Morphological Variations of Twelve Accessions of the Traditional Rice, Heenati, Deposited at the Plant Genetic Resource Center, Sri Lanka

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Abstract
Twelve Heenatirice accessions collected from the plant genetic resources centre (PGRC), Gannoruwa, Sri Lanka were evaluated on the basis of 12 agro-morphological traits in a field experiment during major (*Maha*) season, 2012/13 and 2013/14. The aim of the study was to distinguish the traditional rice accessions identified as Heenati and catalogued under different accessions at PGRC are similar or not in morphological characteristics. Three-week-old seedlings of the accessions were transplanted in rows with 15 cm x 20 cm spacing according to randomized complete block design. Three replicates were arranged for each accession and each replicate consisted of 3 rows of seedlings while 20 plants were included in to each row. Agro-morphological traits, biomass and harvest index of middle row plants were recorded according to the Standard Evaluation System for Rice, IRRI. The data were statically analysed using the SPSS version 20 software. Principal Component analysis (PCA), cluster analysis and morphological dendrograms using Ward Linkage were used to assess the patterns of the morphological variation. The first three principle components (PCs) explained over 80% of the total variation associated within the accessions. Among them the first two principle components cumulatively explained 61.7% of the total variation. All the accessions catalogued under different accession numbers were not significantly different in relation to considered characteristics and all the accessions distinguished in the same name were also not similar in their morphological traits. According to the cluster analysis, Rathu Heenati-5486 rice accession was significantly different from the other Rathu Heentirice accessions at rescaled cluster distance 25. Six Kalu Heenati rice accessions were also grouped into two clusters at cluster distance 13. It can be concluded that rice accessions with the same name may not always belong to the particular cultivar though they have the same name.

Keywords: Heenati, Morphological characteristics, Principal component analysis, Traditional rice accessions
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Introduction

Traditional rice varieties reserve broad range of traits to introduce into elite lines in rice improvement programs which aim to enhance the rice productivity under different agro-climatological conditions (Lasalita-Zapico *et al.*, 2010). The qualities in cooked-rice such as high fibre content and medicinal properties in traditional rice cultivars have gained rice consumers' attention (Wickramasinghe and Noda, 2008).

Among the germplasm collection at plant genetic resources center, Gannoruwa, Sri Lanka, the group of Heenati is low yielding but consist of valuable medical compounds (Seneviniwan, 2010). In the ancient time, Heenati was served to lactating mothers to ensure the good health of both the infant and feeding mother. The group of Heenati has been identified to contain different cultivars such as Heenati, Goda Heenati, Sudu Heenati, Kalu Heenati, Rathu Heenati, Gam Heenati and Thavulu Heenati were considered as the healthiest.

Heenati is reported to be tolerant at biotic stresses. Heeneti-309 scored the highest survival rate at submergence (96.74%) and drought (86.67%) stresses at seedling stage (Ranawake *et al.*, 2014a). Under salinity stress, it has scored only 19.81% survival rate (Ranawake *et al.*, 2014a). In a different study carried out by Ranawake *et al.* (2014b), it has been reported that leaf extracts of Kalu Heenati significantly reduced the seed germination of common weed, *Echinochloa crusgalli* L. which emphasizes the allelopathic effect of Kalu Heenati leaf extract.

Plant genetic resources centre, Gannoruwa, Sri Lanka conserves the seeds of traditional rice accessions. During collection of these accessions they were given the common name and an accession number. Hence there are several rice accessions in the same name in this collection though they were given different accession numbers during the collection. Present study was carried out to evaluate the morphological similarities or divergence of the traditional rice

accessions collected in the same name and catalogued in different accession numbers.

Materials and Methods

The study was conducted at the Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka, during major (*Maha*) season 2012/13 and 2013/14. Twelve *Heeneti* accessions were selected from plant genetic resources centre (PGRC), Gannoruwa, Sri Lanka (Table 1). Seeds collected from PGRC were kept at 50 ^{0}C for 5 days to break the dormancy. The seeds were then soaked in 70% alcohol for 2 minutes and washed thoroughly with distilled water. Surface sterilized seeds were dipped in 2% Clorox for 30 minutes and washed the seeds properly with distilled water. Seeds were kept in incubator at 35^{0}C for 7 days (Ranawake *et al.*, 2013) under dark conditions and the germinated seeds were planted in soil filled trays.

Table 1: Rice accessions used for the study

Accession Number	Accession Name
5486	Rathuheenati
4992	Rathuheenati
6249	Rathuheenati
3471	Kaluheenati
4621	Kaluheenati
5191	Kaluheenati
4991	Kaluheenati
3851	Kaluheenati
7802	Kaluheenati
3998	Heenati
4618	Heenati
4935	Heenati

Ten days old seedlings were transplanted in 3m long rows spaced 20 cm apart. The seedlings were transplanted at 15cm distance within a row. Varieties were transplanted in a randomized complete block design, with 3 replications, (3 rows per replicate and 20 plants per each row). Data were recorded according to the Standard Evaluation System (SES) for rice, international rice research institute (IRRI) (IRRI, 1988). The data were statistically analysed using the SPSS version 20 software (SPSS inc., 2011). Cluster analysis followed by factor analysis was performed for the agronomic data and dendrogram was created in Ward's linkage.

