Conservation and Characterization of Upland Red Rice in 11 Districts in North Sumatra Province

Rahmad Setia Budi[1*], Irfan Suliansyah[2], Yusniwati[3], Sobrizal[4]
[1]Agrotechnology Department, Faculty ofAgriculture UISU Medan 20144, Indonesia
[2]Doctoral Program, Postgraduate Andalas University Padang, Indonesia
[3]Program, Postgraduate Andalas University Padang, Indonesia
[4]Isotop and Radiation Application Center (IRAC) BATAN Jakarta, Indonesia

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Abstract: Germplasm or genetic resources (GR) is very important biodiversity and the basic capital needed in development agricultural industry including new varieties invention in order to increase production to support food security and sustainable agriculture. Paddy (Oryza sativa L.) or rice as the main staple food, is very important food crop for the people of Indonesia. One type among upland rice's in North Sumatra that widely planted by the farmers are the upland red rice's. In order to conserve the extinction of these GR and to empower their cultivars, it is necessary to take action in more dynamic way of conservation such as in situ conservation (on farm conservation) and ex situ conservation. The purpose of this study was to obtain information and data; agronomic, morphological, and production characteristics such as: plant height, harvest age, production per ha, weight of 1000 grains, shape, size, and color of unhulled grain and the hulled one (rice). The research was initiated with exploration activities in 11 districts in North Sumatra from 2015which included literature study, interviews and direct visit to farmer fields. Collection and storage for consolidation and characterization of upland red rice was conducted at Experimental Field and Screen House of Faculty of Agriculture UISU Medan Results obtained; (1) Acquired 22 upland red rice cultivars and most cultivars were found in areas of medium to high altitude, with flat topography, plateau to hilly;(2). All upland red rice cultivars showed good diversity in terms of agronomy, harvest age and production (2). Grain (lemma/palea) and seed (caryopsis) obtained were found to be variated in the shape, size, and color. For subsequent research the selected cultivars will be improved through mutation breeding (induced mutation).

1 INTRODUCTION

Paddy(Oryza sativa L.) or rice is the main staple food for the people of Indonesia, and an important component in the national food security system (Damardjati, 2006). In addition, rice is also one of raw material of various foods, such as cakes flour, noodles, and baby food (brown rice). The demand for rice each year increases inline with the increasing of population. Indonesian rice consumption is 135 kgs/capita/year. Out of the 39.7 million hectares of Indonesianmainland, 20.5% is planted with rice. In 2013, harvested area of Indonesia's rice was 13.83 million hectaresresulting the productivity of 5.15 t/ha and total production of 71.28 million tons (Zaini, et al.(2014).

Rice cultivation in upland areas worldwide accounts for about 15 million hectares and contributes about 4% of the total rice production in the world (GRiSP, 2013). In Indonesia, upland rice production covers about 1.15 million hectares and contributes about 5% of the national rice production (MOA, 2013). The national productivity of upland rice in the country remains low at 3.35 t/ha (MOA, 2013). Indonesian upland rice area is mainly cultivated in marginal areas, which comprise diverse geographical areas from low to high altitude. Breeding to improve rice varieties for upland areas has been established in Indonesia since 1970s with the main target areas were upland rice in low altitude. In contrast, improvement of upland rice varieties for high altitude in the country was just initiated in 2011. It is estimated that 2.07 million ha of upland areas in high altitude has the potential for food crop production including rice (Abdurachman *et al*., 2008). However, in the high-altitude areas, farmers still cultivate traditional rice

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varieties mainly due to the absence of improved varieties specifically released for the areas.

Rice production increased from 52 million tons in 2000 to about 66 million tons in 2010, or an increase of 2.68% per annum as combinatiotion of 1.24% increase in harvested area and 1.41% annual increase in productivity. According to Statistic Indonesia (2011) Indonesia's rice production decreased 1.08 million tonnes compared to the previous year. The lowness increase in harvested area shows that to increase rice production has been more difficult especially in Java, Sumatera and Nusatenggara (MOA, 2013, Atomos, 2014).

