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Original Research Article

# Morpho-Taxonomic Distinction between *Oryza rufipogon* and *Oryza sativa* (Poaceae) at Seedling Stage

**Ajai Kumar Singh*, Rishi Kumar Sahu and Ayush Kumar Singh**
Department of Botany, Udai Pratap College (Autonomous), Varanasi-221 002, U. P., India

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**Abstract:** Present study aimed to identify and differentiate between two important taxa *Oryza rufipogon* and *O. sativa* of the family Poaceae on the basis of their seedling morphology. Seedlings of the reported taxa can be differentiated from each other by comparing some morphological attributes such as Auricle, Caryopsis, Coleoptile, Collet, Epicotyl, First internode, Hypocotyl, Leaf blade, Leaf sheath, Lemma, Ligule and Transitional node roots recorded during study. Comprehensive seedling morphology, Key and sketches have been provided in support of the observation.

**Key Words:** *Oryza*, Seedling Identification.

## Introduction

The genus *Oryza* L. includes 21 wild species and 2 cultivated species, Oryza glaberrima and *O. sativa*. Whereas O. glaberrima is cultivated in restricted areas of western Africa, *O. sativa* is cultivated globally. Since the time of its initial domestication, Asian cultivated rice has been moved across the globe with migrating human populations; rice cultivation can now be found on all continents except Antarctica and feeds more than half of the world's population. Each year an estimated 408,661 million metric tons of rice is consumed, supplying 20% of the world's total caloric intake (Londo *et al.,* 2006).

Asia accounts for 90% of the world's total rice area and production. Rice is an important cereal crop in India for food security. In India, it is grown on approximately 45 million ha annually with a production of 104 million tons. India's rice demand is estimated to rise to 122 million tons in 2020, which is equivalent to an overall increase of 22% in the next 10 years. But, the current evidence shows declining factor productivity and a plateau in rice yields due to fatigued natural resources, declining water table, increasing labour scarcity and energy shortage, escalating fuel prices, and changing climatic conditions. In countries (e.g., Malaysia, Sri Lanka, Thailand, Vietnam, and the United States) where direct-seeding is the dominant rice establishment method, weedy rice (*Oryza rufipogon*) has emerged as a dominant weed species and major threat to rice production. A study in Malaysia reported that *Oryza rufipogon* can cause a yield loss of 60% to 100%. Based on experiences in these countries, it is predicted that weedy rice is likely to emerge as a major threat in direct-seeded rice (DSR) production systems in India (Singh *et al.,* 2013). Weedy rice is highly competitive and difficult to control in rice and can result in complete crop loss if not contained. Therefore, there is a need to develop ecologically based integrated management strategies in advance to deal with the likely problem of weedy rice in DSR, suited to Indian conditions for the long-term sustainability of DSR production systems. In India, weedy rice is prevalent in parts of the rice production areas in rainfed upland rice ecosystems of eastern Uttar Pradesh (part of the present study area), Bihar, Odisha, Manipur, West Bengal, and the hilly tracts of the northeast. Therefore, effective management strategies are needed to counter the weedy rice threat in the irrigated and favourable rainfed rice production environments of India.

The overall aim of the present study is to identify and differentiate the *Oryza rufipogon* and *O. sativa* L. at seedling stage and to justify the morpho-taxonomic significance of seedlings in weed management. The manuscript emphasizes the seedling morphology of both the species of *Oryza* L. upto third leaf stage and some key attributes have been identified which may be

***Corresponding Author:**
**Dr. Ajai Kumar Singh,**
Associate Professor,
Department of Botany,
Udai Pratap College (Autonomous),
Varanasi-221002, INDIA.

useful for their characterization and differentiation at seedling stage.

## Materials and Methods

The mature specimens of *O. rufipogon* and *O. sativa* were identified with the help of authentic literature and their seeds have been collected in the month of October-November, 2013 from Varanasi district ($25^0$ 10´- $25^0$ 37´ N lat. and $82^0$ 11'- $83^0$ 1' E long), Uttar Pradesh, India. All seeds were grown during August-September, 2014, in Petri dishes (20 cm x 5 cm) on moist filter paper at temperature of $20^0$-$22^0$ C in permanent light, and in sandy soil in the green house. The different stages of development of each seedling up to 3rd leaf stage were considered for preparing a complete description out of ten individuals. For morpho-taxonomic description fresh seedlings were analyzed under Stereoscopic Binocular Microscope (Olympus-Magnus MSZ-Bi) and sketches have been prepared. The gross morphological features of the seedlings were described following Tillich (2007), Singh et al. (2013). Seedling vouchers have been deposited in the Herbarium, Department of Botany, Udai Pratap College (Autonomous), Varanasi, Uttar Pradesh, India ((20.08.2014, AKS 07; 14.09.2014, AKS 03).

