

Field Performances of Some Sri Lankan Traditional Rice Cultivars at Reproductive Growth Phase

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Abstract

Thousands of traditional rice cultivars conserved in plant genetic resource center (PGRC), Gannoruwa, Sri Lanka can be used to manipulate the genetic constitution of modern rice cultivars by conventional breeding programs or by gene transformation. Evaluation of agronomic, yield and yield attributing characters of these cultivars would lead to understand the possibility of utilization of these cultivars in local agricultural systems. Twenty Sri Lankan traditional rice cultivars were transplanted in the field at Faculty of Agriculture, Mapalana in 2012 *Maha* season. The experiment was carried out according to the randomized complete block design with three replicates and 20 plants per replicate with 15 cm X 20 cm spacing. Days to flowering, plant height, number of tillers, number of fertile tillers, filled grain percentage, 100 grain weight and yield per plant were evaluated at the reproductive stage. *Muthumanikam* recorded the highest average plant height (184 cm) and *Yakada Wee* recorded the lowest average plant height (95 cm) at reproductive stage. *Kalukanda* recorded the highest number of tillers per plant (7). *Yakada Wee*, *Thawalu*, *Rathkara* and *Masuran* recorded 3 tillers per plant. According to IRRI standard system, 75% of rice cultivars evaluated were very tall and 70% of rice cultivars were low tillering. There was a correlation ($r = 0.452$) between days to maturity and plant height at 0.05% probability level.

Key words: Traditional rice cultivars, Submergence tolerance, Agronomic characteristics, Sri Lanka

Introduction

Rice is a popular cereal crop commonly used as human food. Rice production is intensely depend on rainfall and irrigation throughout the cultivation seasons. In Sri Lanka the principal rice cultivation season, known as "*Maha*", is from October to March and the subsidiary cultivation season, known as "*Yala*", is from April to September. The availability of water for rice cultivation depends on the rice cultivating season. North east monsoon brings enough rainfall during *Maha* season, but in *Yala* only a part of the country is receiving sufficient rainfall and able to cultivate rice. Further, rice lands are distributed in low land flood plains, salinized coastal belts and in upcountry undulated terraces while some rice lands are bog, half bog or alluvial in soil type. Rice cultivars with diverse characteristics are needed for an efficient land use in Sri Lanka.

Seventy percent of paddy lands in Sri Lanka are cultivated with short duration (3 - 3 ½ month) rice

cultivars while 20% lands are cultivated with 4 - 4 ½ month cultivars. Supply of water is the main factor for cultivation of long term varieties. To escape drought season, short duration varieties are very much important. Further short duration rice cultivars are comparatively higher in the water use efficiency (Rajapakse *et al.*, nd).

Other than water availability, several other characteristics of rice cultivars such as photoperiodism, growth duration, height, tillering, filled grain percentage, pest and disease resistance affect the yield stability in rice. Moreover, stress tolerance (drought, flood, adverse soils, and adverse temperatures) are also important factors to consider (Coffman *et al.*, 1989).

Characteristics in different growth stages are very much important in determining yield of rice. The

length of vegetative growth phase of rice determines the growth duration of cultivars. Some very-early maturing cultivars have a shortened vegetative growth phase, while others have both shortened vegetative and reproductive growth phases. Panicle initiation (PI) may occur before the maximum tiller number is reached in very-short duration and some short-duration cultivars. Heading in these cultivars may be staggered due to later tillers which produce panicles. In long duration cultivars, the maximum tiller number is reached and followed by a long vegetative phase before panicle initiation (PI) occurs (Moldenhauer and Nathan Slaton., 2011).

