# Rejuvenation and Characterization of Local Rice Germplasm (*Orya sativa* L.) Under Organic Cultivation System

[1*]Efendi, [1]Bakhtiar, [1]Sabaruddin Zakaria, and [1]Syafruddin

Laboratory of Genetics and Plant Breeding, Department of Agrotechnology, Faculty of Agriculture, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia
**Corresponding Author*: efendi123@unsyiah.ac.id

**Abstract**
The research was carried out to rejuvenate and evaluate the performances of plant characters of rice genotyps to produce a pure lines that are suitable for organic cultivation method. Thirty genotypes of the selected local rice were conducted to evaluate the phenotype performances under the organic cultivation method. The rice genotypes were utilized in this experiment to evaluate their morpho-agronomic characters under organic cultivation system. Characterization of seed performances of each accession was described and catalogued to identify their accession traits. In addition, genotypic differences and similarities were also characterized and catalogued. Duplicate accessions were eliminated from the same variety or nearly identical variants of a variety. The morpho-agronomic performances of plant height, number of tillers, lifespan, number of panicles, filled grains per spike, 1000 grains weight, grain yield potential, and harvest index were clearly affected by the genotype. The results showed that the genotypes were greatly varied the morpho-agronomic performances. , if organic system was applied, it was found that the responses of rice growth and yield of local varieties of Aceh is better than rice varieties cultivated by the national and introduction genotype.
**Key words:** rice, genotypes, organic, germplasm, rejuvenation

## Introduction

Recently, agriculture production has since been affected by climate changes as well. LAPAN analyzed that the daily temperature has been increasing as the highest point in Aceh is located at the northwestern tip of the Sumatera island (Sipayung, 2007). During the period of a hundred year observations from 1900, the surface temperature increases to about 1.9°C. The drought stress and high temperature are becoming two of the significant abiotic stresses limiting plant growth and productivity (IPCC, 2007). Hence, the impacts of global warming of this province become a more serious problem for ensuring food security. Adaptation efforts such as plant breeding for tolerance to abiotic stress must be studied for the exploitation of adaptive genotypes. Characterization of rice collections for identification is very important to exploit the genetic diversity within rice germplasm.

Studies showed that some morpho-agronomic traits, as well as reaction to abiotic stresses, that are known to be in the individual accessions increase the importance of the germplasm (Golam *et al.*, 2011; El-Hendawy *et al.*, 2012; Boriboonkaset *et al.*, 2012). The performance leads to a more efficient use of germplasm in the collection. There is a wide genetic variability available in rice among and between landraces leaving a wide scope for future crop improvement to be efficient. The appropriate methods in the genetic improvement become effecient (Rahman *et al.*, 2009). Lately it was to characterize the performances of morpho-agronomic characters of rice landraces in developing new varieties that are adaptable to climate change and suitable for the organic SRI method. Sixteen genotypes of the selected local rice were treated to evaluate the phenotypes under the organic cultivation method (Efendi *et al.*, 2015). In this research, it was continued to evaluate the morpho-agronomic of different local rice germplasm that could be used for developing a new varieties that are adaptable to climate change.

## Materials and Methods

### *Characterization of rice genotypes*

Thirty samples of local rice varieties were collected from the Aceh province of Indonesia. The samples were analyzed and characterize for seed performances. In detail, genotypic differences and similarities were also characterized and catalogued. Duplicate accessions were eliminated from the same variety or nearly identical variants of a variety. The genotypes of the remaining samples were utilized in this experiment to evaluate their plant characters under organic cultivation system. The sixteen genotypes used in this research are: *Acong*, *Babulon*, *Bo Padang*, *Boh Santeut*, *Boh Sireutoh*, *Cut Krusek*, *Lamno 4, Mayam U, Pade Barcelona, Pade Mas, Pade Pangku, Pade Pe 66, Pandrah, Ramos Tihion, Rom Ilang, Rom Mokot, Rongan Lango, Salah Mayang Ru, Sanbei, Semere, Sepuluo, Sialek, Sigeudop,* *Sigodok 203, Sigodok 209, Silia, Sipirok, Sirende*. The last two varities, Ciherang (national variety and IRBB-27 (intoduction variety) used as the control genotypes.

