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Fertilizer Response of some Sri Lankan Traditional Rice Cultivars during Vegetative Growth Phase

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Abstract- Traditional rice cultivars in Sri Lanka conserve different abiotic and biotic tolerant traits but the yield of traditional rice cultivars is not as much of improved cultivars. Abiotic stress tolerance of some traditional rice cultivars were evaluated in previous studies at Faculty of Agriculture, Mapalana, Sri Lanka and this study attempted to understand the possibility of enhancing the yield and yield components of traditional rice cultivars by altering the fertilizer dose. A field experiment was carried out from October 2011 to April 2012 at the Faculty of Agriculture, Mapalana. Traditional rice cultivars are considered to be weaker in response to fertilizer. Four different fertilizer levels namely no fertilizer, half of the recommended dose, recommended dose and twice of the recommended dose were evaluated with forty Sri Lankan traditional rice cultivars to understand the response of them on different agronomic parameters. Germinated seeds were planted in rows with 15 cm X 20 cm spacing. Twenty plants were managed for each line and three lines were maintained for one replicate of cultivar. Experiment was conducted with four replicates. Effect of fertilizer on the plant height, number of tillers/plant and number of leaves/plant were measured at three weeks after transplanting during the vegetative phase of cultivars. These parameters were significantly differed with the fertilizer doses and with the individual cultivars. Average plant height was ranged from 37.8 cm to 115.8 cm. The highest plant height was obtained by the cultivar Herath Banda (115.8 cm) at the half recommended dose while the lowest plant height was recorded by the cultivar Palasithari 601 (37.8 cm) at no fertilizer dose. Highest number of tillers per plant (7.3) and the highest number of leaves per plant (28.8) were obtained by the cultivar Dena wee at the twice recommended dose and also the lowest tiller number (1.55) and the lowest number of leaves/plant (6.2) was recorded by the cultivar Palasithari 601 at the twice recommended dose. Among tested traditional rice cultivars, cultivar Herath Banda recorded the highest plant height at all four fertilizer levels (no fertilizer (111.6 cm), half recommended dose (115.8 cm), recommended dose (103.6 cm), and twice recommended dose (105.9 cm). Dena wee recorded the highest number of tillers at no fertilizer (7.0), recommended dose (5.9) and twice recommended dose (7.3) while Herath Banda recorded the highest number of tillers (5.6) at half recommended dose. Highest number of leaves at no fertilizer dose was recorded by the cultivar Kotathavalu 1 (22.3). Cultivar Herath Banda (22.2) recorded the highest number of leaves at half of the recommended dose while cultivar Dena wee recorded the highest number of leaves/plant at recommended dose (21.1) and twice recommended dose of fertilizer (28.8). Correlation of these parameters and other yield components with the final yield is yet to be computed.

Index Terms- Fertilizer Response, Sri Lankan Traditional rice

I. INTRODUCTION

Rice is the staple food in the diet for much of the world and it runs second to wheat in its importance as a food cereal in the human diet (FAO, 2011). About 672 Million Metric Tons of rice is grown annually in the world (FAO, 2011). Rice is the single most important crop occupying 34 percent (0.77 million ha) of the total cultivated area in Sri Lanka (Department of Agriculture, 2006). Presently paddy consumes the largest share of chemical fertilizers and it accounts for approximately 50 percent of the overall use of chemical fertilizers in Sri Lanka (Wijewardhena, 1987). There are three major nutrients namely, Nitrogen (N), Potassium (K) and Phosphorus (P) essential for paddy cultivation. Three main fertilizers Urea, Muriete of potash (MOP) and Triple super phosphate (TSP) provide the nitrogen, potassium and phosphorus respectively (Ekanayake, 2006). The fertilizer added to the soil to ensure all necessary nutrient elements are available to the crop to stimulate plant growth and yield (Thenabadu, 1980). Commercial fertilizers have to be supplied to fulfill the compensate the nutrients depleted from the soil by crop-uptake together with leaching and erosion losses (Thenabadu, 1980). Inorganic fertilizers release nutrients in readily soluble mode to soil solution and these are instantly available as plant nutrients (Siavoshi et al. 2011). Fertilizer consumption depends on rice variety, soil condition and farmer practices (Hach and Nam, 2006). Imbalanced fertilizer application, especially in wet season, creates severe diseases and lodging resulting low efficiency of nitrogen fertilizer application (Hach and Nam, 2006). Although there are four techniques available for determining fertilizer requirements namely Field experimentation, Soil tests, Plant tests and biological tests, Field experiments are considered the most dependable for establishing fertilizer recommendations (Priyangani et al. 2008) The fertilizer recommendations for rice have undergone many changes since the first fertilizer recommendation of Joachim in the 1930s (Thenabadu,1980). It should be taken in to consideration the application of fertilizer should be varied during the different growth stages of a plant. If a heavy dressing of inorganic fertilizers is applied as a basal dressing, the high concentration of salts may sometimes damage or inhibit the seed germination (Thenabadu,1980). Along with improved cultural management, the use of balanced fertilizer is one of the most important aspects for increased crop productivity.

