

Original Research Article

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Studies on Morphology, Growth Behavior and Seed Production Capacity of Different Species of Weedy Rice under Red and Lateritic Belt of West Bengal, India

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ABSTRACT

The experiment was laid out in a randomized block design with five replications in earthen pots with four different weedy rice genotypes viz. *O. rufipogon*, *O. nivara*, *O. barthii* and *O. minuta*. Data were subjected to analysis of variance using MS-Excel worksheet. Different morphological and growth behaviors characters and yield parameters were recorded for the morphological study of the different species. The highest plant height was observed in *Oryza rufipogon* which was statistically at par with *O. barthii* and *O. nivara*, whereas *O. minuta* registered the lowest. The lowest number of tillers plant⁻¹ at maturity was recorded by *Oryza rufipogon*. The highest number of tillers at maturity was registered by *O. nivara* which was statistically at par with *O. minuta*. The highest number of panicles plant⁻¹ at maturity of weedy rice was recorded by the species *O. nivara*. The lowest number of panicles plant⁻¹ recorded from the species *Oryza rufipogon*. The species *O. minuta* registered the highest number of seeds plant⁻¹ which was statistically at par with *O. nivara*. The lowest number of seeds plant⁻¹ was recorded by the species *O. rufipogon*. Among the weedy rice species *O. rufipogon* registered the lowest 1000 seed weight whereas *O. minuta* recorded the highest one.

Keywords

Height, Morphology, Seed weight, Tillers, Weedy rice species

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Introduction

Weedy rice (red rice), a conspecific weed of cultivated rice (*Oryza sativa* L.), is a significant problem throughout the world and

an emerging threat in many Asian regions. Weedy rice, a weedy form of cultivated rice crossed with wild rice competes aggressively with the crop, reducing yields and contaminating harvests. It has been identified

as one of the most problematic weeds in the 21st century which seriously affects rice yields. Weedy rice is now affecting rice areas of various countries in Asia, including India, Malaysia, Sri Lanka, Philippines, Thailand, Viet Nam, and South Korea. With diverse biotype, weedy rice has already spread and infested in more than 50 countries in Asia, Africa and Latin America. In India, weedy rice infestations are seen in West Bengal, Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Orissa, Tamil Nadu and Uttar Pradesh (Abraham and Jose, 2015). It is known by different names in different countries. Examples are “*Padi Angin*” in Malaysia, “*Lua Lon*” in Vietnam, “*Lutao*” in China, “*Akamai*” in Japan, “*Sharei*” in Korea, “*Khao Pa*” in Laos, “*Khao Nok*” in Thailand and “*Jhora Dhan*” in Bangladesh and West Bengal. Heavy infestation of weedy rice in rice fields of many countries including some of the states in India (eastern U.P., Bihar, Orissa, Manipur and West Bengal and southern India) during recent years is forcing farmers to abandon the crop due to huge reduction in crop yield around 30-60 percent depending on the severity of infestation (AICRP-WC, 2010). Variations in plant height, tiller production, pigmentation, length of awn and grain are noticed in the wild and weedy rice types of India. Heavy infestation of weedy rice ecotypes in rice fields is a problem in eastern India (Weedy rice is a superior competitor to crop cultivars due to its early vigour, greater tillering and height of plants. Early shattering of seeds, variable seed dormancy, high seed persistence in soil and high nitrogen use efficiency make this weed a strong invader. Growth and competitive ability of weedy rice may vary considerably due to differences in plant height, tiller and leaf area producing capacity (Estorninos *et al.*, 2002). Unlike cultivated varieties, weedy rice seeds show variable degree of dormancy and tendency for the seeds to shatter as soon as they are matured (Perreto *et al.*, 1993).

Seeds mature within a short period and shatter immediately facilitating the build-up of weed seed bank before the farmer gets a chance to remove the seeds and go along with the harvest of rice crop. Emergence of weedy rice is greatly influenced by the soil texture, presence of water in the field and the depth of seed burial, which in turn is strictly related to the tillage adopted for seedbed preparation. The minimum temperature for weedy rice germination is considered to be 10° C, same as that of cultivated rice.

Since the extent and nature of damage depend upon the types of weed, their intensity of infestation, the association with the crop and other biotic and edaphic characteristics, proper knowledge on composition of weed flora in the field crop of a specific region along with their identification, characterization, and assessment are necessary to formulate an economic and effective weed management strategy. Therefore, it is essential to make an information bank on weed biology and ecology is extremely important to prepare better strategy for effective management of the species (Duary *et al.*, 2015). The speedy spread of weedy rice in India serves as a warning to rice-growing states. Immediate attention is to be given towards investigating the weedy rice infestation in India, its biology and management. Integrated and diversified strategies for management of weedy rice should be urgently developed for sustainable rice production under the changing situation of global warming, high labour costs, increased adoption of alternative crop establishment methods and water scarcity.

