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Exploration and Characterization of Brown Rice Germplasms in West Sumatra

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***Abstract*— Studies on brown rice germplasm exploration has been carried out in West Sumatra in January to April 2010. The research aim is to get the brown rice collection from West Sumatera Province. Exploration was carried out in every county and city in West Sumatra Province by collecting all types of brown rice which was obtained in the field. It was Found 19 genotypes of rice brown rice in West Sumatra scattered five districts each with 6 genotypes at Solok regency, 4 genotypes in South Solok, 3 genotypes in Pasaman, 5 genotypes in West Pasaman, and 1 genotype in South Coastal District . Based on the analysis of kinship and RAPD analysis turns red rice paddy West Sumatra is grouped into nine groups on the degree of similarity of 86% and there is still diversity in each group. While the kinship which is based on morphological similarities have two groups with the degree of similarity of 66%.**

***Keywords*— Brown rice, exploration, germ plasm, West Sumatra.**

I. INTRODUCTION

Rice is the staple food for the majority of Indonesian and plays important role in the system of national food security. Rice accounts for 60-65% of total energy consumption (IPB, 2000). In Indonesia rice accounted for 63% of total energy sufficiency, adequacy of 38% of the total protein, and 21.5% of the total iron sufficiency [5].

West Sumatra is one of the provinces in Indonesia with area is not very large in size and crossed by the equator line. This makes West Sumatra has a specific climate, wet tropical forests (tropical rain forest) with relatively uniform distribution rain falls throughout the year. Such climatic conditions allow West Sumatra to have invaluable exotic genetic diversities. One of the germplasms is rice plant.

Rice is classified into two categories, namely rice of paddy fur (because of the hairy skin rice) and rice from paddy cere/Cempa (hairless bran). Generally paddy fur will be fluffier when cooked, while paddy cere will become pera, except for some types of paddy cere that will turn into floppier when cooked. There are three types of rice according to its color and texture, i.e white rice, brown rice, and glutinous rice.

Most of Indonesian likes to consume fluppy rice. Therefore, it is not surprising that pera rice breeding activities is very limited. In contrast, people of West Sumatran region like rice pera more than that of fluppy rice. This enables farmers to grow and conserve rice germplasms from generation to generation. Siwi and Kartowinoto [7] said that local rice cultivars are invaluable asset and need to be managed properly. However, this kind of germplasms is nothing to people if not used for the goodness of people [1].

Exploration is an activity of searching, collecting, and determining certain types of local varieties (in certain areas) to prevent from extinction. This is necessary to save local varieties and landrace resulted from planting new high yielding varieties. Exploration activities should be carried out in various areas such as the production areas, the traditional production areas, isolated areas, agricultural areas on mountain slopes, remote islands, indigenous areas, areas with traditional farming systems/undeveloped, areas where people use the crops for their staple food, endemic areas of pest/disease, as well as old and new resettlement area.

Characterization activity includes identification of important traits of economic value or other specific characters. The characters may be of morphologic (leaf shape, fruit shape, color of seed coat, etc), agronomic (time to harvest, plant height, length of petiole, number of tillers, etc), physiologic (allelochemicals, phenolic compounds, alkaloids, browning process, etc), isoenzyme and molecular markers. The availability of molecular markers to identify important agronomical traits is of important in plant selection process. Assessment of genetic variability based on

DNA or fingerprint analysis can be performed in various ways such as RAPD - Random Amplified Polymorphic DNA_[3].

This study reported here was aimed at determining the collection of brown rice germplasms and their characters in the Province of West Sumatra. The information on the characters may then be used as source materials to improve specific traits for conservation and breeding program of rice germplasms, specially brown rice. It was expected that brown rice along with its morphological and molecular characters will be obtained

II. Materials And Methods

The studies were carried out for two years from January 2009 to October 2010. The first year study focused on exploration, identification (morphological and molecular characters), as well as conservation (storage) of the seed collected. In the second year of the study, various activities involved including evaluation on rice resistant/tolerant to biotic and abiotic stress such as pest and diseases (brown planthopper and bacterial leaf blight and blast), drought stress, acid soil, and Fe toxicity.

