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"Toward Sustainable Utilization of the Tropical Natural Resources for a Better Human Prosperities"

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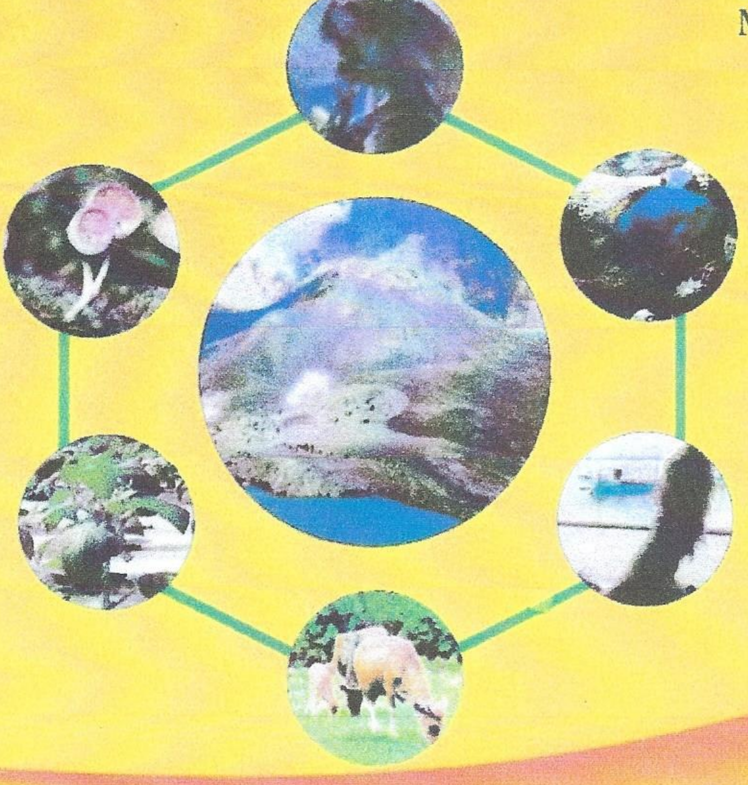

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OPENING SPEECH - RECTOR UNIVERSITY OF MATARAM

International Seminar on the Tropical Natural Resources 2015

Respected Guests,
Keynote speakers,
Seminar participants,
and all other participants.

On Behalf of all staffs of the University of Mataram, I welcome you all to Lombok, a beautiful island in West Nusa Tenggara Province, where the University of Mataram is located. Lombok is known for its natural and cultural diversity where you can enjoy traditional cuisines, beaches, waterfalls, mountain, traditional villages and handicraft of many ethnics including Sasak, Samawa, Mbojo, Balinese, Chinese, Arabic, and many others.

As the Rector of the University of Mataram, it is a great honour for me to address the opening of "the International Seminar on the Tropical Natural Resources" here at the University of Mataram, which will be held from 10th to 13th June 2015, with a theme "toward sustainable utilization of the tropical natural resources for better human prosperity". The main aim of this seminar is to gather scientist from all over the world to share their ideas, knowledge and experiences and to build network for possible future collaboration.

As we are aware that sharing knowledge and experiences from speakers are extremely valuable in a seminar, therefore I would like to express my high appreciation, first, to the keynote speakers from overseas (USA, Australia, New Zealand, China, Singapore, Malaysia, the Philippines) and from Indonesia for their willingness to come to Lombok to share their acknowledged works. Your effort and contribution to this seminar are absolutely valuable. Second, my high appreciation also goes to the national speakers and all other participants, including the speakers from University of Mataram and local universities in West Nusa Tenggara Province,

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your participation in this seminar not only will give incredible share of ideas, skills and knowledge that you have, but also will improve the academic environment that we are developing in this university. I hope this seminar will be a good forum, not only for communicating and sharing ideas, knowledge and experiences, but also for building networking for future collaboration.