Sri Lanka possesses about two thousand indigenous rice accessions (Priyangani et al. 2008), which are having various agronomic characters differing from one another and also

differing from modern rice cultivars (Ranawake et al 2011b). At the onset of green revolution farmers initiated to cultivate high yielding varieties which are highly responsive to inorganic fertilizers as a replacement for traditional rice varieties (Weerahewa et al, 2010). Traditional rice cultivars are generally tall and have few tillers and produce low but stable yields even under unfavorable environments and typically they are cultivated without the application of fertilizer (Saito et al. 2005). Various field fertilizer experiments have been conducted with traditional rice cultivars to understand the expansion of yield potential in different countries by altering fertilizer application and the results revealed that the most of rice cultivars show a remarkable increase in grain yield when fertilizer application is increased (Saito et al. 2005; George et al. 2005). Some Sri Lankan traditional rice cultivars have been screened for abiotic stress tolerances such as drought, salinity and submergence (Ranawake et al 2011b ; Ranawake et al 2010a: Ranawake et al 2011a; Ranawake and Dahanayake 2012a; Ranawake et al 2012b ; Weragodawidana et al. 2012). There is a potential to introduce these cultivars directly to farmer field or use as future breeding materials. In such a process, less yield of traditional rice cultivars may pop-up as the major restriction (Saito et al. 2005; Amarasinghe et al 2013). According to Khuong (2008), fertilizer is the major factor affecting on grain yield and quality. Some of the Sri Lankan traditional rice cultivars have been evaluated for fertilizer response (Amarasinghe et al. 2013). However, there is no adequate information on response of traditional rice cultivars of Sri Lanka for fertilizer applications. Hence, the present study was carried out to understand the response of individual traditional rice cultivar on different levels of inorganic fertilizers at different growth stages. The data presented in the paper is focused on the vegetative growth phase of traditional rice cultivars.

II. MATERIALS AND METHODS

Forty traditional rice cultivars listed in the table 1 having Plant Genetic Resources Center (PGRC) Accession Numbers were geminated and planted in nursery beds. Ten day old seedlings were transplanted in the experimental field at the Faculty of Agriculture, Mapalana, Kamburupitiya, Sri Lanka in rows with 15 cm X 20 cm spacing according to the randomized complete block design. The soil is low humic glay soil with low base saturation.

Table 1
Forty Sri Lankan Traditional rice cultivars used for the experiment

PGRC Acc.No.	Local name	PGRC Acc.No.	Local name
3673	Kaluhandiran	3654	Pokuru Samba
3674	Kirikara	3655	Rata wee
3675	Kotathavalu 1	3660	Suduru
3676	Dena wee	3658	Ingrisi wee
3677	Herath Banda	3659	Kotathavalu 2
3678	Hondarawala	3653	Kalu Karayal
3679	Kottakaram	3668	Ranruwan
3681	Dandumara	3669	Rajes
3686	Karayal 1	3670	Madoluwa
3687	Dewaredderi	3671	Suduru Samba
3469	Sudu wee	3688	Handiran
3477	Sudu Goda wee	3691	Gunaratna
3479	Kiri Naran	3661	Polayal
3480	Karayal 2	3664	Tissa wee
3482	Akuramboda	3665	Sudu Karayal
3486	Puwakmalata Samba	3666	Podisayam
3487	Palasithari 601	3423	Giress
3489	Murungakayan 3	3427	Naudu wee
3490	Murungakayan 101		
3434	Kokuvellai		
3496	Bala Ma wee	3463	Karayal 3

