Genetic diversity of panicle morphological traits of rice (*Oryza sativa* L.)

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Abstract. The variability of rice genotypes is a source of germplasm for rice breeding. As one of the major organs related to yield components in rice, panicle architecture is an important part to be studied, while the information is still limited. The study aimed to obtain information on the diversity of rice genotypes on the panicle character and investigate their relationship within the panicle characters. The experiment was conducted during two seasons using 100 rice genotypes. The analysis of variance showed that genotypes and seasons are significantly different. The character of length of first grain from first node and the number of primary branches increased during the rainy season (rainy season 2015/2016). The performance of panicle traits had been influenced by environment factors regarding to quantitative traits which encoded by multiple genes.

1. Introduction

Food demand is expected to increase anywhere between 59% to 98% by 2050, but the production of staple food especially rice has limited due to environment factors and crop yield which have not achieve maximum production. Nevertheless the superior varieties have been able to increase the national rice production through improving production and stability of rice yields in the green revolution era [1]. The development of new varieties has been widely carried out, such as a new rice type approach which has some characters i.e. small number of tillers (3-4 tillers), small unproductive tillers, 200-250 grains per panicle, plant height of 90-100 cm, thick and sturdy stems, thick leaves, dark green, and erect, the root system is vigor, growth duration is 100-130 days and high yield [2].

The rice yield is determined by the plant growth characters associated with the yield components, especially panicle characters. Rice panicle architecture is very diverse and has specific characteristics within genotypes. The complex branching architecture and the number of grain will determine panicle density [3, 4]. The difference of the number of branches in rice panicles depends on the main stem, tillers, cultivars, crop conditions and environmental factors [5, 6]. Rice panicle is a complex organ consisting of primary, secondary and tertiary branches (Figure 1).

Indonesia has a wide source of germplasm. The use of these genetic diversity in assembling new high yield varieties may concern on the characters that high correlated with grain yield. Genotypes have wide diversity of panicle characters architecture. Vijayalakshmi et al. [7] reported that panicle...
density of genotypes are usually found in upland rice germplasma. Efforts to increase rice production can be carried out by assembling innovation of rice varieties with the main focus of yield components including panicle morphology. This study aimed to observe the morphological diversity of rice panicle characters.

![Figure 1 Architecture of panicle rice](image)

2. Material and Methods
The experiments were conducted in two planting seasons, the first planting season in June - October 2015 (Dry season 2015) and the second planting season in November 2015 - April 2016 (Rainy season 2015/2016) at Babakan Research Station, Bogor.

The genetic materials used were 100 genotypes. The seedling were planted in a row by 12 plants without replication with a spacing of 20 cm x 20 cm. Panicles are harvested after 90% ripe. Morphological observation of panicles was carried out on 3 panicles for each plants with 3 plants for each genotypes. Morphological characters observed consist: panicle length (PL, cm), number of primary branches per panicle (PB), number of primary branches in the first node per panicle (PBN), length of first grain from first node (LFG, cm) and number of nodes on axis per panicle. The experiment design used Randomly Complete Block Design. The data analysis was performed using STAR software.
3. Results and Discussion

The source of genetic materials used was from high variability of national variety and stable advanced lines. The results of variance analysis showed that genotype and season factors were significantly different in the five panicle characters observed (Table 1). There was a high variability of length of first grain from first node (22.7) and the number of primary branches in the first node (18.21). These characters were very diverse as proven by the high CV value in the 100 observed rice genotypes. In contrast to the panicle length character, the number of node and primary branches which only have a low coefficient variation (5.70-8.19). The standard deviation values for genotype factors ranged from 0.56 to 1.58, while for the seasonal factor ranged from 0.05-0.22.

Table 1. Analysis of panicle characters of 100 rice genotypes at Babakan Research Station
Dry Season 2015 and Rainy Season 2015/2016

| Source of Variation | PL  | LFG   | PBN   | PN   | NN   |
|---------------------|-----|-------|-------|------|------|
| Genotype            | 9.28** | 0.53** | 0.51** | 5.68** | 0.99** |
| Season              | 11.54* | 63.83** | 0.02* | 371.04** | 2.29** |
| CV                  | 5.70 | 22.70 | 18.21 | 8.19 | 5.42 |
| Mean                | 27.66 | 2.45 | 1.98 | 14.70 | 10.44 |
| SD Genotype         | 1.58 | 0.56 | 0.36 | 1.20 | 0.57 |
| SD Season           | 0.22 | 0.08 | 0.05 | 0.17 | 0.08 |

Note: * and ** Significantly different at level P <0.05 and P <0.01. CV = coefficient of variation, SD = standard deviation, PL = panicle length (cm), LFG = length of first grain from first node (cm), PBN = number of primary branches on the first node, PB = number of primary branches per panicle, NN = number of nodes per panicle.

The panicle length character observed in 100 rice genotypes had a mean value of 27.90 cm in the first environment and 27.42 cm in the second environment (Figure 2). The mean of the panicle length character in the two growing seasons was 27.66 cm (Figure 3), this showed that the length of panicle did not be influenced by different environments, however, the analysis of most characters has significantly different in seasonal factors caused by the responses of several genotypes showed different performances in both environments.

Branching in panicles consists of primary branches, secondary branches and tertiary branches [8]. In this study, branching observations focused on the number of primary branches. The number of primary branches is one of the determinants of size of rice panicles. This character performance has means of 13.34 branches in the first season and has increased to 16.06 branches in the second season (Figure 4). The mean values of all genotypes were observed in both seasons which has 14.70 primary branches per panicle (Figure 5).
**Figure 2** Distribution of rice genotypes based on panicle length characters at Babakan Research Station in Dry Season 2015 and Rainy Season 2015/2016.

**Figure 3** The mean value of panicle length of 100 rice genotypes in the Babakan Research Station in Dry season 2015 and Rainy season 2015/2016.
4. Conclusion
Rice genotypes have wide variation of panicle characters. All panicle characters observed were significantly differences by genotype and environment. The characters of number of primary branches per panicle, length of filled grain from first node and number of node per panicle were highly significant influenced by environment factors especially in Rainy Seasons. Therefor the interaction
between genetics and environment factor need to be evaluated in further generation of rice planting to find out the character could be a selection character in term of improving yield potential of rice.

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