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Physiological characterization of rice (*Oryza sativa* L) genotypes

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Abstract
Physiological characterization of eleven rice (*Oryza sativa* L) genotypes was studied in Rabi 2021-22. Data on morpho-phenological traits, growth analysis parameters and yield and yield attributes were recorded. Results revealed that genotypes MTU 1121 and MTU 1153 had higher yields among all the tested genotypes. These genotypes also had higher Specific leaf weight at flowering and higher Crop growth rate at 0-30 DAT, 30-60 DAT and 60 DAT-harvest. Higher number of grains per panicle and higher test weight was noted in MTU 1153. Higher number of grains per panicle and leaf area was recorded in MTU 1121. These genotypes also had a higher biomass production.

Keywords: Rice, grain yield, growth analysis, SLA, SLW

Introduction
Rice is a major cereal crop feeding more than half of the world's population (Molina *et al*., 2011) [1]. There is an emerging gap between the demand of rice for consumption and the production of rice. The over growing population is creating pressure for increase in rice production. The cultivars grown presently have reached a yield plateau. So, breaking the present level of yield plateau in rice crop through physiologically efficient plant types is quite essential.

Plant growth analysis is required to understand the differences in plant growth in terms of differences between genotypes growing under same environmental condition in relation to their yield. Yield is a very complex trait governed by a large number of QTLs as well as influenced by environmental factors (Zhang *et al*., 2017) [2]. The traits that indirectly determine the yield include plant height, number of tillers per plant, number of panicles, number of grains per panicle, panicle length and 1000 grain weight (Sakamoto and Matsuoka, 2008; Huang et al., 2013) [3, 4].

Characterization of pre-release and released cultures for their source and sink components is needed in order to assess their physiological efficiency. Knowledge on the performance of grain yield and physiological traits is essential to understand the main yield-limiting factor and make strategies for breeding and crop management in rice (*Oryza sativa* L.). Keeping this in view, this experiment was designed to identify physiologically efficient rice genotypes with high yield potential.

Material and Methods
The experimental material comprised of eleven genotypes viz., (MTU 1001, MTU 1010, MTU 1121, MTU 1153, MTU 1156, MTU 1210, MTU 1224, MTU 1282, MTU 1290, MTU 1341 and MTU 3626) laid down in Randomized Block Design in three replications. The experiment was taken up in *Rabi* 2021-22 at Regional Agricultural Research Station, Maruteru. The plot size for each replication was 20 m2 and the spacing of 15x15 cm was maintained. All the cultural operations and plant protection measures were carried out as per the schedule.

Data at flowering stage was recorded on plant height (cm), Tiller number per m2 and leaf area (cm2). Days to 50% flowering was noted on plot basis. Growth analysis parameters i.e., Crop Growth rate (CGR) and Relative Growth Rate (RGR) expressed in (g/m2/day) and (g/g/day) respectively at 3 intervals (0-30 DAT, 30-60 DAT and 60 DAT- harvest). At flowering stage Specific leaf area (SLA) and Specific leaf weight (SLW) were recorded and expressed in (cm2/mg) and (mg/cm2) respectively. Grain yield and yield attributes such as panicle number/hill, grain number per panicle, 1000 grain weight and Biomass was recorded. Harvest index was further computed.

Results and Discussion

Physiological characterization of eleven selected rice genotypes was tested in this study. Morphological trait, plant height was recorded at flowering. The mean plant height of all the genotypes was 108 cm and it ranged from 92 cm (MTU 3626) to 120 cm (MTU 1156). The mean tiller number per hill was 12 and the variability between genotypes for this trait was very low. The mean leaf area of all the genotypes was 30.4 cm^2. It was maximum in MTU 1121 (36.1 cm^2) and MTU 115 (33.9 cm^2). The days to 50% flowering ranged from 88 days in MTU 1010 to 96 days in MTU 1282. (Table 1)

The Crop growth rate increased from 0-30 DAT to 30- 60 DAT and thereby reduced at 60-harvest. Maximum CGR at 0-30 DAT, 30-60 DAT and 60-harvest was noted in MTU 1121 (3.55, 21.5 and 20.14 respectively) and MTU 1153 (3.2, 20.5, 19.5 respectively). The mean relative growth rate reduced from 0-30 DAT to 60-harvest. Maximum RGR at 0-30 DAT and 60-harvest was noted in MTU 1121 (0.072 and 0.019 respectively) and MTU 1153 (0.071 and 0.02 respectively). At 30-60 DAT it was noted in MTU 1290 (0.045) and MTU 1341 (0.041) (Table 2)

Specific leaf area at flowering ranged from 0.21 cm^2/mg to 0.35 cm^2/mg. Maximum SLA was noted in MTU 3626 (0.35 cm^2/mg) and MTU 1210 (0.28 cm^2/mg). Specific leaf weight at flowering ranged from 2.83 mg/cm^2 to 4.86 mg/cm^2. Maximum SLW was noted in MTU 1153 (4.86 mg/cm^2) and MTU 1224 (4.38 mg/cm^2) (Table 2).

Among the genotypes tested, the differences for yield and yield attributes were statistically significant except for panicle number per hill (Table 3). The grain number per panicle was highest in MTU 1153 (256) followed by MTU 1210 (248). Test weight was maximum in MTU 3626 (24.8 g) followed by MTU 1224 (23.8 g). Among all the tested genotypes, MTU1121 (7250 kg/ha) and MTU 1153 (7110 kg/ha) recorded highest yields (Table 3). Highest biomass was noted in MTU 1153 (9990 g/m2) followed by MTU 1341(9960 g/m2) and MTU 1121 (9850 g/m2). Harvest index ranged from 40.3% (MTU 1341) to MTU 1290 (45.2%).

