8-2014

Multiplex SSR-PCR Analysis of Genetic Diversity and Redundancy in the Philippine Rice (Oryza sativa L.) Germplasm Collection

Jamaica L. delos Reyes

Vivian A. Panes
Ateneo de Manila University

Dindo A. Tabanao

Gabriel O. Romero

Philippine Journal of Crop Science (PJCS) August 2014, 39 (2): 22-43

Full Paper

Multiplex SSR-PCR Analysis of Genetic Diversity and Redundancy in the Philippine Rice (*Oryza sativa* L.) Germplasm Collection

Jamaica L. delos Reyes[1], Vivian A. Panes[2*], Dindo A. Tabanao[3] and Gabriel O. Romero[4]

[1]Natural Sciences Department, Ateneo de Zamboanga University, La Purisima Street, Zamboanga City;[2] Department of Biology, School of Science and Engineering, Ateneo De Manila University, Katipunan Avenue, Loyola Heights 1108 Quezon City, Philippines; [3]Plant Breeding, Genetics and Biotechnology, Division Philippine Rice Research Institute, Maligaya Science City of Muñoz 3119, Nueva Ecija Philippines; [4]Monsanto Philippines, 7th Fl., Ayala Life-FGU Center, Madrigal Business Park, Alabang, Muntinlupa City Philippines. *Corresponding author, vpanes@ateneo.edu

Rice germplasm conservation is vital to ensuring the availability of a rich gene pool for future varietal improvement programs. However, with limited resources for gene banking, there is a need to identify and prioritize unique accessions in the PhilRice gene bank for maximum resource utilization. A robust and unequivocal way to identify duplicates is through multiplex SSR-PCR DNA fingerprinting. The present study established the optimal concentrations and reaction conditions for the successful amplification of PCR products using a multiplex panel composed of rice simple sequence repeat (SSR) markers, namely RM312, RM316, RM514 and RM171. The panel was then used to analyze the genetic diversity and identify duplicates among the 427 rice germplasm accessions with similar or identical variety names from the PhilRice genebank. A total of 15 alleles were detected at the 4 SSR loci. The polymorphism information content (PIC) values of the SSR markers were moderately high ranging from 0.459 to 0.643. A dendrogram was constructed using the Dice similarity coefficient and the UPGMA algorithm. The multiplex SSR-PCR panel produced unique profiles of 31 accessions that, being genetically distinct, should be maintained as part of the main collection of the genebank. There were 17 accessions identified as possible redundants having a bootstrap value greater than 95%. Additional SSR and morphological markers will be required to further strengthen the evidence for redundancy, and hence justify removal of unnecessary duplicates from the collection.

Keywords: dendrogram, genebank, multiplex panel, rice germplasm accession, redundants, SSR

INTRODUCTION

Characterization and quantification of genetic diversity is of fundamental interest to plant breeders. It contributes to monitoring germplasm and can also be used to predict potential genetic gains (Chakravarthi and Naravaneni 2006). Rice germlasm collection and conservation activities in the Philippines started in the early 1900s when rice breeders in the academe and the Bureau of Plant Industry began keeping seeds of popular traditional varieties with the intention of using them as breeding parentals. The initial collection comprised of 300 traditional varieties that early Filipino breeders had assembled for breeding work. The collection grew with the addition of large anthropological set from the Cordillera areas and later through gifts from provincial agricultural colleges and development centers as well as opportunistic collecting by PhilRice staff. The early collection was turned over to the then newly established International Rice Research Institute (IRRI) in 1962. A duplicate of which was retrieved when Philippine Rice Research Institute (PhilRice) was created in 1985 (Romero 2006). The germplasm collection of the Philippines stored in the PhilRice genebank holds 11,259 collections as of May 2013.

Rice germplasm conservation is a vital activity that ensures the availability of a rich gene pool for future varietal improvement programs. However, with the limited resources such as finite storage, space and low processing and maintenance outlay, there is an urgent need to identify truly unique accessions in the PhilRice Genebank for maximum resource utilization.

The key to the determination of duplicate entries is the availability of a reliable means of detecting genetic differences. Identical passport data such as variety names and geographical origins are commonly used as an indication of duplication but these are in many cases of dubious authenticity. The morphological characterization procedure presently employed in the PhilRice genebank is also inadequate for this purpose because morphological traits represent a narrow portion of the genome and are often strongly influenced by the environment.

The development of DNA marker technology has provided an efficient tool to facilitate plant genetic resources conservation and management. In rice, molecular markers have been used to identify acces-

sions (Olufowote et al. 1997; Virk et al. 1995), to determine the genetic structure and pattern of diversity for cultivars of interest (Akagi et al. 1997; Mackill 1995; Yang et al. 1994; Zhang et al. 1992) and to optimize the assembly of core collections (Schoen and Brown 1995). Compared to morphological analysis, molecular markers can reveal differences among accessions at the DNA level and thus provide a more direct, reliable and efficient tool for germplasm conservation and management (Ni et al. 2002). Several types of molecular markers are available for evaluating the extent of genetic variation in rice and it was shown that duplicate and suspected duplicate accessions can be identified using polymerase chain reaction (PCR) based technique (Ni et al. 2002; Ravi et al. 2003; Lapitan et al. 2007; Kibria et al. 2009; Kumar et al. 2012; Martin et al. 2012; Tabhkar et al. 2012).

The extent of duplication in the PhilRice Genebank is not fully known. This study aimed to assess the efficiency of multiplex SSR DNA fingerprinting in determining the genetic diversity of 427 rice germplasm accessions in the PhilRice genebank, identify accessions with duplicates, and determine the level of DNA polymorphism produced by the multiplexed SSR markers. Resource use efficiency in the genebank will be increased with the removal of duplicate entries in the germplasm collection. The DNA fingerprint will show the genetic relationships among the germplasm materials, and thereby aid breeders in choosing diverse materials for breeding.

MATERIALS AND METHODS

Plant Materials

The 427 rice germplasm accessions used in this study consisted of 372 Philippine traditional varieties, 10 traditional varieties from Iran, 8 accessions from Bangladesh, 7 accessions from Cambodia and Indonesia,14 accessions from India, 4 accessions from the United States of America, 1 accession from Fiji and 2 accessions from Senegal and Laos. Rice germplasm accessions were obtained from the Rice Genebank at the Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

DNA Extraction

Fifty pure seeds of each accession from the PhilRice Genebank were pre-germinated in Petri dishes for 3 days and were sown in plastic food keepers with soil in the green house. Around 100 mg of young leaves were collected from 3 wk old seedlings of each rice accession. The leaves from each accession were pooled before DNA extraction. Leaf samples were ground in liquid nitrogen using mortar and pestle. DNA was extracted using a modified CTAB DNA extraction protocol (Rogers and Bendich 1988).

Genomic DNA samples were checked for quality on 1.0% agarose gel electrophoresis, and the concentration was estimated against undigested lambda DNA standard (Invitrogen, Carlsbad CA). Electrophoresis was carried out at 100 V for 2 h. Detection of bands was done in an ethidium bromide staining solution for 15 min.

Design of Multiplex SSR-PCR

Initially, 20 microsatellite markers were selected from previous studies by Filho et al. (2007), Ram et al. (2007) and Thomson et al. (2007) on the basis of their genomic locations, annealing temperature and allele size. The different markers were grouped together to develop multiplex panel on the basis of their allele size range, map location and annealing temperature. The software 'Amplify' for PCR experiments was used to ensure no formation of primer dimers within the different markers in each multiplex panel, which could hamper legitimate amplification of target loci. In each panel, markers with different allele size range were assigned to avoid overlapping bands during gel analysis. In order to obtain completely unambiguous multiplex genotyping, it was important to optimize the combination of primers used. One multiplex panel was assembled that contain 4 primer pairs based on their allele size and optimal annealing temperature. The PCR conditions were optimized by testing different primer concentrations, dNTPs, $MgCl_2$, amounts of DNA template and *Taq* DNA polymerase to equalize signal strength for each panel. The multiplex panel set was tested several times to ensure reproducibility. The optimum PCR cocktail is shown in Table 1.

PCR was run in a 96-well thin walled polycarbonate v-bottom microtiter plate (Costar, Corning Inc., New York, USA) on a programmable thermal cycler (MJ Research PTC-100). PCR products were fractio-nated through electrophoresis on 8% non-denaturing polyacrylamide gel for 2 h. The gels were stained with ethidium bromide for 20 min and then observed under ultraviolet illumination. The PCR profile is shown in Table 2.

Data Analysis

Polymorphic bands were scored as "1" for presence and "0" for absence. Genetic similarity was calculated as Dice coefficient using the SIMQUAL module in Numerical Taxonomy and Multivariate Analysis (NTSYS), Version 2.0 (Rohlf 1993). Polymorphism information content (PIC) was calculated using the formula by Weir (1996):

$$PIC = 1-(\Sigma\, p_i^2)$$

where p_i is the frequency of the ith allele of an SSR marker, and Σ is the summation over the total number of alleles for that marker.

Construction of Dendrogram

The similarity coefficients were used to construct a dendrogram by Unweighted Pair Group Method with Arithmetic Mean (UPGMA) (Sneath and Sokal 1973) as implemented in NTSYS. Bootstrapping of the UPGMA tree was performed using Winboot program (Yap and Nelson 1996) with 2,000 iterations.

Table 1. Polymerase chain reaction components

Components	Volume (µL)	Final Concentration
Sterile distilled water	2.06	-
10 X PCR buffer	0.75	1X
10 mM $MgCl_2$	1.5	2 mM
2.5 mM dNTP	0.69	0.23 mM
10 µM forward primer	0.5	0.67 µM
10 µM reverse primer	0.5	0.67 µM
Taq polymerase	0.5	-
DNA	1	-
TOTAL	7.5	

Table 2. PCR profile of multiplex genotyping

Step	Temperature (°C)	Time (min)
1	94 – initial denaturation	5
2	94 - denaturation	1
3	55 - annealing	1
4	72 – primer extension	2
5	35 cycles to step 2	
6	72 – final extension	5
7	15 - soaking	

Optimization of Multiplex-SSR PCR

In this study, multiplex PCR with SSR markers was used for DNA fingerprinting of rice germplasm. Multiplex-PCR involves more than a pair of primers acting independently. It allows the simultaneous analysis of multiple targets in a DNA sample without having to prepare many individual reactions.