Four replicates were arranged for each fertilizer level and each replicate was consisted of 3 lines. Twenty plants were included in to each line. Four different fertilizer levels were applied: no fertilizer, half of the recommended dose, recommended dose and twice of the recommended dose. The recommended fertilizer dosage for modern rice cultivars was used as the recommended dose (Basal Dressing: Urea 50 Kg/ha, TSP 62.5 Kg/ha, MOP 50 Kg/ha Top Dressing: Urea 37.5 Kg/ha). Basal dressing was applied before planting and top dressing was applied two times at 2 weeks after planting and at 8 weeks after planting. Plant heights (cm), number of tillers/per plant, number of leaves/per plant were recorded during the vegetative growth stage at 6 weeks after planting. Data were statistically analyzed by ANOVA and mean separation was done by DMRT using SAS statistical software (SAS, 2000). Yield and yield components of the population at each fertilizer level are intended to be measured after harvesting.

Considering the contribution of the plant height, number of leaves/plant and number of tillers/plant for the final yield, an arbitrary rating scale was developed for the evaluated parameters. Since the number of tillers is the major contributor to the yield, the highest 5 points were allocated for the maximum number of tillers/plant. Between number of leaves/plant and plant height, number of leaves/plant was given a higher rating 3 points, while less 2 points were allocated to the plant height. Rice cultivars with plant height more than 110 cm were not considered for scoring since they tend to be logged. A fraction of maximum score was given for the second highest and third highest values of each parameter as given in table 2.

Table 2: Arbitrary rating scale used for the evaluation of best fertilizer level for individual rice cultivar

Plant height < 110 cm		Number of leaves	Number of tillers
Highest score	2	3	5
Second highest	1	2	4
Third highest	0.5	1	3
Lowest	0	0	0

III. RESULTS AND DISCUSSION

Plant height: According to ANOVA plant height of individual traditional rice cultivars significantly differed with the fertilizer level where there was a significant difference among rice

cultivars as well. Average plant height of the rice cultivars ranged from 37.8 cm to 115.8 cm. The highest plant height was recorded by the cultivar Herath Banda (115.8 cm) at the half of the recommended dose while the lowest plant height was recorded by the cultivar Palasithari 601 (37.8 cm) at no fertilizer conditions. Cultivar Suduru and cultivar Kalu karayal increased their height linearly with the increased fertilizer applications. Among tested traditional rice cultivars, cultivar Herath Banda recorded the highest average plant height (115.8 cm – 103.6 cm) at all four levels of fertilizer (Table 3). Cultivar Polayal reached its maximum potential height at no fertilizer condition. Further Herath Banda, Sudu wee, Karayal 2, Puwakmalata samba, Murungakayan 101, Bala Ma wee, Rajes, Handiran, Tissa wee, Sudu karayal, Giress and Kokuwellai cultivars recorded their highest plant height at half of the recommended dose. Similarly Kaluhandiran, Kotathavalu 1, Hondarawala, Dandumara, Kirinaran, Akuramboda, Murungakayan 3, Pokuru samba, Kotathavalu 2, Ranruwan, Madoluwa, Suduru Samba, Gunaratna, Podisayam, Naudu wee and Karayal 3 recorded their highest plant height at the recommended fertilizer level.

Plant height of cultivars Kirikara, Dena wee, Kottakaram and Ingirisi Wee were unique for all the fertilizer levels. Karayal 1, Dewaredderi, and Sudu Goda Wee recorded their maximum height at twice the recommended dose of fertilizer and there was no linearity in plant heights with the fertilizer application.

Cultivar Palasithari 601 and cultivar Rata wee gradually decreased their plant height with the increased fertilizer.