In addition, the declination in production is also caused by the occurrence of decreasing in the potential yield of existing rice cultivars. This is due to the narrowness of the genetic diversity of existing rice caused by many released rice cultivars that are related one to each other. As a result, rice diversity is reduced and the yield potential is no different (Susanto, *et al.* (2010). This facts endanger the existence of local rice both wetland and upland rice cultivars, which currently more abandoned by farmers and threatened in extinction (Toha, 2005).

Indonesia is a tropical country with a huge potential and belongs to the second largest country on biodiversity. The high level of biodiversity of germplasm or genetic resources (GR) is because Indonesia has a vast landscape with the spread and condition of geographic areas that vary (Sujiprihati and Syukur, 2012).Germplasm or GR is one of the most important natural resources and is the basic capital needed to develop the agricultural industry. Genetic Resources management is considered successful if it has been able to provide access to GR as a source of donor genes in breeding programs, and plant breeding is considered to be successful if it has utilized the genetic properties available in GR collections(Sumarno and Zuraida, 2004). Local cultivars are seen as a very valuable asset and need to be well managed. Local rice (landrace) is an GR that has a certain genetic advantage, has been cultivated for generations so that the genotype has adapted well to the various land conditions and specific climate in the area oif development. In addition, local rice is naturally resistant to pests and diseases, tolerant to abiotic stress, and has a good quality of rice and generally has a taste and aroma favored by the people (Siwi and Kartowinoto, 1989); Hayward *et al.* (1993) and Sitaresmi *et al.* (2013).

The exploration, collection and conservation of GR has become a global concern, by forming an international body of the International Plant Genetic Resource Institute (IPGRI) based in Rome, which plays a role in the management of germplasm for some particular commodities (Poespodarsono, 1988). Exploration is an activity to seek, find, and collect certain GR to secure them from extinction. In order for the GR to be more efficiently secured it is necessary to conduct more dynamic conservation such as in situ conservation or on-farm conservation.Swasti *et al.* (2007), has explored 182 local rices in West Sumatra, but more directed to wetland rices (Warman *et al.*(2011). In West Sumatra there are still 15 local upland rice cultivars that are still cultivated by the farmer in dry land/hills. From the local upland rice cultivars there is an upland rice that has black endosperm color (black rice).

The development of upland rice is an alternative to increase national rice production, and plays an important role in the Indonesian people's agricultural system, as wetland rice expansion becomes more difficult. Based on the data that the dry land of Indonesia is about 144 million hectares so that in the coming yearsits role in national grain supply becomes increasingly important (Rahayu, et al. (2006). Productivity of 2.57 tons / ha, much lower than the productivity of wetland rice 4.75 tons / ha (MOA, 2006).

One type of upland rice in North Sumatra which widely still being planted by farmers is red upland rice. Red (brown) rice has the advantage of both itstenderness and benefit for the human body. Brown rice is known to be very beneficial to health, as well as staple foods, among others, to prevent food and nutrition shortages and cure diseases. The content of anthocyanin in brown rice is believed to prevent various diseases such as cancer, cholesterol, and coronary heart (Fitriani, 2006).

The utilization of improved varieties is a reliable technology in increasing the production of food crops. This technology is considered safer and more environmentally friendly and cheaper for farmers. Therefore, attention to the effort obtaining superior varieties through breeding research needs to be given so that genetic quality of the local rice can be improved. Indonesian plant breeders successfully breeded 180-day-old rice with productivity of 2-3 tons / ha to 105 days old with 6-8 tons / ha productivity such as Aek Sibundong a local rice varieties of North Sumatra (Irianto, 2008). To support the sustainability of paddy production in the regions and the increasing of national rice production, varieties that are adaptive to environmental conditions in the country are needed (Hairmansis, *et al.* (2015).

The specific purpose of this research is to explore and characterize the various local rice characters of North Sumatra red rice, and followed by characters improvementof North Sumatranred rice upland landraces through further breeding activities. Characters that will be improved primarily are the age of plants, posture, and production.

While the specific objectives of the study are as follows:

1. Getting, and collecting and consolidating the local red rice in North Sumatra as a first step in conservation.
2. Characterization of morphology, especially morphology of rice grain of red rice from exploration results
3. Knowing the genetic kinship of local red rice in North Sumatra.

