Rusdi-tidal.pdf

by

Submission date: 11-Aug-2019 07:17AM (UTC+0700)
Submission ID: 1159151362
File name: Rusdi-tidal.pdf (1.28M)
Word count: 3591
Character count: 18104

BIODIVERSITAS
Volume 18, Number 4, October 2017
Pages: 1289-1293

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d180401

Short Communication: The genetic diversity and agronomical characters of local cultivars of tidal rice in East Kalimantan, Indonesia

RUSDIANSYAH[1,♥], TJATJUK SUBIONO[1], WIDI SUNARYO[1], ANDI SURYADI[1], SULASTRI[2], SAMID ANJASMARA[1]

[1]Department of Agroecotechnology, Faculty of Agriculture, Universitas Mulawarman. Jl. Pasir Belengkong Samarinda 75119, East Kalimantan, Indonesia. Tel.: +62-541-749343, ♥email: rrida_rusdi@yahoo.co.id
[2]Department of Research and Development, PT. Pupuk Kalimantan Timur. Jl. James Simandjuntak No. 1, Bontang 75313, East Kalimantan, Indonesia

Manuscript received: 8 November 2016. Revision accepted: 1 August 2017.

Abstract. *Rusdiansyah, Subiono T, Sunaryo W, Suryadi A, Sulastri, Anjasmara S. 2017. Short Communication: The genetic diversity and agronomical characters of local cultivars of tidal rice in East Kalimantan, Indonesia. Biodiversitas 18: 1289-1293.* Availability of local rice germplasm is very important for plant breeding, especially in the improvement of the genetic diversity. The objectives of the research were to study the genetic diversity and agronomical characters of local characters of tidal rice in East Kalimantan. The research was conducted from May to October 2014 in the Village of Sidomulyo, Anggana Sub-District, Kutai Kertanegara District, East Kalimantan. The experiment was arranged in a randomized complete block design (RCBD) with five replications. Eight selected local tidal rice cultivars from East Kalimantan (Pandan Ungu, Kambang, Amas, Roti, Pudak, Sikin Merah, Sikin Putih and Popot) were used in this experiment as plant materials. The results showed that there was wide genetic diversity among local tidal-rice cultivars selected from East Kalimantan. Number of productive tillers, the percentage of empty grain per panicle, 1000 grain weight and yield per hectare can be used as selection criteria for local lowland rice cultivars from East Kalimantan because they have a high value of heritability (h^2_{bs}), phenotype and genotype and coefficient of variation (PCV and GCV). Pandan Ungu, Kambang, Amas, Roti and Sikin Merah cultivars potential to be used as parents in the breeding program.

Keywords: Genetic diversity, agronomical characters, local cultivars, lowland rice

INTRODUCTION

Indonesia, known as one of megadiverse countries in the world, has abundant natural germplasm resources. One of them is local rice cultivars i.e paddy rice, upland rice and other wild rice species. Up to 2010, more than 2,797 species of rice germplasm consisting of 1,635 local rice cultivars, 978 introduced varieties and 184 new improved varieties have been successfully collected by Rice Research Institute of Sukamandi, Indonesia (Sitaresmi et al. 2013). However, many of these local rice germplasm have depleted due to genetic erosion leading to the extinction of local rice germplasm. This happened due to the lack of conservation efforts (Hendra et al. 2009). Local rice germplasm is a very important source of genetic diversity in plant breeding programs for supporting national food self-sufficiency especially rice.

East Kalimantan with its tropical rain forest climate has genetic diversity resources of local rice which is abundant with exotic characteristics and high economical value. Many of these local rice germplasm have tasty rice flavors and fragrant aromas. In addition, they resistant to abiotic environmental stresses such as drought, aluminum, iron, sour sulfate and salinity; and also biotic stresses such as blast disease, dwarf grass, and others. Of these local rice germplasm, Rusdiansyah (2012) has successfully explored 13 local cultivars of tidal rice paddy which were cultivated by farmers from generation to generation. Nurhasanah et al. (2016) have also successfully collected 73 local rice cultivars consisting of 53 ordinary rice cultivars and 18 glutinous rice cultivars. The initial selection of 13 local cultivars of upland rice tidal showed that eight cultivars have a high potential candidate to be further characterized their agronomical performances and be used as parents in plant breeding program.

