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Evaluation of Some Transplanted AUS Rice Genotypes for Morphology, Yield and Disease Incidence

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Abstract:

The aim of the study was the evaluation of morphology, yield and disease incidence of 7 Aus rice genotypes (Chehrang Sub1, Shengyon 11-25, Shengyon 11-26, NERICA 10, Pariza, BU dhan1 and BRRI dhan48) typical of the Madhupur tract region in Bangladesh. All genotypes contained a significant variation in morphology and yield contributing characters. The magnitude of the reduction in yield was dependent on the

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morphology, varietals susceptibility to the disease and incidence of disease at which stage. All types of the diseases were not negatively correlated with grain yield. Grain quality traits were less affected by the disease treatments compared to the agronomic traits. The present study revealed that disease incidence at later stage cannot reduce yield as Shengyon 11-25 was mostly affected by Bacterial leaf streak but also produces the highest grain yield. And it can be said that disease incidence alone cannot reduce yield.

Key words: Rice genotypes, Morphology, Disease incidence, Yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is an important staple food of more than half of the world population. It is dominantly produced and consumed in the Asia. Since the beginning of civilization, thousands of rice cultuvars have been selected for increasing productivity (Singh *et al*., 2000). Manipulation of genetic resources has contributrd 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 utilization of hih yielding short satured 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 some but population has become manifold. The options available are to enhance yield of rice per unit area basis (Cassman *et al*., 2003) and development of rice cultivars with high yielding ability which can increasing production (IRRI, 1993). Producing varieties having resistance against biotic and abiotic stress by using conventional and modern biotechnological tools can increase rice yields to meet world requirement (Khush, 2005). The varieties have different physiological and morphological characteristics that contribute towards yield (Yang *et al*., 2007; Yang and Hwa, 2008). Yield of rice can be enhanced by improving fertilization, irrigation management and good pest and disease control. Genotype of a crop has a decisive role towards utilization of tthese resources and finally production of economic yield. Growth and yield characteristics of genotypes depends on genetic and environmental factors. Alam *et al*., (2008) reported that among production factors varietal selection at any location has an important role. Proper crop management depends on growth characteristics of various varieties to get maximum benefit from new genetic material.

For successful crop production knowledge of varietal morphological and physiological characteristics and so disease incidence is necessary. The objective of present study was to compare the growth and yield characteristics; and disease incidence in field of some Aus rice genotypes under condition of AEZ 12 (Madhupur Tract), Bangladesh. The finding of the experiment may be beneficial to researchers and farmers to manage particular genotypes for higher yield targets.

MATERIALS AND METHODS

Selected and disinfected seeds of seven Aus rice genotypes were soaked separately for 24 hours in cloth bags. Soaked seeds were wrapped with straw and gunny bag to increase the temperature for sprouting. Seven separate strips were made and sprouted seeds were placed on each strip @ 100 g seed per square meter.
The experiment was conducted at the experimental farm and Seed Technology laboratory of Banganabdhu Sheikh Mujibur Rahman Agricultural University, Bangladesh in a randomized complete block design (RCBD) with three replications. Seven Aus rice genotypes *i.e.* Chehrang Sub1, Shengyon 11-25, Shengyon 11-26, NERICA 10, Pariza, BU dhan1 and BRRI

dhan48 were randomized in plots of size 4.5 m x 3 m. 25 days old healthy seedlings (three seedlings hill^{-1}) were transplanted at separate strip of the experimental field. In each strip 15 cm x 15 cm spacing between plant to plant and row to row, respectively were maintained. Selective herbicide was applied one week after transplanting with manual herbicide spreader. Irrigation with regular interval was given to maintain 5-7 cm water up to hard dough stage of rice. Fertilizers were applied to the plots at the rate of 80.5, 50, 50, 18 and 3.6 kg ha^{-1} of N, P, K, S, Zn in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc oxide. The whole amounts of P, K, S and Zn were applied at final land preparation. Nitrogen fertilizer was applied in three installments, at 7, 21 and 33 days after transplanting.