The optimization of multiplex PCR can pose several difficulties, including poor sensitivity or specificity and preferential amplification of certain specific targets. The presence of more than one primer pair in the multiplex PCR increases the chance of obtaining spurious amplification products, primarily because of the formation of primer dimers. Despite the difficulties in optimizing multiplex PCR, it has the potential to bring considerable savings in time and effort once the optimal procedure is carried out for numerous samples on a routine basis.

This panel consisting of four SSR markers (RM312, RM316, RM514 and RM171) yielded the optimum PCR products. The other multiplex panels did not produce the target composite bands of the component markers at the various primer concentrations tested. Multiplex products run on 8% non-denaturing polyacrylamide gel can be gleaned from Figure 1. The amplicons produced were clear and easy to score. Hence, the multiplex panel consisting of four SSR markers was used for assessing genetic diversity among the 427 rice germplasm accessions. Table 3 describes the four SSR markers used in the multiplex panel and the data on the number of alleles scored and polymorphic information content (PIC). The multiplex panel produced a total of 15 alleles from 427 genotypes. The number of alleles for RM312, RM316, RM171 were 4, 5 and 3 respectively. The PIC values which reflect the robustness of the marker were 0.643 for RM312, 0.598 for RM316, 0.576 for RM514 and 0.459 for RM171.

The polymorphism information content is an estimate of the discriminatory power of an SSR marker (Ram et al. 2007), and is extremely useful in distinguishing the polymorphism rate of a marker at a specific locus (De Woody et al. 1995). Markers with PIC values of 0.5 or higher are highly informative. The robustness of the SSR markers is due to their good PIC values ranging from 0.459 to 0.643.

The observed PIC values are comparable to previous studies. Jain et al. (2003) used four multiplex panels consisting of 30 fluorescent-labeled SSR markers to study the genetic diversity and phylogenetic relationships among the aromatic high quality rice germplasm collections from different parts of India. RM 312 and RM171 were part of one of the multiplex panels together with RM105, RM133, RM103, RM282 and RM337. The PIC values of RM312 and RM171 were 0.558 and 0.732 respectively. Another study by Coburn et al. (2002) noted that RM171 is highly variable at both the inter and intra subspecific levels, making it very useful for distinguishing closely related genotypes. Thomson et al. (2007) characterized 330 rice accessions using multiplex panels of 30-fluorescently-labeled microsatellite markers, where RM514 showed a PIC value of 0.71. RM316 was used by Ravi et al. (2003) to assess the genetic diversity among 40 cultivated varieties and five wild relatives of rice. It yielded a PIC value of 0.581.

SSR markers exhibited high PIC values because of their codominant expression and multiallelism (Ram et al. 2007). The lower PIC values of the four markers on average in this study maybe due to the narrower genetic pool of the samples arising from redundant accessions. The considerably low PIC value of RM171 in this study may be due to the poorer resolution of its large alleles on polyacrylamide gel compared to the other methods. Nevertheless, the four markers were able to detect possible redundant accessions based on bootstrap analysis which already established a number of unique accessions.

Cluster Analysis

The similarity matrix representing the Dice coefficient was used to cluster the data using the UPGMA algorithm. Analysis of the 427 rice germplasm accessions revealed 48 clusters with 100% similarity coefficients (cluster results of the dendrogram is shown in Appendix Table 1). Accessions with similar names

Table 3. Simple sequence repeats (SSR) markers with forward and reverse primer sequences and data on number of alleles and polymorphism information content (PIC)

SSR markers	Forward Primer	Reverse Primer	Number of Alleles	PIC Values
RM312	5'GTATGCATATTTGATAAGAG3'	5'AAGTCACCGAGTTTACCTTC3'	4	0.643
RM316	5'CTAGTTGGGCATACGATGGC3'	5'ACGCTTATATGTTACGTCAAC3'	5	0.598
RM514	5'AGATTGATCTCCCATTCCCC3'	5'CACGAGCATATTACTAGTGG3'	3	0.576
RM171	5'AACGCGAGGACACGTACTTAC3'	5'ACGAGATACGTACGCCTTTG3'	3	0.459
TOTAL			**15**	

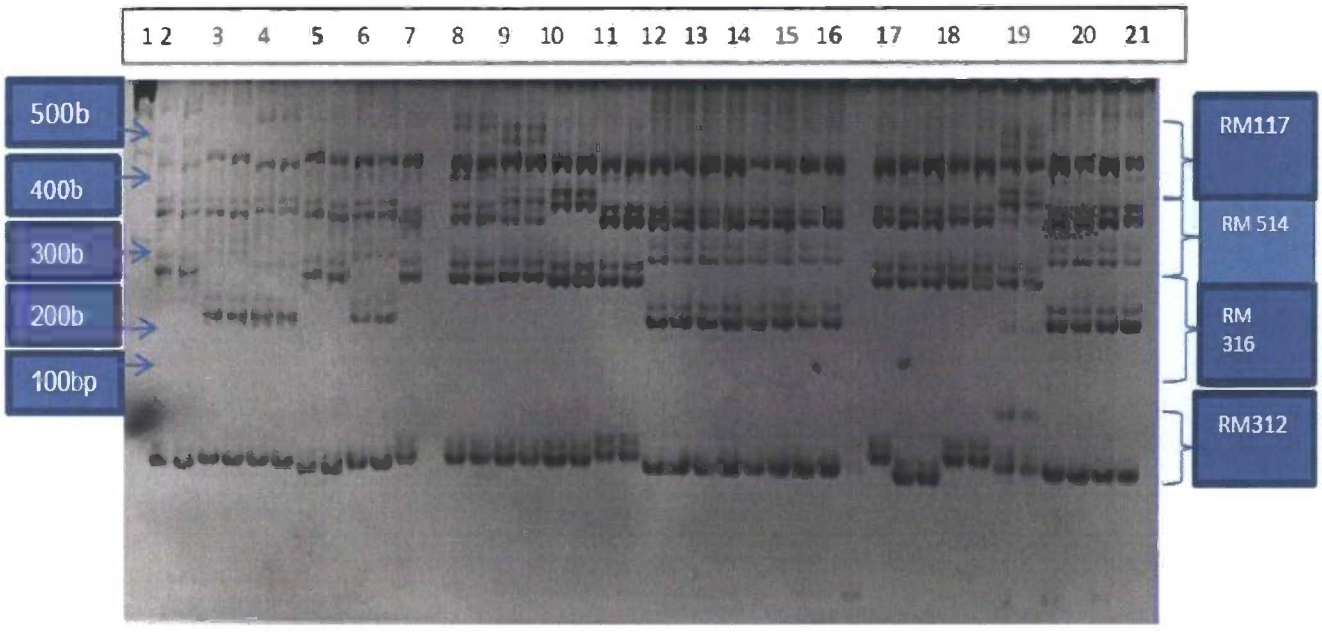

Figure 1. Multiplex PCR panel with RM312, RM316, RM514, RM117 loci on 8% non-denaturing Polyacrylamide gel Lane 1 100 bp DNA ladder; Lanes 2-21 PCR products from the DNA of 20 replicated accessions

and of genetically similar type clustered together. There are 31 accessions that clustered individually and separately from other groups indicating that they are unique accessions (Appendix Table 2).

Efforts should be expected and priority given to unique accessions for conservation purposes. Although, unique accessions have similar names, they should be maintained in the gene bank to conserve their genetic make-up for use in varietal improvement in the future. The knowledge of within-accession variability is important for conservation purposes because it is possible to determine the most genetically variable accessions which would demand an additional effort of sampling a higher quantity of seeds in order to preserve genetic variability (Brondani et al. 2006).

In order to test the robustness of the clusters in the dendrogram, bootstrapping with the software package Winboot was used. A bootstrap confidence value of 95% or greater was considered significant. Possible redundants were identified based on the bootstrap analysis having a confidence level greater than 95%. Passport data and acquisition history supported the bootstrap analysis. Identification of redundant accessions is important to increase the efficiency of resource use in genebanks. For storage purposes, only a representative of each duplicate is necessary. From a purely management point of view, there are distinct advantages in trying to identify duplicate accessions and thereby conserving only the collection of unique genetic materials (Virk et al. 1995). Table 4 shows the Philippine rice accessions with bootstrap values greater than 95%.

Bootstrapping of the clusters revealed that PRRI-000259 Binangkuro (IRGC 44326), PRRI000909 Binangkuro (96- OCM 18) and PRRI000910 Binangkuro (96- OCM 19) of cluster 1 has a confidence value of 100%. The three Binangkuro accessions originated from the same province which is Occidental Mindoro. Therefore, it can be deduced that the three Binangkuro accessions (PRRI000259, PRRI000909 and PRRI000910) are possible redundants. Two other Binangkuro accessions yielded 99.6% confidence value: PRRI003441 Binangkudo (2003-01-01-102) and PRRI000918 Binangkuro (96- OCM 37). This Binangkudo accession is most likely a naming error from Binangkuro when it was introduced in Palawan presumably from Mindoro.

Other accessions that yielded a confidence value of 100% making them possible redundant accessions

are: PRRI003452 Binuhangin (97–SDS 64) and PRRI000649 Binuhangin (96-OCM5); Bintalan accessions (PRRI000919 and PRRI003451) both from Occidental Mindoro; and from Palawan are Bolig-bolig accessions; PRRI003971 Bolig-bolig (2004-02-01-06) and PRRI003972 Bolig-bolig (2004-02-01-03). PRRI002478 Banate2 (IRGC109310) and PRRI000 849 Banate (IRGC 81724) had a confidence value of 99.6%. Both accessions originated from Iloilo and both are *indica* subspecies. Two accessions of *O. glabberima* that originated from Senegal which are CG-14 TML41 and CG-14 yielded a 98.6% confidence value, indicating that the two accessions are indeed similar. PRRI000488 Balatinaw (IRGC 12050) and PRRI0024 72 Balatinao (IRGC 44297) had a confidence value of 98.3%. Both these accessions originated from the Mountain Province.