In plant breeding programs, genetic variability is a major factor in the development of improved varieties. Extensive genetic variability allows superior varieties to be fast developed. In order to expand the genetic diversity of rice, some extensive methods have been conducted by plant breeders, i.e., the exploration of local cultivars, artificial mutations, and the utilization of germplasm from other countries (Kuswantoro 2017a). The effectiveness of the selection can be achieved when the selected characters used as target has a high value of genetic diversity (Herawati et al. 2009; Ishak 2012). Extensive or high genetic diversity will also provide flexibility in the selection of superior genetic or the genetic improvement of rice (Saleem et al. 2008; Idris and Mohamed 2013). Therefore, the objective of the study was to study the genetic diversity and the agronomical characters of local cultivars of tidal rice in East Kalimantan.

MATERIALS AND METHODS

The study was conducted from May to October 2014 in the tidal rice field of Sidomulyo Village, Anggana Sub-District, Kutai Kartanegara District, East Kalimantan, Indonesia. The used material consisted of eight local cultivars of East Kalimantan tidal rice fields such as Pandan Ungu, Kambang, Amas, Roti, Sikin Merah, Sikin Putih, Pudak and Popot (Figure 1) (Rusdiansyah 2012).

The study was conducted in a randomized block design (RAK) with five replications. Each cultivar was grown on 5 × 10 m^2 plot, with the plant spacing of 30 × 30 cm^2 and each planting hole was planted with 1 seed of rice plant. The first fertilization was performed seven days after planting with a dose of 45 kg N. ha^{-1}, 60 kg $P_2O_5.ha^{-1}$ and 60 kg $K_2O.ha^{-1}$. The second fertilization was given 30 days after planting with a dose of 30 kg N. ha^{-1}. Weed control was done at 2, 4, 6 and 8 weeks after planting. Pest and disease control was performed when the plants showed symptoms of an attack. The observed variables included plant height, number of productive tillers, number of grains of content/panicle, percentage of unhulled grain/panai, grain weight/weed, 1000 grains of grain and grain/hectare production.

The data obtained were analyzed using variance (F test) at the real level of 5% and if there was a real effect continued with the smallest real difference test at 5% real level. Analysis of various components such as genotypic variety (σ2g), phenotypic variety (σ2f), environmental variety (σ2e), phenotypic diversity coefficient (PCV) and genotypic diversity coefficient (GCV) was performed on all observed variables. The genotypic diversity coefficient criteria were in broad performances if GCV ≥ 22 $\sigma_\sigma^2 g$, and in narrow performances, if GCV <2 $\sigma_\sigma^2 g$. All analyses of various components were carried out following Seyoum et al. (2012); Sutjahjo et al. (2013); Bagati et al. (2016); Kuswantoro (2017b).

RESULTS AND DISCUSSIONS

Genetic diversity

The estimation of genetic diversity is necessary and of concern in the selection of parent candidates or hybridization outcomes. The selection will be effective if the influence of environmental factors is small and the genetic diversity within the population is wide. The analysis results of h^2_{bs} of all observed characters ranged from 0.44 to 0.96. The highest values of h^2_{bs} were obtained in the plant height parameters with value of 0.96 followed by successive number of productive tillers, production/ha, percentage of unhulled grain/panai, weight of 1000 grains, weight of grain/clump and number of grain content/panicle 0.83; 0.82; 0.80; 0.78, 0.76 and 0.44 (Table 1). The broad perspective of high heritability means that the characters observed in the selected population had high adaptability to the growing environment.

The results obtained in this study was in accordance with Herawati et al. (2013); Idris and Mohamed (2015) who achieved high heritability values (h2bs) in some parameters including plant height, grain/panai, number of unhulled rice, percentage of void and weight of grain/clump. These results indicated that most genetic factors influence and contribute greater to the diversity of the existed characters than environmental factors. According to Ogunbayo et al. (2014) and Bagati et al. (2016), heritability is an overview of the main contribution of genetic factors toward certain characters. This heritability value could be further used as an easy measurement of those characters to be inherited. Kuswantoro (2017a,b) also reported that heritability determines the progress of selection and also the method of selection to be used in generating diversity. Characters that have high heritability value can be used as selection criteria in plant breeding. According to Singh et al. (2011), heritability is the transmission index of a character from an elder to a descendant. Heritability estimation gives a favor for plant breeders in the selection of plant genotype with superior traits in a population. Yakub et al. (2012), stated that the selection of characters with high h2bs values could be possibly done in the early generations because those characters might be easily inherited by their offspring. In this study, some parameters i.e plant height, the number of productive tillers, the percentage of empty grain/panicle, the weight of grain/clump, the weight of 1000 grains of grain and the production/ha had a high value of heritability value, while the number of grain content/panai had a moderate value of broad sense heritability (Table 1).

