The Growth Characteristics of Some Varieties of Aceh's Local Rice (*Oriza sativa* L.) on Acid Soils

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Abstract

To identify the agronomic and morphological characteristic of some local rice varieties in Aceh, to describe based on the classifications of rice and to observe the varieties resistant to soil acidity, it was needed to conduct a study of 18 Aceh's local rice varieties and one "Dupa" variety as a comparison. The results showed that there were 6 local varieties of Aceh tolerant to Al toxicity and 12 were somewhat tolerant varieties, as well as varieties had tolerant nature to "Dupa". There were differences in flowering age, counted from planting rice to grew panicle by 10%. This age difference could be grouped into three, namely: age of flowering under 100 days was found in 2 varieties, age of flowering ranged from 100 to 119 days was found in 12 varieties (including Dupa), while flowering more than 120 days was found in 5 varieties. There were 15 varieties of rice belonging to the class Indica and 4 varieties in Javanica group. The largest stem diameter by Sigupai Wangi variety and smallest by Pade Cut Kresek variety. Longest panicle varieties belonged to Pade Rangan and shortest Sigupai Nagan Raya. There were 14 varieties which did not possess grain hair-tip, while shortest grain hair-tip by 4 varieties and 1 varieties of grain had long hair-tip. The widest seed variety was found in Dupa and the smallest was from Pade Cut Kresek. The thick seed was Dupa variety and the thinnest was Ramos Tihion. Based on length, the longest seed character was found in 17 varieties and other 2 variety was just long.

Keywords: characteristics, variety, local Aceh's rice, acid soils

Introduction

Rice is a strategic commodity plays an important role in the economy and national food security and become a major base in the revitalization of agriculture in the future. About 95% of national rice production depends on the production of rice paddies and only 5% of upland rice. Increased productivity of rice reached only 0.40% per year while the land use field reaches 0.77% per year (Puslitbangtan, 2007).

Expansion of the current wetland is difficult because suitable land for new rice fields are very limited, the cost of irrigation system development and printing of new rice fields are very expensive. Alternative increase rice production can be done by the expansion of upland rice cropping on dry land. Dry land area reached 54.4 million ha, but the 45.8 million ha of land of which is acid (BPS, 2007), and 11 million hectares more of them has the potential to be developed as upland rice cropping land (Puslitbangtan, 2007). However, the development of upland rice on dry land faced with the problem of Al toxicity and nutrient deficiency phosphate appearing simultaneously on acid soils of land (Kochian *et al.,* 2004). Liming and P fertilization are used to overcome these problems, but this way is not economical for areas that are far from sources of lime, not a good means of transportation, the availability of P fertilizers is often not continuous and expensive. It would require the development of varieties that grace Al and efficient in the use of P.

Aceh is a province in Indonesia rich in diversity of rice local varieties, which needs to be preserved and utilized for sustainable development in order to improve the welfare of all people.

Characterization of genetic resources will provide added value in enriching the "gene pool", the new diversity of local varieties is useful for the assembly of new varieties (Neereja *et al.,* 2005). These genetic resources continue to decline due to lack of attention, their utilization, and the changes in traditional farming practices. Introduction of high yielding varieties called genjah to rice production centers in various regions may cause genetic erosion of local varieties existing in certain areas (Mishra *et al.,* 2009). The existence of genetic erosion due to modern farming practices led to increasingly felt the importance of germplasm collection and conservation. To anticipate the erosion of plant genes, it is necessary to preserve the plant genetic material through exploration, characterization, and documentation (Hanarida *et al.,* 2005). Genetic diversity can be determined through characterization and identification. Improved varieties can be done either through conventional breeding or modern breeding program utilizing biotechnology assemblies germplasm using seeds from existing genetic resources. Each variety has certain important characteristics which can be used for crossing among varieties (Liu *et al.,* 2007). Aceh local rice varieties are still widely used by farmers in many districts in Aceh, but in relatively small quantities. Until now, local rice germplasm has not been characterized and evaluated, therefore, this requires the identification, conservation and classification which are useful for the in breeding programs and serve for the protection of local plant varieties (Menkumham, 2000; Bhuyan *et al.* 2007; Silitonga, 2008).