Table 3

Plant height of individual rice cultivar at different fertilizer applications

	Plant height (cm)			
	No F.	X ½ RD	RD	X 2 RD
Kaluhandiran	76.9[b]	73.3[c]	94.6[a]	46.3[d]
Kirikara	81.3[ab]	71.6[c]	86.6[a]	79.3[b]
Kotathavalu 1	93.1[c]	101.3[b]	102.5[a]	68.8[d]
Dena wee	80.7[c]	102.9[a]	102.6[a]	81.7[b]
Herath Banda	111.6[b]	115.8[a]	103.6[d]	105.9[c]
Hondarawala	59.6[b]	56.7[c]	73.2[a]	50.3[d]
Kottakaram	62.0[b]	96.3[a]	97.5[a]	60.5[c]
Dandumara	95.3[b]	64.0[c]	98.5[a]	95.6[b]
Karayal 1	91.5[b]	86.6[c]	71.3[d]	95.2[a]
Dewaredderi	92.7[c]	94.3[b]	91.5[d]	97.5[a]
Sudu wee	72.1[d]	104.6[a]	92.1[c]	98.4[b]
Sudu Goda wee	77.6[d]	80.6[b]	95.8[a]	81.1[c]
Kiri Naran	82.8[d]	87.3[b]	97.0[a]	85.5[c]
Karayal 2	93.5[d]	103.4[a]	101.4[b]	99.2[c]
Akuramboda	43.8[d]	86.0[b]	100.5[a]	50.4[c]
Puwakmalata Samba	60.3[b]	71.6[a]	53.5[c]	59.5[b]
Palasithari 601	100.2[a]	99.4[b]	87.3[c]	37.8[d]
Murungakayan 3	49.5[d]	75.5[b]	82.5[a]	73.5[c]
Murungakayan 101	49.3[d]	83.9[a]	75.6[b]	74.4[c]
Bala Ma wee	94.2[b]	97.3[a]	77.7[c]	90.5[b]
Pokuru Samba	97.4[c]	98.1[b]	101.5[a]	96.8[d]
Rata wee	80.5[a]	75.0[b c]	76.7[b]	72.1[c]
Suduru	73.5[b]	85.3[a]	85.6[a]	85.5[a]
Ingrisi wee	94.7[a]	66.9[c]	94.1[a]	81.3[b]
Kotathavalu 2	76.8[c]	77.9[b]	95.5[a]	76.6[c]
Kalu Karayal	84.1[c]	87.4[b]	96.3[a]	96.9[a]
Ranruwan	87.7[b]	85.1[c]	91.3[a]	83.7[d]
Rajes	89.6[c]	98.0[a]	84.8[d]	90.5[b]
Madoluwa	60.3[c]	51.3[d]	89.6[a]	73.8[b]
Suduru Samba	60.8[c]	63.0[bc]	74.5[a]	64.6[b]
Handiran	96.6[b]	102.1[a]	64.3[c]	98.4[b]
Gunaratna	91.6[b]	55.9[d]	97.4[a]	71.9[c]
Polayal	89.9[a]	81.5[b]	61.0[d]	69.6[c]
Tissa wee	91.9[c]	101.0[a]	91.7[c]	96.9[b]
Sudu Karayal	77.2[c]	94.6[a]	76.4[d]	81.8[b]
Podisayam	68.8[b]	52.9[d]	90.6[a]	62.1[c]
Giress	73.0[c]	93.9[a]	70.5[d]	87.6[b]
Naudu wee	81.4[b]	71.5[d]	86.1[a]	78.3[c]
Kokuvellai	87.9[c]	98.0[a]	82.7[d]	95.1[b]
Karayal 3	84.3[b]	77.2[c]	95.4[a]	83.4[b]

Means with the same letters are not differ significantly
No F No fertilizer, RD Recommended dose

