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Artikel

The Estimation of Genetic Parameters of Yardlong Bean Yield Components (Vigna unguiculata ssp. sesquipedalis)

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ABSTRACT

The estimation of yield component genetic parameters is an important step towards plant breeding activities. This research aims to obtain information about yield components that can be used to increase yield of yardlong bean and accessions of yardlong bean for direct use or breeding materials. The research was conducted at Agrotechnology Innovation centre of Universitas Gadjah Mada, located in Kalitirto, Berbah, Sleman, Yogyakarta. The research materials consist of 29 accessions and 5 high yielding varieties as controls arranged in completely randomized design. Each accession was observed morphologically including days to 75% of flowering, days to first harvest, pod length, pod diameter, number of pods per cluster, number of pods per plant, number of seeds per pod, weight of 100 seeds, seed length, the diameter of seed, potential yield pods per hectare. Observed data were analyzed with ANOVA followed by the estimation of genetic parameters and principal component analysis. The results showed that almost all traits had a high heritability value, except seed length which had a moderate heritability value. Accessions 113, 134, 135, dan 137 could be considered as the promising candidates based on the earliest days to first harvest and highest potential yield.

Keywords: yardlong bean, yield components, genetic parameter

INTRODUCTION

Yardlong beans are easy to develop in Indonesia because they can adapt to diferent agroclimatological zones. Indonesia is deduced as yardlong bean center of origin therefore it has a wide genetic diversity (Deanon and Soriana, 1967). Yardlong beans are among the favorite vegetables in Indonesia and can be consumed as fresh and cooke vegetables (Sutarya et al., 1995). Steamed young yardlong bean leaves can be used as anemia cure (Sarwono, 1998), and it is beneficial for women who are breastfeeding because it can increase breast milk (Sunarjono, 2005). Various uses of long beans can provide promising opportunities. However, the production of yardlong beans every year is declining (Ministry of Agriculture, 2013). The need for vegetables will continue to increase along with population growth and awareness of the importance of vegetable consumption. Efforts to meet the availability of vegetables, especially long beans can be done by

developing new varieties that have special characteristics and good yield through plant breeding. One important step towards carrying out plant breeding activities is to estimate genetic parameters such as genotypic coefficient of variation (GCV), and heritability which can be used in more effective anf efficient selection process.

MATERIALS AND METHODS

The research was conducted at Agrotechnology Innovtion Centre of Universitas Gadjah Mada, located in Kalitirto, Berbah, Sleman, Yogyakarta Special Region. The research materials consist of 29 accessions and with 5 varieties as controls and research was conducted in a completely randomized design with 34 numbers as treatment. The observations include days to 75% of flowering, days to first harvest, pod length, pod diameter, number of pods per bunch, number of pods per plant, number of seeds per pod, weight of 100 seeds, seeds length, diameter of seeds, potential yield pods per hectare. The observed data was statistical analyzed by using ANOVA followed by Scott-Knott test and estimation of genetic parameters with R 3.4.3. The estimated of genotypic coefficient of variation (GCV) was classified for low (0% ≤ 25%), rather low (25% ≤ 50%), quite high (50% ≤ 75%), and high (75% ≤ 100%) (Kearsey and Pooni, 1996). This value is repeated using the highest variation coefficient value of all observed characteristics as a value of 100%. The estimation of broad sense Heritability was considered low (h2 <0.20), medium (0.20 ≤ h2 ≤ 0.50), high (h2> 0.50) (Stansfield, 1991). After obtaining the results of further tests with Scott-Knott, a Principal Component Analysis (PCA) diagram was then made.

