Yield Evaluation of Red Rice Land Races of Tamil Nadu under Organic Practices

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ABSTRACT: Red rice has not been given its due importance due to the emergence of white rice as a predominant staple food since the advent of green revolution. Although the scientific community is totally aware of its wonders as a source of minerals, protein and antioxidants, yet alone they cannot make a significant mark without an immense market potential demand. In recent times, demand for red rice land races is on the increasing trend among the common people due to increased awareness on red rice health benefits. This higher demand favours the small and marginal farmers to market their produce at comparatively higher prices than the high yielding varieties and thus they get benefited good returns from less inputs even under aberrant weather conditions. So, on farmers point of interest, studies on red rice production under organic practices is a need of hour as organic practices minimizes farm inputs (excluding agrochemicals). Therefore, study was put forth with an objective to identify the best performing red rice land race for potential yield. The study revealed that, among different organic practices, the treatment vermicompost + azospirillum + phosphobacteria + PPFM recorded maximum values under growth and yield attributes of all varieties. The grain yield of TKM 9 red rice variety (4980 Kg ha⁻¹) followed by a red rice land race *Kuzhiyadichan* (3804 Kg ha⁻¹) was observed higher than other red rice land races, i.e., *Kullakar* and *Kattuyanam*.

Keywords: Red rice, land races, yield, vermicompost, azospirillum, phosphobacteria, PPFM.

INTRODUCTION

Compared to other cereals including wheat, rice is a high yielding crop, even under adverse conditions. When the water supply is adequate, and naturally occurring nitrogen fixing organisms exist in the paddy fields, no synthetic fertilizers are required to produce upto 2 t ha⁻¹ of the local variety of rice. Characteristics that determine the yield potential of rice cultivars are the number of "productive" tillers per hill and panicle density (number of grains per panicle and grain weight). Many native varieties have greater mean panicle density and grain weight than most high yielding varieties (HYV). The yield in rice crop is calculated as production of grains per unit of inputs of water and agrochemicals. Arumugasamy *et al.,* (2001) declares that paddy can grow even in certain environmental conditions where other crops cannot grow. In India, there are many varieties of paddy, which can be cultivated throughout the year. Paddy can grow at an altitude of 7000 feet above sea level. It can also grow at an altitude of 10 feet below sea level. There are

paddy varieties, which can grow even if the annual rainfall is 500 mm. There are also paddy varieties that can withstand 5000 mm of annual rainfall. Samhitas of the Yajurveda mention about different varieties of grains such as *Vrihi, Yava, Masha, Tila, Mudga, Khalavarsha, Godhuma, Masura, Syamaka, Priyangu, Menava,* and *Nivara* (Richharia and Govindasamy, 1990). Regarding the other varieties of rice mentioned, prominent are hill paddy and deep water red rice varieties as mentioned in the Jatakas (Cowell, 1957). *Udaraka* and *Varaka* are two new varieties of rice introduced during Mauryan rule. In an evaluation programme for biotic stresses, with around 12,750 rice entries have been reported by Indian Institute of Rice Research, Hyderabad, India, 28.31 per cent of entries were coloured rice. Of these 10.48 per cent, 9.41 per cent and 8.40 per cent were red, brown, and purple pericarps. The collection from Central Rice Research Institute, Cuttack, Orissa with 2,960 entries, mainly from the eastern states of India, had a relatively high number of red rice of which 20 per cent were coloured

rice. This coloured rice is rich in minerals like iron, zinc and polyphenol content with antioxidant properties. So, these landraces are gaining interest for research studies. In Tamil Nadu, a greater number of red rice land races continues to exist in Ramnad district and they are found to be drought resistant.

Rice with a red bran layer is called red rice. Red rice was found to be a rich mineral source. The bran layer contains polyphenols and anthocyanin, and possesses antioxidant properties. The inner portion of red and white rice is white alike. The zinc and iron content of red rice is two-three times higher than that of white rice (Deb, 2000). The change in food habits from traditional foods to junk foods has increased the risk of lifestyle-related health issues and diseases – such as diabetes, cancer and heart problems. Red rice meets most of the requirements of a good and healthy food. This cereal is the only one that is eaten consumed as a whole grain, and is more easily digestible. In addition of being nutritive and having medicinal value, red rice possess many other special features. It is common experience that red- and black-husked rice are comparatively more resistant to storage insect pests than brown-husked rices (Sathya *et al.,* 2007).