Number of tillers/plant: Number of tillers/plant in traditional rice cultivars significantly differed with the fertilizer applications. Average number of tillers/plant in the tested traditional rice cultivars ranged from 1.55 to 7.3 while Dena Wee recorded the highest number of 7 tillers at no fertilizer and 6, at recommended dose and at 7.3 at twice the recommended dose while Herath Banda recorded the highest number of tillers of 5.6 at half the recommended dose. The lowest tiller number of 1.55 was recorded by the cultivar Palasithari 601 at twice the recommended dose. Hondarawala, Dandumara, Akuramboda and Rata wee cultivars increased the number of tillers alongwith the increase of fertilizer. Kirikara, Sudu Goda wee, Palasithari 601 and Karayal 3 decreased the tiller numbers with increasing of fertilizer level. Kaluhandiran reached its maximum tiller number even at no fertilizer conditions. Kotathavalu 1, Herath Banda, Kottakaram, Karayal 1, Kiri naran, Karayal 2, Murungakayan 3, Bala Ma wee, Kotathavalu 2, Gunaratna, Sudu Karayal, Podisayam, Giress, Naudu wee and Kokuwellai cultivars gained their maximum number of tillers at half of the recommended dose of fertilizer while Suduru, Suduru samba and Tissa wee recorded their maximum number of tillers at recommended dose. Further elevated amount of fertilizer couldn't boost the tiller number of these cultivars (Table 4). Kalu karayal couldn't response to the fertilizer when increasing its tiller number with the added fertilizer doses at vegetative growth phase. This is contrary with Saleem et al. (Saleem et al. 2010) which indicated that the number of tillers/hill increases with the level of nitrogen fertilizer. However, Murtaza et al. (2000) and Mahmood et al. (1993) recorded that the number of tillers significantly increases with the use of nitrogen fertilizer. Further, Mannan et al. (2011) have also concluded that not only tiller number, but also number of panicles, panicle length, spikelet sterility and straw yield increased with the increase of nitrogen levels.

Table 4

Number tillers/plant of individual rice cultivar at different fertilizer applications

	Number of tillers/plant			
	No F.	X ½ RD	RD	X 2 RD
Kaluhandiran	3.5 [a]	2.9 [bc]	3.0 [b]	2.9 [bc]
Kirikara	3.3 [a]	3.1 [b]	3.1 [b]	2.8 [c]
Kotathavalu 1	5.1 [b]	5.5 [a]	5.0 [b]	4.5 [c]
Dena wee	7.0 [a]	5.3 [c]	5.9 [b]	7.3 [a]
Herath Banda	4.4 [c]	5.6 [a]	4.8 [b]	4.2 [d]
Hondarawala	3.0 [c]	3.2 [b]	3.2 [b]	4.0 [a]
Kottakaram	2.6 [c]	3.0 [a]	2.9 [b]	2.6 [c]
Dandumara	3.3 [d]	3.7 [c]	4.5 [b]	5.2 [a]
Karayal 1	2.8 [d]	5.5 [a]	5.3 [b]	4.4 [c]
Dewaredderi	2.8 [d]	3.6 [b]	3.0 [c]	5.1 [a]
Sudu wee	3.0 [c]	5.2 [a]	3.9 [b]	5.1 [a]
Sudu Goda wee	3.4 [a]	3.1 [b]	3.0 [b]	2.4 [c]
Kiri Naran	2.6 [d]	4.3 [a]	3.8 [b]	3.5 [c]
Karayal 2	3.2 [b]	3.5 [a]	3.1 [b]	3.2 [b]
Akuramboda	3.7 [c]	4.5 [b]	4.5 [b]	4.7 [a]
Puwakmalata Samba	1.8 [c]	3.4 [a]	2.9 [ab]	2.6 [b]
Palasithari 601	3.4 [a]	3.5 [a]	3.6 [a]	1.6 [b]
Murungakayan 3	2.1 [d]	5.0 [a]	3.5 [c]	4.6 [b]
Murungakayan 101	2.0 [c]	4.1 [a]	3.9 [a]	2.9 [b]
Bala Ma wee	3.2 [d]	4.9 [a]	3.8 [b]	3.3 [c]
Pokuru Samba	3.5 [c]	4.0 [ab]	3.8 [b]	4.3 [a]
Rata wee	3.1 [c]	3.2 [b]	3.2 [b]	3.4 [a]
Suduru	3.3 [c]	4.9 [a]	3.9 [b]	4.1 [b]
Ingrisi wee	3.5 [b]	3.3 [c]	3.5 [b]	4.1 [a]
Kotathavalu 2	3.6 [d]	4.7 [a]	4.3 [b]	3.9 [c]
Kalu Karayal	3.7 [a]	3.7 [a]	3.7 [a]	3.8 [a]
Ranruwan	3.5 [b]	3.4 [c]	3.8 [a]	3.7 [a]
Rajes	2.9 [d]	3.4 [b]	3.1 [c]	3.6 [a]
Madoluwa	1.8 [d]	2.1 [b]	1.9 [c]	2.7 [a]
Suduru Samba	1.7 [c]	1.6 [c]	2.4 [a]	2.1 [b]
Handiran	3.3 [c]	4.8 [a]	3.2 [d]	3.8 [b]
Gunaratna	3.4 [c]	4.3 [a]	3.4 [c]	3.8 [b]
Polayal	4.6 [a]	3.5 [c]	4.7 [a]	4.4 [b]
Tissa wee	3.8 [b]	3.5 [c]	3.9 [a]	3.8 [b]
Sudu Karayal	2.7 [c]	3.8 [a]	3.2 [b]	3.2 [b]
Podisayam	2.1 [d]	4.3 [a]	2.2 [c]	3.6 [b]
Giress	1.7 [d]	5.1 [a]	2.3 [c]	3.6 [b]
Naudu wee	3.2 [d]	4.6 [a]	3.3 [c]	3.9 [b]
Kokuvellai	3.0 [d]	3.9 [a]	3.4 [c]	3.6 [b]
Karayal 3	4.6 [a]	3.2 [bc]	3.3 [b]	3.0 [c]