I would also like to take this opportunity to express my appreciation to the sponsors (Bank Mandiri, Bank BNI, Bank BRI, Bank BTN, Bank Bukopin), which have given some contribution to this seminar. Last but not least, I would like to thank the steering and organizing committee as well as all other supporters and participants, without their effort, commitment and hard work, this seminar will not run well.

Finally, I wish you most successful seminar, enjoy Lombok Island and hope to see you again in other forum here at the University of Mataram.

Prof. Ir. Sunarpi, Ph.D
Rector of the University of Mataram

QUANTITATIVE TRAITS AND HERITABILITIES ON CROSSED BLACK PADDY RICE BAAS SELEM vs SITU PATENGGANG

IGP. Muliarta Aryana[1], BB. Santoso[1], M. Zairin[2], N. Farid[3], NT. Ramdani[4]
[1] Faculty of Agriculture, University of Mataram, West Nusa Tenggara, Indonesia
[2] BPTP West Nusa Tenggara, Indonesia
[3] Faculty of Agriculture, University of General Soedirman, Purwokerto, Indonesia
[4] Alumny of Study Program of Agroekoteknology, Faculty of Agriculture, University of Mataram, Indonesia. Email: muliarta12yahoo.co.id

ABSTRACT

Variability on the quantitative traits and heritability for genotype of plant population is very important for plant breeding programs to create new varieties. Present study aims to determine the heritability of quantitative characters on crossed black paddy rice of Baas Selem vs Situ Patenggang. Ten 10 genotypes consisting of eight crossed black paddy rice (BC1.1, BC1.2, F2, F3.1, F3.2, F3.3, F3.4 and F3.5) and two parents (Baas Selem and Situ Patenggang) were used. The experiment was conducted at the experimental site of Faculty of Agriculture, University of Mataram at Nyur Lembang, West Lombok, West Nusa Tenggara in March-June 2014, by used of randomized block design with three replications. Each genotype was planted in dried condition within 25 cm x 25 cm spacing, and fertilized with 300 kg^{-1}.ha Ponska and 200 kg^{-1}.ha Urea. The results shows that there were variability on crossed black paddy rice on quantitative characters such as flowering age, harvesting age, plant height, number of productive tillers/clump, number of filled grains/panicle, number of empty grain/panicle, weight of 100 grain s and grain weight/panicle, but there were no variability on the amount of non-productive tillers/clump and length of panicle. Estimated value of heritability were found higher on flowering age, harvesting age, plant height, number of productive tillers/clump, number of filled grain/panicle, and grain weight/clump; and the middle value of heritability were showed on number of empty grain/panicle and weight of 100 grains, while the lower heritability values were found on amount of non-productive tillers/clump and length of panicle.

Keywords: flowering age, harvesting age, heritability, grain weight

1. INTRODUCTION

Black paddy rice (*Oryza sativa* L.) is a functional food ingredient containing antioxidants such as anthocyanin which capable to inhibiting the growth of cancer cells and reduces cholesterol (Budiman *et al.*, 2012). Black color on black paddy rice is due to high production of anthocyanin produced by alueron and endosperm. Currently black paddy rice needs continue to increase in line with public awareness on the health (Abdel *et al.*, 2006; Kristaminanti and

Purwaningsih, 2010), even more its was popular as basic food stuffs in Europe rather than in the Southeast Asia (Budiman *et al.*, 2012).

Black paddy rice in Indonesia is one of germplasm that increasingly rare due to the planting of new rice varieties. One of black paddy rice cultivars from Bali named "Baas Selem" with flavored and fluffier, but low production potential, around 2 $tons^{-1}$.ha (Muliarta and Kantun, 2011). Therefore, it is necessary to attempt high-yielding varieties of black paddy rice. According to Abdullah *et al.* (2010) assembly of functional rice varieties should be made to meet the energy needs and public health improvement. One of plant breeding techniques in the formation of new varieties are hybridization (Nasrallah, 1994), for increasing of a common genetic diversity beside mutations (Yuniarti *et al.*, 2012).