MATERIALS AND METHODS

The research trial was carried out in Rice Research Station, Tirur, Tamil Nadu, during samba seasons of 2020-2021 to find the performance of traditional red rice varieties in comparison with TKM 9 (red rice variety released by RRS, Tirur). Its geographical coordinates are 13˚7'N latitude and 79˚58'E longitude. The altitude of the research station is 39.47m MSL. Its soil type is sandy clay, and non-calcareous light brown. Field experiments were laid out in strip plot design with three replications. The treatments comprised of four levels of factor A and five levels of factor B. Different varieties of factor A are Kullakar (V_1), *Kuzhiyadichan* (V_2), *Kattuyanam* (V_3) TKM9 (V_4) and different organic sources of factor B are Control (N_1), Greenleaf manure (GLM) + Azospirillum + Phosphobacteria (N_2), Pressmud + Azospirillum + Phosphobacteria (N_3), Farmyard manure + Azospirillum + Phosphobacteria + Pink Pigmented Facultative Methylotrops (PPFM) (N_4), Vermicompost + Azospirillum + Phosphobacteria + Pink Pigmented Facultative Methylotrops(PPFM) (N_5). The performance of traditional red rice varieties with varied duration under scheduled organic manure treatment *viz., Kullakar* (V_1)*, Kuzhiyadichan (*V_2) and *Kattuyanam* (V_3) were tested with TKM 9 (V_4) red rice check variety. The observations on growth and yield attributes and yield were recorded periodically. The grain yield was recorded from the net plot area and expressed in kg ha^{-1} at 14 per cent moisture level. The straw yield of rice was recorded from the net plot area after enough sun drying and expressed in kg ha^{-1}. The leaf area was worked out by measuring of leaf length

and breadth using constant of 0.75 for the estimation. The total area of the leaf to the ground area was expressed as an index of the area of the leaf.

$$LAI = \frac{L \times B \times K \times \text{Total number of green leaves/hill}}{\text{Spacing (cm}^2)}$$

Where,
L - Length of the third leaf from top (cm),
B - Breadth of the third leaf from top (cm), and
K - Constant (0.75).
The data on various characters studied during the investigation were statistically analysed as suggested by Gomez and Gomez (1984) and wherever the treatment differences were found significant (F test), critical differences were worked out at five per cent probability level and the values are furnished.

RESULTS AND DISCUSSION

The observations on growth attributes *viz.,* plant height, tillers, LAI and yield attributes *viz.,* productive tillers, grain and straw yield were recorded periodically. The duration of the crop under north eastern agroclimatic zone of Tamil Nadu was found to be *Kullakar* - 100 days*, Kuzhiyadichan* -115 days, TKM 9 - 105 days and *Kattuyanam* - 150 days (Subbalakshmi *et al.,* 2020). It has observed from the study that among different organic practices, the treatment vermicompost + azospirillum + phosphobacteria + PPFM recorded maximum values under growth and yield attributes of all varieties *viz., Kullakar, Kuzhiyadichan, Kattuyanam* and TKM 9. This increase in growth and yield components of different red rice varieties under the application of vermicompost and biofertilizers is mainly because of microbial stimulation effect and N supplied through gradual mineralization in a steady manner throughout the crop growth period (Roy and Singh,2006).

Growth attributes: *Kattuyanam* (V3) followed by *kuzhiyadichan* (V2) recorded comparatively higher values under the best organic manure treatment *i.e.,* vermicompost + azospirillum + phosphobacteria + PPFM (N5) with regard to plant height and leaf area index. *Kattuyanam* (V3) registered 167 cm of plant height at harvest stage and leaf area index of 5.0 at flowering stage (Table 1 & 2). *Kuzhiyadichan* (V2) was observed to be the second maximum values *viz.,* 128 cm, 15, 4.6 under plant height at harvest stage, number of tillers per hill at active tillering stage and leaf area index at flowering respectively. Considering the varieties' tillering habit, TKM 9 found to be high tillering variety with the values of 20 tillers per hill (Table 1) which is followed by the red rice land race *kuzhiyadichan* (15).

Yield attributes and Yield: Productive tillers plays a key role in grain yield. TKM 9 (V4) records maximum tillers number per hill (21) which is followed by the land race variety *Kuzhiyadichan* (V2) (12) under the best organic manure treatment *i.e.,* vermicompost +

PPFM (N5) (Table 2). The harvest was done at the physiological maturity stage of every individual variety. TKM 9 red rice variety recorded the maximum grain yield of 4980 Kg ha^{-1} (Fig. 1) under the organic manure treatment N5 followed by *kuzhiyadichan* which has recorded 3804 Kg ha^{-1} and the minimum value was recorded in *kattuyanam* of 2275 Kg ha^{-1}. The straw yield was found to be higher in TKM 9 (9961 Kg ha^{-1}), followed by *kuzhiyadichan* (8826 Kg ha^{-1}) and minimum straw yield was observed in the *Kullakar* variety (6814 Kg ha^{-1}) (Fig. 1).

Table 1: Influence of different organic manures on Growth attributes (plant height & tillering) of red rice varieties.