2 MATERIAL AND METHOD

The research was conducted in eight districts in North Sumatra Province from January 2015 until December 2016. The method included the study of literature, interviews to the relevant agencies, the Department of Agriculture, Ministry of Agriculture, Indonesian Center for Rice Research (BB Penelitian Padi Indonesia), Agricultural Extension (PPL), the Village Head, and Farmer Groups, as well as visits and interviews directly to the Farmers fields in the District which are regional producer of rice and have the potential existence of local upland red rice. The research was conducted on several stages of research activities, namely: 1) exploration and rice collection of red rice in North Sumatra and 2) characterization of morphology of red rice in North Sumatera results of exploration activities.

Data collected in this study were primary and secondary data. Primary data collected directly through interviews with respondents using a questionnaire to determine the existence and identify the red rice geographic, agricultural systems, farmers' character, agronomic characters, morphology, and production coverance, plant height, date of harvest, production per hectare, 1000 grain weight, grain shape, and color of grain. Secondary data related to this study were obtained through the agencies associated with this research.

2.1 Exploration and Collection of Red Rice of North Sumatra

Local GR rice exploration activities were carried out in several regencies in North Sumatra Province. Each of these districts was eligible for exploration activities because it stores the diversity of paddy GR which was preserved for years to come. Prior to the initial exploration preliminary survey was conducted, for data collection that contains about the existence of local upland rice species or even wild relatives in the area. Visited and interviewed directly to the fields Farmers in the District which were regional producers of rice and had the potential of the existence of local upland red rice.

Data collection included name of cultivar, number and origin of collection, based on predefined sampling method. The collected cultivars are collected and stored in cold storage, and some are planted for stabilization and rejuvenation either ex situ or in situ, and for characterization purposes.

2.2 Characterization of Grain Morphology

Cultivars collected from farmers' fields, then identified (characterization) and stored. A total of 22 cultivars, 21 cultivars were planted in the experimental field and the green house of Faculty of Agriculture UISU Medan and Andalas University Padang, for evaluation, stabilization, and characterization.

Stages of observation of red rice character was done by observing grain quantitatively and qualitatively. All quantitative data was determined by measuring all grain characteristics in accordance with the rice descriptor issued by IRRI and WARDA (2007). From quantitative data obtained, then processed with Minitab program version 16.14 (Iriawan and Astuti, 2006).

Observations consisted of quantitative and qualitative observation. Quantitative quantities consisting of grain length, grain width, grain thickness, and grain length as measured by using digital slurry in mm, and weight of 100 grains as measured by analytical scales in grams. While qualitative observations consisted of grain color surface color, rice color, and shape of rice. The data of morphological characterization (phenotypic data) were then used for the analysis of diversity and kinship.

3 RESULTS AND DISCUSSION

3.1 Upland GR Data in Location Collection Field Visit

From the exploration result in 11 regencies, there were 22 cultivars of upland red rice, and agronomic data obtained (Table 1).

Table 1. Upland Red rice from exploration in Provincial of North Sumatra Districts