This study aimed to identify the agronomic properties and morphology of 18 local rice varieties in Aceh, based on the classification of rice varieties and to observe their resistant to soil acidity.

Materials and Methods

The research was conducted at the Garden Experiments Faculty of Agriculture, University of Syiah Kuala Banda Aceh from January to June 2010. Rice seeds were 18 local varieties (varieties Ramos Merah, Rom Mokot, Sigupai Wangi, Sigupai Nagan Raya, Sambei, Rasi Singke, Kepala Gajah Kinco, Bo Padang, Rasi Kuneng, Pade Mangat Bu, Bo Santeut, Ramos Tihion, Pade Cut Kresek, Pade Pineung, Cantek Puteh, Itam Tangke, Pade Rangan, Sigupai Blang Pidie), obtained from farmers from several districts of Aceh, and a control varieties of varieties of Incense originally from stone Estuary Borneo leaf blast-resistant and tolerant to Al toxicity.

The research was conducted using a randomized block design (RGD), non-factorial with 3 replicates. Treatment of rice varieties (V) consisted of 19 varieties, and 57 units experiment. Each experimental unit consisted of four plants, so that overall there were 228 units observation. Soils used were soil type ultisol (pH 4.35) at 950 kg obtained from Jantho Aceh Besar district. The soil weight was 8 kg/bucket. Fertilizers used were Urea, KCl, and SP 36 at 2 kg of each. Seeds were germination on paper soaked in water to thei field capacity, then left for 5 days. Each bucket consisted of four seedlings of rice plants. A seeding was planted in each planting hole. Furadan at 0.5 g/bucket was applied to soil surface in each bucket. Urea, SP 36 and KCl at 1 g / bucket of each were given one day before planting. At 15 DAT urea at 1 g/bucket were applied, at 45 DAT Urea and KCl were again applied at 1 g / bucket. At 55 DAT Urea applied at 1 g/bucket. Plant maintenance is carried out by watering, weeding, as well as controlling pest and disease.

The characters observed were agronomic trait (plant height and number of tillers per hill at the age of 30, 45 and 60 DAT, level of tolerance, and the age of flowering) and morphology (diameter of the stem segment below, panicle length, feather edge grain, seed width, seed thickness, and length of seed). The data were described based on Characterization and Evaluation System Guide Rice with scoring for each character observed (Deptan, 2003). Data were calculated for the relative values (RV) to determine differences in plant height and number of tillers of the soil acidity. Grouping level of tolerance to soil acidity was based on the criteria modified from Sarkarung (1986) then grouped to tolerant (when the value of RV was greater than 75%), somewhat tolerant

(when the value of RV was between 50 to 74%), sensitive (when the value of RV was less than 50%).

$$\text{The relative value (RV) (\%)} = \frac{\text{Plant height or number of pups at acid conditions}}{\text{Plant height or number of pups at normal conditions}} \times 100\%$$

Results and Discussion

Agronomic characteristic

The results showed that rice varieties significantly affected the relative values for plant height at 30 DAT, but not at 45 and 60 DAT (data not showed). The relative value of number of tillers per hill of rice plants was not significantly different at 30, 45, and 60 DAT (data not showed). The Aceh local rice varieties Sigupai Nagan Raya (V4) and Cantek Manis (V15) were taller than other local varieties such as Dupa (V19) variety. The shortest rice plant varieties was Red Ramos (V1). The plants high in rice plants had a positive and negative values on the cultivation system. The tall rice plants can be used as an elder male in producing hybrid seed. Tall rice plants will be more easily to spread its pollen to the shorter one (female elders). Hybrid rice production needa the stud taller than 20 cm for the elder females. However, tall rice plants are susceptible to fall down (Samac and Tasfaye, 2003).

