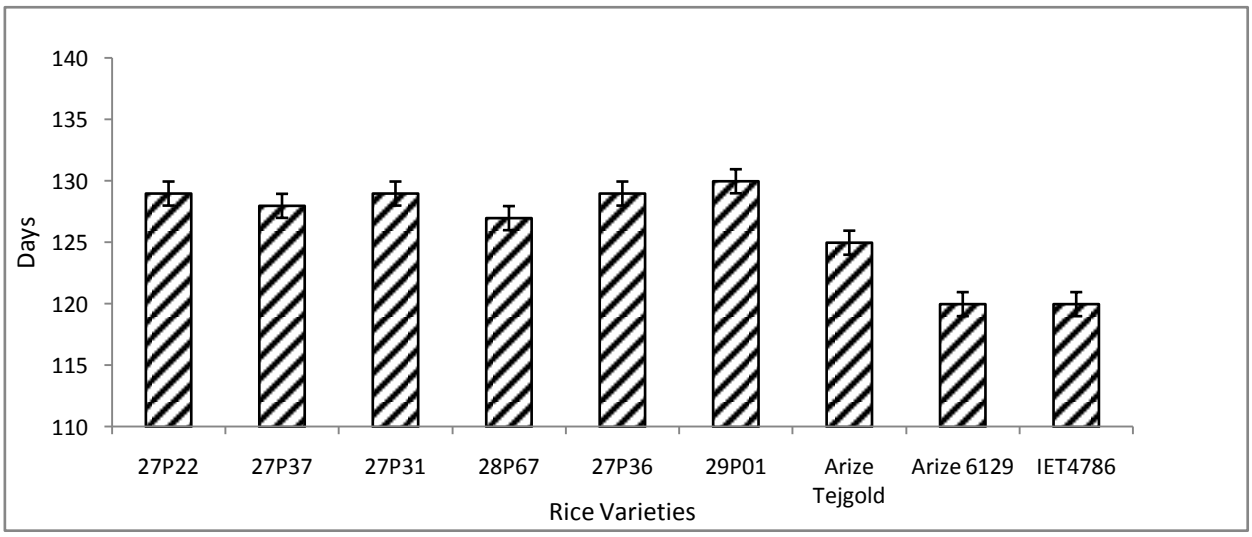

Figure 3 Total duration in days of the different rice varieties

transplanting to maturity including slow increase at early and late phase of life cycle. Sarkar et al. (2016) also reported that plant height increased progressively with the advancement of time and growth stages from early growth to maturity. It was also recorded that plant height of different rice variety was statistically at par (CD at 5% level) with each other at early growth stages (30 DAT and 60 DAT). However, at maturity stage (90 DAT) the hybrid variety 29P01 recorded maximum plant height (102.5 cm) which was significantly higher than the control variety HYV IET 4786 (Table 1). Bhuiyan et al. (2014) reported the similar significant effects on plant height at maturity for different rice hybrid over high yielding varieties.

From the investigation, it was found that among the nine varieties, hybrid 28P67 recorded highest number of tillers. HYV *Satabdi* produced the lowest number of tillers m^{-2} (Table 1). Hybrid rice generally had higher tillering ability than conventional varieties, similarly, Akram et al. (2007) also reported that two hybrids viz., MK Hybrid 111 and 27P72 produced more productive tillers than HYV *KS 282*. The hybrid rice variety, Tia showed superiority in respect of growth parameters like tillers $hill^{-1}$ (Sarkar et al. 2016).

Data presented in figure 4, revealed that leaf area index (LAI) value was highest in hybrid 28P67 and it was lowest in Arize Tejgold. Same types of results were also recorded by Hosain et al (2018). LAI of different rice varieties were not significant in all the three stages. LAI of all varieties increased up to 60 DAT there after it was decreased. Similar results were reported by Mishra & Dash (2014). However, highest LAI was recorded in hybrid

Table 1 Growth parameter of rice varieties (Pooled data of two years)

Variety	Plant height (cm)			Tillers m^{-2}			DMA (g m^{-2})		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
27P22	54.0	79.4	95.1	229.6	361.5	313.2	254.0	672.1	1116.4
27P37	58.1	84.0	98.6	238.4	394.5	376.5	268.5	721.6	1209.1
27P36	56.5	82.9	97.8	214.5	370.4	326.1	272.3	769.4	1250.5
28P67	52.6	80.8	92.2	247.2	443.2	406.3	288.5	802.3	1306.8
27P31	55.2	81.8	96.0	199.8	407.9	378.4	258.4	772.8	1253.3
29P01	57.1	89.2	102.5	233.5	357.3	326.7	263.7	754.6	1245.8
ArizeTejgold	55.3	83.7	94.3	207.0	315.6	301.9	205.6	642.2	1082.1
Arize 6129	55.1	81.9	93.4	231.3	350.1	322.6	226.2	635.5	1113.9
IET4786	50.5	76.1	78.2	159.8	284.0	243.3	212.8	561.4	875.9
S. Em.(±)	3.16	4.15	5.65	30.46	29.16	26.38	36.25	58.11	61.20
CD (p=0.05)	NS	NS	16.94	NS	87.44	79.10	NS	174.27	183.56