Means with the same letters are not differ significantly

No F No fertilizer, RD Recommended dose

Number of leaves: Number of leaves significantly differed with the fertilizer levels and the cultivars as shown in the the ANOVA Table 5.

Table 5

Number of leaves/plant of individual rice cultivar at different fertilizer applications

	Number of leaves/plant			
	No F.	X ½ RD	RD	X 2 RD
Kaluhandiran	13.5 [a]	11.5 [c]	12.0 [b]	9.9 [d]
Kirikara	13.4 [a]	12.0 [b]	12.3 [b]	10.7 [c]
Kotathavalu 1	22.3 [a]	21.8 [b]	21.0 [c]	14.2 [d]
Dena wee	21.3 [b]	21.0 [c]	21.1 [c]	28.8 [a]
Herath Banda	18.4 [b]	22.2 [a]	17.8 [c]	17.5 [c]
Hondarawala	11.2 [c]	11.7 [b]	11.2 [c]	16.0 [a]
Kottakaram	8.8 [d]	12.0 [a]	11.5 [b]	10.5 [c]
Dandumara	13.0 [d]	13.3 [c]	17.3 [b]	20.8 [a]
Karayal 1	11.1 [d]	21.9 [a]	21.0 [b]	17.5 [c]
Dewaredderi	10.8 [c]	14.3 [b]	10.9 [c]	20.5 [a]
Sudu wee	14.5 [d]	20.6 [a]	17.2 [c]	20.3 [b]
Sudu Goda wee	12.6 [a]	12.7 [a]	12.0 [b]	10.6 [c]
Kiri Naran	10.8	17.3 [a]	15.5 [b]	13.5 [c]
Karayal 2	12.6	14.2 [a]	12.8 [c]	13.2 [b]
Akuramboda	15.6 [c]	18.1 [b]	18.3 [b]	18.8 [a]
Puwakmalata Samba	7.1 [d]	13.4 [a]	11.8 [b]	10.2 [c]
Palasithari 601	13.3 [c]	14.0 [b]	14.5 [a]	6.2 [d]
Murungakayan 3	8.7 [d]	19.9 [a]	14.0 [c]	18.4 [b]
Murungakayan 101	8.4 [d]	16.2 [a]	15.2 [b]	11.3 [c]
Bala Ma wee	12.6 [d]	19.8 [a]	15.0 [b]	13.3 [c]
Pokuru Samba	13.7 [d]	15.8 [b]	15.0 [c]	16.9 [a]
Rata wee	12.3 [c]	12.8 [b]	12.8 [b]	13.8 [a]
Suduru	12.3 [d]	19.6 [a]	15.1 [c]	16.0 [b]
Ingrisi wee	14.0 [b]	13.0 [c]	14.0 [b]	16.4 [a]
Kotathavalu 2	14.5 [d]	18.8 [a]	17.3 [b]	15.7 [c]
Kalu Karayal	14.6 [b]	14.6 [b]	14.5 [b]	14.8 [a]
Ranruwan	14.0 [b]	13.5 [c]	15.0 [a]	14.6 [ab]
Rajes	11.7 [d]	13.8 [b]	12.5 [c]	14.5 [a]
Madoluwa	6.5 [d]	8.3 [b]	7.2 [c]	10.6 [a]
Suduru Samba	6.5 [c]	6.5 [c]	10.0 [a]	9.0 [b]
Handiran	13.2 [c]	19.3 [a]	10.0 [d]	15.3 [b]
Gunaratna	13.7 [c]	17.0 [a]	13.8 [c]	15.8 [b]
Polayal	18.3 [b]	14.8 [c]	18.8 [a]	18.1 [b]
Tissa wee	15.1 [a]	14.2 [b]	15.5 [a]	15.2 [a]
Sudu Karayal	10.6 [c]	15.3 [a]	12.6 [b]	12.8 [b]
Podisayam	8.3 [d]	17.3 [a]	8.9 [c]	14.4 [b]
Giress	6.8 [d]	20.5 [a]	9.2 [c]	14.3 [b]
Naudu wee	12.9 [d]	18.3 [a]	13.0 [c]	15.5 [b]
Kokuvellai	12.1 [d]	15.5 [a]	13.5 [c]	14.5 [b]