	Plant height @ harvest stage (cm)							No. of Tillers/hill @ Active tillering stage					
Treatments	N_1	N_2	N_3	N_4	N_5	Mean		N_1	N_2	N_3	N_4	N_5	Mean
V_1	90	97	106	101	113	**101**	V_1	6	12	15	12	19	13
V_2	115	120	135	127	144	**128**	V_2	7	14	17	16	19	15
V_3	151	160	175	169	182	**167**	V_3	5	8	10	9	11	9
V_4	60	67	78	71	85	**72**	V_4	12	19	22	21	26	20
Mean	104	111	124	117	131		Mean	8	13	16	15	19	
	A	B	A at B	B at A				A	B	A at B	B at A		
SEd	4	2	2	2			SEd	0.45	0.46	0.24	0.26		
CD (p=0.05)	10	6	NS	NS			CD (p=0.05)	1.11	1.07	0.57	0.55		

Table 2. Influence of different organic manures on Leaf area index (LAI) and Productive tillers of red rice varieties.

	LAI @ flowering stage							No. of Productive tillers per hill @ flowering					
Treatments	N_1	N_2	N_3	N_4	N_5	Mean	Treatments	N_1	N_2	N_3	N_4	N_5	Mean
V_1	3.5	4.0	4.1	4.1	4.3	4.0	V_1	6	10	12	11	14	11
V_2	3.9	4.6	4.8	4.8	5.0	4.6	V_2	7	11	13	12	15	12
V_3	4.0	5.1	5.4	5.2	5.5	5.0	V_3	5	7	8	8	10	8
V_4	3.8	4.1	4.4	4.3	4.6	4.2	V_4	13	17	24	20	29	21
Mean	3.78	4.45	4.68	4.58			Mean	8	11	14	13	17	
	A	B	A at B	B at A				A	B	A at B	B at A		
SEd	0.18	0.14	0.07	0.07			SEd	0.39	0.38	0.18	0.2		
CD (p=0.05)	0.44	0.32	NS	NS			CD (p=0.05)	0.96	0.88	0.44	0.42		
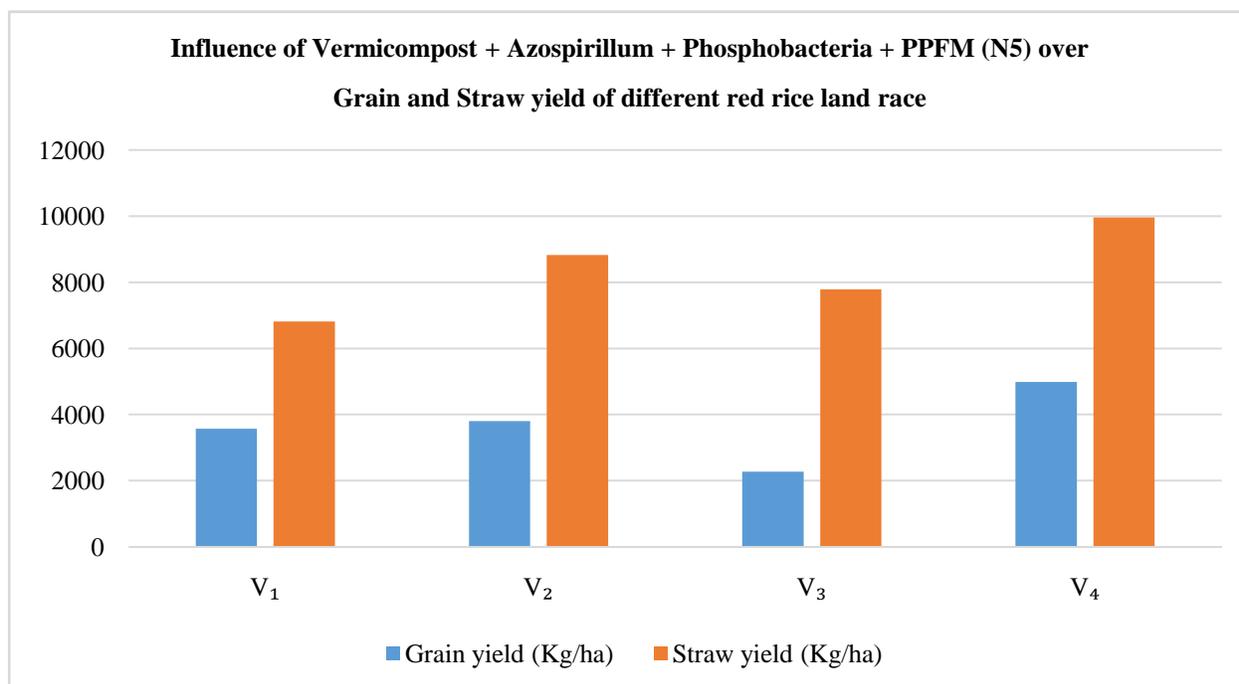
Fig. 1. Influence of vermicompost + azospirillum + phosphobacteria + PPFM over grain and straw yield of different red rice land races.

Fig. 2. Experimental field observation on growth attributes at 30 DAT.

CONCLUSION

The evaluation of red pigmented rice land races and variety under the north eastern agro climatic zone of Tamil Nadu revealed that TKM 9 variety followed by red rice land race *kuzhiyadichan* was found to be best performing red rice which also has the potential to render nutritional security.

Conflict of Interest. None.

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