Number (Genotipe Code)	Local Name (Accession) / Class	Sub District/ District	Plant height (cm) / Age Production (day)	Production (ton)	High area (m-asl)
(BM01)	Gara Geduk/ Indica (Cere)	STM Hulu/ Deli Serdang	180 / 180	1,0 – 1,5	500- 1000
(BM02)	Belacan TM/ Indica (Cere)	STM Hulu/ Deli Serdang	180 / 170	1,0 – 1,5	500- 1000
(BM03)	SiPote/ Japonica	Bintang Bayu/ Serdang Bedagai	160 / 165	1,5 – 2,0	500- 1000
(BM04)	SiPala/ Indica (Cere)	Raya/Simalungun	180 / 170	2,0 – 2,5	500- 1000
(BM05)	SiGambiri SM/ Indica (Cere)	Seribu Dolok/ Simalungun	180 /170	2,5 – 3,0	750- 1300
(BM06)	Pagai Gara/ Indica (Cere)	STM Hulu/ Deli Serdang	180 / 170	1,0 – 1,5	500- 1000
(BM07)	SiPenuh/ Indica (Cere)	Barus Jahe/ Tanah Karo	170 / 170	1,5 – 2,0	750- 1000
(BM08)	Belacan TB/ Indica (Cere)	STM Hulu/ Deli Serdang	160 / 170	1,0 – 1,5	500- 1000
(BM09)	SiBuah/ Indica (Cere)	Raya/Simalungun	180 / 170	2,5 – 3,0	500- 1000
(BM 10)	Condong/ Indica (Cere)	Barus Jahe/ Tanah Karo	150 /160	2,0 – 2,5	750- 1000
(BM 11)	Kabanjahe/ Indica (Cere)	Brampu/Dairi	180 / 165	2,5 – 3,0	750- 1200
(BM 12)	SiKembiri/ Indica (Cere)	Dolat Rayat/ Tanah Karo	180 / 175	1,5 – 2,0	750- 1000
(BM 13)	SiLottik/ Indica (Cere)	Marancar/ Tapanuli Selatan	170 / 160	2,5 – 3,0	750- 1300
(BM 14)	SiGambiri GB/ Indica (Cere)	Munte/Tanah Karo	170 / 165	3,5 – 4.0	750- 1500
(BM 15)	Ro'e/ Japonica	Sanayama/ Nias Selatan	155 / 160	2,0 – 3,0	500- 1000
(BM 16)	SiKariting/ Javanica	Simanindo/ Samosir	160 / 165	1,5 – 2,0	750- 1000
(BM 17)	SiGambiri PB/ Indica (Cere)	PakpakBharat/ Pakpak Bharat	165 / 165	3,5 – 4.0	750- 1000
(BM 18)	Eme Najaro/ Indica (Cere)	Bakti Raja/ HumbangHasundutan	155 /160	2,5 – 3,0	750- 1000
(BM 19)	Eme Si Garang2/ Indica (Cere)	Bakti Raja/ Humbang Hasundutan	155 /160	2,5 – 3,0	750- 1000
(BM 20)	SiLabundong/ Indica (Cere)	Padang Sidempuan/ P. Sidempuan	160 / 170	2,5 – 3,0	750- 1200
21. (BM 21)	Si Babimbing/ Indica (Cere)	Sipirok/ Tapanuli Selatan	160 / 170	2,5 – 3,0	750–1200
22. (BM 22)	Sirata/ Indica (Cere)	Kutalimbaru/ Deli Serdang	130 / 140	3,5 – 4.0	500- 1000

Source: Farmer's information and field visits and observation in the field.

From Table 1 it can be explained the exploration results that in the 11 visited districts were obtained 22 local rice cultivars of red rice.Tanah Karo and Deli Serdang districts had the largest number and varieties of upland red rice, followed by Simalungun compared to other districts, especially in the area around medium to high altitude, where until now upland red rice cultivation still maintained for generations due to local culture.These 11 District (1) Deli Serdang); (2) Tanah Karo; (3) Serdang Bedagai; (4) Simalungun; (5) Dairi; (6) Pakpak Bharat; (7) Samosir; (8) Humbang Hasundutan; (9) Nias Selatan; (10) Tapanuli Selatan; and (11 Padang Sidempuan, planting areas were situated in different ecosystems with varying altitudes from medium to high plains with flat, uneven to hilly topography. (Figure 1).

From the literature data obtained local varieties (accessions) both in ICRR (BB Padi) and BB Biogen that the collection of rice plants in general in North Sumatra including upland rice as much as 175, while the collection of rice crops in general in Indonesia including 750 (BB Biogen) gogo rice; 29 varieties of upland rice, and there are 1729 local rice including 37 from North Sumatra (ICRR, 2015), but not yet explored more related to location or area (village name), lowland, medium or high land location, and type of wetland rice , rain-fed, or gogo. For that still needed exploration activities of local rice cultivars in and subsequently carried out conservation activities and collection of local varieties, Meanwhile, the potential for development of upland rice in North Sumatra is mostly located in the highlands (> 800 m asl). In 2011, based on the temporary figures (Asem), the area of upland rice harvest has reached 52,401 hectares with the production amount of 161,279 tons. Of this area, 77% (40,419 ha) are in the highlands and spread in Simalungun regency (14,708 ha), Dairi (9,056 ha), Tanah Karo (8,793 ha), North Tapanuli (3,744 ha), Pakpak Bharat (3,465 ha), Humbanghas (529 ha), and Toba Samosir area of 124 ha (Sumatera Dalam Angka, 2011), while in the lowlands, farmers no longer plant upland rice as many turn to other more profitable commodities such as oil palm. The farming or cultivation system was still relatively simple and upland rice was planted as intercropping plants with some annual crops such as rubber, palm oil, and coffee. Its also intercropped with horticultural plants, such as bananas, and oranges. Then the planting sites were always altered depend on the condition of the land or could be said as shifting cultivation.

