

## Bringing Medicinally Important Traditional Rice Accessions into Cultivation: Study on Agronomic Characters and Yield Potential

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### Abstract

Some traditional rice cultivars of Sri Lanka constitute natural medicines and used as popular remedies. However, presently these cultivars are not grown in the farmer fields in Sri Lanka due to less yield potential. Green revolution introduced a package of technologies with modern irrigation projects, pesticides, inorganic fertilizers and improved crop varieties. Those improved high yielding varieties out performed in the presence of adequate irrigation, pesticides, and fertilizers. In the absence of these inputs traditional varieties recorded significantly lower yields and they were gradually eliminated from the farmer field with time. In the present study some medicinally important traditional rice cultivars were grown in the field conditions and their agronomic characters and grain yield were evaluated. Rice cultivar Bg379/2 was used as a reference modern rice cultivar. None of the rice cultivars recorded a significantly equal yield and number of fertile tillers with those of the modern rice cultivar. Among tested rice cultivars *Weda Heenati* recorded 14.46 g/plant while all the other cultivars recorded less than 6.6 g/plant. However, due to less tillering ability of the traditional rice cultivars, many rice cultivars including *Dik Wee* accessions, *Gonabaru*, *Rathel* and *Weda Heenati* recorded higher harvest indices than that of modern rice cultivar Bg379/2. Filled grain percentage of *Kuruluthudu 2* was significantly equal with the value of modern rice cultivar. The hundred grain weight of *Kuruluthudu 2*, *Rathel* and *Weda Heenati* were in between 1.3-1.5g (very small) while the highest value (3.2) was in Bg379/2. However, the economical yield per plant in all the traditional rice cultivars is significantly lower than that of modern reference variety. Present study categorizes medicinally important traditional rice cultivars according to age, tillering ability, fertility and plant height using IRRI standard evaluation system. Grain yield/plant and harvest index give the expected yield potential of each cultivar at the field conditions.

**Keywords:** *Traditional rice cultivars, Medicinal value, Field experiment*

### INTRODUCTION

According to Ayurvedic believes rice eliminate toxic metabolites, revitalize the body, regulate blood pressure, prevent skin disease, and stem premature ageing (Ahuja *et al.*, 2008). Anthocyanin-contained extract from black rice have reported anti-cancer properties against human breast cancers (Hui *et al.*, 2010); and rice bran was found to prevent intestinal cancer (Verschoyle, 2007). Some Sri Lankan traditional rice cultivars such as *Goda Heeneti*, *Masuran* and *Dik wee* have shown presence of anti oxidant properties (Abesekera *et al.*, 2012). Anti oxidant properties is important for prevention of oxidative stress related diseases. In recent times, interest in red rices has been reviewed because of the presence of antioxidants. Due to its antioxidant activity rice has been found to have anti-cancer properties (Norhaizan *et al.*, 2011). Due to the polyphenols in red rices, its scavenging activity is higher than in black and white rices (Oki *et al.*, 2005)

*Kaluheenati* enhances male sexual potency, regulates bowel movement, keeps diabetes under control and reduces toxic effects of snake bite sand good for hepatitis patients. *Suwandel* which has specific aroma (<http://livingheritage.org/rice1.htm>) with milky taste is known to enhance good health of fair and glowing skin, improve the proper function of the excretory system, and improve clarity of throat. Another rice variety named *Rathel* has medicinal properties to prevent cirrhosis, fight against viral fever, reduces skin rashes, prevents the formation of stones in the

bladder and gall bladder and has medicinal values for reducing symptoms of tuberculosis and lung ailments. Another commonly used traditional rice cultivar named *Ma wee* cools the body, stops vomiting, reduces alcohol intoxication, good for tuberculosis and diabetes patients. Further monks who did not eat after noon were given *Mawee*, and *Pachchaiperumal* those possesses a high protein content. *Maha Ma wee*, a group of *ma wee* has a religious value as well as it is said to be deposited in Dagaba (<http://janathakshan.com/PDFs>). Further, it is a flood tolerant variety which elongates the culm with risen water level. *Kuruluthuda* and *Rathel* are said to be good for problems in bladder and a remedy for urinary troubles. Further rice cultivars named *Kuruluthudu*, *Kaluheeneti*, *Rathel* and *Suwandel* enhance male sexual potency. *Pachchaperumal* and *Rathel* are said to be rich in nutrients for human growth and development. *Hethada* and *Suwandel* control diabetes while *Hethada* and *Rathel* help to cool the body (Rural enterprise net work, <http://www.rensrilanka.org/tradrice.html>)

Lactating mothers were fed with *Heenati* especially by *Kalu Heeneti* (<http://www.ulpotha.com/heritagerice.html>) and *Kanni murunga* was used for men who worked hard in the fields. *Suwandel* was cultivated for its extraordinary fragrance. Monks who did not eat in after noon were given *Ma wee*, which possesses high protein content (<http://livingheritage.org/rice1.htm>). *Kuruwee* and *Dik wee* are sweet and soft red rice used to give for kids. Further, *Murungakayan* is high in nutritional value (<http://www.ulpotha.com/heritagerice.html>).