The exploration was conducted at every district and city in the province of West Sumatra. The choice of each district was resulted from their potential to have abundant rice germplasms with well-maintained purity. Preliminary survey was carried out for collecting data on the existence of brown rice or landrace in the area. The information was gathered from local community leaders, farmers, and agricultural extension staff in the areas. The search for local brown rice was also directed to the place where the rice grown. Data were collected either on brown rice being grown or brown rice that no longer grown.

Primary data were obtained through interview, information from locals, community leaders, farmers, local agricultural extension staff, and related government official. Data included cultivars name, amount and origin of the collection. Brown rice collected were then conserved as germplasms collection.

Characterization of all the important agronomic and morphological traits was on 19 morphological characters and 11 agronomic characters (yield and yield components) according to IBPGR, [4] and [2]. Data were used for the purpose of analysis of diversity and relatedness. Molecular markers can also be used to determine germplasms diversity through RAPD. In this study, RAPD molecular marker was conducted in three stages i.e 1) DNA extraction optimization, 2) primer optimization, and 3) analysis of RAPD.

III. Results And Discussion

Exploration and identification of brown rice in this study has been conducted in several districts in West Sumatra, namely: Solok, South Solok , Pasaman, Pesisir Selatan, and West Pasaman. Nineteen local brown rice cultivars were collected from these areas (Table 1). We found six cultivars fromSolok, four cultivars from South Solok , three cultivars from Pasaman, five cultivars from West Pasaman, and one cultivar from Pesesir Selatan.

High degree of variability (V>4) was observed from most of the characters noted. There were some characters with low or narrow degree of variability ($V \leq 4$) such as stem diameter, grain length, grain width, and grain shape. The highest value of diversity was observed in the amount of grain (V = 3286.42) whereas the lowest value was found in panicle length (V = 13.86).

TABLE 1.
BROWN RICE CULTIVARS COLLECTED IN WEST SUMATRA

No	Code	Notes
1	A	Beras merah, Kec. Surian, Lolo, The Regency of Solok
2	B	Padi ladang merah, tanah garam, The Regency of Solok
3	C	Beras merah, Talang Babungo, Kec. Hiliran Gumanti, The Regency of Solok
4	D	Beras merah, Pido Manggih, Nagari Muaro Kiawai, West Pasaman
5	E	Beras merah (Sikarujuik), Jorong SP3 Alin, Nagari Muari Kiawai, Kec. Gn. Tuleh, The Regency of West Pasaman
6	F	Beras merah, Sungai Abu, Kec. Hiliran Gumanti, The Regency of Solok
7	G	Padi telur, The Regency of Pasaman
8	H	Beras merah teluk embun, Nagari Cubadak, Kec. Duo Koto, Pasaman
9	I	Beras merah siarang, Gn. Pasir, Kec.Sangir, The Regency of South Solok
10	J	Beras merah, Jorong Mudiak Simpang, Nagari Bancah Laweh, Kec. Sukamenanti, The Regency of Pasaman
11	K	Beras hitam siarang, The Regency of South Solok
12	L	Siarang putih kekuningan, Perbatasan, Kec. Sangir, The Regency of South Solok
13	M	Siarang putih kekuningan, Gn. Pasir, The Regency of South Solok
14	N	Beras hitam, Sariak Alam Tigo, Kec. Hiliran Gumanti, The Regency of Solok
15	O	Beras hitam, The Regency of Solok
16	P	Capacino, The Regency of West Pasaman
17	Q	Silela Turun Daun, The Regency of West Pasaman
18	R	Sikorojuik, The Regency of West Pasaman
19	S	Beras Merah, The Regency of Pesisir Selatan

Results of the analysis of relatedness according to morphological markers are presented in Figure 1. Cluster analysis in Figure 1 shows that the closest level of kinship was in cultivar Siarang Putih Kekuningan found in Sangir, South Solok and that of Gn. Pasir, South Solok with 98.35% similarity. In contrast, the furthest kinship with similarity of 66.33% was found in Beras Merah Pido Manggih Nagari Muaro Kiawai, West Pasaman. The degree of similarity is affected by cultivar variability. Brunell dan Whileus (1999) in [8] stated that high level of variability in morphological characters will constraints the limits for taxonomical purposes.