The tillering ability of modern cultivars is very high under optimal conditions and they produce a larger number of smaller panicles than that of low tillering types. During a serious drought, such high tillering cultivars often give no yield or little grain but traditional cultivars may be able to fill their smaller number of panicles and produce a reasonable yield under such

conditions (Coffman *et al.*, 1989). Therefore, the environmental conditions appear to influence greatly for the degree of tillering. According to IRRI Standard Evaluation System (SES) tillers are classified into five groups as very high (more than 25 tillers / plants), good (20 - 25 tillers/plant), medium (10 -19 tillers/plant), Low (5 - 9 tillers/plant), and very low (less than 5 tillers) (IRRI, 1996)

Reduced plant height is the most economical trait of the modern rice cultivars which improves the harvest index. This represents the ability of the plant to remain standing under heavy doses of nitrogen fertilizer. Although most of the new cultivars released by national rice programs continue to be semi-dwarf, there was a trend to develop intermediate or tall types (Coffman *et al.*, 1989). However, plant height was divided into three groups by IRRI SES as semi-dwarf (less than 110 cm), intermediate (110 - 130 cm) and tall (more than 130 cm) (IRRI, 1996).

Table 1. Details of twenty Sri Lankan traditional rice cultivars used for this experiment

No	PGRC Accession Number	Cultivar Names	Days to Maturity	Plant Height (cm)	No of Tiller/plant	No. of Fertile Tillers	Yield/ Plant (g)	100 Grain Weight
1	3695	<i>Kahata Samba</i>	3	149	4	3	1.97	2.21
2	3713	<i>Kalukanda</i>	3	160	7	5	7.23	2.12
3	3445	<i>Yakada Wee</i>	3	95	3	2	2.31	2.23
4	3387	<i>Kahata Wee (Long Grain)</i>	3	157	4	4	8.68	2.04
5	3197	<i>Nanduheenati</i>	3	157	5	4	4.59	2.39
6	3071	<i>Polayal</i>	3	124	6	5	1.83	1.83
7	3158	<i>Kalubala Wee</i>	3	120	6	5	3.63	2.14
8	3132	<i>Heenati 309</i>	3	122	4	3	1.55	2.22
9	3684	<i>Rathkara</i>	3	118	3	3	2.51	2.51
10	3672	<i>Mudaliwi</i>	3	127	4	4	1.20	1.91
11	3388	<i>Moddai Karuppan</i>	3 1/2	143	5	4	3.14	2.67
12	3407	<i>Dewaraddiri</i>	3 1/2	160	4	4	6.91	3.20
13	3634	<i>Thavalu</i>	3 1/2	164	3	3	2.31	2.60
14	3692	<i>Handiran</i>	3 1/2	147	4	3	3.89	2.17
15	3645	<i>Muthumanikam</i>	3 1/2	184	4	4	3.95	2.07
16	3647	<i>KaluGires</i>	3 1/2	169	6	4	1.43	2.20
17	4563	<i>Mari Juwana</i>	3 1/2	99	4	3	4.21	1.49
18	3472	<i>Masuran</i>	3 1/2	141	3	3	3.64	2.51
19	3487	<i>Palasithari 601</i>	3 1/2	132	4	3	6.41	2.27
20	3391	<i>SinnaKaruppan BG 379/2</i>	3 1/2	142	4	3	4.36	2.70
				99	8	7	26.5	3.2

Agronomic characters of a rice variety are very much related to its economic value. This study was aimed to classify some traditional rice cultivars according to their agronomic characters.

Materials and Methods

Twenty Sri Lankan traditional cultivars were collected from Plant Genetic Resource Center, Gannoruwa and one modern rice cultivar, BG 379/2 was also used for this study as a reference source. Seeds were germinated and planted in trays and two-week-old seedlings were transplanted in the paddy field at Faculty of Agriculture, Mapalana in Maha, 2012. Experiment was designed in a randomized complete block design with three replications and 20 plants were included in each plot. Plants were established in rows with 15 cm X 20 cm spacing. Recommended fertilizer doses were applied during the growth season.

Data were collected on plant height (cm), number of tillers per plant, number of reproductive tillers and unfertile tillers per plant, panicle length (cm), panicle weight, filled grain percentage, 100 grain weight (g), filled grain weight per plant (g), harvest index and biomass per plant at reproductive stage. The average value of some traditional rice cultivars were measured as given in Table 1.

