Fertilizer Response of Traditional Rice Cultivars with Different Maturity Durations

U.G.S. Amarasinghe, A.L. Ranawake and S.G.J.N. Senanayake.
Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya.

Abstract

With the aim of understanding the yield and yield components of some traditional rice cultivars which are having different days to maturity, a field experiment was carried out. Fifty traditional rice cultivars were planted in three rows with 15 cm X 20 cm spacing according to randomized complete block design. Each replicate of one cultivar was consisted with 3 rows. Twenty plants of each cultivar were included in to one row and data were recorded in the middle row. The field was plotted using strong bunds for the separation of control experiment and fertilizer applied plots. The plot treated with inorganic fertilizers as Basal Dressing: Urea 50 Kg/ha, TSP 62.5 Kg/ha, MOP 50 Kg/ha and Top Dressing: Urea 37.5 Kg/ha – 2 Weeks after planting and 8 Weeks after planting. Effect of fertilizer on agronomic characteristics namely plant height (cm), number of tillers/plant and number of leaves/plant, grain yield (g/plant) and harvest index were measured before harvesting. Grain yield and the harvest index were calculated at the end of the experiment. Fifty traditional rice cultivars were categorized into eight age groups according to days to maturity; 105-110,111-115,116-120,121-125,126-130,131-135,136-140 and 141-145. Under fertilized conditions plant height was ranged from 119.0 cm-146.4 cm and the highest plant height was observed at the 105-110 early maturing cultivars. The lowest number of tillers (5.7), lowest number of leaves (10.7), lowest yield (10.0 g) and the lowest harvest index (0.28) were recorded by the age group 121-125. In control plants the lowest plant height (103.9 cm), lowest number of tillers (4.7) and the lowest number of leaves (6.7) were recorded by the age group 111-115. Under fertilized conditions the highest number of tillers (8.0) and the highest yield (24.7 g) were recorded by the age group 126-130.The highest number of leaves was recorded by the age group 116-120 both in treatment (18.4) and in controls (10.8). The highest harvest index (0.49) was recorded by the age group 136-140 under fertilized conditions and in non fertilized conditions 0.46 was recorded by the age group 126 – 130.

Key words: Agronomic characteristics, Traditional Rice, Fertilizer effect

Introduction

Along with improved cultural management, the use of balanced fertilizer is one of the most important aspects for increased crop productivity (Ahmed *et al.*, 2005). Effective use of fertilizer reduces the cost of production of rice especially in irrigated lowlands that produces 75% of rice in Asia. Numerous researches revealed that the application of fertilizer directly influenced the yield and yield attributing characteristics of rice (Arif *et al.*, 2010). Along with the effective use of fertilizer, varietal improvement should be done to meet a higher rice yield (Xiang *et al.*, 2007). However, developing super hybrid rice depends largely on the germplasm resources of the parental lines and the conventional breeding technology (Wang *et al.*, 2005). Most of the researchers collect, conserve and utilize rice germplasm in a systematic way to create high yielding; biotic and abiotic stress tolerant rice varieties (Lang and Buu, 2011). However traditional rice cultivars possess comparatively less yield potential (Mackill *et al.*, 1996). To understand the behavior of yield and agronomic characteristics of traditional rice cultivars, fertilizer response of traditional cultivars with different maturity duration was studied.

Materials and Methods

Fifty traditional rice cultivars were geminated and planted in nursery beds. Ten day old seedlings were transplanted in the field at Faculty of Agriculture, University of Ruhuna in rows with 15 cm X 20 cm spacing. Experiment was conducted in a randomized complete block design with four replicates. Each plot

***Corresponding author:** lankaranawake@hotmail.com

consisted 3 rows of 20 rice plants. The plot treated with inorganic fertilizer as Basal Dressing: Urea 50 Kg/ha, TSP 62.5 Kg/ha, MOP 50 Kg/ha and Top Dressing: Urea 37.5 Kg/ha – 2 Weeks after planting and 8 Weeks after planting. Control experiment was carried out without application of fertilizer.