Presently Sri Lankan government has expressed its willingness to cultivate *Heenati*, *Suvadala*, *Pachchaperumal*, *Weda Heenati* and *Kuruluthuda* for the export zones. Government expects to export rice to the Middle Eastern and European markets in first phase of the program. Nevertheless Sri Lankan government is willing to launch international awareness programs on the medicinal values of Sri Lanka's traditional rice cultivars (<http://www.sundayobserver.lk/2012/03/04/pol05.asp>). Presently *Kalu Heeneti*, *Suwandel*, *Ran Thembili* and *Muthu Samba* are grown in Sri Lanka army governed farms in Kandakadu, Kuttigala and in Alla-Kanthale (Nathaniel *et al.*, 2013, <http://www.thesundayleader.lk/2013/07/28/sri-lanka-army-to-promote-traditional-rice-varieties/>). This study was carried out to understand the agronomically important features of some medicinally important traditional rice cultivars. These cultivars have been duplicated in catalogs at PGRC Gannoruwa (Plant genetic resource center, 1999) in different accession names. In some cases, more than one accession was cataloged in the same number. In this study rice accessions were collected according to its importance in medicine and accessions were randomly selected by the name. Important characters were assessed according to performances of a reference modern rice cultivar Bg379/2.

## MATERIAL AND METHODS

Twenty Sri Lankan traditional rice cultivars were used for the experiment. Seeds were obtained from Plant Genetic Resource Center (PGRC) Gannoruwa, Sri Lanka. Bg379/2 was used as the reference recommended rice cultivar

Seeds were kept at 50°C for 5 days to break dormancy. Dormancy broken seeds were dipped in 70% alcohol for 2 minutes and washed properly with distilled water. Surface sterilized seeds were dipped in 2% Clorox for 30 minutes and wash the seeds properly with distilled water. Seeds were kept in incubator at 35°C for 7 days under dark condition and germinated seeds were planted in trays. Two week old seedlings were transplanted in the field according to the randomized complete block design with three replicates and 20 plants per replicate with 15 cm X 20 cm spacing. Fertilizers were applied at rate of Urea 50 kg/ha, TSP 62.5kg/ha, MOP 50kg/ha at sowing time and urea 37.5 kg/ha was also applied as top dressing at 2 weeks after planting and 7 weeks after planting.

**The following data were taken at the maturity**

1. Plant height: Measured the length from the base of the plant to the top of the latest spikelet on the panicle, excluding awn
2. Number of tillers per plant: Counted tillers at the maturity stage
3. Number of reproductive tillers per plant: Counted the filled grains in the sampled panicles
4. Days to maturity: From the date of seeding to 50% heading date
5. Filled grain percentage: Calculated the percentage of filled grains in a panicle
6. Hundred grain weight (g): Hundred grains were counted from five plants of each replicate
7. Bio mass weight: Average weight of a plant after drying

The average results of the above measured parameters are given in table 1. Data were analyzed using statistical analysis software; SAS institute inc., (2000) to see which characters of the medicinally important traditional rice cultivars are significantly equal with the reference modern rice cultivar Bg379/2

**RESULTS AND DISCUSSION**

Data collected were analyzed by SAS (SAS institute inc., 2000) are tabulated in table 1. DMRT groupings are denoted in superscript.

Rice cultivars were categorized according to IRRI standard evaluation system considering number of tillers per plant, plant height, age and spikelet fertility. All the traditional rice cultivars included in to low or very low tillering groups (Table 2). However, some *Dik Wee* accessions, *Polayal*, and *Gonabaru* were included in to the group to which Bg379/2 was also belonged.