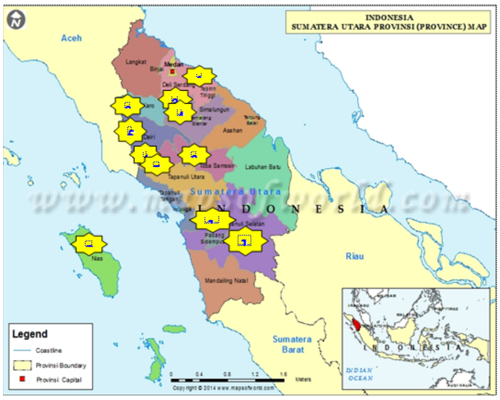

Figure 1: North Sumatra Map (Location of Distribution Upland red rice).

From this data it can be seen that the cultivation of upland rice was still an unimportant crop, although it generally proven to have high adaptation and tolerance to pests and diseases while the land was still available. This was because the field priority of farmers to plant rice, which they would choose irrigated rice fields first, followed by rainfed lowland (gogo rancah), and the last option was dry land for upland rice cultivation.

For farmers who did not have wetland or where rice field was limited, then dry land was chosen to cultivate upland rice. In the other words, the cultivation of upland rice was more directed by the interests to fulfill farmers household consumption.

Harvest age was long (>145 days), ranging from 150.00 to 180.00 days after seed (DAS), and production was still low to moderate (1.0 - 3.5 t / ha). All of harvest ages of cultivars could be categorized in the age of the deep category. This age of harvest could be affected by the altitude of the place and climatic conditions. This was because the collection area was situated on medium to highland which was above 400 m-asl.

Low productivity of lowland rice was mainly caused by environmental stresses, both biotic and abiotic (Hairmansis, *et al*., 2015), varying climatic and soil conditions, the application of cultivation technology that had not been optimum, especially in the use of improved varieties, fertilization and blast disease control (Toha, 2005). The higher the place was planted, the appearance of harvest age would tend to be longer than the plants grown on the lowlands. Farmers tent to choose high potentially yielding cultivars, and moderate to low plant height characters. This was done by farmers to avoid the risk of crop failure due to lodging in the rainy season.

Low temperatures in the highlands could inhibit the growth of seedlings and saplings, causing leaf discoloration (yellowing leaves), slow down the flowering time, exerted abnormal panicles, increased panicle sterility, irregular tassel maturation, which resulted to declining of production. The productivity of upland rice were lower primarily due to climatic and soil conditions varations, unoptimal cultivation technology, especially in the use of high yielding varieties, fertilizing and controlling blast disease (Toha, 2005), also due to various environmental stress both biotic and abiotic (Hairmansis, *et al*., 2015). In addition, the decline in production was also caused by the sloping increase in the potential yield of existing rice cultivars. This was due to the narrowness of the genetic diversity of existing rice cultivars as a result of releasing many rice cultivars that were related one to each other. This caused the existence of local rice both wetland and upland rice, currently increasingly abandoned farmers and threatened extinction (Toha, 2005).

North Sumatra Province had local varieties of upland rice which was very popular as consumer products. Local varieties were in fact a major provider of rice in upland area of Bukit Barisan, North Sumatra. Although there had been a lot of upland rice varieties released by the Government, but no one had been able to adapt well in the highlands. High yielding varieties that had been released, such as Situ Patenggang, Towuti, Situ Bagendit, Batu Tegi, and Limboto that had relatively high yield potential (> 3.5 t/ha), but the level of adaptation was still limited appropriate only in the lowlands (< 500 mdpl) (Toha, 2006; Yusuf, 2009).