Breeding on black paddy rice, through crosses between varieties of Situ Patenggang (drought tolerant and high yield potential) with black rice cultivars Baas Selem (high anthocyanin content and low yield potential) in order to obtain offspring F1 have done by Muliarta *et al.* (2013). The next cross breeding method is Back Cross between F1 as females with P1 and P2 as male parent, then resulting F1BC1.1 and F1BC1.2. Most of F1 population is let to form F2 population. Additionally (Budiman *et al*, 2012) has conducted a research on the growth of two local cultivars of rice black rice originating from East Nusa Tenggara (Laka and Woja), while Kisbintariet *et al.*, (2013) conducted a study on the effect of drought stress to anthocyanins content of local black rice paddy cultivars Bantul. This study aims to determine the quantitative characters and heritability of crossed black paddy rice of Baas Selem vs Situ Patenggang.

2. METHODOLOGY

The experiment was conducted at the experimental side of Faculty of Agriculture, University of Mataram, in Nyur Lembang, Narmada, West Lombok district at 100 m above sea level during March-June 2014. The experiment was designed as a randomized block design with 10 genotypes of rice in three replications. Those genotypes consisting 8 black paddy rice lines and two parents (Table 1). Planting was in dry condition (upland) ast 25 cm x 25 cm spacing with one plant per hole. Fertilization ware used with 300 kg^{-1}.ha Ponsca and 200 kg^{-1}.ha Urea.

Table 1. Studied genotypes

Code	Genotypes	Explanation
G1	BC.1.1	back cross F1 vs P1 parent
G2	BC.1.2	back cross F1 vs P2 parent
G3	F2	F2 black paddy rice
G4	F3. 1	F3 black paddy rice with black color of seed
G5	F3. 2	F3 black paddy rice with blacklist color of seed
G6	F3. 3	F3 black paddy rice with black yellowiest color of seed
G7	F3. 4	F3 black paddy rice with black stripe color of seed
G8	F3. 5	F3 black paddy rice with yellow-black color of seed
G9	P1	Parent, Situ Patenggang, with white color
G10	P2	Parent, Baas selem, with black color

Data were analyzed by analysis of variance at 5% level and Duncan test at 5% significance level. To calculate the broad sense of heritability values using the following formula (Shakoor *et al.* 1978 in Mugiono. 1996):

$$H^2 = \frac{\sigma^2 G}{\sigma^2 F}, H^2 = \frac{\sigma^2 G}{\sigma^2 G + \sigma^2 E}, \sigma^2 G = \frac{KTG - KTE}{Ulangan}$$

H^2 = Heritability
$\sigma^2 G$ = Variability in genotype
$\sigma^2 F$ = Variability in phenotype
$\sigma^2 E$ = Environment variability

3. RESULT AND DISSCUSSION

There was significant differences among 10 genotype studied on quantitative characters observed such as time of flowering, harvesting age, plant height, number of productive tillers/clump, panicle length, number containing grain/panicle, number of empty grain, weight of 100 grains and weight of grain/clump. While there no significant different was observed on the number of non productive tillers/clump and panicle length (Table 2).

Table 2. Analysis of variance of quantitative characters

Characters	Fcalc.	Probability	Notation
Flower time (flowering age)	131,27	0,000	S
Harvest age	79,62	0,000	S
Plant height	4,77	0,002	S
Number of productive tiller/clump	62,07	0,000	S
Number of non-productive tiller/clump	0,74	0,673	NS
Length of panicle	2,07	0,089	NS
Number of filled grain/penicle	6,63	0,000	S
Number of empty grain/penicle	0,34	0,005	S
Weight of 100 grain	7,44	0,000	S
Weight of grain /clump	16,43	0,000	S

S = significant; NS = no significant

Flowering phase is a stage in the reproductive cycle of the rice plant. The set of panicle decide as the time when 50% of the population of the plant has been out of panicles and take approximately 7-10 days to complete anthesis (Yoshida, 1981). There was significant differences flowering dates of genotypes studied. The flowering dates vary, ranged between 74.26 to 80.79 days after planting with averages of 77.66 days after planting (Table 3). The fastest (early maturing) was found on parent (P1, Situ Patenggang) followed by F2 genotype The latest time of flowering 80.79 days after seedling was found in F3.3 Based on the classification of the flowering dates (Anonymous, 2003). of all genotypes included in the category fast or early flowering. Age flowering harvesting age-related premises. According Ismunadji *et al.*, (1988) that plants with earliest flowering had short generative phase, so then the time of harvest will sooner.