Karayal 3	18.5 [a]	12.9 [c]	13.1 [b]	12.0 [d]

DMRT groups are given in English letters

No F No fertilizer, RD Recommended dose

Average number of leaves ranged from 6.2 to 28.8 in the tested traditional rice cultivars. The development stage of the rice plant can be determined by the number of leaves it bears. The population used for the study included different cultivars with different days to maturity. From germination to heading, the number of leaves developed from the main culm is generally less in number for a short duration variety than a long duration variety (Datta, 1981). Highest average number of leaves (28.8) was obtained for the cultivar Dena wee in 117 days at twice the recommended dose and also the lowest average number of leaves (6.2) was recorded by the cultivar Palasithari 601 (123 days to maturity) at the twice the recommended dose (Table 3). Vegetative growth was vigorous, especially with nitrogen application and number of leaves in main stem is frequently more than 20 in modern rice cultivars according to Tanaka et al. [Tanaka, 1976]. Tanaka et al. (1976) further reported that the rice yield can be increased if the number of active leaves on plant can be increased. The cultivars Dandumara, Akuramboda, Rata wee and Kalu karayal proved this phenomenon by gradually increasing the number of leaves with the increase fertilizer but Kirikara, Kotathavalu 1 and Sudu Goda wee decreased their number of leaves with the increased fertilizer (Table 5). Herath Banda, Kottakaram, Karayal 1, Sudu wee, Kirinaran, Karayal 2, Puwakmalata Samba, Murungakayan 3, Murungakayan 101, Bala Ma wee, Suduru, Kotathavalu 2, Handiran, Gunaratna, Kokuvellai, Podisayam, Giress, Naudu wee and Sudu Karayal acquired maximum number of leaves at half of the recommended dose and Palasithari 601, Suduru samba and Polayal recorded the highest number of leaves at the recommended fertilizer dose during the vegetative phase. Intermediate plant type records the plant height between 80 cm - 120 cm and they are well adapted to both poor and favorable environments and provide medium to good grain yield (www.knowledgebank.irri.org/extension/ farmersguideuplandrice). Further semi-dwarf cultivars normally reached up to 110 cm height (www.knowledgebank.irri.org/extension/index.php/ses). Roberts et al. (Roberts et al. 2013) have also concluded that the semi-dwarf cultivars produced higher yields than that of tall cultivars. Hence in this study when use arbitrary rating scale to evaluate the performances of cultivars, cultivar increases its plant height over 110 cm even at vegetative stage was considered as unfavorable in plant architecture. Plant height also a major contributor to the yield (Yadav et al. 2011) but greater plant height susceptible to lodging reduces yield, quality of production, and mechanical harvesting efficiency (Weber, 1966; Kono, 1995). It was estimated that lodging caused a loss of 26 kg ha–1 in rice production in southern India (Duwayri et al. 2000).