In general, farmers cultivated local varieties (Sunjaya, 2011) that tasted good, tolerant of marginal land, resistant to some kinds of pests and diseases, requiring low fertilizer inputs as well as easy and simple cultivation. However, it had low productivity (Ahadiyat, 2011). Then, the development of upland rice planting should consider soil conservation, productivity levels, taste, also the resistance to pests and diseases through modeling approaches of integrated crop management and resource (ICM) in the area of specific locations, to achieve food security and sustainable agricultural systems (Toha, 2005).

From the results of rejuvenation and observation of morphological character of upland rice from 11 regencies were obtained 22 cultivars of local red rice from North Sumatera. From the observations both in the field and initial studies, could be obtained morphological characters and component resulted in Figure 2.

Figure 2: The Raising of Rice Cultivars of Upland Red Rice of North Sumatra.

From the Figure 2 above, there were several variations of 19 cultivars of upland red rice from 11 districts which were grown for further rejuvenation. Characterization of all important morphological and agronomic properties of GR exploration results was carried out on several morphological characters and agronomic characters (yield component) by IRRI standard, IBPGR (1980).

Base on morphological character (phenotypic data) of 22 local red rice cultivars, there were variations of each cultivar as follows: Plant height was high > 125 cm (score 7). Productive tillers was classified as little < 10 (score 3) ranging from 5,78 - 9,78 tillers. Long panicle was medium with score 20 - 30 cm to long (31 - 40 cm) rangimg from 21.7 - 35 cm.

3.2 Collection Field Visit Character of Grain Morphology

3.2.1 Qualitative Character

From the exploration result in 11 regencies, 22 local rice cultivars of red upland rice from north sumatra were obtained. Observations both in the field and by conducting initial studies then could be obtained some characters, both morphological and anatomical characters. Morphological and anatomical characteristics of 19 local upland red rice cultivars are presented in figures 3 and 4.

Based on the observations obtained, the longest length of red rice grains are genotypes bm 01 and bm 06, while the shortest is genotype bm 15. Irri and warda (2007) divide the length of grain in three classes, ie short (<7.5 mm), medium (7.5-12 mm), and long (> 12 mm). Based on the classification of irri and warda (2007), we obtained short, medium and long red rice genotypes.

The result of qualitative observation on red rice grain showed the variation between each genotype. Grain of red rice both unhulled and hulled had varying surface and shape colors (figure 3). Based on the observation on the qualitative character, the color of the grain surface was generally colored yellow straw, brownish, and brownish red. According to irri and warda (2007), the colors of the grain surface were quite diverse, ie brownish yellow, brownish white, brownish orange, light brown, brownish red, and greenish brown.

Similarly, there are also variations on the color of the seed (caryopsis). Namely red, pink, blackish-red rice. According to indrasari (2006), different rice colors were genetically regulated, due to differences in genes that regulate aleuron color, endosperm color, and starch composition in endosperm.

The shape of rice also showed variations, which were round, semi-round, and oval. Most of the red rice form found to be oval followed by a semi-spherical shape and the smallest was round.

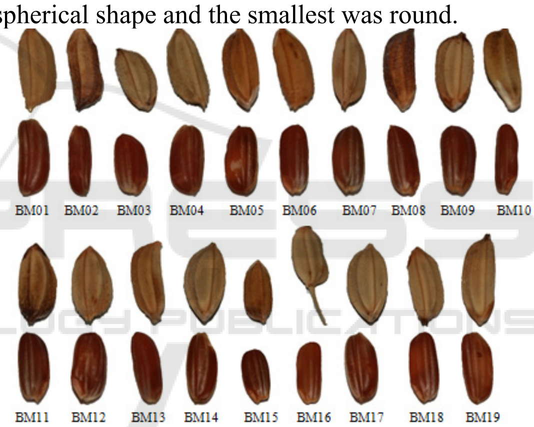

Figure 3: Grain and rice husked rice from the North Sumatra red rice.

