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Seedling morphological diversity of traditional rice (*Oryza sativa* L.) varieties of Tamil Nadu during *Navarai* season

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Abstract
Tamil Nadu state of India has nearly 1200 traditional rice varieties under Farmers field. The present field investigation was made in Tamil Nadu Agricultural University farm, Coimbatore during *Navarai*, 2022 season to study the morphological diversity of seedlings of twenty-five traditional rice varieties. Seedling morphological characters such as coleoptile anthocyanin colouration on 7 days after sowing (DAS), seedling height, number of leaves, leaf length, leaf breadth, leaf area and seedling drymatter on 20 DAS were measured. The results revealed that rice varieties such as *Chandikar*, *Chithiraikar*, *Kallundaikar* and *Paal Thondi* had shown strong coleoptile anthocyanin colouration. Seedlings of varieties such as *Chandikar* and *Maranel* grew taller than others and fell in very tall (>35 cm) seedling grouping. Production of number of leaves on 20 DAS was significantly more in *Paal Thondi*, than all other varieties. Longer leaves of rice were measured in *Maranel* over other varieties. Leaf blade was significantly broader in *Kallundaikar*, *Maranel*, *Kalanamak*, *Attur Kichadi Samba*, *Chandikar* and *Thooyamalli* compared to others. When comparing among varieties, *Maranel*, *Kallundaikar* and *Thooyamalli* varieties measured significantly more leaf area than other varieties under study. Drymatter of rice seedlings was significantly more in *Maranel* variety compared to other varieties. Based on the above results it can be inferred that seedling morphology of traditional rice varieties of Tamil Nadu during *Navarai* season had more genetic diversity and can effectively contribute to gene pool.

Keywords: Traditional rice varieties, Seedling morphology, Genetic diversity, Coleoptile anthocyanin colouration

1. Introduction
Rice (*Oryza sativa* L.) is the most important cereal crop in the world. Almost more than half of the people in the world are consuming rice as a staple food. Rice has the largest germplasm collections in the world. This accessible collection of diverse cultivated varieties, landraces and related wild species has made great contributions to rice breeding and they played a very important role in the local food security and sustainable development of agriculture, in addition to their significance as a genetic resource for rice genetic improvement (Tang *et al*., 2002) [13].

India has a rich and wide range of genetic wealth of rice. It has been estimated from various surveys that nearly about 50,000 traditional rice varieties are still being grown in the country (Patra, 2000) [9]. Introduction of high-yielding varieties and new technologies become a great threat to the security of the age-old practice of growing traditional varieties and landraces which may have immense potential for different important traits (Raut, 2003) [11].

Agro-morphological characterization should eventually lead to a system of recording and storing useful data that can be readily retrieved and made available to others and help in planning screening as well as breeding programmes (Umarani *et al*., 2017) [14]. Morphological characterization at seedling stage would be an useful information for identifying genetic diversity of traditional rice varieties. Keeping in view, the present investigation was undertaken to characterize the 25 traditional rice varieties during *Navarai* season 2022.

2. Materials and Methods
The present study was conducted during *Navarai* season 2022 at Wetland farms, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore (11^0N and 77^0E at an altitude of 426.7 m above MSL), Tamil Nadu, India. The surface soil was clay loam in texture with alkaline pH. Organic carbon status of the soil was low with low in available nitrogen, high in

both available phosphorus and available potassium. Twenty-five traditional rice varieties were collected from farmer's fields in different locations of Tamil Nadu and used for the study. A nursery bed of 7.0 m in length and 1.3 m in width was prepared and these varieties were sown in well-prepared seedbeds on 12.01.2022. Before sowing, each variety was taken in a separate cloth bag and soaked for 12 hours in water then incubated for 24 hours for pre-germination. The pre-germinated seeds of each variety were sown in three rows at spacing of 15 cm between rows (Fig. 1).

Fifteen plants were tagged randomly and five plants each were treated as replication. The seedling morphological observations namely seedling length, leaf length, leaf breadth and number of leaves per seedling were recorded in randomly tagged plants by using standard procedure. Apart from that, coleoptile anthocyanin colourations (score 0 – absent, score 1 – very weak, score 3 – weak, score 5 – medium and score 7 – strong) was observed on 7 days after sowing was categorized as per Biodiversity International Rice descriptor (Bosetti *et al*., 2011) [2]. The data subject to statistical analysis (Gomez and Gomez, 2010) [5].

3. Results and Discussion

3.1 Coleoptile anthocyanin colouration

The intensity of anthocyanin colouration of leaves was observed in all the varieties and presented in the Table 1. The varieties such as *Chandikar*, *Chithiraikar*, *Kallundaikar* and *Paal Thondi* had shown strong coleoptile anthocyanin colouration, whereas, traditional rice varieties such as *Kullakar* showed medium anthocyanin colouration. Weak and very weak anthocyanin colouration of coleoptile were noted in *Navara* and *Kalanamak* and; *Poongar* and *Naatu Ponni* varieties, respectively. In all other varieties, the coleoptile anthocyanin colouration was absent. The anthocyanin colouration of coleoptile was mainly due to the genetic nature of the traditional rice varieties studied. Mageshwaran (2010) [7], Sarika *et al*. (2011) [12] and Rachappanavar *et al*. (2018) [10] also reported the variation in anthocyanin colouration of coleoptile among different varieties.