Some rice germplasm accessions are clustered individually and are separate from other groups (Appendix Table 2). PRRI0003520 Diket (98-QUI 16) and PRR I003521 Diket (98-QUI 20) both from the province of Quirino and both of *javanica* subspecies are clustered individually. One Binangkuro accession which is PRRI 000442 Binangkuro (Balayang) (IRGC 44292) from Ilocos Norte is clustered separately from the major cluster where majority of Binangkuro accessions are grouped together (Appendix Table 1), raising doubts over its name. PRRI002763 Burean (aromatic) and PRRI002268 Bureau are also found as separate clusters. Cluster analysis also separated one accession of *javanica* Azucena, PRRI002234 Azucena 1 from the rest of the *indica* Azucena accessions.

Three Basmati accessions: PRRI000965 Basmati narot 493, PRRI000969 Basmati 5851 and PRRI-004402 Bashmoti (D) clustered individually and separately from the other Basmati accessions. Other accessions that were clustered individually are the following: PRRI002997 Bayabas (IRGC19385), PRRI 002171 Batangas mixture (Ginit-an), PRRI00265 Kinandang puti, PRRI002269 Kinanda, PRRI002609 China rice, C22, PRRI002190 Binig-it, PRRI001847 Burik, PRRI005322 Binuhangin (IRGC 67430), PRRI003126 Benerhin (IRGC 44311), C22, PRRI-000729 Sigadis milagrosa, PRRI000923 Binibe (96-OCM 49), PRRI001968 C22, Brown gora TML 40, C22, Chinsurah boro 2 (IRGC 11760), BPI R1 10 TML 40, PRRI004512 Diamante (IRGC 44393), PRRI002213 Eurian, PRRI001919 Batangas mixture (minantika) and PRRI000778 Cambodia 3 (FC 14) (Appendix Table 2). These results suggest that accessions which are clustered separately from the major groups represent a unique genetic make-up. Although, some have similar variety names, they should be regarded as unique accessions and thus should be accorded equal attention and resources for conservation purposes to ensure long term survival.

Due to the fact that only one multiplex panel was optimized with four SSR markers, it is still possible that the genetically identical materials based on DNA profiling can be different; hence, they should be considered probable duplicates only. Nevertheless,

Table 4. List of the Philippine rice accessions with bootstrap confidence values greater than 95%

No.	Accession	Variety	Boot-Starp Values
1	PRRI000259	BINANGKURO (IRGC 44326)	
2	PRRI000909	BINANGKURO (96-OCM 18)	100%
3	PRRI000910	BINANGKURO (96-OCM 19)	
280	PRRI000919	BINTALAN (96-OCM 42)	
281	PRRI003451	BINTALAW (2003-11-01-04)	
282	PRRI000649	BINUHANGIN (96-OCM5)	
283	PRRI003452	BINUHANGIN (97-SDS 64)	100%
287	PRRI003971	BOLIG-BOLIG (2004-02-01-03)	
288	PRRI003972	BOLIG-BOLIG (2004-02-01-06)	
5	PRRI003441	BINANGKUDO	
6	PRRI000918	(2003-01-01-102)	99.60%
		BINANGKURO (96-OCM 37)	
253	PRRI002478	BANATE 2 (IRGC 109310)	
254	PRRI000849	BANATE 1 (IRGC 81724)	99.60%
332	----------	CG-14 TML 41	
333	----------	CG-14	98.60%
103	PRRI002472	BALLATINAO (IRGC 44297)	
101	PRRI000488	BALATINAW (IRGC 12050)	98.30%

the panel produced unique profiles of 31 accessions out of 427 or 7.25% of the materials. These accessions are therefore genetically distinct and should be maintained as part of the main collection of the genebank.

CONCLUSIONS AND RECOMMENDATIONS

DNA fingerprinting using multiplex-SSR PCR with four markers produced good amplification products in a large collection of germplasm materials inferred to be mostly redundant entries due to their similar variety names. Cluster analysis with the UPGMA algorithm was used to group the germplasm accessions into a dendrogram that provided a complete perspective of their genetic relationships. Accessions sharing the same branch at *S=1.0* are considered probable redundants. After bootstrapping, accessions registering 100% confidence within each branch at *S=1.0* are highly probable redundants. A grow-out test of these

accessions planted side-by-side will be the final arbiter for deciding on their duplicate nature. For materials with less than 100% confidence level, additional 3-5 SSR markers for DNA profiling are recommended to further reliably determine if the materials are unique or duplicates. In conclusion, the allelic diversity revealed by multiplex PCR consisting of four SSR markers serves as baseline information of the genetic diversity of the 427 rice germplasm accessions. Further optimization of more SSR primer pairs in a multiplex-PCR is recommended for more definitive separations or support of clusters of genotypes.

While multiplex PCR clearly enhances the efficiency of SSR markers, there is, however a trade-off between the investment in labour and resources to establish this method and the time saved by the need to run fewer gels. The methodology developed will be useful to study the levels and patterns of genetic diversity in rice germplasm collections, where a large number of accessions and genotypes need to be fingerprinted.

In this study, manual system was used for the development of multiplex SSR-PCR panels. For high throughput fingerprinting of rice germplasm accessions and assaying genetic diversity, it is recommended to use the Geneflow software in designing multiplex panels. Fragment sizing analysis with GeneScan and Beckman's Fragment Analysis is also recommended. The panels of microsatellite markers should greatly expedite genotyping. Many more markers can be assembled for use in diversity studies. The ability to assemble multiplex combinations will greatly improve the efficiency of genetic analysis. Since optimization of multiplex SSR-PCR is time consuming, it is also recommended that manpower should be doubled especially when the samples are rice germ plasm collection from a genebank.

A follow-up study of the comparative analysis of morphological characteristics is highly recommended to consistently confirm if indeed the accessions were redundant. For the identification of duplicates of rice germplasm accessions, a prior knowledge of morphological characters of duplicates is recommended mainly for comparison purposes. However, care must be taken when utilizing morphological data for they are subject to variation caused by the environment.

LITERATURE CITED

Akagi H, Yokozeki Y, Inagaki A, Fujimura T. 1997. Highly polymorphic microsatellites of rice consist of AT repeats and a classification of closely related cultivars with these microsatellite loci. Theor. Appl. Genet. 94:780-792.

Brondani C, Borba TCO, Rangel P, Brondani RP . 2006. Determination of genetic variability of traditional varieties of Brazilian rice using microsatellite markers.Genetics and Molecu lar Biology 29(4):676-684.

Chakravarthi KB, Naravaneni NR. 2006. SSR marker based DNA fingerprinting and diversity study in rice (*Oryza sativa* L.). African J. Biotech. 5:684-688.

Coburn JR, Temnykh SV, Paul EM, McCouch SR. 2002. Design and Applications of Micro satellite Marker Panels for Semiautomated Genotyping of Rice (*Oryza sativa* L.). Crop Sci. 42:2092-2099.

DeWoody JA, Honeycutt RL, Skow LC. 1995. Microsatellite markers in white-tailed deer. J Hered 86:317-319.

Filho MP, Belo A, Acochete AN, Rangel P, Ferreira ME. 2007. A set of multiplex panels of microsatellite markers for rapid molecular characterization of rice accessions. BMC Plant Biology 7:23.

Jain S, Mitchell SE, Jain RK, Kresovich S, d McCouch SR. 2003. DNA fingerprinting and phylogenetic analysis of Indian aromatic high quality rice germplasm using panels of fluorescent-labeled microsatellite markers. In: Advances in Genetics.Supplement to Rice Genetics IV. Proceedings of the 4th International Rice Genetics Symposium, 21-27 October 2000. Los Banos, Philippines. International Rice Research Institute, Manila. p.162-166.

Kibria K, Nur F, Begum SN, Islam MM, Paul SK, Rahman KS, Azam SMM. 2009. Molecular Marker-Based Genetic Diversity Analysis In Aromatic Rice Genotypes Using SSR and RAPD Markers. J. Sustain. Crop Prod. 4(1):23-24.

Kumar R, Kumar Singh A, Kumar A, Kuman R. 2012. Evaluation of genetic diversity in rice using simple sequence repeats (SSR) markers. African Journal of Biotechnology 11(84): 14956-14995.

Lapitan V, Darshan BS, Abe T, Redoña ED. 2007. Assessment of Genetic Diversity of Philippine Rice Cultivars Carrying Good Quality Traits Using SSR Markers. Breeding Science 54 (4):263-270.

Mackill DJ. 1995. Classifying japonica rice cultivars with RAPD markers. Crop Sci. 35: 889-894.

Martin S, Ashratuzzaman M, Monisul Islam M, Sikdar SU, Zobayer N. 2012. Molecular marker based (SSR) genetic diversity analysis in deep water rice germplasms of Bangladesh. International Journal of Biosciences 10(2):64-72.

Ni J, Colowit PM, Mackill DJ. 2002. Evaluation of genetic diversity in rice subspecies using microsatellite marker. Crop Sci. 42:601-607.

Olufowote JO, Xu Y, Chen X, Park WD, Beachell HM , Dilday RH, Goto M, McCouch SR . 1997. Comparative evaluation of within-cultivar variation of rice (*Oryza sativa* L.) using microsatellite and RFLP markers. *Genome* 40: 370-378.

Ram SG, Thiruvengadam V, Vinod KK. 2007. Genetic diversity among cultivars, Landraces and wild relative of rice as revealed by microsatellite markers. J. Appl. Genet. 48: 337- 345.

Ravi M, Geethanjali G, Sameeyafarheem F, Maheswaran M. 2003. Molecular marker-based genetic diversity analysis in rice (*Oryza sativa* L.) using RAPD and SSR markers. *Euphytica* 133: 243-252.

Rogers SO, JA Bendich. 1988. Extraction of DNA from plant tissues. Plant Mol. Biol. Manual. A6:1-10.

Rohlf FJ. 1993. NTSYS-PC Numerical Taxonomy and Multivariate Analysis System. New York: Exeter Software version 2.1.

Romero GO. 2006. Rice germplasm collection, management and exchange in the Philippines. Report of the 2006 APEC-ATCWG Workshop on Interaction of CBD and TRIPs Related Issues on the Plant Genetic Resources. (Chinese, Taipei 11-16 Dec. 2006). http://www.achpco.com/CBD-TRIPs/doc/0.2. Session 5-2 report. Doc.

Schoen DJ, Brown ADH. 1995. Maximizing genetic diversity in core collections of cold relatives of crop species. In: T Hodgkin et al. eds.Core collections of plant genetic resources. John Wiley and Sons, UK. p.55-76.