Among tested medicinally important traditional rice cultivars, *Kuru Wee*, *Samba*, *Kuruluthudu*, *olayal*, and *Masuran* were tall and *Kalu Heenati*, *Murungakayan 101*, *Dik Wee* (2203), *Dik Wee* (3444), *Gonabaru* (3543), *Kuruluthudu 2* (3656), *Rathel*, *Weda Heenati*, and Bg379/2 were semi-dwarf (Table 3). *Dik Wee* accessions were included in to both intermediate and semi-dwarf groups.

All the medicinally important traditional rice cultivars included in to different age groups (Table 4). *Pachchaiperumal 2462-11*, *Polayal*, and *Gonabaru* were three month cultivars while *Kuru Wee*, *Dostara Heenati*, and *Heenati 309* were 3 and ½ month varieties. All the other cultivars named *Dik Wee* (2203), *Kuruluthudu*, *Weda Heenati*, *Masuran*, *Samba*, *Kalu Heenati*, *Dik Wee*, *Dik Wee 328*, *Murungakayan 101*, *Murungakayan 3*, *Dik Wee* (2203), *Dik Wee* (3444), were included in to 4-4 and ½ month age group (Table 4).

Rice cultivar *Kuruluthudu 2* was highly fertile like modern rice cultivar Bg379/2 (Table 5). Rice cultivars *Kuru Wee*, *Dik Wee 3444*, *Samba*, *Kalu Heenati*, *Dik Wee 2203*, *Dostara Heenati*, *Weda Heenati*, *Polayal*, and *Heenati 309* were included in to fertile group. All the other accessions named *Pachchaiperumal 2462-11*, *Dik Wee*, *Murungakayan 101*, *Murungakayan 3*, *Gonabaru*, *Rathel*, *Masuran*, and *Dik Wee 328* were highly or partly sterile (Table 5).

When consider the number of tillers/plant *Dik Wee 3444*, *Gonabaru*, *Polayal*, and Bg 379/2 recorded low number of tillers while all the other cultivars recorded very low tillering (Table 6).

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Table 1: Comparison of characteristics of traditional rice varieties