Information on the degree of relatedness will help plant breeders to produce new variety with either narrow or wide variability through crossing. Varieties closely related to each other can be used to produce crop variety with low variability. In contrast, variety with high variability is produced through crossing plants having distant relatedness. The higher the distance in relatedness resulted in higher variability of recombinants. Davis and Hehwood (1973) in [8] stated that phylogenetic relationship between taxa of plants can be projected through determining similarities between plant taxa using morphological characters.

Twenty-four primers were used to amplify DNA sequences in five rice cultivars using RAPD technique. The

primer selection was based on the level of polymorphism and total DNA bands generated from the RAPD technique. The primers selected from the study were OPE8, OPH8, OPH11, OPH14, OPH19, and OPM2.

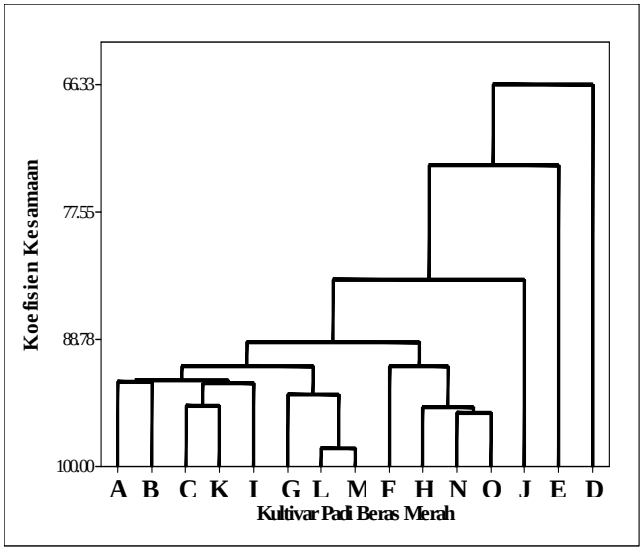

Fig 1. Dendrogram Of Brown Rice with Morphological and Agronomical Markers

Figure 2 demonstrates that brown rice in West Sumatra has nine major groups with coefficient of similarity of 0.60. Cultivars that have a lot in common stay in the same group. Sometimes, cultivars within a major group may further be divided according to coefficient of similarity of >0.60. The higher the coefficient of similarity the closer the relatedness of the cultivars, and vice versa.