Grouping of local rice varieties tolerant to acid soil in Aceh was based on the relative value (RV). According to Sarkarung (1986), local rice in Aceh produces 6 varieties having a relative value of more than 75% (tolerance type), and 12 varieties having a relative value between 50-74% (somewhat tolerant type) similar to the control Dupa tolerant nature (Table 1). Varieties tolerant to high acid soil may also tolerant to stress of Al. This was shown by the relative value of more than 75%. Tolerant plants allegedly had the ability to suppress the adverse influence of Al by reducing the Al^{3+} ion uptake by roots and neutralize toxic Al in the network, so that plant growth is not disturbed (Watanabe and Osaki, 2002; Sopandie *et al.,* 2003). Variations in the nature of resistance 18 local varieties of Aceh on Al toxicity in this study presumably because the genes resistant to Al toxicity did not work together (Nguyen *et al.,* 2002).

Age of flowering plants in Aceh local rice was varied. Sambei (V5) and Rom Mokot varieties (V2) were flowering under 100 days. Varieties flowerring at 100-119 days were 11 varieties, including control variety Dupa (V19), varieties flowerring at more than 120 days were 5 varieties (Table 1).

Morphological characteristic

The results showed that local rice varieties based on morphological characters of rice were grouped in two, namely the Indica and Javanica groups. There were 15 varieties *Indica* type, and 4 varieties of *Javanica*. Indica rice (paddy cere) had several characteristics of : having a lot of roots, smooth leaf surfaces, long panicle, litle hair on the the surface of the grain, no tail on the end grain, slender grain shape, grain size was small to moderate and harvest age was faster. Characteristics of the group Javanica rice (paddy fur) were : the number of tillers was less, leaves had a rough surface, long panicle, hairy grain surface, a tail on the end grain, medium to large grain size and the age old crop (Grubben and Partohardjono, 1996).

The largest diameter stem segment was found in Sigupai Wangi (V3), while the smallest diameter of the rod segment was found in Pade Cut Kresek variety (V13) (Table 2). The longest panicle variety was found in Pade Rangan (V17) and the shortest panicle variety was found in Nagan Raya Sigupai (V4) (Table 2). According to the AAK (1990), panicle length is divided into three different sizes which are short panicle (less than 20 cm), medium panicle (20-30 cm), and long panicle (more than 30 cm).

Table 1. Grouping of local rice varieties for tolerance to soil acidity based on the relative value (NL) and by age of flowering

Varieties of rice	Relative value (%)	Criteria	Flowers age
V1 (Ramos Merah)	66,40	somewhat tolerant	113
V2 (Rom Mokot)	75,52	Tolerant	98
V3 (Sigupai Wangi)	65,71	somewhat tolerant	112
V4 (Sigupai Nagan Raya)	79,53	Tolerant	112
V5 (Sambei)	72,75	somewhat tolerant	96
V6 (Rasi Singke)	68,09	somewhat tolerant	120
V7 (Kepala Gajah Kinco)	72,44	somewhat tolerant	130
V8 (Bo Padang)	77,37	Tolerant	130
V9 (Rasi Kuneng)	68,69	somewhat tolerant	130
V10 (Pade Mangat Bu)	73,43	somewhat tolerant	120
V11 (Bo Santeut)	74,98	somewhat tolerant	101
V12 (Ramos Tihion)	73,03	somewhat tolerant	112
V13 (Pade Cut Kresek)	69,19	somewhat tolerant	115
V14 (Pade Pineung)	77,00	Tolerant	110
V15 (Cantek Puteh)	75,23	Tolerant	101
V 16 (Itam Tangke)	75,06	Tolerant	119
V17 (Pade Rangan)	65,54	somewhat tolerant	115
V18 (Sigupai Blang Pidie)	70,71	somewhat tolerant	116
V 19 (Dupa)	77,21	Tolerant	100

Table 2. Classification of rice based on morphological characters, diameter of rod segment and panicle length of rice plants