Sneath PA, Sokal . 1973. Numerical Taxonomy, WH Freeman and Company, San Francisco, Calif. USA. p.230-234.

Tabkhkar N, Rabiei B, Sabouri S. 2012. Genetic diversity of rice cultivars by microsatellite markers tightly linked to cooking and eating quality. Aust. J. of Crop Sci.6(6):980-985.

Thomson MJ, Septiningsih EM, Suwardjo F, Sartoso TT, Silitonga TS, McCouch SR. 2007. Genetic diversity analysis of traditional and improved Indonesian rice (*Oryza sativa* L.) germplasm using microsatellite markers. Theor. Appl. Genet. 114: 559-568.

Virk PS, Ford-Lloyd BV, Jackson MT, Newbury NJ. 1995. Use of RAPD for the study of diversity within plant germplasm collections. Heredity 74:170-179.

Weir BS. 1996. Genetic data analysis II, 2nd ed. Sunderland, Massachusetts, Sinauer Associates:377.

Yang GP, Maroof MAS, Yu CG, Zhang Q, Biyashev RM. 1994. Comparative analysis of microsatellite DNA polymorphism I in landraces and cultivars of rice. Mol. Gen. Genet. 245:187-194.

Zhang QF, Maroof MAS, Lu TY, Shen BZ. 1992. Genetic diversity and differentiation of *indica* and *japonica* rice detected by RFLP analysis. Theor. App. Genet. 83:495-499.

Appendix Table 1. List of 48 clusters of Philippine rice accessions with 100% similarity coefficients, including passport data and key

CLUSTER 1

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	Plant Height (cm)	Ave. No. of Panicle/Plant
1	PRRI000259	Binangkuro (IRGC 44326)	Indica	Occ. Mindoro	White	Spindle	2.5-2.99	159.42	13
2	PRRI000909	Binangkuro (96-OCM 18)	Indica	Occ. Mindoro	--------	--------	--------	--------	--------
3	PRRI000910	Binangkuro (96-OCM 19)	No Data	Occ. Mindoro	White	Half-spindle	2.0-2.49	175.70	4
5	PRRI003441	Binangkudo (2003-01-01-102)	No Data	Palawan	White	Half-spindle	2.0-2.49	--------	12
6	PRRI000918	Binangkuro (96-OCM 37)	Indica	Occ. Mindoro	White	Half-spindle	2.0-2.49	141.36	17
9	PRRI000804	Belibod na Pula	Indica	Quezon	White	--------	--------	121.00	--------
13	PRRI000630	Balibod (96-QZN 50)	No Data	Quezon	White	--------	--------	143.20	
21	PRRI000855	Bulibod na Puti	Indica	Quezon	--------	Semi-round	1.5-1.99	109.20	15
22	PRRI002879	Bolibod (IRGC 52865)	Indica	Cam. Sur	--------	--------	--------	--------	--------
415	PRRI005331	FK 178 A (IRGC 298)	Indica	Ilocos Sur	--------	--------	--------	172.20	--------
42	PRRI000661	Binato (96-OCM 31)	Indica	Occ. Mindoro	White	--------	--------	--------	--------
46	PRRI000829	Binato	Indica	Indica	--------	--------	--------	--------	--------
48	PRRI000917	Binato (96-OCM 33)	Indica	Occ. Mindoro	White	--------	--------	118.00	--------
49	PRRI000921	Binato (96-OCM 46)	Indica	Occ. Mindoro	--------	--------	--------	152.10	14
58	PRRI000967	Basmati C 622	Indica	India	White	Long spindle	≥3.0	139.74	56
59	PRRI000970	Basmati 372	Indica	India	White	--------	--------	170.60	--------
61	PRRI000963	Basmati 123	Indica	India	White	Long spindle	≥3.0	140.20	27
95	PRRI001756	Awot	Indica	S. Cotabato	White	--------	--------	105.38	--------
105	PRRI000648	Binagimbin (96- OCM 4)	Indica	Occ. Mindoro	Purple	--------	--------	124.00	--------
107	PRRI003475	Bulaw (IRGC 11290)	Indica	N. Vizcaya	--------	--------	--------	--------	--------
125	PRRI002483	Bangitan (98- PAL 17)	Indica	Palawan	Light Brown	--------	--------	--------	--------
137	PRRI002194	Dumali	Indica	Antique	--------	--------	--------	--------	--------
139	PRRI001869	Bihod	No Data	Iloilo	White	--------	--------	--------	--------
141	PRRI003483	Busiyetan (IRGC 11205)	Javanica	N. Vizcaya	White	--------	--------	--------	--------
142	PRRI003484	Busiyetan (IRGC 11312)	Javanica	N. Vizcaya	--------	--------	--------	--------	--------
145	PRRI002192	Binakayo	Indica	Pampanga	--------	--------	--------	--------	--------
381	PRRI001821	Dinorado B 1997 DS- 136	No Data	Agusan del Sur	Light Brown	--------	--------	--------	--------
246	PRRI000631	Camoros (96-QZN 52)	No Data	Quezon	Light Brown	--------	--------	--------	--------
247	PRRI000667	Camuros (96- OCM 48)	Indica	Occ. Mindoro	Mixture	--------	--------	--------	--------
248	PRRI004495	Camoros (2004-02-01-40)	No Data	Palawan	--------	--------	--------	--------	--------
327	----------	Cambodia 3 (FC 14)	No Data	Cambodia	--------	--------	--------	--------	--------
338	PRRI005294	Cina Mee (IRGC 6693)	Indica	Fiji	--------	--------	--------	158.20 cm	22
342	PRRI001787	DA Var A	No Data	No data	--------	--------	--------	--------	--------

Appendix Table 1. Continued

CLUSTER 2									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
8	PRRI003442	Binangkudo	No data	Palawan	-------	-------	-------	-------	-------
37	PRRI003269	Binalasang (IRGC 47149)	Indica	Apayao	-------	-------	-------	-------	-------
128	PRRI002494	Basilanen (IRGC 19384)	Indica	Palawan	-------	-------	-------	-------	-------
133	PRRI003448	Binegqit (IRGC 11300)	Javanica	N. Vizcaya	Light Brown	----------	----------	149.24	14
136	PRRI001928	Dumali	No Data	Batangas	White	Half-spindle	2.0-2.49	118.2	16
143	PRRI000092	Binotete (IRGC 44339)	Indica	Ilocos Norte	-------	-------	-------	-------	-------
173	PRRI002255	Kinandang Pula	No Data	Batangas	-------	-------	-------	-------	-------
175	PRRI002936	Kinanda (IRGC 4015)	No Data	No data	-------	-------	-------	-------	-------
178	PRRI000877	Kinandang Puti	Indica	Batangas	White	-------	-------	123	-------
195	PRRI002422	Ambol (IRGC 52990)	Indica	Cagayan	White	-------	-------	182.4	-------
221	PRRI003224	Milagrosa (IRGC 44636)	Indica	Pangasinan	-------	-------	-------	-------	-------
226	----------	Milagrosa (IRGC 44635)	Indica	No Data	-------	-------	-------	-------	-------
CLUSTER 3									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
43	----------	Binato (96-OCM 39)	Indica	Occ. Mindoro	White	-------	-------	134.6	-------
245	PRRI000668	Camoros (96- OCM 54)	Indica	Occ. Mindoro	White	-------	-------	149.84	-------
44	PRRI000662	Binato (96-OCM)	Indica	Occ. Mindoro	Light Brown	-------	-------	135	-------
CLUSTER 4									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
50	PRRI003446	Binato (2003-11-01-03)	Indica	Occ. Mindoro	-------	-------	-------	-------	-------
392	PRRI003153	Dinolores (IRGC 44403)	Indica	Ilocos Norte	-------	-------	-------	-------	-------
210	PRRI005107	Antipolo (1999-09-01-22)	Indica	Abra	-------	-------	-------	-------	-------
208	PRRI001754	Anglad	Indica	Palawan	-------	Half-spindle	2.0-2.49	161	13
204	PRRI003151	Diket (Anangka)	Indica	Ilocos Norte	-------	-------	-------	-------	-------
203	PRRI000417	Americano (IRGC 64168)	Indica	Palawan	-------	-------	-------	138.6	14.2
211	PRRI002454	Antipolo (IRGC 47095)	Indica	Pampanga	-------	-------	-------	-------	-------
209	PRRI002452	Anglad (2003-01-01-047)	Indica	Palawan	-------	-------	-------	-------	-------
188	PRRI003186	Kinandang Puti	Indica	Or. Mindoro	-------	-------	-------	-------	-------
189	PRRI002414	Alabang (354)	Indica	No Data	-------	-------	-------	-------	-------
187	PRRI002989	Ginanda (IRGC 16917)	Indica	Bulacan	-------	-------	-------	-------	-------
158	PRRI002998	Binagacay (IRGC 19389)	Indica	Palawan	-------	-------	-------	-------	-------
167	PRRI002980	Kinandang Puti	Indica	No Data	-------	-------	-------	-------	-------
174	PRRI002891	Kinandang Pula	Japonica	No Data	-------	-------	-------	-------	-------
238	PRRI002261	Camoros	No Data	Batangas	White	-------	-------	-------	-------
63	PRRI003436	Basmati 370	Indica	India	-------	-------	-------	-------	-------
239	PRRI003116	Camorrus (IRGC 30332)	Indica	Antique	-------	-------	-------	-------	-------
164	PRRI002782	Kinandang Pula	Indica	Batangas	Light Brown	-------	-------	-------	-------
91	PRRI002456	Arabon	Indica	Zamboanga	White	-------	-------	90.07	-------