Note:

Colourof Lemma and Palea	20	Yellow Straw	**Colour of Caryopsis**	1	Pink
	52	Brown (tawny)		2	Dark Red
	53	Brown spots		3	Red Black
	54	Brown furrows		4	Black
	80	Purple			
	100	Black			
Shape of Caryopsis	1	Round	2 Semi of Round	3	Oval

The result of qualitative observation on red rice grain showed the variation between each genotype. Grain of red rice both unhulled and hulled had varying surface and shape colors (table 3 and figure 3). Based on the observation on qualitative character, the colors of the grain surface were generally yellow straw, brownish, dark red, and red black according to irri and warda (2007), the colors of the grain surface were quite diverse, namely brownish yellow, brownish white, brownish orange, light brown, brownish red, and greenish brown. According to putra *et al.* (2010), the colors of the grain surface were quite diverse, namely brownish yellow, brownish white, brownish orange, light brown, brownish red, and greenish brown.

Likewise there were also variations considering the colors of the seed (caryopsis). Most of the hulled grains were dark red, pink, and blackish red. According to indrasari (2006), different hulled grains colors were genetically regulated, due to differences in genes that regulate aleuron color, color of endosperm, and starch composition in endosperm the shape of hulled grains also showed variations, namely round, semi-round, and oval. Most of the hulled rice grains forms found to be oval, followed by semi-spherical, and the smallest is round.

3.2.2 Quantitative Character

The results of observation of the quantitative character of upland red rice grain can be seen in table 2.

Table 2: The quantitative character of upland red rice grain.

N	Cultivar Genotype	Observation of Grain (G) and Rice (R) (Long (L), Width (W) Thick (T) = mm); Weight = g)						
		L (G)	W (G)	T (G)	L (R)	W	T (R)	Weight 100 (g)
1	1	8.66	2.28	1.66	8.64	2.24	1.63	2.72
2	2	8.75	2.02	1.54	8.73	2.00	1.52	2.42
3	3	7.05	2.39	1.62	6.72	2.22	1.69	1.69
4	4	9.00	2.35	1.62	8.99	2.33	1.60	2.10
5	5	7.96	2.91	1.89	7.91	2.87	1.88	3.34
6	6	8.71	2.18	1.64	8.67	2.16	1.62	2.42
7	7	8.09	2.78	1.93	8.03	2.78	1.92	3.23
8	8	8.85	1.97	1.57	8.86	1.95	1.57	2.43
9	9	7.21	2.25	1.61	7.19	2.23	1.59	2.27
10	10	9.14	2.21	**1.53**	9.13	2.19	**1.51**	2.62
11	11	7.75	2.69	1.77	7.73	2.67	1.74	2.75
12	12	7.77	2.74	2.02	7.76	2.72	2.00	3.32
13	13	8.55	**1.85**	1.54	8.53	**1.83**	1.52	2.33
14	14	7.19	2.85	1.92	7.15	2.85	1.89	2.68
15	15	**6.72**	2.41	1.68	**6.70**	2.38	1.66	**1.66**
16	16	9.36	2.23	1.80	9.33	2.21	1.77	2.36
17	17	7.61	**2.96**	**2.17**	7.58	**2.94**	**2.08**	2.66
18	18	9.34	2.37	1.75	9.31	2.34	1.73	**3.46**
19	19	**9.60**	2.26	1.65	**9.57**	2.24	1.62	2.77
	Average	**8.28**	**2.40**	**1.73**	**8.24**	**2.38**	**1.71**	**2.59**
	Ragam	**0.76**	**0.11**	**0.03**	**0.81**	**0.11**	**0.03**	**0.25**
	SD	**0.87**	**0.33**	**0.18**	**0.90**	**0.33**	**0.17**	**0.50**
	2.SD	**1.74**	**0.65**	**0.36**	**1.80**	**0.66**	**0.34**	**1.01**
	Variabil	**Narrow**	**Narro**	**Narro w**	**Narro**	**Narro**	**Narrow**	**Narrow**

In general, there was a difference in the characteristics of each of the red rice genotypes. The observation of quantitative variables on grain showed that the length of grain ranged from 6.72 - 9.60 mm. The width of grain ranged from 1.85 - 2.96 mm. Grain thickness ranged from 1.53 - 2.17 mm. The weight of 100 grain seeds ranged from 1.66 to 3.46 g.