Table 1. The variety and broad sense heritability amongst agronomic characters of local cultivars of tidal rice in East Kalimantan, Indonesia

Parameters	σ^2_g	σ^2_p	σ^2_e	h^2_{bs}
Plant height	436.63	451.56	14.93	0.96 T
Number of productive tillers	29.89	36.09	6.20	0.83 T
The number of grain content/panai	398.89	900.59	501.70	0.44 M
Percentage of unhulled grain/panai	32.92	40.96	8.04	0.80 T
Weight of grain/clump	140.92	184.35	43.43	0.76 T
Weight of 1000 grains	1.92	2.46	0.54	0.78 T
Production/ha	0.93	1.13	0.20	0.82 T

Note: σ^2_g = Genotypic variety; σ^2_p = phenotipic variety; σ^2_e = environtmental variety; h^2_{bs}= broad sense heritability; T = high; M = medium/moderate

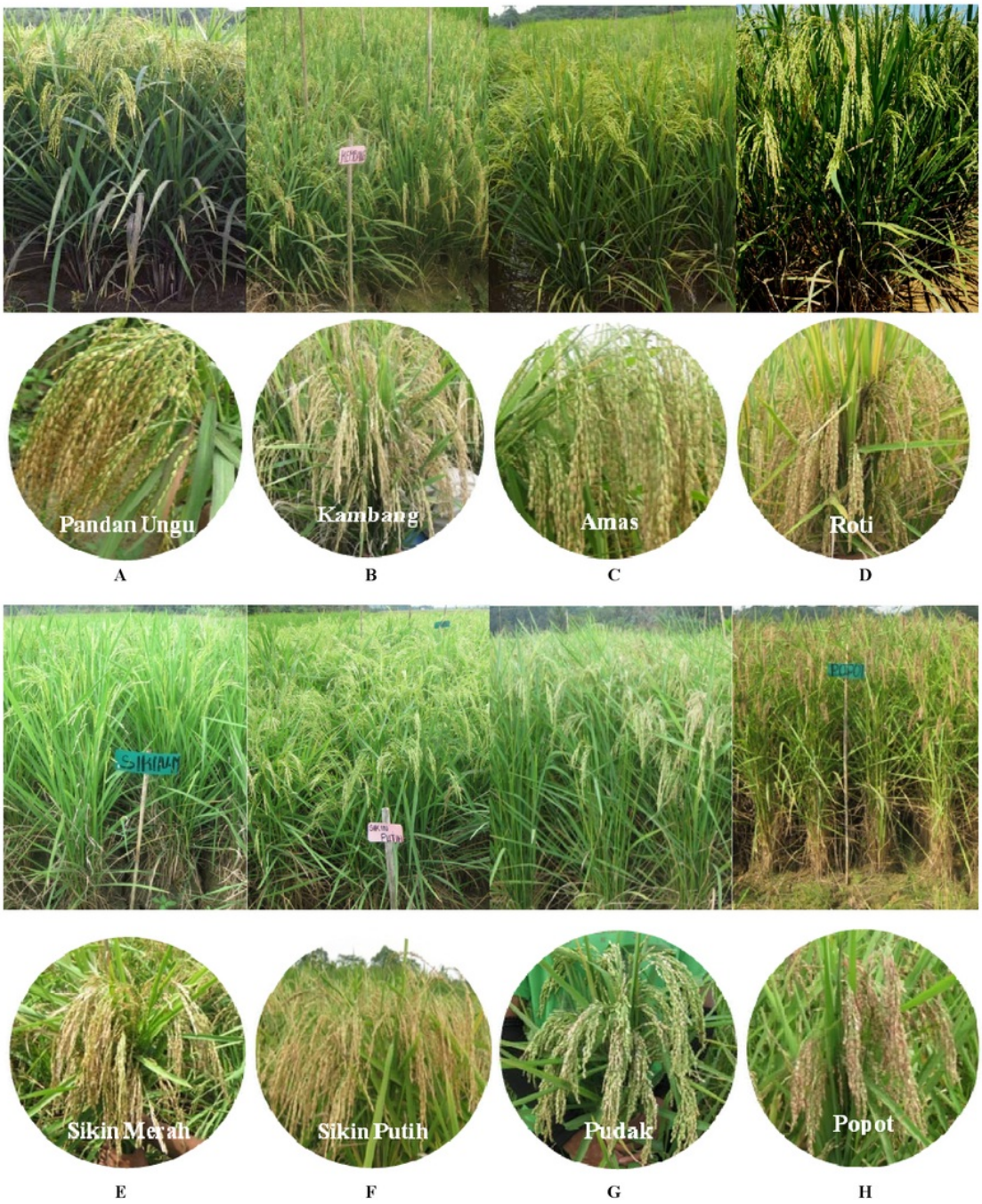

Figure 1. Appearance of plants and panicles from the cultivars of A. Pandan Ungu, B. Kambang, C. Amas, D. Roti, E. Sikin Merah, F. Sikin Putih, G. Pudak, H. Popo

The results showed that the value of phenotypic diversity coefficient (PCV) of all observed characters was higher than the value of genotypic diversity coefficient (GCV) (Table 2). These results were in accordance with several other studies conducted by Seyoum et al. 2012; Idris and Mohamed 2013; Ogunbayo et al. 2014; Bagati et al. 2016; Hefena, et al. 2016. Despite the different value of PCV and GCV, it seemed that the gap value is small. This

showed that the environmental factors had a less influence on the phenotypic and genotypic characters (PCV and GCV) of tidal rice species. Table 2 shows that four agronomical characters including number of productive tillers, percentage of empty grain/panicle, weight of 1000 grains and production per hectare had broad criteria of PCV and GCV. While the other three characters such as plant height, the number of grain content/panicle and the weight of grain/clump had narrow criteria so that they could not be used as selection criteria. Selection of characters with wide genetic diversity will be effective and able to increase the genetic potential of the character in the next generation (Herawati et al. 2013). Based on the results of h2bs values, the agronomical characters including PCV and GCV, the number of productive tillers, the percentage of empty grain/panai, the weight of 1000 grains and the production/ha can be used as the selection criteria for the local cultivars of tidal rice in East Kalimantan.