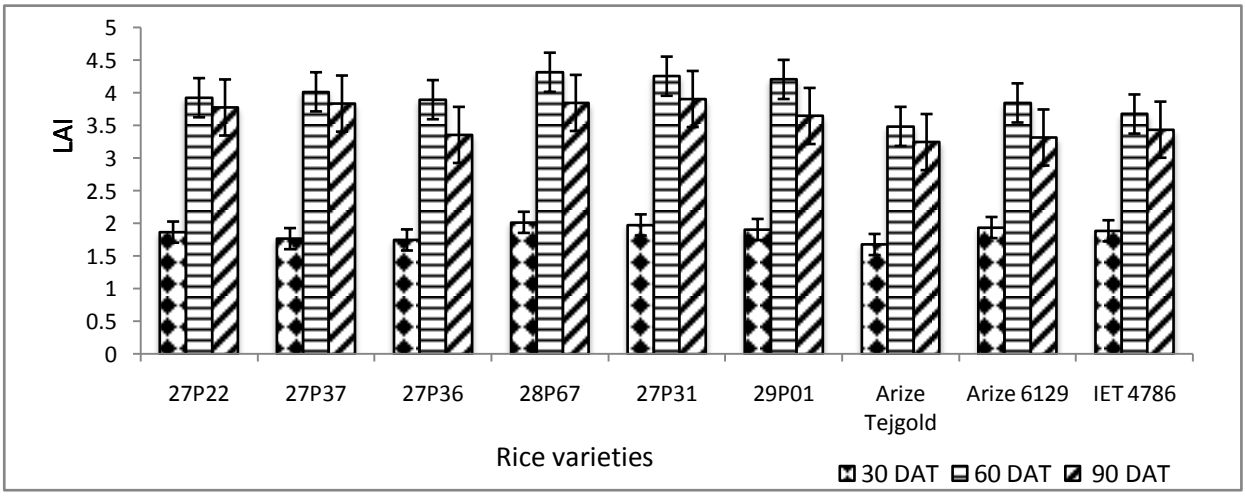

Figure 4: Leaf Area Index (LAI) of different rice varieties

Table 2 Yield components, yield and Harvest Index of rice varieties (Pooled data of two years)

Variety	Panicle m^{-2}	Filled grains $panicle^{-1}$	Test weight (g)	Yield (tha^{-1})		Harvest Index (%)
				Grain	Straw	
27P22	278.5	136.4	22.4	5.84	5.94	49.56
27P37	319.3	141.6	23.6	6.63	6.78	49.45
27P36	289.2	155.1	24.1	6.44	6.76	48.77
28P67	351.4	158.2	24.9	7.13	7.23	49.65
27P31	331.5	157.8	22.7	6.83	6.95	49.55
29P01	282.8	154.9	23.0	6.12	6.22	49.58
ArizeTejgold	259.9	137.5	22.4	5.06	5.44	48.19
Arize 6129	265.7	143.7	23.3	5.38	5.68	48.66
IET4786	202.6	118.3	19.8	3.54	4.64	43.25
SEm(±)	16.51	11.36	0.63	0.39	0.40	-
CD (p=0.05)	49.52	34.07	1.87	1.17	1.20	-

Table 3 Time required for Panicle Emergence (PE) 50% flowering and total duration of different rice varieties.

Varieties	Required time for PE (Days)	Required time for 50% Flowering (Days)	Total Duration of crop (Days)
27P22	57	62	129
27P37	59	64	128
27P36	60	67	129
28P67	58	66	127
27P31	58	65	129
29P01	57	64	130
ArizeTejgold	56	62	125
Arize 6129	56	61	120
IET4786	53	60	120
SEm(±)	0.822	0.684	0.979
CD (p=0.05)	2.486	2.068	2.960

28P67 followed by 27P31 and lowest in Arize Tejgold in all the three growth stages (Table 1).

Dry bio-mass of different rice varieties recorded at 30 DAT was found statistically not significant. However dry bio-mass at 60 DAT and 90 DAT were found statistically significant. At 60 DAT dry matter accumulation ranged from 661.4 g/m^2 to 802.3 g/m^2 while at 90 DAT, the range was 875.9 g to 1306.8 g/m^2. The significantly higher dry bio-mass was observed in variety 28P67 followed by 27P31 and significantly lowest in IET-4786 at both 60 DAT and 90 DAT (Table 1).