3.2 Seedling height

There existed a wide variation of seedling height of traditional rice varieties tested during *Navarai* 2022 season (Table 2). Traditional rice varieties such as *Maranel* and *Chandikar* grew taller compared to all other varieties under testing and fell in very tall (>35 cm) group on 20 DAS. In taller seedling (>30 cm) group, *Kullakar*, *Kudavazhai*, *Paal Thondi*, *Chithiraikar* and *Kallundaikar* varieties were categorized. Varieties such as *Karung Kuruvai*, *Kullankar*, *Thooyamalli*, *Navara*, *Karuthakar* and *Annamazhagi* were grouped under moderately tall (>20.0 - 25.6 cm) category. Varieties like *Naatu Ponni*, *Kothamalli Samba*, *Sorna Masuri*, *Mattakar*, *Ottukichadi*, *Kochin Samba*, *Kuruvai Kalanjium*, *Bhavani*, and *Attur Kichadi Samba* were grouped under moderately short (>15-20 cm). In short (12-15 cm) grouping, *Poongar*, *Kalanamak* and *Mysore Malli* varieties are placed. Among twenty-five varieties, the seedling height had varied from 12.3 to 37.7 cm on 20 DAS. It is clearly indicating that traditional rice varieties grown during *Navarai* season shown wide variation due to its genetic characters. Indhirajith *et al*. (2021) [6] reported that *Chithiraikar* recorded highest plant height at active tillering stage and *Mapillai Samba* at panicle initiation stage. The variation in plant height was due to the genetic variances as mentioned earlier (Das *et al*., 2012) [3].

3.3 Leaf characters

Leaf characters such as number of leaves plant^{-1}, leaf length, leaf width and leaf area (cm^2) varied significantly among the varieties tested (Table 3). Significantly longer leaves were noted in *Maranel* variety over other varieties tested. *Kallundaikar* (0.60 cm), *Maranel* (0.54 cm), *Attur Kichadi Samba* (0.52 cm), *Thooyamalli* (0.50 cm) and *Kalanamak* (0.50 cm) varieties measured broader leaves than all other varieties under study. *Paal Thondi* and *Mysore Malli* varieties produced significantly more number of leaves compared to other varieties. *Maranel*, *Kallundaikar* and *Thooyamalli* varieties registered significantly more leaf area over all other varieties. Leaves are photosynthetic organs which support for the process of photosynthesis and leaf surface is the base for the process. The variation of leaf characters indicates the wide genetic variability among traditional rice varieties tested (Manikanta *et al*., 2019) [8].

3.4 Seedling drymatter

Biomass accumulation in the early stage of growth is an important trait of early seedling vigour in rice. There existed a significant variation on seedling drymatter among traditional rice varieties under study. Significantly more seedling drymatter was measured in *Maranel* variety compared to all other varieties. Variation in accumulation of seedling drymatter was mainly due to the genetic variability of traditional rice varieties. Accumulation of biomass at initial stage or early stage indicates the vigour of seedlings and more vigour reduced weed competition. Fauzi *et al*. (2021) [4] and Banik *et al*. (2020) [1] also reported the supressed weed growth. Indhirajith *et al*. (2021) [6] reported that *Mapillai Samba* recorded more drymatter at active tillering and panicle initiation stages compared to other varieties.

Table 1: Coleoptile anthocyanin colourations score

Score		Varieties
0	Absent	*Annamazhagi, Attur Kitchadi Samba, Bhavani, Karung Kuruvai, Karuthakar, Kochin Samba, Kothamallai Samba, Kullankar, Kuruvai Kalanjium, Kuliyadichan, Maranel, Mattaikar, Mysore Malli, Ottukichadi, Sorna Masuri, Thooyamalli.*
1	Very weak	*Navara, Kalanamak*
3	Weak	*Naatuponni, Poongar*
5	Medium	*Kullakar*
7	Strong	*Chandikar, Chithiraikar, Kallundaikar, Paal Thondi*

Table 2: Grouping of traditional rice varieties based on seedling height (cm)

S. No.	Grouping	Varieties
1.	Very tall (> 35 cm)	*Chandikar, Maranel*
2.	Taller seedling (>30 cm)	*Kullakar, Kudavazhai, Paal Thondi, Chithiraikar, Kallundaikar*
3.	Moderately tall (>20.0 - 25.6 cm)	*Karung Kuruvai, Kullankar, Thooyamalli, Navara, Karuthakkar, Annamazhagi*
4.	Moderately short (>15-20 cm)	*Naatu Ponni, Kothamalli Samba, Sorna Masuri, Mattakar, Ottukichadi, Kuruvai Kalanjium, Bhavani, Kochin Samba, Attur Kichadi Samba*
5.	Short (<15cm) (12-15 cm)	*Kalanamak, Poongar, Mysore malli*

