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RESEARCH ARTICLE

Evaluation of grain density, yield and agronomic characters in some selected rice (*Oryza sativa* L.) genotypes

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Abstract: Rice (*Oryza sativa* L.) is the most important food crop of the developing world and belongs to family Poaceae (Graminae). This experiment was conducted at Regional Rice Research and Development center, Bombuwala with the objective of evaluating grain density, yield and agronomic characters of some selected rice genotypes with five new breeding lines and five improved varieties. The new breeding lines 09-892, 09-897, 03-1198, 09-1054-1, 09-1063-3 and the improved varieties Bg 358, Bg 359, Bw 363, Bw 364 and At 362 were cultivated in randomized complete block design with three replicates. After land preparation, the field layout was prepared and then the seeds were broadcasted. Observations of yield and agronomic characters were taken at their corresponding stages of the plant. The variety Bw 364 and 09-1063-3 new breeding line had significantly long culm length and panicle length than other varieties. But 09-892 breeding line with intermediate culm showed a lodging problem in the field. New breeding line of 09-1054-1 showed early flowering than other varieties and it deviated from 3½ month aged group flowering. New breeding line of 09-892, 09-897 and 09-1054-1 took shorter time for maturity. The variety Bw 364 (2.6 g) had significantly higher hundred seed weight than other varieties. Numbers of spikelets/panicle did not vary significantly with treatments in the experiment. The variety At 362 (16.3%) and the new breeding lines 09-897 (25.6%), 03-1198 (26.3%) had the lowest spikelet sterility percentage and Bw 363 (40%) showed the highest spikelet sterility percentage in the trial. High density grain percentage significantly varied among the tested genotypes ranging from 45 to 68%. The highest high density grain percentage was shown by Bg 358, Bg 359, Bw 364, At 362,09-892,09-897 while 03-1198 and 09-1054-1 had the lowest high density grain percentage. Among the improved varieties, Bw 364 (5.3 t/ha) and At 362 (5.1 t/ha) showed the highest yield in the trial whereas the new breeding lines 03-1198 (4.1 t/ha) showed the highest yield. Hence, 03-1198 new breeding line can be selected for adaptability tests and it promises to proceed in the varietal selection programme to become a recommended variety.

Keywords: Grain density, Grain yield, *Oryza sativa* L., Agronomic characters

Introduction

Rice (*Oryza sativa* L.) is one of the world's main staple crops with nearly 2.5 billion people depend on it as their main food (FAO, 2004). Today, increasing rice production has become a major goal because world population is increasing very rapidly. With the assumption of constant annual population growth rate of 1.2% and the annual per capita consumption of 100kg of rice, the total rough Rice requirement to satisfy the demands in years 2005, 2010 and 2020 are estimated to be 3.23, 3.46 and 3.83 million Mt, respectively (Abeysiriwardena, 2003). The main contributory factor for increasing rice production is the high yielding rice varieties. During the past three decades, plant breeders have greatly contributed to the development of high-yielding crop varieties to meet the food needs of the growing population. The ultimate goal of crop breeding is to develop varieties with high yield potential and desirable agronomic characteristics.

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In rice breeding, the most important qualities sought by breeders have been high yield potential, resistance to major diseases and insects, and improved grain and eating quality. Then identification of rice varieties with high yield, yield and agronomic characteristics is an important aspect. Some physiological studies have reported the possibility of increasing grain yield potential through increase in the number of high density (HD) grains. Studies in the plant physiology department of IRRI (International Rice Research Institute) in the past years showed the possibility of increasing grain yield potential through increase in the number of high density grains (Vergara et al, 1990). Varieties differ in the number of HD grains per panicle. Hence, if we have an ability to identify rice varieties with highest HD grain % there is an ability to increase the grain yield of rice. Therefore, selection for varieties with highest HD grain percentage is useful to increase the rice yield.

Materials and Methods

New breeding lines 09-892, 09-897, 09-1054-1, 09-1063-3, 03-1198 and improved varieties Bw 363, Bw 364, Bg 358, Bg 359, At 362 were used as experimental materials. The design used for the experiment was Randomized Complete Block Design with three replicates. The plot size in this experiment was 6 m x 3 m. The seeds of relevant varieties were soaked, incubated and then sprouted seeds were broadcasted. For data collection, plants were selected randomly from each plot in each replicate. Observations of yield and agronomic characters were made at corresponding stages of the plant. To evaluate grain density, samples of 20 g from the whole plot harvest were used. A solution with 1.2 specific gravity (SG) was prepared using sodium chloride using tap water and each sample was placed in this solution separately and stirred. Floating grains were taken out with a plastic mesh and pressed with finger to identify chaff and partially filled. At 1.2 specific gravity level, the submerged grains were counted and they were considered as high density grains. According to the Complete Randomized Block Design (RCBD), analysis of variance was done at 0.05 significant levels by using SAS package (v6.12).

$$\text{High density grain\%} = \frac{\text{Number of grains submerged in 1.2 SG level}}{\text{Total Number of grains (20 g)}} \text{X } 100$$