Accession No	Variety	Days to flowering	Plant height (cm)	No. of tillers/plant	No. of fertile tillers/Plant	Panicle length(cm)	Filled grain %	100 grain weight (g)	(g)/plant	weight of biomass (g)/plant	Harvest Index
2203	<i>Dik Wee</i>	90 <sup>cdefg</sup>	124 <sup>de</sup>	3.8 <sup>cd</sup>	2.8 <sup>efgh</sup>	24.2 <sup>ab</sup>	83.7 <sup>abc</sup>	2.25 <sup>abc</sup>	5.1 <sup>def</sup>	9.36 <sup>f</sup>	0.54
3982	<i>Kuru Wee</i>	78 <sup>ghi</sup>	136 <sup>bed</sup>	4 <sup>cd</sup>	3 <sup>defgh</sup>	19.3 <sup>b</sup>	79 <sup>abc</sup>	2.03 <sup>abc</sup>	2.1 <sup>i</sup>	17.12 <sup>bc</sup>	0.12
3136	<i>Pachchaiperumal 2462-11</i>	68 <sup>i</sup>	119 <sup>e</sup>	4.3 <sup>cd</sup>	3.3 <sup>defg</sup>	16 <sup>b</sup>	73.5 <sup>cd</sup>	2.1 <sup>abc</sup>	2.0 <sup>i</sup>	6.276 <sup>g</sup>	0.32
3468	<i>Samba</i>	101 <sup>c</sup>	154 <sup>a</sup>	4 <sup>cd</sup>	2.5 <sup>fgh</sup>	21.2 <sup>ab</sup>	75.6 <sup>c</sup>	2.91 <sup>a</sup>	2.6 <sup>hi</sup>	13.5 <sup>de</sup>	0.19
3656	<i>Kuruluthudu</i>	87 <sup>defg</sup>	141 <sup>abc</sup>	3.9 <sup>cd</sup>	2.7 <sup>fgh</sup>	20.34 <sup>ab</sup>	77.0 <sup>bc</sup>	2.28 <sup>abc</sup>	3.4 <sup>efg</sup>	10.44 <sup>ef</sup>	0.33
3200	<i>Kalu heenati</i>	100 <sup>cd</sup>	86.8 <sup>g</sup>	2.6 <sup>e</sup>	2.2 <sup>gh</sup>	21.5 <sup>ab</sup>	89.5 <sup>ab</sup>	2.33 <sup>abc</sup>	5.1 <sup>cd</sup>	14.8 <sup>cd</sup>	0.34
	<i>Dik wee</i>	96 <sup>cd</sup>	129 <sup>cde</sup>	9 <sup>a</sup>	3 <sup>defgh</sup>	21.8 <sup>ab</sup>	72.8 <sup>cde</sup>	2.13 <sup>abc</sup>	6.6 <sup>c</sup>	11.54 <sup>ef</sup>	0.57
3504	<i>Dik wee 328</i>	98 <sup>cd</sup>	128 <sup>cde</sup>	4.6 <sup>c</sup>	4.2 <sup>bcd</sup>	30.6 <sup>a</sup>	24.3 <sup>g</sup>	2.9 <sup>a</sup>	4.1 <sup>efg</sup>	18.2 <sup>b</sup>	0.23
3490	<i>Murungakayan 101</i>	99 <sup>cd</sup>	88 <sup>g</sup>	3.9 <sup>cd</sup>	3.5 <sup>cdef</sup>	24.8 <sup>ab</sup>	60.9 <sup>ef</sup>	2.5 <sup>abc</sup>	4.4 <sup>efg</sup>	15.7 <sup>bcd</sup>	0.28
3489	<i>Murungakayan 3</i>	95 <sup>cd</sup>	121 <sup>e</sup>	4.1 <sup>cd</sup>	3.5 <sup>cdef</sup>	25.2 <sup>ab</sup>	62.6 <sup>def</sup>	2.5 <sup>abc</sup>	4.9 <sup>defg</sup>	16.2 <sup>bcd</sup>	0.30
3882	<i>Dostara Heenati</i>	70 <sup>hi</sup>	129 <sup>cde</sup>	4.5 <sup>cd</sup>	3 <sup>defgh</sup>	18.1 <sup>b</sup>	77.0 <sup>bc</sup>	2.68 <sup>abc</sup>	2.7 <sup>hi</sup>	6.08 <sup>g</sup>	0.44
2203	<i>Dik Wee</i>	95 <sup>cde</sup>	56.3 <sup>ij</sup>	4.6 <sup>c</sup>	4 <sup>bcde</sup>	21.9 <sup>ab</sup>	77.3 <sup>bc</sup>	2.3 <sup>abc</sup>	5.12 <sup>de</sup>	11.2 <sup>ef</sup>	0.46
3444	<i>Dik Wee</i>	94 <sup>cde</sup>	60.3 <sup>i</sup>	6.6 <sup>b</sup>	5 <sup>b</sup>	23.15 <sup>ab</sup>	74.7 <sup>cd</sup>	2.4 <sup>abc</sup>	5.2 <sup>de</sup>	10.4 <sup>ef</sup>	0.50
3543	<i>Gonabaru</i>	135 <sup>a</sup>	65 <sup>h</sup>	6 <sup>b</sup>	5 <sup>b</sup>	22.4 <sup>ab</sup>	58.3 <sup>f</sup>	1.9 <sup>abc</sup>	5 <sup>d</sup> <sup>ef</sup>	10.1 <sup>f</sup>	0.50
3548	<i>Kuruluthudu 2</i>	131 <sup>a</sup>	57 <sup>ij</sup>	4 <sup>cd</sup>	3 <sup>defgh</sup>	22.4 <sup>ab</sup>	90 <sup>a</sup>	1.3 <sup>c</sup>	3.7 <sup>fgh</sup>	9.9 <sup>f</sup>	0.37
2196	<i>Rathel</i>		45.7 <sup>j</sup>	2.6 <sup>e</sup>	2 <sup>h</sup>	19.55 <sup>ab</sup>	54.1 <sup>f</sup>	1.4 <sup>c</sup>	5.1 <sup>de</sup>	10.2 <sup>f</sup>	0.50
2340	<i>Weda Heenati</i>	83 <sup>efg</sup>	53 <sup>ij</sup>	4.3 <sup>cd</sup>	2.33 <sup>fgh</sup>	19.6 <sup>ab</sup>	82 <sup>ab</sup> <sup>c</sup>	1.5 <sup>bc</sup>	14.46 <sup>b</sup>	25.18 <sup>bcd</sup>	0.57
3472	<i>Masuran</i>	91 <sup>cdef</sup>	141.3 <sup>abc</sup>	3.33 <sup>cd</sup>	3 <sup>defgh</sup>	24.5 <sup>ab</sup>	73.99 <sup>cd</sup>	2.51 <sup>abc</sup>	3.6 <sup>gh</sup>	9.4 <sup>f</sup>	0.39
3339	<i>Polayal</i>	68 <sup>i</sup>	148.8 <sup>ab</sup>	6.2 <sup>b</sup>	4.6 <sup>bc</sup>	18.1 <sup>b</sup>	83.35 <sup>abc</sup>	2.37 <sup>abc</sup>	4.3 <sup>efg</sup>	15.88 <sup>bcd</sup>	0.27
3132	<i>Heenati 309</i>	81 <sup>fgh</sup>	121.5 <sup>e</sup>	4.25 <sup>cd</sup>	3 <sup>defgh</sup>	21.08 <sup>ab</sup>	77.61 <sup>bc</sup>	2.22 <sup>abc</sup>	1.55 <sup>i</sup>	11.25 <sup>ef</sup>	0.14
	<i>Bg379/2</i>	120 <sup>b</sup>	103 <sup>f</sup>	8.3 <sup>a</sup>	7 <sup>a</sup>	22.2 <sup>ab</sup>	91 <sup>a</sup>	3.2 <sup>a</sup>	26.5 <sup>a</sup>	58.9 <sup>a</sup>	0.45