Table 3: Seedling characters of traditional rice varieties during *Navarai* 2022

Sl. No.	Varieties	Seedling height (cm)	Leaf length (cm)	Leaf breadth (cm)	No. of leaves plant^{-1}	Seedling drymatter (mg)
1	*Maranel*	37.7	25.7	0.54	4.00	883
2	*Chithiraikar*	30.8	18.7	0.45	3.90	578
3	*Navara*	23.8	14.5	0.40	4.00	392
4	*Bhavani*	17.7	11.3	0.31	3.30	295
5	*Ottukichadi*	16.5	11.3	0.38	3.50	312
6	*Kuruvai Kalanjium*	17.3	11.9	0.38	3.60	357
7	*Kullankar*	21.3	15.0	0.34	3.80	398
8	*Attur Kichadi Samba*	19.0	13.8	0.52	3.70	272
9	*Annamazhagi*	25.3	16.4	0.34	3.70	458
10	*Chandikar*	35.5	21.9	0.44	3.90	754
11	*Kalanamak*	14.8	8.8	0.50	3.70	194
12	*Karung Kuruvai*	20.8	13.8	0.32	3.40	345
13	*Kallundaikar*	30.8	17.8	0.60	4.10	649
14	*Thooyamalli*	22.5	18.8	0.50	4.20	365
15	*Karuthakkar*	25.1	15.1	0.31	3.90	265
16	*Kullakar*	29.9	18.4	0.40	4.00	346
17	*Kochin Samba*	17.9	11.8	0.43	4.10	246
18	*Kothamalli Samba*	15.7	10.8	0.30	3.90	194
19	*Mattakar*	16.2	11.7	0.47	3.90	234
20	*Poongar*	14.2	10.1	0.35	3.50	217
21	*Paal Thondi*	30.1	19.3	0.44	4.90	569
22	*Naatu Ponni*	15.3	10.1	0.32	3.20	213
23	*Mysore malli*	12.3	10.0	0.31	3.40	158
24	*Kudavazhai*	30.0	20.1	0.42	4.40	537
25	*Sorna Masuri*	15.9	10.0	0.31	3.10	275
	S.Ed	1.6	1.2	0.05	0.24	43
	CD (P=0.05)	3.4	2.4	0.10	0.50	89

Fig 1: Nursery view

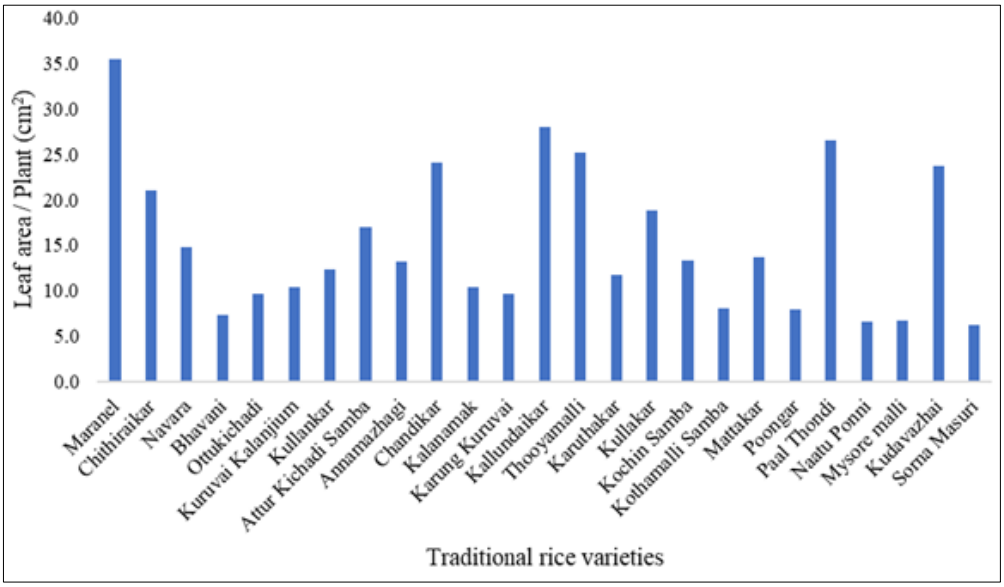

Fig 2: Leaf area (cm^2) of traditional rice varieties

4. Conclusion

The field study during seedling stage indicated wider genetic variability on morphological characters of traditional rice varieties of Tamil Nadu during *Navarai* season. In general, at seedling stage, the traditional rice variety *Maranel* registered higher morphological characters than all other varieties.

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