Appendix Table 1. Continued

CLUSTER 5									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
87	PRRI002942	Binirhen (IRGC 4022)	Indica	No Data	--------	--------	--------	--------	--------
180	PRRI002776	Kinanda	Indica	Batangas	White	Spindle	2.5-2.99	143.74	24
255	PRRI000520	Sa-Igorot (IRGC 44725)	Javanica	La Union	Red	--------	--------	--------	--------
130	PRRI003423	Basilanin (2003-01-01-1)	No Data	Palawan	--------	--------	--------	--------	--------
256	PRRI005287	Sa-Igorot (IRGC 44727)	Javanica	La Union	Light Brown	--------	--------	162.4	--------
168	PRRI002256	Kinandang Puti	Indica	Batangas	White	--------	--------	122.6	--------
169	PRRI003085	Kinandang Patong	Indica	Batangas	--------	--------	--------	133.2	--------
120	PRRI003339	Carabao (IRGC 52885)	Indica	Zamboanga	--------	--------	--------	--------	--------
129	----------	Basilanen (IRGC 19384)	No Data	Palawan	--------	--------	--------	--------	--------
90	PRRI000181	Arabon (Glut)	Indica	Nueva Ecija	White	Long-spindle	≥3.0	149.62	--------
88	PRRI002887	Binirhen (IRGC 3809)	Indica	No Data	--------	--------	--------	--------	--------
89	PRRI002425	Arabon (97-BHL 14)	Javanica	Bohol)	White	--------	--------	--------	--------
CLUSTER 6									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
123	PRRI003376	Bungkitan (IRGC 53000)	Indica	Ifugao	--------	--------	--------	--------	--------
124	PRRI001980	Bongkitan	Indica	Cagayan	--------	--------	--------	--------	--------
CLUSTER 7									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
163	PRRI002916	Kinandang Inuzo	Japonica	No Data	--------	--------	--------	--------	--------
179	PRRI002869	Kinandang Pula	Javanica	No Data	White	--------	--------	147.58 cm	14
CLUSTER 8									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
14	PRRI000621	Balibod (96-QZN 38)	No Data	Quezon	--------	--------	--------	--------	--------
421	PRRI003988	Gal-it (98- ABR 28)	Indica	Abra	--------	--------	--------	--------	--------
417	PRRI003008	Fortuna (IRGC 19401)	Iindica	Palawan	--------	--------	--------	--------	--------
56	PRRI000962	Basmati 370 A	Indica	India	White	Long-spingle	≥3.0	165.3	25
70	PRRI000669	Azucena (96-OCM 55)	Indica	Occ. Mindoro	White	--------	--------	141	--------
94	PRRI000210	Arimongmong	Indica	Nueva Ecija	White	--------	--------	144.52	30.8
99	PRRI000744	Awot (96 ANT 12)	Indica	Antique	White	--------	--------	135.78	--------
110	PRRI003123	C 22 (C22-51)	Hybrid	Laguna	--------	--------	--------	--------	--------
273	PRRI003131	Binastian (IRGC 44327)	Indica	No Data	--------	--------	--------	--------	--------
274	PRRI000444	Binignay (IRGC 44334)	Indica	Occ. Mindoro	--------	Half-spindle	2.0-2.49	133.88	19.4
291	PRRI001850	BPI	Indica	Cagayan	Light Brown	--------	--------	123.32	--------
288	--------	--------	--------	--------	White	Half-spindle	2.0-2.49	131.5	15
287	PRRI003971	Bolig-Bolig	No Data	Palawan	White	Half-spindle	2.0-2.49	114.14	13
280	PRRI000919	Bintalan (96 – OCM 42)	Indica	Occ. Mindoro	--------	--------	--------	--------	--------

Appendix Table 1. Continued

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
CLUSTER 8									
283	PRRI003452	Binuhangin(97-SDS 64)	Indica	Surigao del Sur	Red	-------	-------	-------	11
282	PRRI000649	Binuhangin (96- OCM 5)	No Data	Occ. Mindoro	White	Half-spindle	2.0-2.49	-------	12
281	PRRI003451	Bintalaw (2003)	No Data	Palawan	Speckled Brown	Semi-round	1.5-1.99	-------	13
CLUSTER 9									
268	PRRI000040	Bandera (IRGC 5168)	Indica	Nueva Ecija	-------	-------	-------	-------	-------
411	PRRI000005	Eruian (IRGC 5254)	Indica	Nueva Ecija	-------	-------	-------	-------	-------
CLUSTER 10									
171	PRRI002944	Eruian (IRGC 5254)	Indica	No Data	-------	-------	-------	-------	-------
422	PRRI004533	Gal-it (98- ABR 1)	Indica	Abra	-------	-------	-------	-------	-------
418	PRRI003550	Fortuna (98-PAL 50)	Indica	Palawan	-------	-------	-------	-------	-------
410	PRRI005398	Inanod (IRGC 24235)	Indica	Mountain Prov.	White	-------	-------	177.2	-------
368	PRRI000277	Decola (IRGC 44392)	Indica	Pangasinan	White	-------	-------	137.65	-------
354	-------	Digha (IRGC 26331)	Indica	Bangladesh	-------	-------	-------	-------	-------
367	PRRI000225	Dicula (IRGC 36729)	Indica	Pangasinan	White	-------	-------	142	-------
184	PRRI002909	Kinandang Polopot	Indica	No Data	-------	-------	-------	107	-------
405	PRRI000024	Ennano (IRGC44411)	Indica	La Union	-------	-------	-------	-------	-------
235	PRRI003811	Milagrosang Puti	Indica	Catanduanes	-------	-------	-------	-------	-------
403	PRRI003159	Ilon-ilon	Indica	Basilan	White	Long-spindle	≥3.0	93.36	29
261	PRRI000873	C-1	No Data	Batangas	White	-------	-------	124.4	-------
426	PRRI005274	Gallano (IRGC 44422)	Indica	Ilocos Norte	-------	Long-spindle	≥3.0 mm	194.7	9
387	PRRI003528	Dinorado(CMU-Bukidnon	No Data	Bukidnon	-------	-------	-------	-------	-------
236	PRRI000720	Milagrosa (Tall)	No Data	Nueva Ecija	White	-------	-------	156.2	-------
232	PRRI003809	Milagrosang Puti	Indica	Catanduanes	-------	-------	-------	-------	-------
CLUSTER 11									
32	PRRI003480		No Data	Occ. Mindoro	-------	-------	-------	-------	-------
408	PRRI001903		Indica	Nueva Ecija	-------	-------	-------	146	-------
207	PRRI005103		Indica	Iran	White	Long-spindle	≥3.0	132.72	27
257	PRRI000378		Indica	Kalinga/Apayao	Light Brown	-------	-------	145.56	-------
407	PRRI000479		Indica	La Union	White	-------	-------	-------	-------
79	-------		Indica	No Data	-------	-------	-------	-------	-------
80	-------		Indica	No Data	-------	-------	-------	-------	-------
81	-------		Indica	No Data	-------	-------	-------	-------	-------
82	PRRI003132		Indica	No Data	-------	-------	-------	-------	-------

Appendix Table 1. Continued

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
CLUSTER 11									
122	PRRI000256	Bangkitan	Indica	No Data	Purple	--------	--------	--------	--------
CLUSTER 12									
71	PRRI002437	Azucena (IRGC 47124)	Indica	Bukidnon	--------	--------	--------	--------	--------
359	PRRI001586	Digul	No Data	Indonesia	--------	--------	--------	--------	--------
CLUSTER 13									
40	--------	Balasang (IRGC 44291)	Indica	Ilocos Norte	Red	--------	--------	--------	--------
348	PRRI003514	Demil (IRGC 19399)	Javanica	Nueva Vizcaya	--------	Half-spindle	2.0-2.49	134.9	18
349	PRRI003515	Demmil (IRGC 11277)	Indica	Nueva Vizcaya	--------	Spindle	2.5-2.99	141.56	17
73	PRRI002439	Azucena (IRGC 52992)	Indica	Ifugao	--------	--------	--------	--------	--------
369	PRRI001808	Decola	Hybrid	Nueva Vizcaya	White	--------	--------	114.6	--------
275	PRRI003270	Bugnay (IRGC 47152)	No Data	Apayao	--------	--------	--------	--------	--------
92	PRRI000252	Aribongbong Alog	Indica	La Union	White	--------	--------	--------	--------
93	PRRI002426	Aribungbong	Indica	Cagayan	White	--------	--------	117.24	--------
258	PRRI000460	Buwoo-wa (IRGC 50388)	Javanica	Kalinga/Apayao	Red	--------	--------	--------	--------
CLUSTER 14									
101	PRRI000488	Balatinaw (IRGC 12050)	Javanica	Mountain Prov.	Purple	--------	--------	--------	--------
103	PRRI002472	Ballatinao (IRGC 44297)	Indica	Ifugao	Purple	Semi-round	1.5-1.99	--------	13
CLUSTER 15									
185	PRRI002253	Kinandang Pula	Hybrid	Batangas	White	--------	--------	117.26	--------
375	----------	Dinorado	No Data	No Data	--------	--------	--------	--------	--------
409	PRRI003167	Innano (IRGC 44470)	Indica	Ilocos Sur	--------	--------	--------	--------	--------
CLUSTER 16									
183	PRRI002164	Kinandang Pula	No Data	Batangas	White	--------	--------	107	--------
416	PRRI005332	FK 178 A (IRGC 299)	Indica	No Data	White	--------	--------	161.6	--------
386	PRRI003117	Dinorado (IRGC 30333)	Indica	Davao del Norte	--------	--------	--------	--------	--------
419	--------	Gabura (IRGC 26343)	Indica	Bangladesh	--------	--------	--------	178	--------
329	--------	Cambodia 3 Mix	No Data	Cambodia	--------	--------	--------	--------	--------
335	PRRI005371	Chao-Kao (IRGC 12876)	Javanica	Laos	White	--------	--------	148.4	--------
334	PRRI005369	Chao-Khao	Indica	Laos	White	--------	--------	171.94	--------

Appendix Table 1. Continued

CLUSTER 17									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
290	-------	-------	-------	-------	-------	-------	-------	-------	-------
328	-------	Cambodia 4 (FC 15)	No Data	Cambodia	-------	-------	-------	-------	-------