According to Ogbodo et al. (2010) and Yadav et al. (2011) number of tillers/plant directly contributes to the yield. Thus the fertilizer level which recorded the highest tiller number was considered as the best fertilizer level for increasing tiller number in arbitrary rating scale. Further Tanaka et al. (1976) stated that the rice yield is increased with the higher number of leaves on plant. In the present study the cultivars with the highest number of leaves/plant were considered as more suitable cultivars for higher yield.

Yadav et al. (2011) concluded that the harvest index, numbers of tillers per hill, panicle length, number of spikelets per panicle, plant height as the main contributors to yield. Among those parameters harvest index, number of tillers per hill, panicle length and number of spikelet per panicle are the most important characters that directly contribute to yield (Weber, 1966). Hence in the used arbitrary rating scale, number of tiller/plant was given the highest score (Table 2).

Table 6 Cumulative values of scores at different fertilizer levels

	No F.	X ½ RD	RD	X 2 RD	Best level
Kaluhandiran	9	1.5	10.5	4	RD
Kirikara	9	6	15	0.5	RD
Kotathavalu 1	7.5	8	15.5	0	RD
Dena wee	12	3	15	9	RD
Herath Banda	6	8	12	2	RD
Hondarawala	2	6.5	8.5	8	RD
Kottakaram	4	10	14	4	RD
Dandumara	1	4.5	5.5	9	2RD
Karayal 1	1	13	14	6	RD
Dewaredderi	0.5	7	7.5	10	2RD
Sudu wee	3	10	13	8	RD
Sudu Goda wee	5	7.5	12.5	2	RD
Kiri Naran	0	9	9	4.5	R D or RD/2
Karayal 2	4	10	14	6.5	RD
Akuramboda	0	7	7	8.5	2RD
Puwakmalata Samba	1	10	11	5.5	RD
Palasithari 601	8	8	16	0	RD
Murungakayan 3	0	9	9	6.5	RD or RD/2
Murungakayan 101	0	10	10	5.5	R Dor RD/2
Bala Ma wee	1	10	11	4.5	RD
Pokuru Samba	0.5	8	8.5	8	RD
Rata wee	2	6.5	8.5	8	RD
Suduru	0.5	9	9.5	7	RD
Ingrisi wee	6	1.5	7.5	9	2RD
Kotathavalu 2	0.5	9	9.5	4.5	RD
Kalu Karayal	5.5	8	13.5	10	RD
Ranruwan	7	0.5	7.5	7	RD
Rajes	0.2	8	8.2	9	2RD
Madoluwa	0.5	6	6.5	9	2RD

Suduru Samba	1	5	6	7	2RD
Handiran	5	10	15	7	RD
Gunaratna	5	8	13	6.5	RD
Polayal	9	2	11	6.5	RD
Tissa wee	7.5	7	14.5	8	RD
Sudu Karayal	1.5	10	11.5	7	RD
Podisayam	0.5	8	8.5	6.5	RD
Giress	0.5	10	10.5	7	RD
Naudu wee	1	8	9	6.5	RD
Kokuvellai	0.5	10	10.5	7	RD
Karayal 3	9	6	15	1	RD

According to used scoring system, among tested traditional rice cultivars majority of the rice cultivars performed well at the recommended fertilizer dose. Rice cultivar Dandumara, Dewaredderi, Akuramboda, Ingirisi wee, Rajes, Modaluwa and Suduru Samba performed well at twice the recommended fertilizer dose while Kiri Naran and Murungakayan-3 performed well at half of the recommended dose.

CONCLUSIONS

Response of individual traditional rice cultivar for fertilizer on vegetative growth phase parameters such as plant height, number of tillers/plant and number of leaves/plant are significantly different at field conditions. For rice cultivars Dandumara, Dewaredderi, Akuramboda, Ingirisi wee, Rajes, Modaluwa and Suduru Samba, twice the recommended fertilizer dose is better while half of the recommended dose is suitable for Kiri Naran and Murungakayan-3. Recommended fertilizer dose is suitable for all the other cultivars. However, the climatic, agro-ecological as well as soil factors have to be given due attention as the availability of nutrients may be different in soils of different regions of the country.

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