With these perspectives the investigation on “Studies on morphology, growth behavior and seed production capacity of different species of weedy rice under red and lateritic belt of West Bengal” was carried out.

Materials and Methods

Before the experiment conducted a survey was done to find weedy rice species from the survey area i.e. the red and lateritic belt of West Bengal. Red and Lateritic belt of west Bengal consist of Purulia, Bankura, Birbhum and parts of Burdwan district of West Bengal. The experiment was carried out during 2014-'15 at Sriniketan, Birbhum district of West Bengal. The experiment was laid out in a randomized block design with five replications in earthen pots.

The four different weedy rice genotypes viz. *O. rufipogon*, *O. nivara*, *O. barthii* and *O. minuta* were taken as treatments. MTU 7027 of paddy plants were simultaneously grown in pots for comparisons.

Data were taken in every 5-7 days interval to noticed any characteristic change in behavior of weedy rice species. Data were subjected to analysis of variance (ANOVA) using MS-Excel worksheet. Plant height at maturity, culm length, Leaf length and width, ligule length, panicle length, spikelet, colour of spikelet, colour of nodes and internodes, awn length, awn colour, apiculas colour, stigma colour, 1000 grain weight (g), grain length and width (mm) were recorded for the morphological study of the different species of weedy rice.

Results and Discussion

The morphological characters of four weedy rice species i.e. *Oryza rufipogon*, *O. barthii*, *O. minuta* and *O. nivara* are presented in the Table 1. It revealed that *Oryza rufipogon*, *O. barthii* and *O. nivara* registered plant height taller than cultivated rice at maturity except *O. minuta* which was as tall as cultivated rice variety MTU 7029 (Fig. 1). Details and other morphological studies have been presented in Table 1 and described below:

Plant height (cm)

The data on plant height (cm) at maturity of weedy rice species were statistically analysed and presented in Table 2. From the Table it revealed that the highest plant height was observed in *Oryza rufipogon* species which was statistically at par with *O. barthii* and *O. nivara*. The lowest plant height was observed in *O. minuta*.

Number of tillers plant⁻¹ at maturity

The data on number of tillers plant⁻¹ at maturity of weedy rice species as presented in Table 2 revealed that the lowest number of tillers plant⁻¹ at maturity was recorded by *Oryza rufipogon*. The highest number of tillers at maturity was registered by *O. nivara* which was statistically at par with *O. minuta* and *O. barthii*.

Number of panicles plant⁻¹ at maturity

The highest number of panicles plant⁻¹ at maturity of weedy rice was recorded by the species *O. nivara* which was statistically at par with the species *O. minuta*. The lowest number of panicles plant⁻¹ recorded from the species *Oryza rufipogon* (Table 2).

Number of seeds plant⁻¹

The Table expressed that the species *O. minuta* registered the highest number of seeds plant⁻¹ which was statistically at par with *O. nivara* and *O. barthii*. The lowest number of seeds plant was recorded by the species *O. rufipogon*.

Number of filled grains plant⁻¹

O. minuta registered the highest number of filled grains plant⁻¹. The lowest number of filled grains plant⁻¹ was recorded by the species *O. rufipogon* (Table 2).

