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**SHORT PAPER**

# Salient characters of Weedy rice (*Oryza sativa* f. *spontanea*) populations in highly infested areas in Sri Lanka

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**Abstract.** Weedy rice (WR) was first reported in 1990 and it is occurring with varying population densities in all agro-ecological zones in Sri Lanka. The identification of WR eco-types using agro-morphological characters which vary with time and remains as a major problem among the farmers and the agronomists. The WR population possesses a number of pleisomorphic (primitive) and apomorphic (derived) characters. This study focuses on identification of primitive and derived characters observed in WR. The identification of the salient trends of specialization of characters in WR populations facilitates the understanding of the rate diversification of WR populations. Seeds of presumed WR eco-types were collected from five different locations in Kurunegala and Matara districts. Five replicates with three plants of each eco-type were planted in plastic pots with representative paddy soils from each location. Replicates were arranged in Complete Randomized Design (CRD). Agro-morphological characterization (using thirty characters) of WR eco-types, wild rice and cultivated rice varieties were made using a Standard Characterization Catalogue. The collected data were separated into nominal and scalar variables and the nominal data were used to construct Classification and Regression Trees using CART algorithm. The long-fully awned and absence of awn were pleisomorphic characters and short-fully awned and long-partly awned characters were apomorphic in WR eco-type populations in Sri Lanka. These characters could be hypothesized as derived from mixing of germplasm either of cultivated or wild rice varieties indicating the possibilities of cross-pollination among wild, cultivated and weedy rice eco-types.

**Keywords.** Agro-morphological, *Oryza sativa f. spontanea*, salient trends, Weedy rice.

## 1 Introduction

Paddy cultivation in the country has been threatened by a number of challenges, and among those, the emergence of rice weeds plays an important role. It has been reported that yield loss due to the infestation of rice fields ranged from 30-40% (Khush 1997). However, the appearance of "weedy rice" (WR) became the most prominent weed problem in rice growing areas. WR first reported in 1990 in a small area in Ampara District in Eastern Province of Sri Lanka and by 1997 it had become a serious problem in the area. WR now occurs, in varying population densities, in all agro-ecological zones of the country (Abeysekara *et al*. 2010). The term "weedy rice" generally includes all the species of the genus *Oryza* which behave as rice and is in rotation with rice weeds. WR populations have been reported in many rice-growing areas in the world where the crop is directly seeded (Ferrero and Finassi 1995). The phylogenetic origin of the weedy forms is closely related to that of cultivated rice. Many weedy plants share most of the features of the two cultivated species *Oryza sativa* and *O. glaberrima* (Khush 1997). Agro-morphological and topographical characteristics of the plants have been the criteria in the identification and classification of WR eco-types (Qinjin *et al*. 2006). However, at seedling stage, weedy plants are difficult to distinguish from the crop (Hoaghland and Paul 1978).

The previous studies carried out on the WR populations in the country, especially in Matara and Kurunegala districts have indicated that higher numbers of WR eco-types were reported from the Kurunegala (Intermediates zone) district. The main problem faced by the farmers and the agronomist is the identification of WR eco-types using agro-morphological characters. Meanwhile, there will be a number of derived characters (apomorphic) and primitive characters (plesiomorphic) within the WR population in the country. The present study focused on the identification of primitive and derived characters observed in the WR populations and the use of those features to identify the primitive eco-types in the WR populations in the country. In addition, the identification of primitive vs. novel characters of WR populations facilitates the understanding of the salient characters and their trends within weedy and cultivated rice populations.

**Table 1.** Agro-morphological characters used for the characterization WR and cultivated rice varieties included in the study (PGRC, 1999)