Results and Discussion

Principle component analysis showed that the first three PCs having Eigen values greater than1 accounted for 81.62% of the total variation. The PC 1, 2 and 3 explained 33.1%, 28.6% and 19.8% variability respectively (Table 2). Plant height, panicle length, yield per plant and harvest index contributed for extremely high PC1 while panicle weight, total grain per panicle, hundred grain weight, yield per plant and biomass contributed for PC2. PC3 has the greater influence of days to flowering, filled grain percentage and biomass (Table 2).

All Heenati rice accessions were grouped into several clusters in the dendrogram (Figure 1). Rathu Heenati-5486 was in a different cluster from other two accessions; Rathu Heenati-6249

Table 2: Variation among rice accessions accounted for first three principle components

Parameter	Principle Component		
	1	2	3
PH	.806	-.084	.387
TNT	-.784	.479	-.197
DF	-.776	.157	.550
FT	-.784	.479	-.197
PL	.717	-.183	.212
PW	.472	.714	.038
TG	.419	.724	-.444
FGP	-.489	-.070	.749
HGW	.482	.820	.185
YLDP	.595	.699	.196
BM	-.447	.580	.516
HI	.708	-.219	.303

Extraction Method: Principal Component Analysis.
PH: Plant height, TNT: Total number of tillers/plant, DF: Days to flowering, FT: Number fertile tillers/plant, PL: Panicle length, PW: Panicle weight, TG: Total Grain per panicle, FGP: Filled grain percentage, HGW: Hundred grain weight per plant (100 gr wt), YLDP: Filled grain weight, BM: Biomass per plant and HI: Harvest index.

and Rathu Heenati-4992 at cluster distance 25. Rathu Heenati-6249 and Rathu Heenati-4992 belonged to different clusters at cluster distance 13. Hence these three Rathu Heenati accessions were different from each other according to their morphological characteristics though they were given the same name.

Six Kalu Heenati accessions were clustered in to two groups at cluster distance 13 in the dendrogram (Figure 1). Kalu Heenati-3471and Kalu Heenati-5191 were in different clusters from other four Kalu Heenatiaccessions (-3851,-7802,-4621,-4991). Kalu Heenati-3471 and Kalu Heenati-5191 were belonged to the same cluster. Therefore, these two accessions were

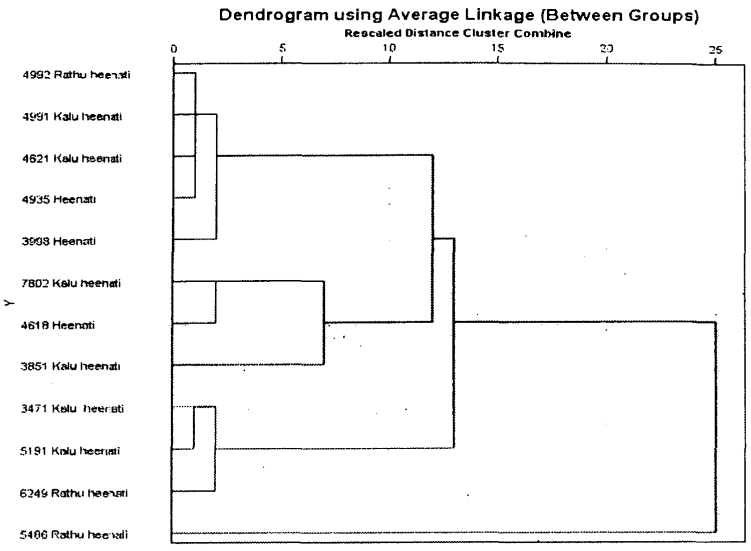

Figure 1: Dendrogram of rice accessions obtained in Ward linkage analysis

morphologically similar from other all Kalu Heenati accessions. Rest of the Kalu Heenati accessions were clustered in to two groups at cluster distance 12. Kalu Heenati-3851 and Kalu Heenati-7802 were clustered in to the same cluster; cluster II. Therefore, these two accessions were morphologically similar from other two Kalu Heenati accessions. Kalu Heenati-4991 and Kalu Heenati-4621 were in the same cluster, cluster I. Therefore, these two accessions were morphologically similar.

Three Heenati accessions were grouped in to two clusters at cluster distance 12. Heenati-4618 was in a different cluster from other two Heenati accessions (-4935, -3998) (Figure 1). Heenati-4935 and Heenati-3998 were belonged to the same cluster. These two Heenati accessions were similar according to their morphological characteristics though they were given different accession numbers.

Rice accessions in Cluster I which consisted of three rice accessions named Rathu Heenati-4992, Kalu Heenati(-4991,-4621) and Heenati(-4935,-3998)consisted of semi-dwarf, low tillering, semi-sterile or highly-sterile accessions. Kalu Heenati-7802 and Heenati-4618in cluster II were semi-dwarf, low or very low tillering, and fertile or semi-sterile. Kalu Heenati-3851 and Rathu Heenati-5486 accessions were grouped in to two different clusters, cluster III and cluster V respectively, where cluster III could be identified as a semi-dwarf, very lowtillering and semi-sterile group and cluster V was a semi-dwarf, low-tillering and semi-sterile group. Kalu Heenati(-3471,-5191) accessions and Rathu Heenati-6249 those belonged to cluster IV were semi-dwarf, low tillering and fertile or highly fertile.

Conclusions

Over 80% of total variance was explained by the resulted principal components. This study indicated that rice with the same cultivar name but in different accession numbers may not always belong to the exact cultivar under which they have been catalogued based on their morphological traits.

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