CLUSTER 18									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
343	PRRI001788	DA Var E	No Data	No Data	Light Brown	-------	-------	-------	-------
406	PRRI000025	Ennano (IRGC 44411)	Indica	Pangasinan	White	-------	-------	-------	-------
402	PRRI003542 B	E2- 227	No Data	Pakistan	-------	-------	-------	-------	-------
400	PRRI003542	E2- 227	No Data	Pakistan	-------	-------	-------	76.88	-------
398	PRRI005415	Domsiah (IRGC 32292	Indica	Iran	White	-------	-------	149.1	-------
396	PRRI000978	Domsiah	No Data	Iran	White	-------	-------	150.4	-------
394	PRRI000939	Dom Noub Sor	No Data	Cambodia	White	-------	-------	-------	-------
382	PRRI002565	Dinurado	No Data	Camarines Sur	-------	-------	-------	-------	-------
374	PRRI000281	Dinominga	Indica	Ilocos Norte	-------	-------	-------	-------	-------
379	PRRI000976	Dinorado (White)	No Data	Nueva Ecija	Light Brown	-------	-------	177.34	-------
373	PRRI000280	Dinominga	Indica	La Union	White	-------	-------	-------	-------
401	PRRI003542	E2-227	No Data	Pakistan	-------	-------	-------	-------	-------
399	PRRI005416	Domsiah (IRGC 32293)	Indica	Iran	White	-------	-------	160.04	-------
397	PRRI005413	Damsiah (IRGC 32290)	Indica	Iran	White	-------	-------	163.5	-------
395	------	Domsian (IRGC 3512)	Indica	Iran	White	-------	-------	178.6	-------
393	PRRI000774	Dom Naucht (FC 6)	No Data	Cambodia	-------	-------	-------	-------	-------
391	PRRI002245	Dinolores	No Data	Quezon	White	-------	-------	170.8	-------

CLUSTER 19									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
7	PRRI000912	Binangkuro	No Data	Occ. Mindoro	White	-------	-------	123	-------
65	PRRI001859	Azucena	No Data	S. Cotabato	White	-------	-------	-------	-------

CLUSTER 20									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
10	PRRI000394	Bangkoro	Indica	Benguet	Light Brown	-------	-------	173.16	-------
425	PRRI005272	Galiano(IRGC 44418)	Indica	Ilocos Norte	-------	Spindle	2.5-2.99	-------	-------
404	PRRI003545	Elon-Elon(98- SDN 4)	Indica	Surigao del Norte	-------	-------	-------	-------	-------
97	PRRI002433	Awot	Indica	Antique	-------	-------	-------	-------	-------
112	PRRI001969	C 22	Indica	No Data	White	Spindle	2.5-2.99	143.98	18

Appendix Table 1. Continued

CLUSTER 20									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
10	PRRI000394	Bangkoro (IRGC 53132)	Indica	Benguet	Light Brown	-------	-------	173.16	-------
425	PRRI005272	Galiano (IRGC 44418)	Indica	Ilocos Norte	-------	Spindle	2.5-2.99	170.20	11.8
404	PRRI003545	Elon-Elon (98-SDN 4)	Indica	Surigaodel Norte	-------	-------	-------	-------	-------
97	PRRI002433	Awot	Indica	Antique	-------	-------	-------	-------	-------
112	PRRI001969	C 22	Indica	No Data	White	Spindle	2.5-2.99	143.98	18
113	PRRI002812	C 22 (IRGC 50)	Indica	Laguna	-------	-------	-------	-------	-------
114	-------	C 22	Indica	No Data	-------	-------	-------	-------	-------
118	-------	C 22	Indica	No Data	-------	-------	-------	-------	-------
119	-------	C 22	Indica	No Data	-------	-------	-------	-------	-------
191	PRRI000249	Alaminos (IRGC 44268)	Indica	Ilocos Norte	White	-------	-------	-------	-------
192	PRRI000086	Aluminus (IRGC 44269)	Indica	Ilocos Norte	White	-------	-------	-------	-------
193	PRRI002420	Aluminos	Indica	Ilocos Norte	White	-------	-------	150.48	-------
198	-------	-------	-------	-------	White	-------	-------	-------	-------
205	-------	Canilangka	Indica	No Data	-------	-------	-------	-------	-------
213	PRRI001797	Milagrosa	No Data	No Data	-------	-------	-------	-------	-------
253	PRRI002478	Banate 2	Indica	Iloilo	White	-------	-------	-------	-------
254	PRRI000849	Banate 1 (IRGC 81724)	Indica	Iloilo	Light Brown	-------	-------	159.80	16.2
262	-------	C-1	No Data	No Data	-------	-------	-------	-------	-------

CLUSTER 21									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
102	PRRI001006	Ballatinao (96-ABR 19)	Indica	Abra	Brown	-------	-------	164.70	-------
372	PRRI000047	Dinominga (IRGC 5187)	Indica	La Union	-------	-------	-------	-------	-------
370	PRRI003525	Dinarunan (IRGC 11206	Javanica	Nueva Vizcaya	White	-------	-------	130.20	-------
301	PRRI000447	Bulastog (IRGC 44358)	Indica	Ilocos Norte	White	-------	-------	----------	-------

CLUSTER 22									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
19	PRRI000834	Bulibod na Puti	Indica	Quezon	-------	-------	-------	-------	-------
427	PRRI005276	Gallano(IRGC 44424)	Indica	Pangasinan	White	-------	-------	165.20	-------
388	PRRI003981	Denorado (97-MAG 5)	Javanica	Maguindanao	-------	-------	-------	174.98	-------
380	PRRI001793	Dinorado A	No Data	South Cotabato	Brown	-------	-------	115.42	-------
378	PRRI000805	Dinurado	No Data	Quezon	Brown	-------	-------	134.56	-------
376	PRRI000641	Dinorado (96- ARAK 3)	No Data	North Cotabato	-------	-------	-------	----------	-------
38	PRRI000255	Balasang (IRGC 44288)	Indica	Ilocos Norte	White	Spindle	2.5-2.99	181.54	-------
265	PRRI005270	Borik (IRGC 44351)	Indica	La Union	-------	Half-spindle	2.0-2.49.	169.90	-------

Appendix Table 1. Continued

CLUSTER 22

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
264	PRRI000874	C-1 (Pula/Puti)	No Data	Cavite	--------	--------	--------	--------	--------
47	PRRI000653	Binato (96-OCM 12)	Indica	Occ. Mindoro	White	Half-spindle	2.0-2.49	138.62 cm	21.2
383	PRRI002786	Dinorado FG 653	No Data	Leyte	--------	--------	--------	--------	--------
147	----------	Bengawan (IRGC 47096)	Indica	Ilocos Norte	Brown	--------	--------	--------	--------
251	PRRI002716	Binatang	Indica	Quezon	Brown	--------	--------	106.00 cm	127.82
270	----------	Bangbang (IRGC 53131)	Indica	Benguet	--------	--------	--------	--------	--------
160	PRRI002294	Bina-ay (96- ABR 8)	Indica	Abra	--------	--------	--------	--------	--------
230	PRRI002958	Milagrosa (IRGC 5159)	Indica	Laguna	--------	--------	--------	--------	--------
241	PRRI003143	Camuros (IRGC 44376)	Indica	Occ. Mindoro	--------	--------	--------	--------	--------
166	PRRI003185	Kinandang Pula	Indica	Ilocos Sur	--------	--------	--------	--------	--------
237	PRRI003325	Kamoros (IRGC 52851)	Indica	Aklan	Red	--------	--------	185.8	--------
371	PRRI003526	Dinrunan (IRGC 11222)	Javanica	N. Vizcaya	Light Brown	Half-spindle	2.0-2.49	128.66	11.2
219	PRRI003803	Milagrosa (97- CAT 3)	Indica	Catanduanes	Red	--------	--------	--------	--------
202	PRRI005098	Americana (IRGC 54133)	Indica	Indonesia	White	--------	--------	191.2	14.2
272	PRRI002871	Binastian (IRGC 740)	Indica	No Data	--------	--------	--------	--------	--------

CLUSTER 23

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
17	PRRI002466	Balibud (IRGC 26871)	Indica	Isabela	--------	--------	--------	--------	--------
424	PRRI003284	Galliano (IRGC 47209)	Indica	Apayao	Red	--------	--------	181.06	--------
390	PRRI003518	Detagen (IRGC 11317)	Javanica	N. Vizcaya	--------	--------	--------	--------	--------
41	PRRI003129	Binalasang (IRGC 44321)	Indica	Ilocos Norte	--------	--------	--------	--------	--------
271	--------	--------	Indica	India	--------	--------	--------	--------	--------
45	PRRI001014	Binato (96-ABR 62)	Indica	Abra	White	Half-spindle	2.0-2.49	172.26	16.8
121	PRRI000201	Macan Caraboa	Indica	N. Ecija	White	--------	--------	147.8	--------
389	PRRI003513	De-Tagen (IRGC 11265)	Javanica	N. Vizcaya	White	Spindle	2.5-2.99	119.16	16.2
132	PRRI002759	Bukay/Basilanin Puti	No Data	Palawan	White	--------	--------	175.36	--------

CLUSTER 24

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
78	--------	Binerhen	Indica	No Data	--------	--------	--------	--------	--------
357	--------	Digha (Sada)	Indica	Bangladesh	--------	--------	--------	--------	--------

CLUSTER 25

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
74	PRRI002235	Azucena 2	Indica	Iloilo	White	Long-spindle	≥3.0	160.24	14.4
75	PRRI002438	Azucena (IRGC 52861)	Indica	Sorsogon	--------	--------	--------	--------	--------
76	PRRI002441	Azucena (IRGC 328)	Indica	Palawan	--------	--------	--------	166.22	--------
85	PRRI002170	Binirhen B (Field C)	Indica	Batangas	Light Brown	--------	--------	124.64	--------
83	PRRI001783	Binirhen A (Field C)	Indica	Batangas	White	--------	--------	100	--------