It was significantly different of the harvesting time (age) among the genotypes studied (Table 3), between 113-118 days after planting with averages of 115.63 days after planting. The latest harvesting time was showed by F3.5 genotype e.g. 118 days after planting and it was significantly different with all others genotypes tested. While the earliest harvest time was showed by F3.1 genotype e.g. 113 days after planting. According to Siregar (1981) classification, F3.1, F3.2, F3.5, BC.1.1, and BC.1.2 genotypes include in early maturity category, while F3.3, F3.4, P1, P2, and F2 genotypes comprise in moderate category. According to Yoshida (1981) plants that have early maturity able to increase the production of grain per day and increase water use efficiency. Plant breeding program in Indonesia is intended for create shorter age or early maturation than the existing local varieties.

There was significant different in plant height among genotypes. Plant height was ranged between 121.25-134.18 cm with averages of 127.65 cm. Parent genotype of P2 (Baas Selem) was the shortest plants, whereas F3.5 genotype the tallest plants followed by F3.2, and BC.1.1 (Table 3). According to Lopez *et al.* (1995) grouping of high rice plants it can be stated that the genotypes tested was in the medium category to high. Genotypes were included in the group of medium were of F3.1, P1, P2, and BC.1.2., while F3.2, F3.3, F3.4, F3.5, BC.1.1 and F2 include in to the high group. Plant height is one factor in the ability of plants to absorb light which then effected to assimilate production, and it was one of the selection criteria in rice plants. According to Yoshida (1981) plant with shorter in height was focused for breeder to selected genotype. Furthermore Muliarta *et al.,* (2012) mentions that an ideal plant height ranged between 90-105 cm to avoid from the fall incident. Therefore, in this study, plant height was the traits have to be considering as criteria for black paddy rice breeding program, due to it was range between moderate to high.

The number of productive tillers/clump is one of supporting for yield rather than other parameters. According Simanulung (2001) in Endrizal and Bobihoe (2007) that productive tillers/clump determines the number of panicles, thus productive tillers/clump had direct effect to the grain (seed) yield. Table 3 shows that range of the number of productive tillers/clump was ranged 7.93-21.58 tiller with the average of 12.67 tiller. The higher number of productive tillers was found in BC.1.2 e.g. 21.58 tiller. While parent P1 (Situ Patenggang) was the least number of productive tiller e.g. 7.93 tiller, followed by F3.2 and F3.3 genotypes. Therefore, F3.1, F3.2, F3.3, F3.4, F3.5, and P1 genotypes included in the category little/lower tillers, and P2, BC.1.1, and F2 include into medium category, while BC.1.2, include into numerous categories. Number of productive tiller of BC.1.2 genotype was higher than two parents of P1 (Situ Patengang) and P2 (Baas Selem).

There is no significant difference in the number of non productive tillers/clump among genotypes (Table 3). The average range of the number of non-productive tillers/clump was between 0-1.22 stem with a mean value of 0.44 stem. According Thamrin *et al.* (2010) in

Muliarta *et al.* (2012) that, the non productive tillers are competitor of productive tillers in harnessing the energy of light and nutrients.