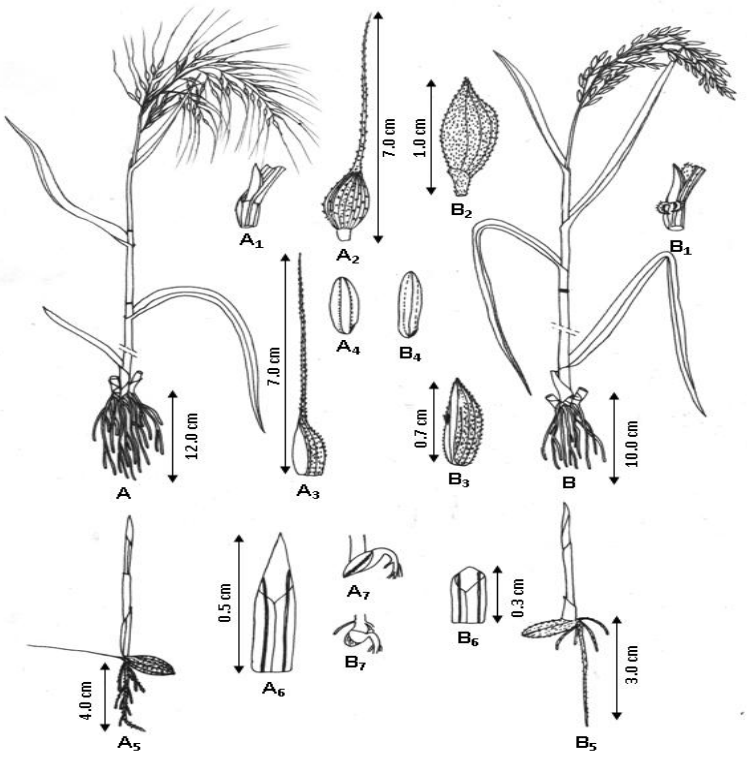


**Fig. 1:** A. *Oryza rufipogon* (mature mother plant), $A_1$. Ligule, $A_2$. Spikelet, $A_3$. Lemma, $A_4$. Caryopsis, $A_5$. Seedling, $A_6$. Coleoptile, $A_7$. Scutellum; B. *Oryza sativa* (mature mother plant), $B_1$. Ligule, $B_2$. Spikelet, $B_3$. Lemma, $B_4$. Caryopsis, $B_5$. Seedling, $B_6$. Coleoptile, $B_7$. Scutellum.

## Results

**Seedling Morphology:**

***Oryza rufipogon* Griff.** Notul. 3: 5, 1851. *O. sativa* sensu **Hook**. f. Fl. Brit. India 7: 92. 1896, p.p., non L. 1753. (Fig. 1A, Fig. $1A_1$, Fig. $1A_2$, Fig. $1A_3$, Fig. $1A_4$, Fig. $1A_5$, Fig. $1A_6$, Fig. $1A_7$). Seedling mesogeal type (Fig. $1A_5$). Primary root fibrous, less developed than shoot, much branched, light brown and hairy, terete in cross section, 2.4 cm long at coleoptile stage, and 3.0 cm, 3.5 cm and 4.0 cm long at 1st, 2nd and 3rd leaf stage respectively. Transitional node roots, collet and hypocotyl not distinct. Lemma obovate, 0.50 x 0.30 cm, mean Length/Width ratio (L/W) 1.6, base cuneate, apex acute and awned; awn 3.5 cm long; margins entire, brown, hirsute; hairs brown, base broad, apex acute, <0.1 cm long (Fig. $1A_3$). Palea same as lemma but awnless. Caryopsis oblong, 0.5 x 0.2 cm, mean L/W 2.5, base obtuse-oblique, apex acute, white and glabrous (Fig. $1A_4$). Scutellum trigonous, white and glabrous (Fig. $1A_7$). Coleoptile lanceolate, base truncate, apex acuminate, translucent, loose and binerved, 1.3cm long (Fig. $1A_6$). Epicotyl green, glabrous, terete in cross section, not distinct at first leaf stage, 1.9 cm and 3.0 cm long at 2nd and at 3rd leaf stages respectively. Internodes (at 3rd leaf stage): First internode not distinct, second one 2.5 cm long, later internodes elongating. Leaf sheath green, glabrous, margins hyalin, 1.4 cm long. Auricle, ligule and leaf blade not distinct at first leaf stage. Second and subsequent leaves with distinct ligule and leaf blade. Ligule membranous, apex erose, 0.2 cm long (Fig. $1A_1$). Leaf blade linear, 6.0 x 0.5 cm, mean L/W 12.0, base attenuate, apex apiculate, margins entire, both surface green and glabrous. Venation parallelodromous; multicostate striated, several primary veins distinct, reaches to blade apex. Subsequent leaves same as that of 2nd leaf.