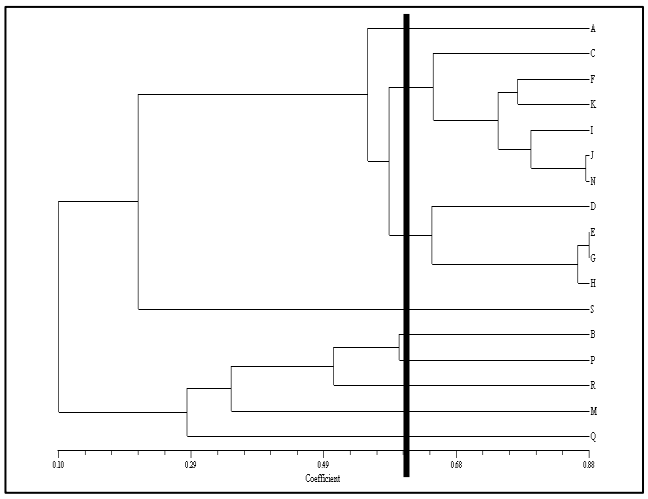

FIGURE 2.
DENDROGRAM RICE BROWN RICE WITH 6 PRIMERS (OPE8, OPH8, OPH11, OPH14, OPH19, AND OPM2

Brown rice from Pesisir Selatan is very different to other cultivars. This was reflected on the dendogram where the cultivars are clustered with low coefficient of similarity (0.20) compared to other cultivars indicating low similarity between this cultivar compare to others. Similar phenomenon was found in cultivar Silela Turun Daun of West Pasaman. These two cultivars were from two distantly separated areas and were not found in other areas due to some agronomical or socio-economical traits were not suit local preferences. Data on Table 2 demonstrated clusters of brown rice according to primers used.

TABLE II
BROWN RICE GROUPED FOLLOWING PRIMERS USED OPE8, OPH8, OPH11, OPH14, OPH19, AND OPM2.

Groups	Code of cultivar	Name of cultivar
I	A	Beras merah, Kec. Surian, Lolo, The Regency of Solok
IIa	C	Beras merah, Talang Babungo, Kec. Hiliran Gumanti, The Regency of Solok
IIb	F	Beras merah, Sungai Abu, Kec. Hiliran Gumanti, The Regency of Solok
	K	Beras hitam siarang, The Regency of South Solok
	I	Beras merah siarang, Gn. Pasir, Kec.Sangir, The Regency of South Solok
	J	Beras merah, Jorong Mudiak Simpang, Nagari Bancah Laweh, Kec. Sukamenanti, The Regency of Pasaman
	N	Beras hitam, Sariak Alam Tigo, Kec. Hiliran Gumanti, The Regency of Solok
IIIa	D	Beras merah, Pido Manggih, Nagari Muaro Kiawai, West Pasaman
III b	E	Beras merah (Sikarujuik), Jorong SP3 Alin, Nagari Muari Kiawai, Kec. Gn. Tuleh, The Regency of West Pasaman
	G	Padi telur, The Regency of Pasaman
	H	Beras merah teluk embun, Nagari Cubadak, Kec. Duo Koto, Pasaman
IV	S	Beras Merah, The Regency of Pesisir Selatan
V	B	Padi ladang merah, tanah garam, The Regency of Solok
VI	P	Capacino, The Regency of West Pasaman
VII	R	Sikorojuik, The Regency of West Pasaman
VIII	M	Siarang putih kekuningan, Gn. Pasir, The Regency of South Solok
IX	Q	Silela Turun Daun, The Regency of West Pasaman

The greatest coefficient of similarity of 0.80 was reflected from brown rice cultivars Jorong Mudiak Simpang Nagari Bancah Laweh Kec Sukamenanti District Pasaman, cultivar Beras Hitam Sariak Alam Tigo Kec Hiliran Gumanti District Solok, Beras Merah (Sikarujuik) Jorong SP3 Alin Nagari Muari Kiawai Kec Gn. Tuleh District West Pasaman,

and Padi Telur of District Pasaman. This may happen if the parents share the origin and spread into different areas.

Data and figures reported here indicate that rice cultivars coming from the same district do not necessarily share significant similarity but may be affected by the origin of the parental lines. When a cultivar spread into different climate and geographical condition it will interact with its growth environment. A cultivar has to have certain survival mechanisms to adapt and survive in a new environment that is completely different to its previous site. This mechanism resulted in the evolution of one or more alleles which in turn creates new traits.

IV. CONCLUSIONS

The exploration of brown rice resulted in 19 brown rice genotypes in West Sumatra as follows: 6 genotypes found at District Solok, 4 genotypes found at District South Solok , 3 genotypes found at District Pasaman, 5 genotypes found at District West Pasaman, and 1 genotypes found at District Pesisir Selatan. Analysis of relatedness and RAPD resulted in clustering brown rice of West Sumatra into nine groups with degree of similarity of 86% with slight differences in each group. Furthermore, relatedness according to morphological similarity was found in two groups with 66% similarity.

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