Plant height, number of tillers/plant and number of leaves/plant were measured in the middle row plants of the three-row-grown rice cultivars both in fertilized and in control plants. Grain yield and the harvest index were calculated at the end of the experiment. Plant height was measured in centimeter (cm) from soil surface to tip of the tallest panicle (awns excluded) according to the standard evaluation system for rice (IRRI, 2002). Number of leaves/plant and number of tillers/plant were counted manually. Grain yield (g/plant) was measured in individual rice cultivar after harvesting and removing unfilled grains. Harvest index was calculated according to Li *et al.*, (2012) as follows;

$$\text{Harvest index} = \frac{\text{Grain yield (g)/plant}}{\text{Total biomass (g)/plant}}$$

Fifty traditional rice cultivars were categorized into eight age groups according to days to maturity; 105-110,111-115,116-120,121-125,126-130,131-

Table 1. PGRC accession numbers and names of fifty traditional rice cultivars

3383	EAT Samba	3517	Seeraga Samba Batticaloa	3614	Sinnanayam
3389	Sirappu Paleusithri	3518	H 10	3615	Yakadawee
3394	Muthu Samba	3519	Manchel Perunel	3616	Jamis wee
3395	Podi sudu wee	3550	Bathkiriel	3645	Muthumanikam
3401	Wanni Heenati	3562	Thunmar Hamara	3646	Induru Karayal
3409	BG 35-2	3567	Dingiri Menika	3647	Kalu gires
3410	BG 35-7	3570	Madael	3650	Madabaru
3415	BG 34-8	3571	Miti Riyan	3651	Balakara
3416	A 6-10-37	3572	Suduru Samba	3652	Buruma Thavalu
3417	Periamorungan	3588	Heenpodi wee	3713	Kalukanda
3497	Sinnanayan 398	3589	Gangala		
3498	Geeraga Samba	3591	Mudukiriel		
3504	Dik wee 328	3594	Suduru Samba		
3506	MI 329	3595	Kaharamana		
3507	Suwanda Samba	3598	Bala Ma wee		
3508	Madael Galle	3606	Chinnapodiyan		
3510	Sudu wee Ratnapura	3607	Kiri Murunga wee		
3511	Maha Murunga Badulla	3610	Heendikki		
3514	Madael Kalutara	3612	Jamis wee		
3516	Seevalee Ratnapura	3613	Lumbini		

135,136-140 and 141-145. Days to maturity was decided according to the characterization catalogue on rice germplasm (Plant Genetic Resource Center, 1999).

Data were analyzed using ANOVA and mean separation was done by DMRT using SAS statistical software (*SAS Institute Inc., 2000)*

Results and Discussion

The days to maturity of the selected traditional rice cultivars were spanned from 105-145. These characteristics showed nearly normal distribution in the selected traditional rice cultivars.

According to ANOVA plant height significantly increased with the fertilizer at each age group compare to that of control (Table 2). Under fertilized conditions plant height ranged from 119.0 cm to 146.4 cm and the highest plant height was observed at the 105-110 age group. Plant height in control plants was ranged from 103.9 cm to 119.7 cm and the highest plant height was recorded by 126-130 age group. In control plants the lowest plant height (103.9 cm), lowest number of tillers (4.7) and the lowest number of leaves (6.7) were recorded by the age group 111-115. In treatments the lowest number of tillers (5.7), lowest number of leaves (10.7), lowest yield (10.0 g) and the lowest harvest index (0.28) was recorded by the age group 121-125.

Number of tillers significantly increased with fertilizer only at the 111-115 and 116-120 age groups. The early maturing rice cultivars increased their tiller number with no fertilizer conditions (Table 2).

Under fertilized conditions the highest number of tillers (8.0) and the highest yield/plant (24.7 g) were recorded by the age group 126-130.