Table 3.Vegetatives character

Genotype	FA	HA	PH	NPT	NNPT
BC.1.1	76,00 d	115,00 d	131,83 ab	13,41 d	0,41
BC.1.2	77,25 cd	115,00 d	122,25 e	21,58 a	0,66
F2	74,41 e	117,00 b	127,00 ed	14,58 c	1,08
F3.1	79,24 ab	113,33 e	124,49 de	10,12 f	0,50
F3.2	79,16 ab	114,66 d	130,89 ab	10,72 e	0,07
F3.3	80,79 a	116,33 c	129,35 bc	10,68 ef	0,10
F3.4	79,38 ab	118,00 a	129,07 bc	10,49 f	1,22
F3.5	78,71 bc	113,00 f	134,18 a	10,01 f	0,00
P1	74,26 e	117,00 b	124,86 de	7,93 g	0,40
P2	77,33 cd	117,00 b	122,66 e	17,25 b	0,00
Average	77,66	115,63	127,65	12,67	0,44
Maximum	80,79	118	134,18	21,58	1,22
Minimum	74,26	113	122,25	7,93	0

Explanation : *) number followed by the same letter are not significantly different according to Duncan Multiple Range Test at 5% level.

FA : flowering age (days after seed sowing); HA : harvest age (time) (days after seed sowing); PH : plant height (cm); JAP : number of productive tiller/clump; NNPT : number of non-productive tiller /clump;

Table 4. Generative (reproductive's) character

Genotype	LT	NFG	NEG	W100G	WSPG
BC.1.1	23,10	190,45 ab	11,00 ab	2,91 a	47,86 a
BC.1.2	20,94	118,66 f	3,29 c	2,84 ab	49,57 a
F2	22,76	145,54 de	6,87 bc	2,75 bcd	48,72 a
F3.1	22,56	173,91 bcd	10,31 ab	2,60 e	27,25 c
F3.2	22,65	173,03 cd	10,27 ab	2,69 cde	31,21 b
F3.3	22,17	173,01 cd	10,15 ab	2,65 de	33,18 b
F3.4	22,97	144,44 e	6,93 bc	2,78 bc	31,19 b
F3.5	24,82	162,60 de	11,50 ab	2,84 ab	34,30 b
P1	22,38	192,70 a	15,40 a	2,74 bcd	31,50 b
P2	22,02	187,58 abc	9,16 b	2,66 de	42,21 b
Rerate	22,64	166,19	9,49	2,76	37,69
Maximum	24,82	192,7	15,40	2,91	49,57
Minimum	20,94	118,66	3,29	2,6	27,25

Explanation : *) number followed by the same letter are not significantly different according to Duncan Multiple Range Test at 5% level.

LT; length of tiller (cm); NFG: number of filled grain/penicle; NEG: number of empty grain/penicle; W100G : weight of 100 grain (filled grain); WSPC: weight of grain /clump (g).

Length of panicle is selection criteria in rice breeding programmers because it affects to the yield. According to yoshida (1981) panicle length character associated with the production. There is no significant difference in panicle length among genotypes. Panicle length was ranged between 20.94-24.82 cm, with average of 22.64 cm (Table 4). The longest panicle was showed by F3.5 genotype, 24.82 cm, it was significantly different to F3.1, F3.3, P1, P2, and BC.1.1. The shortest panicle length was showed by BC.1.2 genotype, 20.94 cm. Based on the classification of panicle length, all genotypes included in the medium category, except BC.1.2 which include into short category. Panicle length of genotypes F3.5 was go above length of the two parents.

Number of filled grains per panicle was ranged from 118.66 to 192.7 grains with average of 166.19 grains (Table 4.3). Parent P1 (Situ Patenggang) was showed the highest number of filled grains, 192.7 grain, followed by parent P2 (Baas Selem) and BC.1.1. While the genotype of BC.1.2 was the least amount of filled grain, 118.66 grains. According Endrizal and Bobihoe (2007) that, the number of filled grains per panicle had correlated with crop yield but is strongly influenced by empty grain. Furthermore, rice yield is determined by the yield components like number of filled grain/panicle and 1000 grain weight.

