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Panicle Length and Weight Performance of F3 Population from Local and Introduction Hybridization of Rice Varieties

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Plant breeding program consists of establishment of the population, selection, and evaluation. The study aimed to observe the variability of yield components, the heritability, and the distribution of the yield component characters in the F3 populations. The experiment was conducted at Muara Experimental Farm Bogor, from April to August 2012 on Latosol soil. The F3 populations derived from crosses of Bintang Ladang x US2, Gampai x IR77674, and Progol x Asahan and their parental were used as plant materials. Twenty one-day-old seedlings from each population were planted in plots of 2 x 12 m, with planting space of 20 x 20 cm and 3-5 seedlings per hole. Panicle length and weight were observed on 300 randomly selected plant samples from each population. The results showed that there was a variation of agronomic characters among genotypes. The heritability of characters, the panicle length and weight was low to high. Panicle length and weight were controlled by many genes with additive gene action in the Gampai x IR77674 derived population, while panicle weight was controlled by few genes with complementary epistatic additive gene action in both Bintang Ladang x US2 and Progol x Asahan derived populations. The more genes controlling a character, the more distribution classes formed and the greater variance among genotypes.

Keywords: F3 population, yield components, heritability, variability

INTRODUCTION

Rice is an important staple food in most of the world's population, especially for the people of Indonesia. The increase in population and decrease of the land in Indonesia lead to a need to increase in rice productivity especially on marginal which have a potential for rice cultivation. Marginal lands are characterized with drought, salinity, Al toxicity, and heat stress. One of the potential strategies to improve productivity, quality and competitiveness of rice is through plant breeding approaches. Therefore, plant breeding activities is necessarily directed to the establishment and development of new cultivars for these lands (Witcombe *et al*. 2008; Kumar *et al*. 2008; Babu 2010; Cha-um *et al*. 2010).

Through breeding activities, it is expected to produce a variety of new high yielding rice cultivars and other characters that support the improvement of rice quality and competitiveness. In general, plant breeding program consists of the establishment of the population variability, selection, evaluation and testing of the selection results. Establishment of populations and their variability were gained through hybridization (Kanya *et al*. 2012; Ai-Yun *et al*. 2005), mutation (Lang *et al*. 2007; Shehata *et al*. 2009), varietal introduction (Dibba *et al*. 2012) or exploration (Singh *et at*. 2005). The next step that is considered to be important is the selection of the population and the evaluation and testing of the selected lines to obtain the new desired varieties desired with predetermined advantages.

It was known that local varieties have more characters advantages than others, such as resistance to marginal land or suboptimum conditions, resistance to pests and diseases, as well as good quality rice. Therefore local varieties could be a major genetic resource for breeders to develop new varieties with improved architecture. It is expected that genetic variability can be selected and obtained genotypes able to produce optimally on suboptimum soil conditions, resistant to pests and diseases, and

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good rice quality. Selection activities usually done in the next generation, after majority of the genetic was suspected homozygous.

This study aimed to observe the variability and heritability of panicle length and weight characters in three F3 populations obtained from crosses of local and introduced IRRI rice variety, as well as the distribution of both characters in those populations against.

MATERIALS AND METHODS

The experiment was conducted on the Latosol land at the Muara Experimental Farm Bogor, Indonesia starting from April to August 2012. Rice genotypes used in the experiment were rice genotypes from three F3 populations and their parental, i.e.: Bintang Ladang x US2, Gampai x IR77674, Progol x Asahan, Bintang Ladang, US2, Gampai, IR77674, Progol, Asahan. Each genotype was planted in plots of 2 x 12 m, planting space of 20 x 20 cm with 3-5 2-day-old seedlings from each seeds per hole. The plants were fertilized with 150 kg/ha urea, 100 kg/ha SP36 and 100 kg/ha KCl. Pests and diseases were controlled optimally. A total of 300 plant samples were randomly selected from each population, and the panicle length and weight were observed. Data was analyzed using Microsoft Excel 2007 and Minitab 15.

The average value and variance are used to estimate the heritability (Allard 1960). There were three heritability classes, i.e.: high ($h^2 > 0.5$), moderate ($0.2 < h^2 < 0.5$), low ($h^2 < 0.2$). Genetic variability was calculated by reducing the range of phenotypes F3 with a variety of environments, which is obtained from a variety of environmental averaging range of the parent.

$$\mu \frac{\sum x_i}{n} \qquad \sigma^2 = \frac{\sum x_i - \frac{1}{n}(\sum x_i)^2}{n-1}$$

$$h^2 = \frac{\sigma^2 g}{\sigma^2 F3} \qquad \sigma^2 e = \frac{\sigma^2 p2 + \sigma^2 p1}{2}$$

μ = general mean, h^2 = heritability, σ^2= variance, σ^2 g = genetic variance, x_i = observed value, σ^2 *e* = environment variance, n = number of observation, $\sigma^2 p$ = parent variance.

Skewness (K3), the third degree statistics and kurtosis (K4), the fourth degree statistics estimated to understand the distribution of different character in a population (Roy 2000).

$$\text{Skewness} = K3 = \frac{\sum (xi - \mu)^3 / N}{\sum (xi - \mu)^2 / N} \times \sqrt{\sum (xi - \mu)^2 / N}$$

Skewness shows epistasis effected expression of a character. If K3 equals to zero, there is no epistasis, K3>0, there are complementary epistasis gene action, and K3<0, there are duplicate epistasis gene action.

$$\text{Kurtosis} = K4 = \frac{\sum (xi - \mu)^4 / N}{\sum (xi - \mu)^2 / N}$$

Kurtosis shows number of gene that controlling a character. If K4>3, has positive value, character is controlled by a few gene and if K4<3, has negative value, so that the character is controlled by many genes.

RESULTS

General Field Condition. Planting conditions at vegetative and generative phases were presented on Figure 1. In early condition, the plants were attacked by snails. The snails attack was then controlled by drying the fields for a week and removing the snails manually. By this way the snails would be difficult to move from one area to another to minimize the spread and plants damage. While in the generative phase when the plants enter seed filling period rice bug and birds attacked the plant. Rice bug was then sprayed with insecticide, while the birds were controlled manually by covering the planting area with net.

Plant Performance. Bintang Ladang had the longest panicle length (27.15 cm) followed by IR77674 (26.62 cm), while Gampai had the shortest panicle length (19.42 cm) (Table 1). The Bintang Ladang x US2 population had the highest average of panicle length (25.90 cm) over the other populations. Panicle weight also showed similar characteristics with panicle length, where the F3 population and parents with long panicles also has an average of panicle weight more than 3.5 g, such as Bintang Ladang x US2 (3.97 g), Bintang Ladang (3.81 g) and IR77674 (3.16 g). Progol x Asahan population also

Figure 1. Planting conditions. Preparation (upper), vegetative phase (lower left), and generative phase (lower right).

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