***Oryza sativa* L.** Sp. Pl. 333. 1753; Hook. f. Fl. Brit. India 7: 92. 1896. (Fig. 1B, Fig. $1B_1$, Fig. $1B_2$, Fig. $1B_3$, Fig. $1B_4$, Fig. $1B_5$, Fig. $1B_6$, Fig. $1B_7$). Seedling mesogeal type (Fig. $1B_5$). Primary root fibrous, less branched, less developed than shoot, glabrous, white, terete in cross section, 0.8 cm long at coleoptile stage, 1.0 cm, 2.0 cm

and 3.5 cm long at 1st, 2nd and 3rdleaf stage respectively; transitional node roots same as primary root, much branched, more developed than primary root, 5.2 to 6.9 cm long. Collet and hypocotyl distinct. Lemma oblong 1.2 x 0.3 cm, mean L/W 4.0, base and apex acute, margins entire, straw colored, surface hairy; hairs unicellular, base broad, apex acute, transparent, <0.1 cm long (Fig. $1B_3$). Palea same as lemma. Caryopsis oblong 0.9 x 0.2 cm, mean L/W 4.5, membranous, base obliquely acute, margins entire, surface longitudinally ribbed and glabrous (Fig. $1B_5$). Scutellum flat and slightly convex, milky white and glabrous (Fig. $1B_7$). Coleoptile transluscent, glabrous, tight, base truncate, apex obtuse, binerved, 0.4 cm(Fig. $1B_6$). Epicotyl light pink, glabrous, terete in cross section, 1.7 cm, 1.9 cm and 2.7 cm at 1st, 2nd and 3rd leaf stages respectively. Internodes (at 3rd leaf stage): First one 1.7 cm long, later internodes elongating. Leaf sheath transluscent, green, glabrous, margins hyaline and glabrous, 1.9 cm long. Ligule membranous, base truncate, apex obtuse-truncate, 0.2 cm long (Fig. $1B_1$). Leaf blade linear, 1.2 x 0.8 cm, mean L/W 1.5, base attenuate, apex acute, margins entire, both surface green and glabrous. Venation parallelodromous; multicostate striated; 7 primary veins distinct, all reaches to blade apex. Second and subsequent leaves same as of 1st leaf.

***Key to the seedlings***

Transitional node roots, Collet and Hypocotyl distinct. Lemma awnless, oblong, base acute, straw colored, hairy, 1.2 x 0.3 cm, mean L/W 4.0. Caryopsis base obliquely acute, surface longitudinally ribbed, mean L/W 4.5. Coleoptile 0.4 cm long, apex obtuse. Epicotyl light pink, distinct at first leaf stage. First internode distinct at third leaf stage. Leaf sheath 1.9 cm long. Auricle, leaf blade and ligule distinct at first stage. Leaf blade apex apiculate. *O. sativa*

Transitional node roots, Collet and Hypocotyl not distinct. Lemma awned, obovate, base cuneate, brown, hirsute, 0.50 x 0.30 cm, mean L/W 1.6. Caryopsis base obtuse-oblique, surface smooth, mean L/W 2.5. Coleoptile 1.3 cm long, apex acute. Epicotyl green, not distinct at first leaf stage. First internode not distinct at third leaf stage. Leaf sheath 1.4 cm long. Auricle, leaf blade and ligule not distinct at first leaf stage. Leaf blade apex acute. *O. rufipogon*

## Discussion

*Oryza rufipogon* is a wide spread weed in most of the rice growing countries of the world. It easily crosses with the cultivated rice, reducing its market value. But it is important for the germplasm which has many resistant genes, and hence is collected and conserved in-situ and ex-situ in China. In China, a program on in-situ conservation has been started.

It is evident from above taxonomic key that weedy rice *O. rufipogon* can be recognized at seedling stage and differentiated from cultivated rice *O. sativa* on the basis of some morphological attributes such as distinction of transitional node roots, collet, and hypocotyl, lemma (awn, shape, base and colour), caryopsis (base and surface), coleptile (length and apex), Epicotyl colour at first leaf stage, distinction of auricle, leaf blade and ligule at first leaf stage and leaf blade apex. The size and apex of coleoptile found significant very mush in distinction of reported taxa at seedling stage. Only by observing the coleoptile length and their apex, the reported taxa can be identified and differentiated very easily.

## Conclusion

Most of the weed identification manuals feature mature weeds and use characteristics of flowers and fruits as an aid in their identification. However it is must to control weeds at seedling stage, to prevent them from competing with crops. Accurate identification of weed seedling is also necessary to select the herbicide or other method of weed control. From present contribution it is also evident that the role of plant morphologists and taxonomists is significant in weed management.

## Acknowledgement

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**Conflict of interest:** None Declared