Data on morphology and yield contributing characters were recorded by random destructive sampling method. Plant height, tillers hill^{-1}, dry matter accumulation and lodging (at maturity) were recorded at 30 days after transplanting (DAT), at 50% flowering and at maturity from randomly selected five hills of each genotypes of each plot. After maturity the selected 10 hills of each genotype of each plot were harvested to record yield contributing characters like number of effective tillers hill^{-1}, panicle length, grains number panicle^{-1}, number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1}, number of deformed grains panicle^{-1}, number of spotted grains panicle^{-1}, 1000 seed weight.

Data on disease incidence was recorded on random sampling method at three stages *viz.* 30 DAT, 50% flowering and at maturity. Selected 10 hills from each plot were tagged for recording the number of diseased tillers. Disease samples were collected and the associated pathogens were identified in the laboratory.

Disease incidence was calculated by the following formula

$$\%\text{Disease incidence (I)} = \frac{\text{Number of diseased tillers}}{\text{Total number of tillers}} \times 100$$

All data were subjected to statistical analysis by analysis of variance (ANOVA). Microsoft EXCEL and MSTAT-C program software programs were used wherever appropriate to perform statistical analysis. Means were separated using Duncan's Multiple Range Test (DMRT) at a significance level of 0.001, 0.01 and 0.05 (Gomez and Gomez).

RESULTS AND DISCUSSION

Morpho-physiological and yield contributing characters of Aus rice genotypes

Different genotypes showed significant variations in plant height, dry mater accumulation, days to flowering and maturity, lodging, number of effective tillers hill^{-1}, panicle length, number of filled grain panicle^{-1}, 1000 grain weight, grain yield, straw yield, biological yield and harvest index, germination, vigour, number of normal seedlings, number of non-germinated fresh seeds and fungal disease incidence in the field. The results also showed that genotypes had non-significant effect on panicle number, number of unfilled grains panicle^{-1}, number of deformed and spotted grains panicle^{-1}, number of abnormal seedlings, number of deformed seedlings, viability, dormancy, purity and on pure live seed.

Plant height is a complex character and is the end product of several genetically controlled factors mostly governed by the genetic make-up of the genotypes, generally depends on their number of internodes and length of internodes. In this experiment Shengyon 11-26 produced the tallest (82.13 cm) plant at 30 DAT, at 50% flowering stage the tallest (134.4 cm) plant was recorded in BU dhan1 and at maturity stage the tallest (136.6 cm) plant was recorded in Shengyon 11-25. The rate of increasing plant hieght was higher from 30 DAT to 50% flowering. The rapid increase of plant hieght was an indication of changing vegetative to reproductive phase of crop growth (Krishman *et al*., 2011). Pariza rice genotypes produced the shortest (65.36 cm at 30 DAT, 83.88 cm at 50% flowering and 87.47 cm at maturity) plant in almost all growth stages but it produced the highest number of total tillers hill^{-1} (10.00, 14.93 and 11.33) at 30 DAT, 50% flowering and maturity stage. It was observed that number of total tillers hill^{-1} increased from 30 DAT to 50% flowering in all genotypes but thereafter reduction took place due to dying of some tillers. That means the total number of tillers hill^{-1} become highest before panicle emergence stage and then declined or remained the same with advancing maturity. At the later growth stages food requirements in the panicle was higher and newly developed tillers did not get enough nutrients and ultimately dye.

In case of effective tillers hill^{-1} in all stages the highest (12.75) total number was recorded in Pariza and the lowest (6.42) was in NERICA 10. The variation observed among the genotypes was influenced by environmental and genetical factors. Results also revealed that number of effective tiller alone does not determine the high grain yield as Pariza genotypes produced highest number of effective tiller. But panicle length is an important factor for determining grain yield as shortest panicle length (18.76 cm) was recorded in Pariza producing lower yield (3.21 ton ha^{-1}). The findings are in agreement with those of Zafar and Ahmed (2004) who stated that longer panicles and greater number of grains panicle^{-1} ultimately contribute to higher yield.

Considering the characters of flowering and maturity Chehrang Sub1 took maximum days to first flowering and 50%

flowering (96 and 101 days) and NERICA 10 took maximum days to maturity (135 days) where Pariza took minimum days (64, 69 and 100 days) in all growth stages. The differences between first flowering to maturity was highest (52 days) at NERICA 10 and lowest (34 days) at Chehrang Sub1. At maturity maximum lodging (78.33%) was recorded in BRRI dhan48 and no lodging occurred in NERICA 10. Among the genotypes NERICA 10 was highly strought due to presence of maximum sclerenchyma tissue. The result revealed that lodging was not affected by days to flowering and maturity.