| Character number | Character | Description | Character number | Character | Description |
|---|---|---|---|---|---|
| 1 | Seedling height (cm) | Recorded at the five leaf stage | 16 | Culm angle | 1.Erect 3.Intermediate 5.Open 7.Spreading 9.Procumbent |
| 2 | Leaf blade length (cm) | Measured from top most leaf below the flag leaf on the main culm at late vegetative stage. | 17 | Inter node color after full heading | 1.Green 2.Light gold 3.Purple lines 4.Purple |
| 3 | Leaf blade width (mm) | Measured at the widest portion of the leaf blade | 18 | Culm strength | 1.Strong 3.Moderately strong 5.Intermediate 7.Weak 9.Very week |
| 4 | Leaf blade pubescent | 1.Glabrous 2.Intermediate 3. Pubescent | 19 | Panicle length | From the base to the tip of the panicle |
| 5 | Leaf blade color | 1. Pale green 2. Green 3. Dark green 4.purple tips 5.purple margins 6.Purple blotch 7. Purple | 20 | Panicle type | 1.Compact 5.Intermediate 9.Open |
| 6 | Basal leaf sheath color | 1.Green 2.Purple lines 3.Light purple 4.Purple | 21 | Secondary branching | 0.Abscent 1.Light 2.Heavy 3.Clustering |
| 7 | Leaf angle | 1.Erect 2.Intermediate 3.Horizontal 4.Descending | 22 | Panicle exsertion | 1.Well exsertion 3.Moderately 5.Just exterted 7.Partly exserted 9.Enclosed |
| 8 | Flag leaf angle | 1.Erect 2.Intermediate 3.Horizontal 4.Descending | 23 | Awning after full heading | 0. Absent 1.Short and partly awned 5.Short and fully awned 7.Long and partly awned 9. Long and fully awned |
| 9 | Ligule length (mm) | Measured at late vegetative stage | 24 | Apicus color | 1.White 2.Straw 3.Brown 4.Red 5.Red apex 6.Purple 7.Purple apex |
| 10 | Ligule color | 0.Absent 1.White 2.Purple lines 3.Purple | 25 | Lemma and palea color | 0.Straw 2.Gold 3.Brown spot on straw 4.Brown 5.Reddish to light purple 6.Purple spots on straw 7.Purple 8.Black 9.White |
| 11 | Collar colour | 1.Pale green 2.Green 3.Purple | 26 | Lemma and palea pubescence | 1. Glabrous 2.Hairs on lemma keel 3. Hairs on upper portion 4.Short hairs 5.Long hairs |
| 12 | Auricle colour | 0.Abscent 1.Pale green colour 2.Purple | 27 | Sterile lemma color | 1.Straw 2.Gold 3.Red 4.Purple |
| 13 | Days of heading | No. Of days from effective seeding to 50% heading | 28 | Sterile lemma length | 1.Short 3. Medium 5.Long 7.Extra long 9.Asymmetrical |
| 14 | Culm length (cm) | From ground level to the base of the panicle | 29 | 100 grain weight | A random sample of 100 well developed grains dried 13% moisture content |
| 15 | Culm number | Total no. Of grain bearing and non bearing tillers | 30 | Seed coat color | 1.White 2.Light brown 3.Speckled brown 4.Brown 5.Red 6.Variable purple 7.Purple |

## 2 Materials and Methodology

Seeds of presumed different WR eco-types which were identified during field collection, wild rice (*O. nivara*) and cultivated rice (Bg 358, Bg 352, Bg 359, Bg 379-2, Bg 307, At 362) varieties were collected from five different locations in Matara and Kurunagala districts. Collected seeds were subjected to dormancy breaking treatments (hot water treatment) and sown in plastic trays (60 cm x 30 cm x 5 cm) in a plant house at the Open University of Sri Lanka, Nawala. A total of five replicates with three plants in a replicate of each WR eco-type, wild rice and cultivated rice varieties were planted in plastic pots with representative paddy soils from each location. Complete Randomized Design (CRD) was used for this experiment. Agro-morphological characterization (thirty characters) (Table 1) of WR eco-types, wild rice and cultivated rice varieties were made using the Standard Characterization Catalogue (PGRC, 1999). The collected data were separated into nominal and scalar variables and the nominal data were used to construct Classification and Regression Trees using CART algorithm (Breiman *et al*. 1984). The CHAID (Chi-squared Automatic Interaction Detection) procedure was specified and other parameters were set at default values. The analysis was carried out using SPSS PC Ver. 20.

## 3 Results and Discussion

The data set included five cultivated rice varieties from Kurunagala and Matara District and one wild rice variety (*O. nivara*). The number of WR eco-type varies with the district and the highest number of WR eco-types was reported from the Kurunegala District. The result of the classification and regression tree analysis (CART) is shown in Fig. 01. According to the figure, there were ten child nodes and three parental nodes. The character, lemma and palea color split the entire sample into two groups. The characters, seed coat color and awning after full heading further split the child nodes into six terminal groups. The used agro-morphological character in the study plays an important role in classifying the WR eco-types, cultivated and wild rice into well-separated entities indicating their primitiveness of the characters they possess. Characters such as the lemma and palea color, seed coat color, awning after full heading seem to be derived characters when compared to other 27 characters used for characterization. Further, gold and gold furrows on straw background, was the characteristic state of palea color which occurs in *O. nivara*. Meanwhile, all the cultivated rice varieties possess brown furrows on straw. The two character states of lemma and palea color seem to occur in the populations of wild rice and cultivated rice and it can be considered as a primitive character.