Varieties of rice	Group	Diameter of rod segments (cm)	Length of panicle (cm)
V1 (Ramos Merah)	*Indica*	0.51	24.03
V2 (Rom Mokot)	*Indica*	0.53	23.50
V3 (Sigupai Wangi)	*Indica*	0.91	20.65
V4 (Sigupai Nagan Raya)	*Indica*	0.58	18.85
V5 (Sambei)	*Indica*	0.55	23.28
V6 (Rasi Singke)	*Indica*	0.55	29.70
V7 (Kepala Gajah Kinco)	*Indica*	0.59	24.03
V8 (Bo Padang)	*Javanica*	0.61	24.23
V9 (Rasi Kuneng)	*Javanica*	0.70	30.17
V10 (Pade Mangat Bu)	*Indica*	0.43	24.63
V11 (Bo Santeut)	*Javanica*	0.52	28.85
V12 (Ramos Tihion)	*Indica*	0.61	26.50
V13 (Pade Cut Kresek)	*Indica*	0.42	21.75
V14 (Pade Pineung)	*Indica*	0.53	29.65
V15 (Cantek Puteh)	*Indica*	0.50	24.50
V 16 (Itam Tangke)	*Javanica*	0.54	20.18
V17 (Pade Rangan)	*Indica*	0.60	34.88
V18 (Sigupai Blang Pidie)	*Indica*	0.50	23.78
V 19 (Dupa)	*Indica*	0.60	21.68

Grain hair-tip was not found in 13 local rice varieties and the control Dupa (V19). Four varieties had short grain hair-tip and some furry at Rasi Singke (V6), Bo Padang (V8), Rasi Kuneng (V9) and Itam Tangke (V16), while Bo santeut (V11) varieties had a long grain hair-tip and all furry (Table 3).

Differences in width and thickness of seeds in each variety are presented in Table 3. Control varieties (V19) had the widest seed, meanwhile the Pade Cut Kresek varieties (V13) was the slimmest variety. Varieties of Dupa (V19) also had the thickest seeds and variety Ramos Tihion (V12) was a thin variety. Character of the length scale 1 (seed longer than 7:50 mm) was found at 17 varieties, including varieties of Dupa (V19). Character length scale 2, (seed length of 6.61-7.50 mm) was found in Singke Rasi variety (V6) and Itam Tangke (V16).

A number of rice varieties characteristic were difficult to distinguish. Abdullah *et al.,* (2006) stated that the differences will affect the nature of plant varieties. Each plant has the characteristics for special properties that may differ from each other, so it will show the diversity of characters. According to Lesmana *et al.,* (2004) morphological features often used to distinguish varieties of rice are plant height, stem color, leaf color, leaf surfaces, grain shape, grain color and grain surfaces. The character of grain morphology on the presence of feathers covering the tip of grain, seed thickness, seed width and seed length. According Aldair *et al.,* (1966) *in* Grist (1986), grain shape consisting of three kinds, namely rounded, medium and lean. In addition, the inflorescence characters can distinguish rice varieties (Wet *et al.,* 1986).

Table 3. The presence of feather tip of grain, seeds character width, thickness and length of seed grain Aceh local

Varieties of rice	The presence of grain hair- tip	Width seeds (mm)	The thickness of the seeds (mm)	Length of seeds
V1 (Ramos Merah)	Lint	2.10	1.50	Very long
V2 (Rom Mokot)	Lint	3.00	2.00	Very long
V3 (Sigupai Wangi)	Lint	2.10	1.90	Very long
V4 (Sigupai Nagan Raya)	Lint	2.10	1.90	Very long
V5 (Sambei)	Lint	2.70	2.00	Very long
V6 (Rasi Singke)	Short and partly feathered	2.49	1.79	Long
V7 (Kepala Gajah Kinco)	Lint	3.04	2.00	Very long
V8 (Bo Padang)	Short and partly feathered	2.15	1.68	Very long
V9 (Rasi Kuneng)	Short and partly feathered	2.70	2.00	Very long
V10 (Pade Mangat Bu)	Lint	2.15	1.92	Very long
V11 (Bo Santeut)	Length and all hairy	2.10	2.00	Very long
V12 (Ramos Tihion)	Lint	2.06	1.50	Very long
V13 (Pade Cut Kresek)	Lint	1.90	1.52	Very long
V14 (Pade Pineung)	Lint	2.90	2.00	Very long
V15 (Cantek Puteh)	Lint	2.50	1.90	Very long
V 16 (Itam Tangke)	Short and partly feathered	2.20	1.79	Long
V17 (Pade Rangan)	Lint	4.10	2.00	Very long
V18 (Sigupai Blang Pidie)	Lint	2.20	1.88	Very long
V 19 (Dupa)	Lint	4.50	2.10	Very long

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