Number of leaves significantly increased with the fertilizer at each age group except 121-125 compare to that of control (Table 2). The highest number of leaves was recorded by the age group 116-120 both in

Table 2. DMRT groupings of yield and other agronomic characteristics at each maturity duration.

Days to maturity	Plant height (cm)		Number of tillers		Number of leaves		Yield (g/plant)		Harvest index	
	Treat.	Con.	Treat.	Con.	Treat.	Con.	Treat.	Con.	Treat.	Con.
105-110	146.39	111.38^{b}	6.57^{a}	7.03^{a}	17.29	8.50^{b}	13.14^{a}	9.68^{b}	0.34^{a}	0.32^{a}
111-115	132.52	103.91^{b}	6.20^{a}	4.67^{b}	13.93	6.70^{b}	13.79^{a}	11.80^{b}	0.38^{a}	0.36^{a}
116-120	139.85	110.13^{b}	6.67^{a}	5.47^{b}	18.42	10.78^{b}	16.55^{a}	12.67^{b}	0.37^{a}	0.36^{a}
121-125	138.05	111.92^{b}	5.67^{a}	5.90^{a}	10.65	9.45^{a}	9.97^{a}	9.92^{a}	0.28^{a}	0.28^{a}
126-130	145.30	119.68^{b}	7.97^{a}	7.33^{a}	18.14	9.76^{b}	24.65^{a}	20.54^{b}	0.4^{b}	0.46^{a}
131-135	135.78	108.30^{b}	6.36^{a}	6.18^{a}	15.38	10.35^{b}	16.73^{b}	23.27^{a}	0.48^{a}	0.4^{b}
136-140	119.00	112.25^{b}	5.90^{b}	7.30^{a}	13.20	8.40^{b}	12.23^{b}	21.82^{a}	0.49^{a}	0.34^{b}
141-145	133.08	119.45^{b}	6.50^{b}	7.40^{a}	13.73	8.93^{b}	10.32^{b}	21.80^{a}	0.48^{a}	0.26^{b}

DMRT groupings (given as a, b) for plant height, number of tillers, number of leaves, yield and harvest index were calculated separately for the maturity durations for each treatment and control. Means with the same letters are not significantly different. Treat. = Treatment, Con. = Control. Values with the same letter not significantly different

treatment (18.4) and in controls (10.8). In rice, the optimum leaf areas for seedlings, optimum leaf shapes to maximize photosynthetic efficiency, leaf area index (LAI) have been identified as the major determinants of yield (Sun et al., 1999).

The early maturing traditional rice cultivars increased yield significantly with fertilizer while the late maturing cultivars performed well under no fertilizer condition (Table 2). The highest significant yield (24.7 g) was recorded by the age group 126-130 in treated cultivars while in controls it was recorded by the age group 131-135 as 23.3 g/plant.

Fertilizer could not significantly increase the harvest index of early maturing rice cultivars. The late maturing rice cultivars recorded higher harvest index with the application of fertilizer (Table 2). The highest harvest index (0.49) was calculated by the age group 136-140 under fertilized conditions and in non fertilized conditions 0.46 was recorded by the age group 126 - 130. The high levels of nitrogen increases the grain yield and harvest index (Sinclair, 1998).

Harvest index (HI) of the studied cultivars ranged from 0.28 to 0.49 in fertilized conditioned and in non fertilized conditions it ranged from 0.26 to 0.46. This value in modern rice cultivars are more than 0.4 (Li *et al.*, 2012). The HI values of the age groups 126-130 (0.4), 131-135 (0.48), 136-140 (0.49) and 141-145 (0.48) were lied nearly the reference values of Sri Lankan cultivars as mentioned by De Costa *et al.*, (2003)

Plant height was significantly increased with the fertilizer at each age group. Number of tillers was significantly increased with fertilizer only at the 111-115 and 116-120 age groups. Number of leaves was significantly increased with the fertilizer at each age group except 121-125 compare to that of control. The highest significant yield (24.7 g) was recorded by the age group 126-130 while the highest harvest index (0.49) was recorded by the age group 136-140.

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