Appendix Table 1. Continued

CLUSTER 26									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
84	PRRI001878	Binirhen (B)	Indica	Batangas	White	--------	--------	131.74 cm	--------
363	PRRI003148	Daliket (Pilis)	Indica	No Data	--------	--------	--------	--------	--------
108	PRRI001981	C 22	Indica	No Data	--------	--------	--------	--------	--------
104	PRRI003128	Binagimbing	Indica	No Data	--------	--------	--------	--------	--------
126	PRRI000443	Ballukok (IRGC 44300)	Indica	La Union	White	--------	--------	--------	--------
127	PRRI000393	Balokok (IRGC 53129)	Indica	Benguet	White	--------	--------	163.14 cm	--------
106	PRRI002878	Bulao (IRGC 797)	Indica	No Data	--------	--------	--------	--------	--------
CLUSTER 27									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
140	PRRI003330	BIUD (IRGC 52871)	Indica	Agusan d. Sur	--------	--------	--------	--------	--------
384	PRRI002893	Denorado (IRGC 3827)	Indica	No Data	--------	--------	--------	--------	--------
385	PRRI002943	Dourado Agaulha	Indica	No Data	--------	--------	--------	--------	--------
CLUSTER 28									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
15	PRRI002462	Balibod (IRGC 38722)	Indica	N. Ecija	--------	--------	--------	--------	--------
423	PRRI001775	Galliano	Indica	Cagayan	White	Half-spindle	2.0-2.49mm	151.88 cm	20.2
352	--------	Digha (IRGC 26453)	Indica	Bangla-desh	--------	--------	--------	--------	--------
413	PRRI001843	Fancy	Hybrid	Ilocos Sur	White	--------	--------	145.62 cm	--------
52	PRRI002551	Binayabas	Indica	N. Ecija	--------	--------	--------	--------	--------
319	PRRI001576	C4-87-21-1	No Data	No Data	--------	--------	--------	--------	--------
134	PRRI002533	Bineg-it	No Data	Quirino	--------	--------	--------	--------	--------
150	----------	Bengawan mutant	No Data	No Data	--------	--------	--------	--------	--------
159	PRRI001008	Bina-ay (96 –ABR 25)	Indica	Abra	--------	--------	--------	--------	--------
320	PRRI002388	C4-878-21-1	No Data	No Data	--------	--------	--------	--------	--------
206	PRRI005102	Anbarboo (IRGC)	Indica	Iran	White	--------	--------	161.80 cm	--------
215	PRRI004679	Milagrosa (2004)	No Data	Palawan	--------	--------	--------	--------	--------
216	PRRI003805	Milagrosa (98 –Qui 5)	Hybrid	Quirino	--------	--------	--------	--------	--------
234	PRRI002152	Sigadis Milagrosa	No Data	No Data	--------	--------	--------	--------	--------
263	PRRI002271	C-1	No Data	Batangas	White	Long-spindle	≥3.0 mm	101.44 cm	12.6
269	PRRI002479	Banban (IRGC 11193)	Indica	N..Vizcaya	White	--------	--------	132.80 cm	--------
CLUSTER 29									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
98	PRRI004387	Awot (LB ML 208)	Indica	Kalinga	--------	--------	--------	--------	--------
149	--------	Bengawan mutant	No Data	No Data	--------	--------	--------	--------	--------
					--------	--------	--------	--------	--------

Appendix Table 1. Continued

CLUSTER 30									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
53	PRRI002447	Bakhaw (97-CAT-26)	Indica	Catanduanes	--------	--------	--------	--------	--------
356	----------	Digha(IRGC110364)	Hybrid	Bangladesh	--------	--------	--------	--------	--------
344	PRRI002172	DA Var D	No Data	No Data	--------	--------	--------	--------	--------
252	PRRI002951	Binatangan	Japonica	No Data	--------	--------	--------	--------	--------
250	PRRI000675	Kamoros(96-Ant 21)	No Data	Antique	--------	--------	--------	--------	--------
233	PRRI003804	Milagrosa(97-CAT6)	Indica	Catanduanes	--------	--------	--------	--------	--------
156	PRRI002731	Batang Anai	No Data	Indonesia	--------	--------	--------	--------	--------
155	PRRI000779	Batang Anai	No Data	Indonesia	White	Long-spindle	≥3.0	115.6	27.4
148	PRRI003264	Bengawan **(M)**	No Data	No Data	--------	--------	--------	--------	--------
249	PRRI000677	Kamoros (96- CAP 4)	Indica	Capiz	Red	--------	--------	132.12	--------
54	PRRI000384	Bakhaw (IRGC 52863)	Indica	Sorsogon	Brown	--------	--------	154.34	--------
86	PRRI002168	Binirhen (Field B)	Indica	Batangas	White	--------	--------	104.84	--------
CLUSTER 31									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
358	PRRI000784	Digul (F1 7)	No Data	Indonesia	--------	--------	--------	--------	--------
362	PRRI001894	Diket (Pilis)	Hybrid	N. Ecija	--------	--------	--------	135.60 cm	--------
CLUSTER 32									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
11	PRRI000804	Belibod na Pula	Indica	Quezon	Light Brown	--------	--------	--------	--------
12	PRRI003332	Bolibod(IRGC52874)	Indica	Leyte	--------	--------	--------	--------	--------
62	PRRI001917	Basmati 370	Indica	India	White	--------	--------	--------	--------
66	PRRI001866	Azucena	Indica	Batangas	White	--------	--------	--------	--------
67	PRRI001867	Azucena	Indica	Batangas	White	Half-spindle	2.0-2.49mm	--------	--------
298	PRRI003138	Buayan(IRGC44354)	Indica	Zamboanga	--------	--------	--------	--------	--------
310	PRRI002816	C-21 (IRGC 331	Indica	Laguna	--------	--------	--------	--------	--------
CLUSTER 33									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
16	PRRI002464	Balibod (IRGC 44296)	Indica	Occ. Mindoro	--------	--------	--------	--------	--------
414	PRRI003549	Fancy (IRGC 79035)	Hybrid	Ilocos Sur	--------	--------	--------	--------	--------
350	PRRI002744	Diamante	No Data	Eastern Samar	--------	--------	--------	--------	--------
347	PRRI003006	Dinayang	Indica	Palawan	--------	--------	--------	--------	--------
311	----------	C4-137	Hybrid	Laguna	--------	--------	--------	--------	--------
18	PRRI002465	Balibod (IRGC 52864)	Indica	Cam. Sur	--------	--------	--------	--------	--------
20	PRRI002877	Bolibod natural	Indica	Laguna	--------	--------	--------	--------	--------
23	PRRI000145	Belibod (IRGC 52865)	Indica	Cam. Sur	Red	Half-spindle	2.0-2.49mm	--------	--------
24	PRRI002714	Balibod na pula	Indica	Quezon	--------	--------	--------	--------	--------

Appendix Table 1. Continued

CLUSTER 33									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
25	PRRI002714	Bilibod na pula	Indica	Quezon	Brown	Spindle	2.5-2.99 mm	130.54 cm	28.6
39	PRRI000570	Balasang (IRGC44289)	Indica	Ilocos Norte	White	--------	--------	--------	--------
321	PRRI001149	California 1	No Data	US	--------	--------	--------	--------	--------
317	PRRI003395	C4-63 (IRGC 11352)	Indica	Laguna	--------	--------	--------	--------	--------
260	PRRI002259	C-1	No Data	Batangas	--------	--------	--------	--------	--------
144	PRRI000090	Bimmotit (IRGC 44316)	Indica	La Union	White	--------	--------	159.74 cm	--------
146	PRRI003264	Binakayo (IRGC 47096)	Indica	Pampanga	--------	--------	--------	--------	--------
151	PRRI002610	Binangahan	No Data	Eastern Samar	--------	--------	--------	--------	--------
313	----------	C4-63 (Purple Base)	Hybrid	Laguna	--------	--------	--------	--------	--------
152	PRRI001032	Binangahan	No Data	Eastern Samar	--------	--------	--------	--------	32.8
153	PRRI003399	BE (IRGC 44315)	Indica	Ilocos Norte	--------	--------	--------	--------	--------
157	PRRI002862	Binagacay (IRGC 604)	Javanica	No Data	--------	--------	--------	--------	--------
162	PRRI002296	Binaay (96-ABR 14)	Indica	Abra	--------	--------	--------	--------	--------
168	PRRI002256	Kinandang puti	Indica	Batangas	White	--------	--------	122.60 cm	--------
172	PRRI002777	Kinandang puti	No Data	Batangas	Brown	--------	--------	143.84 cm	--------
176	PRRI002715	Kinandang puti	Indica	Quezon	White	--------	--------	87.32 cm	--------
177	PRRI002937	Kinandang puti (IRGC)	Indica	No data	--------	--------	--------	--------	--------
322	--------	--------	--------	--------	--------	--------	--------	--------	--------
318	PRRI003397	C4-63 (Green base)	Hybrid	Laguna	--------	--------	--------	--------	--------
199	PRRI000569	Ampipit (IRGC 44273)	Indica	Ilocos Norte	--------	--------	--------	--------	12.8
228	PRRI003801	Milagrosa (97-Cat 23)	Indica	Catanduanes	Red	--------	--------	--------	--------
229	PRRI003808	Milagrosa (Pula)	Indica	Catanduanes	--------	--------	--------	--------	--------
224	PRRI004045	Milagrosa (97- Akl 2)	Indica	Aklan	White	--------	--------	151.56 cm	--------
222	PRRI003802	Milagrosa (97- Cat 28)	Indica	Catanduanes	Brown	--------	--------	--------	--------
223	PRRI003806	Milagrosa (Fancy)	No Data	No data	White	--------	--------	139.16 cm	--------
227	PRRI003393	Milagrosa(IRGC 53182)	Indica	N. Vizcaya	--------	--------	--------	--------	--------
200	PRRI001753	Amelia	Indica	N. Vizcaya	--------	--------	--------	148.30 cm	--------
312	PRRI003396	C4-137 (IRGC 11354)	Hybrid	Laguna	--------	--------	--------	--------	--------
201	PRRI000070	Amelia (IRGC 38717)	Indica	N. Ecija	--------	--------	--------	--------	--------
214	PRRI000975	Milagrosa	No Data	N. Ecija	White	Half-spindle	2.0-2.49 mm	164.00 cm	12.4
314	--------	C4-63 FG 080	Indica	No data	--------	--------	--------	--------	--------

CLUSTER 34									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/Plant**
60	PRRI000949	Basmati 372	Indica	India	White	--------	--------	--------	--------
323	PRRI001834	California	Indica	Cagayan	White	Half-spindle	2.0-2.49mm	--------	--------
309	PRRI000827	C-21	Indica	Laguna	--------	--------	--------	--------	--------