In case of dry matter accumulation significant differences were recorded in all growth stages. Chehrang sub-1 accumulated the highest dry matter (4.50 g $hill^{-1}$) at 30 DAT and (39.87 g $hill^{-1}$) at maturity where BU dhan1 at 50% flowering (28.11 g $hill^{-1}$). NERICA 10 accumulated the lowest dry matter (1.12 g $hill^{-1}$) at 30 DAT and (6.31 g $hill^{-1}$) at 50% flowering stage where Pariza at maturity (12.75 g $hill^{-1}$) . The rate of accumulation of dry matter was rapid in all genotypes. From 30 DAT to 50% flowering maximum accumulation of dry matter was recorded in BU dhan1 (22.35g) and from 50% flowering to maturity maximum accumulation of dry matter was recorded in Shengyon 11-25 (15.05g). It indicates that accumulation of dry matter at different growth stages does not affect on panicle number and panicle length.

The total number of filled grains $panicle^{-1}$ varied significantly. Shengyon 11-26 produced maximum number (142.6) of filled grains $panicle^{-1}$. On the other hand, number of unfilled grains $panicle^{-1}$, deformed grains $panicle^{-1}$ and spotted grains $panicle^{-1}$ did not vary significantly among the genotypes. Number of filled grains $panicle^{-1}$ is an important aspects for increasing grain yield as Shengyon 11-25 produced maximum number of filled grains and so produced highest grain yield (6.13 ton ha^{-1} at 12% moisture) .

Thousand seed weight, grain yield, straw yield, biological yield and harvest index were significantly influenced by the genotypes. 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. Shengyon 11-25 showed high productivity in terms of grain yield among the genotypes and it was mainly due to its maximum number of filled grain and also for its heaviest grains (0.03518 g individual seed weight at 12% moisture). It also produced the highest (7.41ton ha^{-1}) straw yield which leads to the highest biological yield (13.54 ton ha^{-1}) and harvest index (45.28%).

In all yield contributing charactersistics the co-efficient of variations (CV%) showed high value indicating high co-efficient of variability with high heritability for grain and straw yield per plant in rice. Similar result was presented by Shrirame and Muley (2003).

Table1: Morpho-physiological and yield contributing characters of Aus rice genotypes

Rice genotypes	Plant height at different stages (cm)			No. of tiller/hill			No. of effective tiller/hill		Panicle length (cm)	Days to first flowering	Days to 50% flowering	Days to maturity
	30 DAT	50% flowering	Maturity	30 DAT	50% flowering	Maturity	50% flowering	Maturity				
Chehrang Sub1	70.76 b	123.8 a	130.1 ab	8.70 ab	10.17 b	8.78 b	9.43 b	9.43 b	25.77 a	96 a	101 a	130 b
Shengyon 11-25	79.30 a	130.3 a	136.6 a	8.67 ab	8.88 bc	7.34 b	8.74 b	8.74 b	25.89 a	74 c	79 c	112 d
Shengyon 11-26	82.13 a	117.2 a	123.1 bc	7.45 b	9.50 b	8.57 b	8.80 b	8.80 b	26.33 a	76 c	79 c	114 c
NERICA 10	57.43 d	125.6 a	120.8 bc	3.33 c	6.60 c	5.33 c	6.42 c	6.42 c	24.26 ab	83 b	91 b	135 a
Pariza	65.36 c	83.88 b	87.47 d	10.00 a	14.93 a	11.33 a	12.75 a	12.75 a	18.76 c	64 d	69 d	100 e
BU dhan1	67.65 bc	134.4 a	135.9 a	9.56 a	9.56 b	8.13 b	8.94 b	8.94 b	26.85 a	95 a	100 a	130 b
BRRI dhan48	65.78 bc	114.3 a	115.1 c	7.22 b	8.76 bc	8.80 b	8.64 b	8.64 b	22.65 b	75 c	80 c	112 d
CV (%)	4.34	8.97	5.55	13.03	14.87	13.29	12.95	12.95	6.07	2.12	2.43	0.8
Level of significance	***	**	***	***	***	**	**	**	***	***	***	***