Number of panicles m^{-2} was found significant between the hybrid and control HYV. Significantly lowest number of panicles m^{-2} (202.6) was recorded in HYV (IET-4786) and highest in Hybrid varieties. Among the eight hybrids, maximum number of panicles m^{-2} was obtained in 28P67 (351.4) which were followed by 27P31 and 27P37. Hybrid vigour is the probable reason for this significant difference in panicle number m^{-2}. The results are also in agreement with Yang et al. (2007).

3.2 Yield and yield attributes

The number of filled grains $panicle^{-1}$ was varied significantly among the hybrids as well as in between hybrids and HYV (control). Highest value of 158.2 was recorded in hybrid variety 28P67 and lowest value of 118.3 in HYV IET4786. Akram et al. (2007) also reported that all most all the hybrids produced more

number of grains panicle^{-1}. However, number of filled grains panicle^{-1} for hybrids 27P36, 27P31, and 29P01 were significantly higher over HYV IET4786 though they are at par with hybrid 28P67 (Table.2).

Like the number of filled grains panicle^{-1}, test weight of grains was found statistically significant among the hybrids as well as in between hybrids and HYV. Significantly higher test weight was recorded in hybrids and lowest in HYV (IET 4786). Akram et al. (2007) also reported that hybrids produced higher weight of 1000 grain than check variety. However, among the hybrids, Variety 28P67 recorded the highest test weight of 24.9 g followed by 27P36 and 27P37 whereas the lowest test weight was in 27P22 (Table.2).

Grain yield was significantly varied among the all varieties. Significantly higher grain yield (7.13 t ha^{-1}) was reported in 28P67 followed by 27P31 (6.83 t ha^{-1}) and 27P37 (6.63 t ha^{-1}) might be due to higher number of panicles m^{-2}, filled grains panicle^{-1}, test weight etc. However, the lowest grain yield of 3.54 t ha^{-1} was obtained in HYV IET 4786 (Table.2). Hybrid rice has a distinct yield advantage over the conventional varieties (Khushik et al. 2011). Sarwar et al. (2010) also reported that the hybrid cultivars produced longer panicle, higher number of filled grain panicle^{-1} heavier grains and finally higher grain yield ha^{-1} than inbreed rice cultivars. Aktar et al. (2016) also reported that hybrid varieties exhibited superiority in respect of growth characters, yield and yield attributes such as plant height, tillers hill^{-1}, leaf area index, total dry matter hill^{-1}, weight of 1000 grains, biological yield over the inbred. Similar results were also reported by many researchers like Akram et al. (2007); Uddin et al. (2007), Maiti & Bhattacharya (2012) and Tanmoy (2012).

From the experiment it was found that straw yield also varied significantly among the tested varieties. Significantly higher straw yield (7.23t ha^{-1}) was recorded in 28P67 which was at par with 27P31, 27P37, 27P36 and 29P01 and the lowest straw yield (4.64t ha^{-1}) was with IET 4786 (Table.2). Similar results were reported by Singh & Bharadwaj (2007), these researchers suggested that hybrid variety gave more straw yield and other growth parameter than any inbreed variety.

Regarding harvest index (HI), it was found that all the hybrids gave higher HI over control variety HYV. Among the various tested hybrids, higher harvest index (49.65%) was noted in 28P67 and lower (48.19%) in ArizeTejgold. However, HYV IET-4786 recorded the lowest HI of 43.25% (Table 2). Similarly, Aktar et al. (2016) reported that hybrid varieties produced more harvest index over the inbred and average harvest index of hybrid genotype ranged between 46.5 and 53.0%. Hosain et al (2018) also found the same result i.e. highest harvest index was recorded by BRRI hybrid Dhan 3 (43.26%) over check variety BRRI Dhan 45.

Conclusion

There was a significant difference in crop performance between the hybrid varieties and HYV *Satabdi* (IET 4786). Hybrid varieties exhibited better growth over the HYV *Satabdi* (IET 4786). Rice hybrids also showed significantly higher grain yield and yield attributing characters like panicle m^{-2},filled grains panicle$^{-1,}$ test weight etc. Among the different rice hybrids, better growth and grain yield (7.13 t ha^{-1}) were obtained from 28P67 followed by 27P31 (6.83 t ha^{-1}) and 27P37 (6.63 t ha^{-1}) and the rice hybrid Arize Tejgold was poor performer. Similar trend was also found in case of stover yield and harvest index (HI).

Conflict of interest

All the authors would like to declare that there is no conflict of interest among themselves that could possibly arise.

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