As well as the amount of filled grain, the number of empty grains/panicle showed significant differences among genotypes. Number of empty grains/panicle was between 3.29-15.40 grains. The lowest amount of empty grain was found on BC.1.2 genotype. Total empty grain at F3.4 and F2 was 6.39 grain and 6.87 grain respectively. According to Yoshida (1981) the level of emptiness of grain is influenced by climatic factors (low or high temperature at around anthesis stage (cell division and sterility), fertilizing, and disease-pest.

There was significantly difference in the weight of 100 filled grains among genotypes (Table 4). Weight of 100 filled grains was ranged from 2.6 to 2.91 grams with a average of 2.76 grams. According to the FAO in IRRI (1965) that, most of genotypes studied include into the weight category, except F3.5, BC.1.1 and BC.1.2 were include into very heavy category. Measurements of 100 filled grains weight useful in determining large or small size of grain of a variety. The heavier 100 grain of variety indicates the great that variety (Fadjry *et al*, 2012). According Fagi and Las (1988) in Endrizal and Bobihoe (2007) that, the grain size is influenced by the nature of the genetic and adaptability to growth environment.

Table 4 also shows that, the weight of grain/clump was ranged between 27.25-49.57 grams with a average of 37.69 grams. The heaviest of grain weight/panicle was showed by genotype of BC.1.2 (49.57 grams) and followed by BC.1.1 and F2 respectively with a value of 47.86 grams and 48.72 grams. Grain weight/clump of three those genotypes was exceeds of the two parents P1 (Situ Patenggang) and P2 (Baas Selem). Meanwhile the lowest weight of grain/clump was found on genotype of F3.1, 27.25 grams. Grain weight/clump strongly influenced by the amount of filled grain, the number of panicles, and a weight of 100 grains, so that will also affect to the yield.

Estimation of heritability value of genotypes studied was ranged between 0 to 0.99. Character of flowering age, harvesting age, plant height, number of productive tillers, number of filled grains, the weight of grain/clump include into the criteria of high heritability, whereas medium value of heritability was showed by number of empty grain and weight of 100 grains. Low heritability values was indicated by number of non-productive tillers/clump and panicle length.

Character plant with a expected value of heritability in moderate to high such as flowering age (0.85), harvesting age (0.96), plant height (0.55), number of productive tillers (0.95), number of filled grains (0.99), the amount of empty grain (0.50), weight of 100 grains (0.47) and grain weight/panicle (0.83) were showed no effect of the environment. Crowder (1988) stated that, when the high heritability of a trait appear, the breeder meet selection gain (progress in the selection) due to the genetic diversity was effected by genetic material, so that the selection can be done in early generations. Malik *et al* (1988) in Limbongan (2008) reported that, selection of the number of grain/panicle was more effective starting from segregating generation, like generations F2 until F4.

Instead of characters with low heritability values such as the number of non productive stem (0.01) and panicle length (0.01) shows that the environmental effect was found greater than genetic factor. This means that if the value of heritability is low, the breeder will not meet progress in the selection of a trait, because of the diversity was dominantly effected by environmental factors. Furthermore Saleh (2010) state that, if the characters with low heritability value as a result of inconsistent appearance of the phenotype, then the selection can be done in the next generation.

Table 5. Value of heritability in broad sense in quantitative characters

4. CONCLUSION

1. There were variability in quantitative trait such as flowering age, harvesting age, plant height, number of productive tillers, number of filled grains, the amount of empty grain, weight of 100 grains and grain weight/clump, but there was no variations in the amount of non-productive tillers and panicle length of crossed black paddy rice Baas Selem vs Situ Patenggang.
2. The high heritability estimates on a crossed black paddy rice Baas Selem vs Situ Patenggang was found in flowering age, harvesting age, plant height, number of productive tillers, number of filled grains/panicle, and grain weight/clump. Criteria of moderate heritability was shown by number of empty grain and weight of 100 empty grain, while the low heritability value was found in number of non productive tillers and panicle length.
3. Selection in early generation can be done on a character that has a high heritability estimates, while the selection can be done on the next generation on the characters with low heritability

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