***Rejuvenation and evaluation of plant characters***

The rejuvenation was conducted at the Experimental Station, Faculty of Agriculture, University of Syiah Kuala, Banda Aceh, Indonesia from Februray to July, 2015. Rice was planted with oganic system that followed by cultivating plants in pots. Germination of the rice seeds were done into a tray containing natural sandy loam soil with compost. Seedlings of seven days old were uprooted from the nursery trays carefully. Continously, the seedlings were transplanted into the well-puddled experimental pots filled. No chemical fertilizers were applied during both in land preparation and crop establishment. Irrigation was applied by regular irrigation with alternate wetting and drying from transplanting to the maximum tillering stage. The crop of each plot was harvested separately on different dates, when 90% of the grains became golden yellow in color. The principal plant characters that were systematically recorded on the plant and pot basis at different growth stages. The research was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. Rice of thirty genotypes were designed as non-factorial RCBD. The data were statistically analyzed by ANOVA (analysis of variance) technique.

**Results and Discussion**

***Plant height, number of tillers, life cycle, and productive panicles***

The results (Tabel 1) showed significant differences among the rice genotipes for traits related to plant height, number of tillers, life cycle, and productive panicles. The plant performances of rice genotypes clearly referred to a high genetic variation of the local rice. Plant height was significantly affected by the observed genotypes. This result showed that plant height was clearly different among the genotypes. The plant height ranged between 87-205 cm. These results indicated that the identified genotypes of rice have a high genetic variation. Some studies revealed that plant height is affected by a series of nodes and internodes of the genotypes. However, during reproductive growth, the uppermost internodes elongate to exert the panicle above the leaf sheaths (Yoshida and Horie, 2010; El-Hendawy *et al*., 2012). The number of tillers and productive panicles were significantly affected by the genotypes. The number of tillers ranged from 6-42 and productive panicles ranged from 5-30. Smith and Dilday (2003) explained that some cultivars have a maximum tiller number and are also observed to have a termination point for effective tillering. This condition of tiller number relates to the number of panicles at maturity. Thakur *et al*. (2011) proved that significant improvements were observed in number of tillers per hill under an aerobic condition.

***Filled grains per spike, 1000 grains weight***

The yield components were significantly influenced by the genotypes of rice (Table 2). In this study, the highest percentage of filled grains per spike was observed from the genotype of Pade Pe-66. Tuyen and Prasad (2008) explained that the difference of yield parameters among rice genotypes varied among all morphological traits. The results of grains weight also showed a phenotype variation in grains weight of the observed rice landraces (Table 2). This study found that 1000 grains weight of the rice genotypes was significantly different among the genotypes. Sarwar *et al*. (2012) found that there are significant differences regarding the values of morphological characters of rice grains. Grain size is the most important factor which influences the yield of rice quality. The grain has a strong correlation with 1000-grain weight.

Table 1. The average of plant height, number of tillers, life cycle, productive panicles that effected by the different of rice genotypes

| Genotypes | Plant Height (cm) | Number of tillers | Life cycle (days) | Productive panicles |
|---|---|---|---|---|
| Acong | 96 | 9 | 127 | 9 |
| Babulon | 87 | 18 | 119 | 17 |
| Bo Padang | 103.5 | 11 | 114 | 7 |
| Boh Santeut | 86.5 | 23 | 121 | 15 |
| Boh Sireutoh | 93 | 22 | 121 | 17 |
| Ciherang | 90 | 11 | 101 | 8 |
| Cut Krusek | 119 | 23 | 119 | 22 |
| IRBB27 | 92 | 18 | 105 | 15 |

| | | | | |
|---|---|---|---|---|
| Lamno 4 | 93 | 18 | 117 | 17 |
| Mayam U | 137 | 21 | 114 | 13 |
| Pade Barsilona | 134 | 21 | 119 | 18 |
| Pade Mas | 134 | 11 | 102 | 9 |
| Pade Pangku | 111 | 9 | 119 | 5 |
| Pade Pe 66 | 187 | 13 | 108 | 10 |
| Pandrah | 170 | 6 | 119 | 6 |
| Ramos Tihion | 167 | 10 | 119 | 8 |
| Rom Ilang | 159 | 15 | 114 | 7 |
| Rom Mokot | 169 | 9 | 129 | 9 |
| Rongan Lango | 156 | 42 | 119 | 30 |
| Salah Mayang Ru | 113 | 19 | 129 | 26 |
| Sanbei | 165 | 10 | 120 | 6 |
| Semere | 162 | 10 | 112 | 9 |
| Sepuluo | 139 | 23 | 112 | 15 |
| Sialek | 171 | 13 | 119 | 11 |
| Sigeudop | 151 | 14 | 126 | 11 |
| Sigodok 203 | 183 | 6 | 95 | 6 |
| Sigodok 209 | 129 | 17 | 108 | 17 |
| Silia | 205 | 12 | 119 | 8 |
| Sipirok | 151 | 8 | 111 | 8 |
| Sirende | 151 | 24 | 130 | 18 |