Rice Genotypes	% Lodging	Leaf dry weight (g $hill^{-1}$			Stem+Leaf sheath dry weight (g $hill^{-1}$)			Total dry matter (g $hill^{-1}$)		
		30 DAT	50% flowering	Maturity	30 DAT	50% flowering	Maturity	30 DAT	50% flowering	Maturity
Chehrang Sub1	30.00 b	1.89 c	9.01	13.68 a	2.61 a	17.33 a	26.19 a	4.50 b	26.34 a	39.87 a
Shengyon 11-25	66.67 a	2.76 ab	7.74	12.05 abc	3.32 a	13.80 ab	24.54 a	6.08 ab	21.53 ab	36.58 a
Shengyon 11-26	66.67 a	3.09 a	6.70	10.08 bcd	3.59 a	12.04 ab	19.10 b	6.69 a	18.74 ab	29.18 b
NERICA 10	0.0 c	1.12 d	6.31	8.85 d	1.45 b	10.41 b	13.71c	2.57 c	16.72 b	22.55 c
Pariza	0.0 c	2.02 c	6.31	8.66 d	2.59 a	9.78 b	11.86 c	4.62 b	16.09 b	20.52 c
BU dhan1	28.33 b	2.61 abc	9.94	12.75 ab	3.15 a	18.17 a	23.42 a	5.76 ab	28.11 a	36.16 a
BRRI dhan48	78.33 a	2.23 bc	5.94	9.21 cd	2.80 a	9.38 b	14.91c	5.04 ab	15.32 b	24.12 c
CV (%)	36.41	16.97	23.85	14.17	18.54	26.02	11.2	17.37	24.12	9.03
Level of significance	***	***	ns	**	**	*	***	**	*	***

Rice genotypes	1000 Seed weight (g)	No. of filled grains $panicle^{-1}$	No. of unfilled grains $panicle^{-1}$	No. of deformed grains $panicle^{-1}$	No. of spotted grains $panicle^{-1}$	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t ha^{-1})	Harvest Index (%)
Chehrang Sub1	25.31 d	103.6 b	25.1	6.67	9.83	3.65 c	5.72 bc	9.37 b	38.91 c
Shengyon 11-25	35.18 a	142.6 a	25.9	6.47	8.73	6.13 a	7.41 a	13.54 a	45.28 a
Shengyon 11-26	33.05 b	119.4 ab	26.73	7.17	9.2	5.82 ab	7.04 a	12.86 a	45.13 a
NERICA 10	29.64 c	63.13 cd	41.43	8.87	12.8	2.78 d	4.16 d	6.94 c	40.05 bc
Pariza	21.15 e	39.17 d	36.2	8.67	10.53	3.21 c	4.74 cd	7.95 bc	40.40 bc
BU dhan1	25.95 d	103.7 b	29.17	6.73	8.4	3.80 c	5.86 bc	9.66 b	39.67 bc
BRRI dhan48	28.40 c	96.20 bc	22.87	6.6	5.97	5.34 b	6.85 ab	12.19 a	43.79 ab
CV (%)	3.32	19.89	28.53	19.55	23.75	9.55	10.53	9.08	5.22
Level of significance	***	***	ns	ns	ns	***	***	***	*

Means followed by same letter(s) in a column are not significantly different by DMRT.

Disease incidence at different growth and development stages of Aus rice genotypes in the field

A total of five diseases were recorded in seven rice genotypes *viz.* Chehrang Sub1, Shengyon 11-25, Shengyon 11-26, NERICA 10, Pariza, BU dhan1 and BRRI dhan48. In order to prevalence they were bacterial leaf streak, blast, brown spot bacterial leaf blight and narrow brown spot. Of them bacterial leaf streak, blast and brown spot were taken into account for detailed studies. Incidence of other diseases was very low.

Bacterial leaf streak

The incidence of bacterial leaf streak disease of rice recorded at 30 DAT varied among the genotypes and ranged from 0 to 7.5%. Recorded incidence was 7.5% in both Shengyon 11-25 and Shengyon 11-26. Other genotypes were free from incidence of bacterial leaf streak up to 30 DAT.