Agronomical characters

The results of the analysis showed a significant difference in all observed agronomical characters. The mean of plant height was in range between 95,93 and 157,49 cm followed by number of productive tiller/clump, number of grain of content/panicle and percentage of empty grain/panai which in range of 15,07 -31,08 stems, 164,52-237,69 Grains and 15.25-28.99% (Table 3). There are four cultivars, namely Kambang, Amas, Roti and Sikin Merah which had plant height <125 cm, number of productive tillers/clumps> 25 stems and percentage of empty grain/panai <20%. In addition, Kambang, Amas, and Sikin Merah cultivars had a number of grains/panicle around 180 grains. Although the cultivar of Pandan Ungu has the less number of productive tillers/clumps around 15.07 stems, but, it has the highest plant height, the highest number of grains of content/panai, the grain and the percentage of the lowest empty grain of 104.92 cm, 237.69 grains and 15.25%. Plant height, number of tillers, number of grains/panicle and percentage of grain content/panicle is an important character in rice plant breeding especially for the increased production and development of new type of rice varieties. Short stems and tillers characters can represent how much they produce panicle/clump and number of grains/panicles (Abdullah et al. 2008; Abdullah 2009). Based on the selection criteria, Kambang, Amas, Sikin Merah and Pandan Ungu cultivars could be used as parent in the formation of new rice varieties with the range of plant height between 115 and 120 cm, the number of grains between 180 and 240, and the number of grains/panicle around 80%. Abdullah et al. (2008), stated that the generation of new rice cultivars in Indonesia need a genetic diversity source with the number of tillers in moderate level with high productivity (12-18 crops), the number of grains from range of 150 to 250 grains and the number of full grain contents between 85 and 95%.