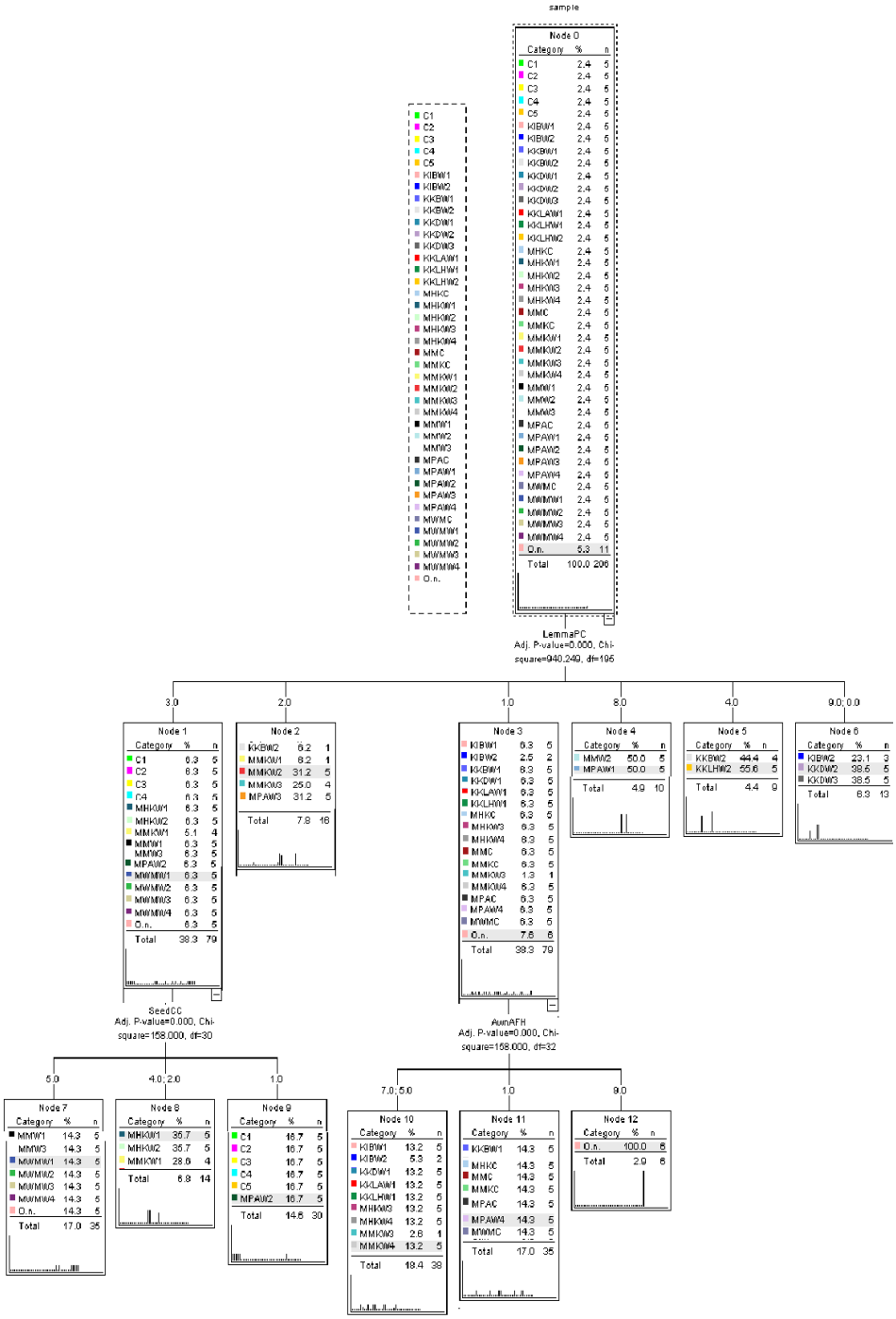


**Fig 1. The classification and regression tree analysis of Weedy, Wild and cultivated rice varieties.**

The character, seed-coat color also indicated a considerable variation between the wild, cultivated and WR eco-types and red seed coat color occur in seeds of *O. nivara* and brown and light brown color commonly found in WR eco-types and white seed coat color were restricted to the cultivated rice varieties. The white and red seed coat colors seem to be primitive since the characters are shared by *O. nivara* and cultivated rice varieties. The character such as awning after full heading also indicated the limited occurrence and on this basis *O. nivara* and cultivated rice varieties could be considered as potential parents of the most weedy rice eco-types. The appearance of the characters, long and fully awned and the absence of the awn can be considered as primitive and the other characters such as short and fully awned and long and partly awned rice seeds can be considered as derived characters.

## 4 Conclusion

The limited number of salient agro-morphological characters are found within the WR eco-types and those characters are supposed to be derived from a mixing of germplasm either of cultivated or wild rice varieties. This process is enhanced by the variation in climatic conditions. The character, awning after full heading also indicated the limited occurrence and on this basis, *O. nivara* and cultivated rice varieties were the potential parents of the most of the WR eco-types. The appearance of long-fully owned and the absence of the awn is pleisomorphic (primitive) characters, while short-fully and long-partly awned characters are apomorphic (derived) characters in weedy rice populations in Sri Lanka. These characters are hypothesized as derived from mixing of germplasm either of cultivated or wild rice varieties indicating higher possibilities of cross-pollination among wild, cultivated and WR eco-types. However, further studies are necessary to confirm the results.

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