The incidence recorded at 50% flowering differed widely among the genotypes and ranged from 0 to 35%. The highest incidence (35%) was observed in Shengyon 11-25. The incidence was 27.5% in Shengyon 11-26 and 7.5% in Pariza, respectively. In case of Chehrang Sub1, NERICA 10, BU dhan1 and BRRI dhan48 no incidence of brown spot was noticed.

At maturity the incidence ranged from 0 to 85%. The highest incidence (85%) was observed in Shengyon 11-25. The incidence was 77.5% in Shengyon 11-26 and 37.5% in Pariza, respectively. Incidence of bacterial leaf streak was nil in Chehrang Sub1, NERICA 10, BU dhan1 and BRRI dhan48 at maturity.

Blast

Considerable variation observed in blast incidence among the studied genotypes. At 30 DAT the blast incidence ranged from 0 to 12.5%. The highest incidence (12.5%) of blast disease was observed in Pariza. The incidence was 7.5% in Shengyon 11-25, NERICA 10 and BU dhan1. In case of Chehrang Sub1 and Shengyon 11-26, no incidence of blast was noticed.

At 50% flowering the incidence ranged from 0 to 17.5%. The highest incidence of 17.5% was recorded in Pariza and 12.5% in all other genotypes except Chehrang Sub1 and Shengyon 11-26.

At maturity stage the incidence ranged from 0 to 27.5%. The highest incidence of 27.5% was recorded in Pariza. The incidence was zero in Chehrang Sub1 and Shengyon 11-26 and 12.5% incidence was recorded in rest of the genotypes.

Brown spot

At 30 DAT the incidence ranged from 0 to 17.5%. The highest incidence of 17.5% brown spot disease was recorded in NERICA 10. The incidence was 2.5% in Chehrang Sub1 and 12.5% in Pariza, respectively. In case of Shengyon 11-25, Shengyon 11-26, BU dhan1 and BRRI dhan48 no incidence of brown spot was noticed at 30 DAT.

At 50% flowering the incidence ranged from 0 to 37.5%. The highest incidence of 37.5% was recorded in NERICA 10, while the incidence was 17.5% in Chehrang Sub1 and 17.5% in Pariza, respectively. In case of Shengyon 11-25, Shengyon 11-26, BU dhan1 and BRRI dhan48 no incidence of brown spot was noticed.

At maturity stage incidence ranged from 0 to 37.5%. The highest incidence of 37.5% was recorded in NERICA 10, while it was 17.5% in Chehrang Sub1 and 22.5% in Pariza, respectively. In case of Shengyon 11-25, Shengyon 11-26, BU dhan1 and BRRI dhan48 no incidence of brown spot was noticed.

We have a good idea of what diseases affect rice, but we do not always have a clear picture of where individual or groups of diseases occur and how much effect they have on rice yield. A production situation is a combination of physical and genetical factors that influence rice production.

The magnitude of the reduction was dependent on the varietals susceptibility to the disease and incidence of disease at which stage. All types of the diseases were not negatively correlated with grain yield. Grain quality traits were less affected by the disease treatments compared to the agronomic traits. The present study revealed that disease incidence at later stage can not reducce yield as Shengyon 11-25 was mostly affected by Bacterial leaf streak but also produces the highest grain yield.

Table 2. Disease incidence (%) at different growth and development stages of different Aus rice genotypes in the field

Rice genotypes	Bacterial leaf streak			Blast			Brown spot		
	30 DAT	50% flowering	Maturity	30 DAT	50% flowering	maturity	30 DAT	50% flowering	maturity
Chehrang Sub1	0	0	0	0	0	0	2.5	17.5	17.5
Shengyon 11-25	7.5	35	85	7.5	12.5	12.5	0	0	0
Shengyon 11-26	7.5	27.5	77.5	0	0	0	0	0	0
NERICA 10	0	0	0	7.5	12.5	22.5	17.5	37.5	37.5
Pariza	0	7.5	37.5	12.5	17.5	27.5	17.5	22.5	22.5
BU dhan1	0	0	0	7.5	12.5	17.5	0	0	0
BRRI dhan48	0	0	0	2.5	12.5	12.5	0	0	0

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