Growth analysis is a quantitative approach for determining the nature of genotype x environment interactions on plant growth and development. It has been stated that the yield potential in rice crop is closely related to crop growth rate (CGR) particularly in the late reproductive period (Takai *et al*., 2006) [5]. In this study, a higher CGR was maintained by MTU 1121 and MTU 1153 which were even high yielding genotypes among the tested entries. It has been reported that specific leaf weight (SLW) can be taken as selection trait for high yield (Luo, 1979) [6]. In this study too the high yielding genotypes had a higher SLW. It has been reported that leaves with lower SLA and or higher SLW are thicker (Amanullah, 2015) [7] and leaf thickness plays an important role in leaf and plant functioning of resource acquisition and utilization (Vile *et al*., 2005) [8]. It was reported that the grain yield could be increased in cereals either by increasing the biomass production or harvest index or both (Yoshida, 1981) [9]. Results herein demonstrated that dry matter production greatly was higher in both MTU 1153 and MTU 1121 that also had higher yields. It has been reported that increase in biomass in modern rice cultivars was associated with enhancement of physiological traits such as leaf area and photosynthesis (Zhang *et al*., 2013) [10]. Similarly in our study also higher leaf area was noted in both MTU 1121 and MTU 1153.

Table 1: Studies on Morpho-Phenological traits of selected rice genotypes

Entry	Flowering stage			Phenological parameters
	Plant height (cm)	Tiller number per hill	Leaf area (cm^2)	Days to 50% flowering
MTU 1001	112	12	28.7	92
MTU 1010	108	12	26.0	88
MTU 1121	111	12	36.1	95
MTU 1153	115	13	33.9	89
MTU 1156	120	11	32.6	89
MTU 1210	115	13	26.1	92
MTU 1224	101	12	31.9	95
MTU 1282	100	11	31.7	96
MTU 1290	98	12	32.6	89
MTU 1341	111	12	22.7	91
MTU 3626	92	13	31.8	95
Mean	108	12	30.4	95
LSD (V)	6.5	NS	11.6	4.0
CV (%)	4.9	7.2	5.2	2.0

Table 2: Studies on Growth analysis parameters of selected rice genotypes

Entry	Growth Analysis parameters							
	CGR (g/m2/day)			RGR (g/g/day)			Specific Leaf Area (cm2/mg)	Specific Leaf Weight (mg/cm2)
	0-30	30-60	60-har	0-30	30-60	60-har	At flowering	
MTU 1001	3.12	18.56	17.21	0.062	0.038	0.010	0.24	4.17
MTU 1010	2.56	20.12	18.52	0.058	0.030	0.012	0.27	3.76
MTU 1121	3.55	21.5	20.14	0.072	0.038	0.019	0.23	4.32
MTU 1153	3.20	20.5	19.5	0.071	0.035	0.020	0.21	4.86
MTU 1156	2.89	15.67	14.56	0.068	0.030	0.018	0.26	3.80
MTU 1210	2.68	16.12	13.56	0.068	0.028	0.017	0.28	3.59
MTU 1224	2.14	19.51	14.56	0.059	0.025	0.015	0.23	4.38
MTU 1282	2.15	18.51	14.58	0.064	0.030	0.018	0.25	4.06
MTU 1290	2.26	17.89	14.21	0.055	0.045	0.018	0.24	4.13
MTU 1341	2.14	19.12	15.22	0.054	0.041	0.012	0.27	3.68
MTU 3626	2.10	13.55	10.59	0.051	0.022	0.011	0.35	2.83
Mean	2.62	18.28	15.70	0.062	0.033	0.015	0.26	3.96
LSD (V)	1.5	3.12	2.1	0.004	0.003	0.001	0.1	NS
CV (%)	7.5	10.2	8.4	5.9	4.8	6.5	6.5	5.6

Table 3: Studies on Yield and yield attributes of selected rice genotypes

Entry	At Harvest					
	Panicle number /hill	Grain number/ panicle	1000 grain wt (g)	Grain yield (kg/ha)	Biomass (g/m2)	Harvest index (%)
MTU 1001	13	150	22.5	6120	8990	40.5
MTU 1010	12	138	22.1	6550	8750	42.8
MTU 1121	12	215	19.0	7250	9850	42.3
MTU 1153	10	256	22.5	7110	9990	41.5
MTU 1156	11	222	22.9	7070	8590	45.1
MTU 1210	12	248	16.8	6920	8740	44.1
MTU 1224	10	232	14.2	6890	8770	43.9
MTU 1282	12	180	16.3	6552	8960	42.2
MTU 1290	13	130	21.6	6980	8440	45.2
MTU 1341	12	168	23.5	7040	9960	40.3
MTU 3626	13	124	24.8	6440	9450	40.5
Mean	12	188	20.6	6811	9135	42.6
LSD (V)	NS	30.5	1.8	1215	574	1.9
CV (%)	4.8	10.5	3.9	14.6	18.5	8.6

Conclusion

In this study, MTU 1121 and MTU 1153 recorded higher yields and this could be attributed to a higher number of grains per panicle and higher test weight in MTU 1153, whereas in MTU 1121 due to a higher number of grains per panicle and leaf area. Higher SLW and CGR at all the stages was also noted in these two genotypes.

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