Results and Discussion

According to the days to maturity all the cultivars were spanning either three months or three and half months. Plants were categorized using IRRI standard evaluation system (IRRI 1996) as given in Table 2. Out of all 10% of cultivars, belonged to < 110 cm height group. Twenty five percent of rice cultivars were in 110 -130 cm height group and 65% of cultivars were in > 130 cm height group. *Muthumanikam* recorded the highest average plant height (184 cm) and *Yakada Wee* recorded the lowest average plant height (95 cm) at reproductive stage.

With respect to the total numbers of tillers per plant, 30% of cultivars produced between 5 – 9 tillers/plant and 70% produced less than 5 tillers/plant. *Kalukanda* recorded the highest number of total tillers (7 tillers) and five reproductive tillers per plant. *Yakada Wee*, *Thawalu*, *Rathkara* and *Masuran* recorded lower number of total tillers per plant (3 tillers/plant). Out of these cultivars, all the tillers produced by *Kahata Wee* (4 tillers), *Rathkara* (3 tillers), *Mudaliwi* (4 tillers), *Dewaraddiri* (4 tillers), *Tahawalu* (3 tillers), *Muthumanikam* (4 tillers) and *Masuran* (3 tillers) (35%) were reproductive tillers. This value is significantly lower than that of the value recorded in reference improved rice cultivars Bg 379/2 which produced around 7 reproductive tillers per plant. Of all evaluated cultivars, 50% of the rice cultivars identified

Table 2. Cultivars categorized into groups based on plant height

Characters	Plant Height (cm)	Cultivars
Semi-dwarf	< 110	<i>Yakada Wee</i> , <i>Mari Juwana</i>
Intermediate	110-130	<i>Polayal</i> , <i>Kalubala Wee</i> , <i>Heenati 309</i> , <i>Rathkara</i> , <i>Mudaliwi</i>
	>130	<i>Kahata Samba</i> , <i>Kalukanda</i> , <i>Kahata Wee (Long Grain)</i> , <i>Nanduheenati</i> , <i>Moddai Karuppan</i> , <i>Dewaraddiri</i> , <i>Thavalu</i> , <i>Handiran</i> , <i>Muthumanikam</i> , <i>Kalu Gires</i> , <i>Masuran</i> , <i>Palasithari</i>
Tall		<i>601</i> , <i>Sinna Karuppan</i>

with less than three reproductive tillers per plant at reproductive growth stage. According to SES (IRRI, 1996), none of the rice cultivars belonged to very high, good and medium reproductive tillers/plant categories (Table 3).

Average yield per plant varied between 1.20 g and 8.68 g among 20 traditional rice cultivars. Twenty percent of rice cultivars recorded the yield more than 6 g/per plant. Those were *Kalukanda* (7.23 g), *Kahata Wee* (8.68 g), *Dewaraddiri* (6.91 g) and *Palasthari 601* (6.41g).

There was a correlation between plant height ($r = 0.452$) and days to maturity. Days to maturity did not correlate with other parameters such as number of tillers/plant, number of fertile tillers/plant, yield/plant, filled grain percentage and 100 grain weight.

These cultivars were very diverse in plant height as semi-dwarf, intermediate and tall. Among evaluated cultivars 75% of rice cultivars were very tall; those tend to be lodging. Seventy percent of the cultivars were very poor in tillering which resulted in a less yield. *Kahatawee* was the best high yielding cultivar among these twenty traditional rice cultivars.

Acknowledgements

Authors would like to acknowledge NRC Sri Lanka for financial support and PGRC, Gannoruwa, Sri Lanka for traditional rice seed materials.

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Table 3. Cultivars categorized into groups based on plant height

Characters	Number of tillers/plant	Cultivars
Very high	>25	0
Good	20-25	0
Medium	10-19	0
Low	5-9	<i>Kalukanda, Nanduheenati, Polayal, Kalubala Wee, Moddai</i> <i>Karuppan, KaluGires</i> <i>Yakada Wee, Kahata Wee (Long Grain), Kahata Samba, Heenati 309, Rathkara, Mudaliwi, Mari Juwana, Masuran, Palasthari 601, Sinna Karuppan, Dewaraddiri, Thavalu, Handiran, Muthumani kam</i>
Very low	<5	