Results and discussion

Table 01. Agronomic and Yield characters of selected Rice genotypes

Variety	CL (cm)	PL (cm)	TPH (cm)	DF (days)	DM (days)	SW (g)	SS (%)	PW (g)	GY (t/ha)	HD (%)
Bg 358	88.13^{a}	22.53^{cd}	110.67^{b}	74^{ab}	103^{a}	1.67^{e}	33.01^{abc}	19.57^{e}	3.39^{dc}	61.36^{a}
Bg 359	85.53^{b}	22.87^{bcd}	108.2^{b}	69.6^{b}	96^{b}	2.2^{dc}	28.37^{bc}	30.83^{abc}	4.69^{ab}	67.48^{a}
Bw 363	66.5^{f}	22.23^{de}	88.733^{e}	69.67^{b}	96^{b}	2 .2^{dc}	40.03^{a}	25.87^{cde}	3.58^{bdc}	51.62^{bc}
Bw 364	97.9^{a}	24.33^{a}	122.7^{a}	74^{ab}	96^{b}	2.6^{a}	34.37^{ab}	26.76^{bcde}	5.34^{a}	61.81^{a}
At 362	70.3^{e}	24.07^{ab}	94.5^{d}	73.5^{ab}	103^{a}	2.3^{bc}	16.37^{dc}	30.13^{abcd}	5.16^{a}	66.35^{a}
09-892	80.5^{c}	21.03^{e}	101.2^{c}	69.75^{b}	92^{c}	2.17^{dc}	29.65^{abc}	31.68^{abc}	2.63^{d}	65.24^{a}
09-897	76.1^{d}	18.27^{f}	94.4^{d}	69.67^{b}	92^{c}	2.43^{ab}	25.61^{dc}	34.25^{ab}	2.83^{d}	66.85^{a}
03-1198	85.26^{b}	23.83^{abc}	109.1^{b}	74^{ab}	96^{b}	2.43^{ab}	26.37^{dc}	37.36^{a}	4.16^{bac}	62.49^{a}
09-1054-1	74.6^{d}	23.27^{abcd}	98^{cd}	63.33^{c}	90^{c}	1.27^{f}	33.74^{abc}	22.397^{de}	2.4^{d}	45.28^{c}
09-1063-3	96.26^{a}	24.63^{a}	120.87^{a}	75^{a}	103^{a}	2.1^{dc}	28.35^{bc}	24.68^{cde}	3.5^{bdc}	59.27^{ab}

*Means within a column with the same letters are not significantly different at 5% level

(CL=culm length, PL=panicle length, TPH=total plant height, DF=days to 50% flowering, DM=days to maturity, SW=seed weight, SS=spikelet sterility, PW=panicle weight, GY=grain yield, HD=high density grain%)

Analysis of Variance was performed on agronomic characters such as culm length, panicle length and plant height showed that they significantly varied among the tested verities (Table 01). The highest culm length, panicle length and total plant height were shown by Bw 364 and 09-1063-3 and they were not significantly different from each other. The variety Bw 363 had the lowest culm length, panicle length and total plant height. New breeding lines, 09-92 and 09-897 which had intermediate culm length showed lodging in the field. Chang and Bardenas (1965) had observed that prompt emergence and rapid growth were generally desired in commercial varieties, particularly those designed for direct seeding. The highest number of days to 50% flowering was recorded in the variety 09-1063-3 (75 days). Days to maturity of Bg 358, At 362 and 09-1063-3 were highest and they were not significantly different from each other. In new breeding lines 09-892, 09-897 and 09-1054-1 days to maturity was lowest. When yield characters were considered, the highest hundred-grain-weight was shown by Bw 364 (2.6g) and that of the lowest was shown by 09-1054-1(1.27g) new breeding line. In this experiment, number of spikelets/panicle did not significantly vary with treatments. The highest spikelet sterility percentage (40%) was shown by Bw 363.The lowest spikelet sterility percentage was shown by At 362 (16.3%), 09-897 (25.6%) and 03-1198 (26.3%). New breeding line 03-1198 had highest panicle weight (37.3g) whereas Bg 358 (19.7g) had the lowest. Panicle weight among Bg 358, At 362, 09-892, 09-897 and 03-1198 did not significantly differ from each other. Improved varieties Bw 364 (5.3 t/ha), At 362 (5.1 t/ha) and new breeding line 03-1198 (4.1 t/ha) showed the highest yield in the trial. The yield among Bw 364, At 362, Bg 359 and 03-1198 were not significantly different from each other. Grain yield in the experiment varied between 2.4 - 5.4 t/ha. Matsushima, 1980 showed that the number of spikelets per panicle was the major yield component when the number of panicle per plant was high and the number of spikelets per panicle is low in that plant. The 100 grain weight depends on the grain size, which is controlled by the size of the hull. Thus, a grain is not grown to a size greater than that permitted by the hull. Favorable weather conditions and the supply of nutrients do not change the grain size. However, it is subjected to slight modifications by solar radiation during the two weeks before anthesis (Yoshida, 1981).

Conclusion

As it is evident from the results, the new breeding line 03-1198 shows better yield characters than other new breeding lines and some improved varieties such as Bg 358 and Bw 363.The new breeding line 03-1198 can therefore, be selected for adaptability tests and it shows a promise to proceed in the varietal selection program and become a recommended variety.

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