***Grain yield potential and harvest index***

Table 2 shows that genotypes affected grain yield potential and havest index significantly. The highest result of grain yield potential was obtained from the genotype of Rom Ilang. However, the best harvest index was found at genotype of *Pade Pangku*. Mishra and Slokhe (2011) explained that greater root length density and chlorophyll content of the flag leaf and the duration of grain filling affect the yield-contributing parameters in all trials. These relationships can significantly improve rice plant physiological efficiency and, hence, grain yield. In another research, Thakur *et al*. (2011) found that grain yield increased and significant improvements were observed in the morphology of rice plants.

Table 2. The average of filled grains per spike, 1000 grains weight, grain yield potential harvest index that effected by the different of rice genotypes.

| Genotypes | Filled grains per spike (g) | 1000 grains weight (g) | Grain yield potential (ton/ha) | Harvest index (%) |
|---|---|---|---|---|
| Acong | 33.53 | 24 | 5.16 | 66.36 |
| Babulon | 26.66 | 25 | 4.10 | 48.82 |
| Bo Padang | 31.86 | 28 | 4.90 | 62.51 |
| Boh Santeut | 32.55 | 28 | 5.01 | 55.27 |
| Boh Sireutoh | 24.75 | 29 | 3.81 | 39.81 |
| Ciherang | 29.45 | 22 | 4.53 | 59.48 |
| Cut Krusek | 26.56 | 23 | 4.09 | 36.08 |
| IRBB27 | 36.72 | 26 | 5.65 | 49.86 |
| Lamno 4 | 25.34 | 26 | 3.90 | 53.86 |
| Mayam U | 23.22 | 28 | 3.57 | 35.39 |
| Pade Barsilona | 51.4 | 31 | 7.91 | 48.55 |

| | | | | |
|---|---|---|---|---|
| Pade Mas | 37.9 | 26 | 5.83 | 48.48 |
| Pade Pangku | 34.56 | 28 | 5.32 | 69.21 |
| Pade Pe 66 | 43.1 | 23 | 6.63 | 51.75 |
| Pandrah | 33.35 | 17 | 5.13 | 35.81 |
| Ramos Tihion | 36.81 | 33 | 5.66 | 45.03 |
| Rom Ilang | 43.3 | 24 | 6.66 | 64.06 |
| Rom Mokot | 30.19 | 22 | 4.64 | 42.54 |
| Rongan Lango | 31.66 | 18 | 4.87 | 41.46 |
| Salah Mayang Ru | 24.74 | 20 | 3.81 | 23.28 |
| Sanbei | 21.4 | 27 | 3.29 | 29.37 |
| Semere | 32.64 | 19 | 5.02 | 40.15 |
| Sepuluo | 37.53 | 25 | 5.77 | 44.48 |
| Sialek | 36.8 | 20 | 5.66 | 43.04 |
| Sigeudop | 32.03 | 16 | 4.93 | 37.20 |
| Sigodok 203 | 27.2 | 18 | 4.18 | 38.77 |
| Sigodok 209 | 23.1 | 18 | 3.55 | 30.68 |
| Silia | 39.23 | 20 | 6.04 | 32.18 |
| Sipirok | 31.6 | 25 | 4.86 | 41.13 |
| Sirende | 28.41 | 24 | 4.37 | 32.07 |

## Conclussion

The plant characteriation of rice genotypes clearly referred to a high genetic variation of traits related to plant height, number of tillers, productive panicles, heading date, filled grains per spike, 1000 grains weight, grain yield potential, and harvest. *Silia* showed the tallest genotype, while *Rongan Lango* had the highest numbers of tillers number and productive panicles. *Sigodok 203* had the shortest life cycle, while the longest life cycle found at *Sirende* genotype. The genotype of *Pade Barsilona* had the highest grain yield potential. However, the highest harvest index found at *Pade Pangku* genotype.

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