**Table 2:** Grouping traditional rice cultivars according to number of tillers

Category	No. of tillers/plant	Cultivar
Very high	>25	-
Good	20-25	-
Medium	10-19	-
Low	5-9	<i>Dik Wee, Dik Wee (3444), Gonabaru (3543), Polayal (3339), Gonabaru (4726), Bg 379/2</i>
Very low	<5	<i>Dik Wee(2203), Kuru Wee, Pachchaiperumal 2462-11, Samba, Kuruluthudu, Kalu heenati, Dik Wee 328, Murungakayan 101, Murungakayan 3, Dostara Heenati, Dik Wee (2203), Kuruluthudu 2 (3656), Rathel, Weda Heenati, Masuran, Heenati 309</i>

**Table 3:** Grouping traditional rice cultivars according to plant height

Category	Plant height	Cultivar names
Semi-dwarf	<110	<i>Kalu Heenati, Murungakayan 101, Dik Wee(2203), Dik Wee (3444), Gonabaru (3543), Kuruluthudu 2 (3656), Rathel, Weda Heenati, Bg 379/2</i>
Intermediate	110-130	<i>Dik Wee(2203), Pachchaiperumal 2462-11, Dik Wee, Dik Wee 328, Murungakayan 3, Dostara Heenati, Heenati 309, Gonabaru</i>
Tall	>130	<i>Kuru Wee, Samba, Kuruluthudu, Polayal, Masuran</i>

**Table 4:** Grouping traditional rice cultivars according to age

Age (months)	Cultivar names
3	<i>Pachchaiperumal 2462-11, Polayal, Gonabaru</i>
3 1/2	<i>Kuru Wee, Dostara Heenati, Heenati 309</i>
4	<i>Dik Wee(2203), Kuruluthudu, Weda Heenati, Masuran,</i>
4 1/2	<i>Samba, Kalu Heenati, Dik Wee, Dik Wee 328, Murungakayan 101, Murungakayan 3, Dik Wee(2203), Dik Wee (3444), Bg 379/2</i>
5 1/2	<i>Gonabaru (3543)</i>

**Table 5:** Grouping traditional rice cultivars according to spikelet fertility

Highly fertile (>90%)	<i>Bg379/2, Kuruluthudu 2,</i>
Fertile (75-89%)	<i>Kuru Wee, Dik Wee 3444, Samba, Kalu Heenati, Dik Wee 2203, Dostara Heenati, Weda Heenati, Polayal, Heenati 309,</i>
Partly sterile (50-74%)	<i>Pachchaiperumal 2462-11, Dik Wee, Urungakayan 101, Murungakayan 3, Gonabaru, Rathel, Masuran,</i>
Highly sterile (<50% to trace)	<i>Dik Wee 328,</i>
0%	

**Table 6:** Grouping traditional rice cultivars according to number of tillers

Very high (more than 25 tillers/plant)	-
Good (20/25 tillers/plant)	-
Medium (10-19 tillers/plant)	-
Low (5-9 tillers/plant)	<i>Dik Wee 3444, Gonabaru, Polayal, Bg 379/2</i>
Very low (less than 5 tillers/plant)	<i>Dik Wee, Dik Wee 3444, Gonabaru, Polayal, Dik Wee (2203), Kuru Wee, Pachchaiperumal 2462-11, Samba, Kuruluthudu, Kalu heenati, Dik Wee 328, Murungakayan 101, Murungakayan , Dostara Heenati, Dik Wee 2203, Kuruluthudū 2, Rathel, Weda Heenati, Masuran, Heenati 309</i>