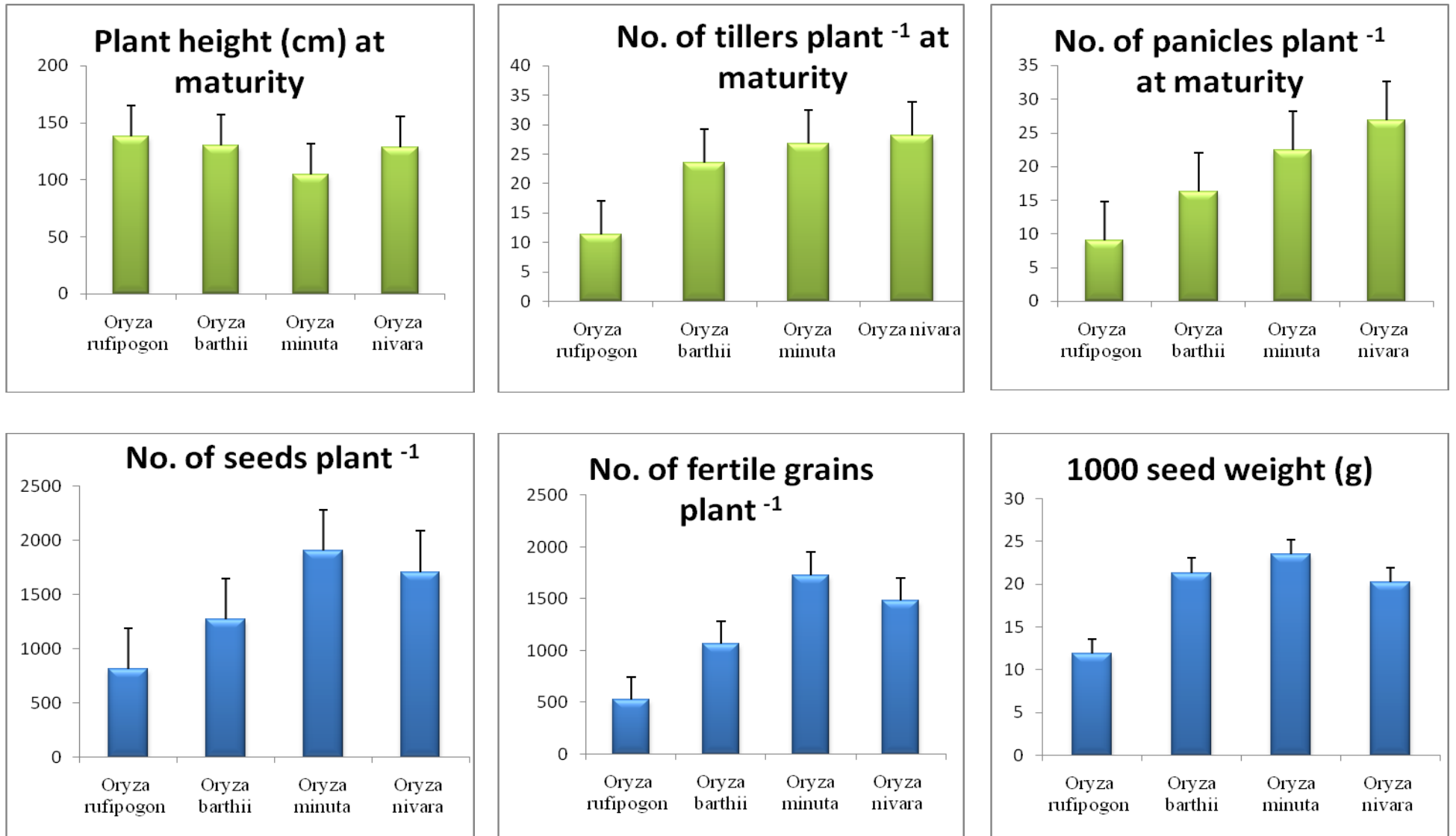
Table.1 Morphological characters of four weedy rice species

Characters	Species			
	<i>Oryza rufipogon</i>	<i>Oryza barthii</i>	<i>Oryza minuta</i>	<i>Oryza nivara</i>
Plant	Taller than cultivated rice	Taller than cultivated rice	As tall as cultivated rice	Taller than cultivated rice
Culm	Thin, very slender	Thick, strong	Thin, very slender	Thick, strong
Leaf	Length : 19.5 cm Width: 0.75 cm	Length : 28.5 cm Width: 0.80 cm	Length : 21.5 cm Width: 0.75 cm	Length : 25.0 cm Width: 0.85 cm
Ligule	1.05 cm long, narrowly triangular	2.35 cm, very narrowly triangular	0.85 cm long, triangular	1.5 cm long triangular
Panicle	30 cm long, lax, branches right angle to rachis,	24 cm long, compact, branches ascending and close to rachis	17.5 cm long, compact, branches ascending and close to rachis	20.5 cm long, compact, branches ascending and close to rachis
Spikelet	Filled grain 65%, greenish-yellow with deep pinkish-red awn	Filled grain 84%, yellow with deep pinkish-red awn	Filled grain 91%, black with black awn	Filled grain 86%, yellow turning to brown with white awn
Colour of nodes	Green	Green	Green	Green
Internodes colour	Purple green	Green	Blackish green	Pinkish green
Awn	Long awned	Long awned	Very short awned	Long awned
Awn colour	Red	Red	Black	Red
Apiculas colour	Red	Red	Black	Red
Stigma colour	Purple	Purple	Blackish purple	Purple
1000 grain weight (g)	11.9	21.3	23.5	20.2
Grain length	6.10 mm	6.40 mm	6.10 mm	6.30 mm
Grain width	1.60 mm	2.35 mm	1.75 mm	2.30 mm