Based on observations obtained in table 2., the longest length of red rice grass was silabundong genotype (9,60 mm), while the shortest was ro'e genotype (6,72 mm). Irri and warda (2007) divided the length of grain in three classes, ie short (<7.5 mm), medium (7.5-12 mm), and length (> 12 mm). Based on the classification of irri and warda (2007), we obtained 1 short size red rice genotype while the remaining were classified as medium size.

Shape of grain form started from oval, round, and semi of round, brown grain color (brown), brown spots, and brown stripes. The color of the seeds of the 19 existing cultivars can be seen on the characterization of grain (lemma/palea and seeds (caryopsis) in figure 2.

3.2.3 Results of Cluster Analysis based on Grain Morphology

Dendogram of grouping results based on genotype is shown in figure 4.

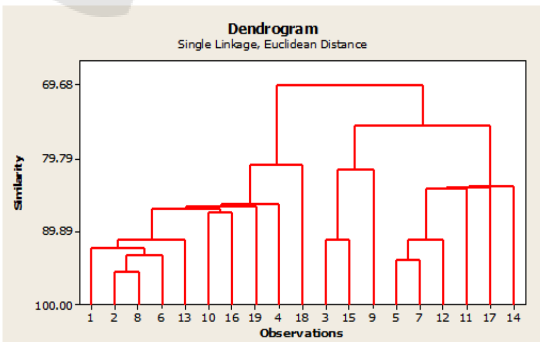

Figure 4: Dendogram grouping based on grain morphology.

Based on the clustering of red rice genotypes grouping at 79.79% similarity, the upland red rice genotypes were grouped into three groups. The first group consisted of 10 genotypes. The second group consisted of 3 genotypes. The third group consisted of 6 genotypes.

The close relationship of kinship can be seen from the percentage of similarity. The size of the percentage of similarity is influenced by the extent or narrowness of diversity (variability). According to Winarti (2005), generally a high level of variability of morphological characters would complicate the limitation of taxon under the type.

Figure 4 shows the level of kinship of each red rice genotype in North Sumatera Province. The level of kinship should be known to facilitate breeders in producing new varieties that have a wide or narrow diversity through crosses. To produce varieties with a narrow diversity varieties are used that close kinship level, while to produce a wide level of diversity crossing of varieties that have A distant kinship level. The further the kinship relationship, the recombinant will be more diverse. Winarti (2005) states that to determine the proximity of kinship relationships between plant taxon can be done by determining the similarity between plant taxon using morphological properties because morphological properties can be used to recognize and describe kinship of type. In the characterization activities that had been done could be known the character of each cultivar to be used and developed in plant breeding activities in accordance with the purpose of superior varieties which wanted to be assembled. Given this variation, further selection activities could be performed because the selection would be successful if the plant populations that would be selected had variations or diversity.

4 CONCLUSIONS AND SUGGESTIONS

We hope you find the information in this template useful in the preparation of your submission.

4.1 Conclusions

Germplasm exploration / conservation plays an important role in avoiding the extinction of local / wild rice species due to the rapid growth of modern high yielding varieties, the opening of new land, the transition of rice cultivation to other crops, and the development of settlements.

1. Results of exploration in 11 districts obtained 22 local rice genotypes of red rice in North Sumatra. Meanwhile, the potential development of upland rice in North Sumatra are mostly located in the highlands (> 700 mdpl).
2. Grain morphology characterization results indicated the variations on quantitative and qualitative characters. The widest level of diversity was obtained from the long feather characters. Correlation analysis results showed the correlation between some variables of morphology of grain and caryopsis.
3. Based on the morphological character of grain at the similarity level of 79.79%, the rice genotypes of North Sumatran red rice could be grouped into three groups.
4. The efforts of genetic improvement of upland red rice are currently being implemented for Sigambiri Merah varieties through induce mutations.

4.2 Suggestion

Undertake field days for farmers in understanding the farm system in implementing the specific commodity upland rice in particular locations.

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