Table 2. The coefficient of phenotypic and genotypic diversity amongst agronomic characters of local cultivars of tidal rice in East Kalimantan, Indonesia

Parameters	PCV	GCV	$\sigma_\sigma^2{}_g$	Criteria
Plant height	17.48	17.19	208.18	Narrow
Number of productive tillers	26.06	23.72	14.68	Wide
The number of grain content/panai	15.86	10.56	236.77	Narrow
Percentage of unhulled grain/panai	29.67	26.60	16.28	Wide
Weight of grain/clump	29.39	25.69	70.56	Narrow
Weight of 1000 grains	6.18	5.46	0.96	Wide
Production/ha	23.36	21.19	0.46	Wide

Note: PCV = The coefficient of phenotypic diversity; GCV = The coefficient of genotypic diversity

Table 3. The agronomical characters of rice cultivars observed after harvesting times

Cultivars	Plant height (cm)	Number of productive tiller/clump	Number of full grain contents/panicle	Percentage of unhulled grain/panai (%)	Weight of grain/clump (g)	The weight of 1000 grains (g)	Production/ha ($Mg.ha^{-1}$)	The harvest age (days)+
Pandan Ungu	104.92 b	15.07 e	237.69 a	15.25 a	51.75 b	28.14 a	5.05 b	115
Kambang	95.93 a	31.08 a	185.52 bc	16.57 a	47.07 bc	26.22 b	4.87 b	106
Amas	104.15 b	25.28 bc	194.72 b	18.55 a	50.02 b	24.68 de	4.87 b	122
Roti	114.53 c	26.10 b	171.82 bc	18.13 a	60.54 a	25.50 bcd	5.42 ab	121
Pudak	133.63 e	21.95 d	164.52 c	28.49 b	30.20 d	24.50 e	3.16 c	149
Sikin Merah	120.95 d	26.92 b	196.92 b	18.41 a	61.11 a	25.70 bc	5.87 a	125
Sikin Putih	140.75 f	22.63 cd	181.88 bc	28.13 b	39.05 c	24.78 cde	3.71 c	134
Popot	157.49 g	15.37 e	180.55 bc	28.99 b	29.89 d	23.34 f	3.44 c	145
BNT 5%	5.01	3.23	29.02	3.67	8.54	0.96	0.58	-

Note: The data with plus sign +) was calculated based on the harvest age of plants in field

Furthermore, of the average analysis of weight grain/clump weight showed that the weight of 1000 grains ranged from 29.89 to 61,11 g and the production of grain/ha ranged between 23,34 and 28,14 g, respectively. The cultivars which had weight of grain/clump> 45 g, production/ha> 4.5 Mg. ha^{-1} and harvest age ≤ 125 days were obtained in Red Sikin, Roti, Pandan Ungu, Amas and Kambang. While from other parameters specify the weight of 1000 grains, none of observed cultivars had the weight of 1000 grains ≥ 30 g. However, four observed cultivars i.e. Pandan Ungu, Kambang, Roti and Sikin Merah produced the weight of 1000 grains in range from 25 g to 28 gr (Table 3). Besides, agronomical parameters such as the number of tillers, the number of grain content and the percentage of grain/panicle are used in the development of new parents in the breeding programs, other parameters such as the character of the number of grains/panicles and the size of a large panicle and weight of 1000 grains between 25 and 26 g are of importance to the successful result of breeding program (Abdullah et al. 2008).

Based on the genetic diversity and agronomic characters observed in this study, five cultivars including Pandan Ungu, Kambang, Amas, Roti and Sikin red are potentially used as parents in the rice plant breeding program. The agronomical characters in terms of character of productive tillers, percentage of unhulled grain/panai, weight of 1000 grains and production/ha can be used as selection criteria for local cultivars of East Kalimantan tidal rice due to its high h2bs value and the wider type of PCV and GCV.

ACKNOWLEDGEMENTS

The authors would like to thanks to the director of PT. Pupuk Kalimantan Timur, Bontang, Indonesia who has funded this research.

REFERENCES

Abdullah B, Tjokrowidjojo S, Sularjo. 2008. The development and prospect of a new variety of rice assembly in Indonesia. J Penelitian dan Pengembangan Pertanian 27 (1): 1-9. [Indonesian]

Abdullah, B. 2009. Progress of rice through recurrent selection. J Agron Indonesia 37 (3): 188-193.