Appendix Table 1. Continued

CLUSTER 34									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
292	PRRI002983	BPI76	Indica	No data	--------	--------	--------	--------	--------
316	PRRI001535	C4-63 G	No Data	Laguna	--------	--------	--------	--------	--------
196	--------	--------	--------	--------	--------	--------	--------	--------	--------
194	PRRI002162	Ambul	Indica	Cagayan	White	--------	--------	85.72	--------
197	--------	--------	--------	--------	--------	--------	--------	--------	--------
138	PRRI002949	Dumali (IRGC 5105)	Indica	No data	--------	--------	--------	--------	--------
289	--------	--------	--------	Cagayan	--------	--------	--------	--------	--------
161	PRRI002408	Binaay bayag	Indica	Mt. Province	White	--------	----------	96.86	--------
259	PRRI002813	C-1 (IRGC 290)	Japonica	Laguna	--------	--------	--------	--------	--------
72	PRRI001916	Azucena	No Data	S. Cotabato	--------	--------	--------	--------	--------
96	PRRI001757	Awot	Indica	S. Cotabato	Red	Half-spindle	2.0-2.49	170.28	15.2
315	--------	C4-63 G	No Data	No data	--------	--------	--------	--------	--------
109	PRRI001982	C 22	Indica	No data	--------	--------	--------	--------	--------
CLUSTER 35									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
100	PRRI000060	Balatinaw	Indica	Mt. Province	White	--------	--------	168.50	--------
303	PRRI005408	Bungan	Indica	Iran	White	Long-spindle	≥3.0	159.80	19
299	PRRI003139	Buayan Blanco	Indica	Zamboanga	--------	--------	--------	--------	--------
297	PRRI003752	Brown Gora	Indica	India	Brown	--------	--------	131.36	--------
304	PRRI005410	Bungan (IRGC 32287)	No Data	Iran	--------	--------	--------	--------	18
278	PRRI001853	Beniding	Hybrid	Cagayan	White	--------	--------	109.18	--------
325	PRRI000883	Calrose 3 (M-202)	No Data	US	Light Brown	--------	--------	136.04	--------
339	--------	Chinsurah Boro 2	O. glabberima	India	--------	--------	--------	--------	--------
277	PRRI002165	Binibi	Binibi	Palawan	--------	--------	--------	--------	--------
324	PRRI004493	California rice	No Data	No data	--------	--------	--------	--------	--------
302	PRRI005409	Buncan (IRGC 32285)	Indica	Iran	White	Spindle	2.5-2.99	146.70	19.2
300	PRRI000264	Bolastog(IRGC 44345)	Indica	Ilocos Norte	--------	--------	--------	--------	--------
341	--------	Chinsurah Boro 2	Indica	Indonesia	--------	--------	--------	--------	--------
170	PRRI001910	Kinandafor	Indica	N. Ecija	--------	Spindle	2.5-2.99	113.12	16.2
CLUSTER 36									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
68	PRRI000698	Azucena	No Data	N. Ecija	--------	--------	--------	--------	--------
267	PRRI001802	Bandera	Indica	N. Ecija	--------	Half-spindle	2.0-2.49	117.56	19.8
CLUSTER 37									
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/ Plant
154	PRRI000788	BE 3	Indica	Iloilo	White	--------	--------	--------	--------

Appendix Table 1. Continued

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
				CLUSTER 37					
346	PRRI003005	Dayang-Dayang(19398)	Indica	Palawan	-------	-------	-------	-------	-------
345	PRRI003004	Dayang-dayang (19397)	Indica	Palawan	White	Spindle-shape	2.5-2.99	98.26	19.4
220	PRRI003220	Milagrosa(IRGC 44634)	Indica	No data	-------	-------	-------	-------	-------
				CLUSTER 38					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
331	PRRI002802	Cambodia 1 (FC 12)	No Data	Cambodia	-------	-------	-------	-------	-------
420	-------	Gabura (IRGC 37428)	Indica	Bangladesh	-------	-------	-------	142.7	-------
337	PRRI005113	China Patarka	No Data	Fiji	White	Long spindle	≥3.0	133.16	-------
				CLUSTER 39					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
353	-------	Digha (IRGC 26454)	Indica	Bangladesh	-------	-------	-------	-------	-------
355	-------	Digha (IRGC 31770)	Indica	Bangladesh	-------	-------	-------	-------	-------
				CLUSTER 40					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
279	PRRI004405	Beniding (96- CAG 03)	No Data	Cagayan	White	-------	-------	111.3	-------
293	-------	BPI RI 10 1991 DS-039	Hybrid	No data	-------	-------	-------	-------	-------
				CLUSTER 41					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
131	PRRI003410	Basilanin (98- PAL 101)	Indica	Palawan	-------	-------	-------	-------	-------
326	PRRI000884	Calrose 2 (L-203)	No Data	US	White	-------	-------	96.88	-------
				CLUSTER 42					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
27	PRRI001919	Batangena	No Data	Palawan	-------	-------	-------	-------	-------
295	-------	BPI RI 10	No Data	N. Ecija	-------	-------	-------	-------	-------
286	PRRI002977	Binundok(IRGC5991)	India	No data	-------	-------	-------	-------	-------
				CLUSTER 43					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
285	PRRI000010	Binondoc (IRGC 38726)	Indica	N. Ecija	-------	-------	-------	-------	-------
305	-------	Burdagol TML 5	No Data	N. Ecija	-------	-------	-------	-------	-------
306	-------	Burdagol	No Data	N. Ecija	-------	-------	-------	-------	-------
				CLUSTER 44					
No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
28	PRRI003426	Batangena	No Data	Palawan	-------	-------	-------	-------	-------
30	PRRI003426	Batangenio	No Data	Palawan	-------	-------	-------	-------	-------
240	PRRI003144	Camuros na puti	Indica	Or. Mindoro	-------	-------	-------	-------	-------

Appendix Table 1. Continued

CLUSTER 45									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/ Plant**
33	PRRI000184	Balasang (IRGC 5167)	Indica	Nueva Ecija	White	-------	-------	-------	-------
35	PRRI003370	Binalasang(IRGC52971)	Indica	Ilocos Sur	-------	-------	-------	-------	-------
CLUSTER 46									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/ Plant**
31	PRRI003482	Bursinay(2003-11-0107	No Data	Occ. Mindoro	-------	-------	-------	-------	-------
34	PRRI003369	Binagsang (IRGC 52970)	Indica	Ilocos Sur	Red	-------	-------	207.80 cm	-------
36	PRRI004401	Bumalasang	Javanica	Nueva Ecija	White	-------	-------	122.90 cm	-------
CLUSTER 47									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/ Plant**
360	PRRI001158	Dalikit (Buluhan)	No Data	Cavite	White	-------	-------	141.50 cm	-------
366	PRRI003573	Habolde Dayakot	Indica	Ifugao	White	-------	-------	143.20 cm	-------
361	PRRI001823	Dalikit	Indica	Cavite	-------	-------	-------	-------	-------
CLUSTER 48									
No.	**ACC. Code**	**Variety**	**Sub-Species**	**Origin**	**Seed Coat Color**	**Seed Shape**	**Seed Length (mm)**	**PLT Height (cm)**	**Ave. No. of Panicle/ Plant**
332	-------	CG-14 TML 41	O. glabberima	Laos	-------	-------	-------	-------	-------
333	-------	CG-14	O. glabberima	Senegal	-------	-------	-------	-------	-------

Appendix Table 2. List of the 31 unique Philippine rice accessions that clustered individually, including passport data and key morphological traits.

No.	ACC. Code	Variety	Sub-Species	Origin	Seed Coat Color	Seed Shape	Seed Length (mm)	PLT Height (cm)	Ave. No. of Panicle/Plant
4	PRRI000442	Binangkuro (IRGC 44292)	Indica	Ilocos Norte	White	------	------	------	------
26	PRRI001919	Batangas mixture minantika	No Data	Batangas	------	------	------	------	------
29	PRRI002171	Batangas mixture (Ginitan)	Indica	Batangas	------	------	------	------	------
51	PRRI002997	Bayabas (IRGC 19385)	Indica	Palawan	------	------	------	------	------
55	PRRI000965	Basmati narot 493	Indica	India	Speckled brown	------	------	144.3	------
57	PRRI004402	Bashmoti (D)	Indica	No data	------	------	------	------	------
64	PRRI000969	Basmati 5851	Indica	India	------	Long-spindle	≥3.0	155.6	15.2
69	PRRI002234	Azucena 1	Javanica	Iloilo	------	------	------	------	------
77	PRRI003126	Benerhin (IRGC 44311)	Indica	Occ. Mindoro	------	------	------	------	------
111	PRRI001968	C 22	Indica	No data	White	Spindle	2.5-2.99	145.94	28.8
115	------	C 22	Indica	No data	------	------	------	------	------
116	------	C 22	Indica	No data	------	------	------	------	------
117	------	No data	Indica	No data	------	------	------	------	------
135	PRRI002190	Binig-it	No Data	No data	------	------	------	------	------
181	PRRI002269	Kinanda	No Data	Batangas	------	------	------	------	------
182	PRRI002765	Kinandang puti	Indica	Batangas	Brown	------	------	141.26	------
212	PRRI000729	Sigadis Milagrosa	No Data	N. Ecija	Brown	------	------	90.28	------
266	PRRI001847	Burik	Indica	Cagayan	White	Half-spindle	2.0-2.49	179.8	14.4
276	PRRI000923	Binibe (96-OCM 49)	Indica	Occ. Mindoro	Red	Semi-round	1.5-1.99	146.6	13.4
284	PRRI005322	Binuhangin (IRGC 67430)	Indica	Cavite	White	Spindle	2.5-2.99	101.02	27.8
294	------	BPI RI 10 TML 40	No Data	Nueva Ecija	------	------	------	------	------
296	------	Brown Gora TML 40	Indica	India	------	------	------	------	------
307	PRRI002268	Bureau	No Data	Batangas	White	------	------	137.6	------
308	PRRI002763	Burean (aromatic)	No Data	Batangas	White	------	------	147.92	------
330	PRRI000778	Cambodia 3 (FC 14)	No Data	Cambodia	------	------	------	115.66	------
336	PRRI002609	China rice	No Data	Eastern Samar	------	------	------	------	------
340	------	ChinsurahBoro2 (IRGC 11760)	Indica	India	------	------	------	------	------
351	PRRI004512	Diamante (IRGC 44393)	Indica	No data	------	------	------	------	------
364	PRRI003520	Diket (98- Qui 16)	Javanica	Quirino	------	------	------	------	------
365	PRRI003521	Diket (98- Qui 20)	Javanica	Quirino	------	------	------	------	------
412	PRRI002213	Eurian	No Data	N. Ecija	------	------	------	------	------