Table.2 Morphological characters of four weedy rice species

Species	Parameters					
	Plant Height (cm) at maturity	No. of tillers plant ⁻¹ at maturity	No. of panicles plant ⁻¹ at maturity	No. of seeds plant ⁻¹	No. of fertile grains plant ⁻¹	1000 seed weight (g)
<i>Oryza rufipogon</i>	138.1	11.4	9.0	810.8	526.2	11.90
<i>Oryza barthii</i>	129.9	23.6	16.2	1268.0	1062.8	21.30
<i>Oryza minuta</i>	104.7	26.8	22.4	1901.2	1730.0	23.50
<i>Oryza nivara</i>	128.4	28.2	26.8	1706.8	1480.4	20.20
S. Em±	8.7	1.8	1.9	122.7	71.4	0.54
CD (at 0.05)	26.9	5.7	5.8	378.2	220.0	1.73
CV (%)	12.59	11.30	12.73	19.31	10.54	11.39

Figure.1 Different morphological characters of four weedy rice species



1000 seed weight (g)

The data on 1000 seed weight of weedy rice were statistically analysed and presented in Table 2. From the Table it expressed that among the weedy rice species *O. rufipogon* registered the lowest 1000 seed weight. On the other hand the highest 1000 seed weight was recorded by the species *O. minuta* followed by *O. barthii* and *O. nivara*.

The results revealed that the *Oryza rufipogon*, *O. barthii* and *O. nivara* registered plant height taller than cultivated rice at maturity except *O. minuta* which was as tall as cultivated rice variety MTU 7029. Same findings were observed by Park *et al.*, (1999), Baki *et al.*, (1999), Baki *et al.*, (2000), Yu *et al.*, (2005) and Shivrain *et al.*, (2010). The lowest numbers of tillers plant⁻¹ at maturity was recorded by *Oryza rufipogon*. The highest number of tillers at maturity was registered by *O. nivara* which was statistically at par with *O. minuta* and *O. barthii* (Table 2). The highest number of panicles plant⁻¹ at maturity of weedy rice was recorded by the species *O. nivara* which was statistically at par with the species *O. minuta*.

The lowest number of panicles plant⁻¹ recorded from the species *Oryza rufipogon*. The Table 2 expressed that the species *O. minuta* registered the highest number of seeds plant⁻¹ which was statistically at par with *O. nivara* and *O. barthii*. The lowest number of seeds plant was recorded by the species *O. rufipogon*. *O. minuta* registered the highest data on number of fertile grains plant⁻¹ presented in the Table 2. The lowest number of fertile grains plant⁻¹ was recorded by the species *O. rufipogon*. Among the weedy rice species *O. rufipogon* registered the lowest 1000 seed weight. On the other hand the highest 1000 seed weight was recorded by the species *O. minuta* followed by *O. barthii* and *O. nivara*. The expression of vegetative and

reproductive characters is mainly regulated by genetic behavior of a species, though environment plays an important role. Different weedy rice species under the present investigation expressed their vegetative and reproductive characters and which varied significantly among the species. Though weedy rice species *O. rufipogon* is very frequently observed in low lying waterlogged areas by the side of the road and the adjacent to rice field but the tiller production, panicle plant⁻¹, seeds panicle⁻¹, and 100 seed weight were the lowest which were also recorded in the present investigation. Similar reports of lower values of reproductive parameters were earlier reported by Baki *et al.*, (2000). On the other hand *O. minuta* and *O. nivara* produced higher number of tillers hill⁻¹, panicles hill⁻¹, seeds panicle⁻¹ and also higher test weight. The results were in congruity with Chin (1997), Chin *et al.*, (2000) and Baki *et al.*, (2000).

Conclusion is as follows:

While studying biology of weedy rice species the highest plant height was observed in *Oryza rufipogon* which was statistically at par with *O. barthii* and *O. nivara*. The lowest plant height was observed in *O. minuta*. But the lowest number of tillers plant⁻¹ at maturity was noticed in *Oryza rufipogon* whereas it was the highest in *O. nivara* which was statistically at par with *O. minuta* and *O. barthii*. The lowest number of panicles plant⁻¹ was also recorded in the species *Oryza rufipogon*. *O. minuta* registered the highest number of seeds plant⁻¹ and filled grains plant⁻¹ which was statistically at par with *O. nivara* and *O. barthii*. The species *O. rufipogon* also registered the lowest number of seeds plant⁻¹ and 1000 seed weight. On the other hand the highest 1000 seed weight was recorded by the species *O. minuta* followed by *O. barthii* and *O. nivara*.

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