Bagati S, AK Singh, RK Salgotra, R Bhardwaj, M Sharma, SK Rai, A Bhat. 2016. Genetic variability, heritability and correlation coefficients of yield and its component traits in basmati rice (*Oryza sativa* L.). SABRAO J Breed Genet 48 (4): 445-452.

Hefena, AG, MS Sultan, MA Abdel-Moneam, SA Hammoud, C Barutçular, A El-Sabagh. 2016. Genetic variability, heritability and genetic advance for yield and associated traits in F_2 rice population. J Agric Biotech 1 (2): 49-58.

Hendra M, Guhardja E, Setiadi D, Walujo EB, Purwanto Y. 2009. Cultivation practises and knowledge of local rice varieties among Banuaq Farmers in Muara Lawa Sub-District West Kutai, East Kalimantan, Indonesia. Biodiversitas 10: 98-103.

Herawati R, Purwoko BS, Dewi IS. 2009. Genetic diversity and agronomic character of haploid double line of upland rice with new types of anther culture. J Agron Indonesia 37 (2): 87-94. [Indonesian]

Idris AE, KA Mohamed. 2013. Estimation of genetic variability and correlation for grain yield components in rice (*Oryza sativa* L.). Global J Pl Ecophysiol 3 (1): 1-6.

Ishak. 2012. The agronomic nature, heritability and interaction of G x E upland rice lineage (*Oryza sativa* L.). J Agron. Indonesia 40 (2): 105-111. [Indonesian]

Kuswantoro H. 2017a. Genetic variability and heritability of acid-adaptive soybean promising lines. Biodiversitas. 18 (1): 378-382.

Kuswantoro H. 2017b. The role of heritability and genetic variability in estimated selection response of soybean lines on tidal swamp land. Pertanika J Trop Agric Sci 40 (2): 319-328.

Nurhasanah, Sadaruddin, W Sunarya. 2016. Diversity analysis and genetic potency identification of local rice cultivars in Penajam Paser Utara and Paser Districts, East Kalimantan. Biodiversitas 17 (2): 401-408.

Ogunbayo SA, Sie M, Ojo DK, Sanni KA, Akinwale MG, Toulou B, Shittu A, Idehen EO, Popoola AR, Daniel IO, Gregorio GB. 2014. Genetic variation and heritability of yield and related traits in promising rice genotypes (*Oryza sativa* L.). J Plant Breed Crop Sci. 6 (11):153-159.

Rusdiansyah. 2012. Some germplasm of local tidal rice paddy in East Kalimantan. In: Dwiyanto K, Sobir, Syukur M, Yudiwanti, Inounu I, Bahagiawati, Efendi D, Surahman M. (eds). Prosiding Seminar Nasional Sumber Daya Genetik Dan Pemuliaan Tanaman. Badan Penelitian dan Pengembangan Pertanian, Kementerian Pertanian. Bogor,6 -7 November 2012. [Indonesian]

Saleem MY, Mirza JI, Haq MA. 2008. Heritability, genetic advance, and heterosisin line x tester crosses of Basmati rice. J Agric Res 46: 15-26.

Seyoum M, Alamerev S, Bantte K. 2012. Genetic variability, heritability and correlation coefficient and path analysis for yield and yield related traits in upland rice (*Oryza sativa* L.). J Plant Sci 7 (1): 13-22.

Singh SK, Singh CM, Lal GM. 2011. Assesment of genetic variability for yield and its component characters in rice (*Oryza sativa* L.). Res Plant Biol 1 (4): 73-76.

Sitaresmi T, Wening RH, Rakhmi AT, Yunani N, Susanto U. 2013. Utilization of local rice germplasm varieties in the assembling of superior varieties. Iptek Tanaman Pangan 8 (1): 22-30. [Indonesian]

Sutjahjo SH, Herison C, Sulastrini I, Marwiyah S. 2015. Estimation of genetic diversity of several growth and yield characters on 30 local tomato genotypes. J Hortikultura 25 (4): 304-310. [Indonesian]

Yakub B, Kartina AM, Isminingsih S, Suroso ML. 2012. Estimation of genetic parameters of yield and yield component of local rice strains from Banten. J Agrotropika 17 (1): 1-6. [Indonesian]

Rusdi-tidal.pdf

ORIGINALITY REPORT

6%	0%	0%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Udayana University Student Paper	6%

Exclude quotes	Off	Exclude matches	< 3%
Exclude bibliography	On		