RESULTS AND DISCUSSION

This research was conducted at Agrotechnology Innovation Centre, Universitas Gadjah Mada, located in Kalitirto, Berbah, Sleman, Yogyakarta. The research was carried out in a screen house with temperatures was around 31ºC and high humidity is 67.98%. Water was managed properly using drip irrigation. The estimation of genetic parameters in the yield component is carried out to obtain information about the yield component that can be used to assist indirect selection for increasing the yield of yardlong beans. Indirect selection is chosen because direct selection of yield is often difficult due to the complex nature of the results. The diversity of traits consists of qualitative diversity and quantitative diversity. The quantitative characteristics used include days to 75% of flowering, days to first harvest, pod length, pod diameter, number of pods per bunch, number of pods per plant, number of seeds per pod, weight of 100 seeds, seed length, diameter of seeds and potential yield pods per hectare.

In plant breeding activities, there are genetic parameters that have to know the magnitude of the expected value, including the genotypic coefficient of variation (GCV) and heritability in a broad sense (Zulfikri et al., 2015). Table 1 showed that pod length has a quite high genotypic coefficient of variation. This shows that the genotypic coefficient of variation of pod lengths is still high due to the genetic factors of each accession (Trustinah and Iswanto, 2013). A relatively low genotypic coefficient of variation was observed in the number of pods per bunch. Meanwhile, for low genotypic coefficient of variation were

Table 1. Genotype, Genotypic Coefficient of Variation, and Heritability of Yardlong Bean Yield Components

Yield Component	$\sigma^2 g$	GCV (%)		H	
Days to 75% of Flowering	13,376	10,126	Low	0,967	High
Days to First Harvest	15,428	7,459	Low	0,970	High
Pod Length (cm)	814,000	59,877	Quite High	0,974	High
Pod Diameter (cm)	0,007	9,812	Low	0,513	High
Number of Pods Per Bunch	1,028	34,519	Rather Low	1,000	High
Number of Pods Per Plant	20,458	11,313	Low	0,581	High
Number of Seeds Per Pods	7,116	13,733	Low	0,960	High
Weight of 100 Seeds (gram)	9,184	21,244	Low	0,879	High
Seed Length (cm)	0,030	17,074	Low	0,364	Medium
Diameter of Seed (cm)	0,004	10,741	Low	0,824	High
Potential Yield Pods Per Hectare (ton/ha)	10,868	39,693	Rather Low	0,652	High

Note :
Criteria for the Genotypic Coefficient of Variation (GCV): low (0-25%), relatively low (25-50%), quite high (50-75%), high (75-100%) (Kearsey & Pooni, 1996).
Heritability (H) Criteria: low (0 <h2 <0.2), medium (0.2 <h2 <0.5), high (0.5 <h2 <1.0) (Stanfield, 1991).

on the days to 75% of flowering, days to fist harvest, pod diameter, number of pods per plant, number of seeds per pod, the weight of 100 seeds, seed length, the diameter of seed, potential yield pods per hectare.

Heritability in a broad sense is a comparison of the amount of genotype variety with the total magnitude of the variety of phenotypes of a trait. The heritability value is greater than 0 and equal to or less than 1. In table 1, almost all traits have a high heritability, except for seed length that has a medium heritability. Trustinah and Iswanto (2013), said that the current heritability was not an effective selection criterion because the criterion was influenced by environmental, so it can be said that theseed length cannot be used as a reference selection criteria.

Pod length showed high heritability and genotypic coefficient of variation values (table 1) so that they could be used as reference criteria in the initial selection. According to Hapsari and Adi (2010), high heritability followed by high genotypic coefficient of variation can provide opportunities for genetic progress. On the other hand, the number of pods per bunch, days to 75% of flowering, days to first harvest, pod diameter, number of pods per plant, number of seeds per pod, weight of 100 seeds, seed length, diameter of seed, and potential yield pods per hectare have genotypic coefficient of variation and heritability which waere not linear. Effendy et al., (2018) mentioned that environmental factors affected the heritability.

Principal Component Analysis (PCA) is a technique for simplifying a data set by reducing the dimensions of the data set to a smaller dimension while maintaining as much display as possible variations (Lin, 2006). The use of PCA aims to simplify data sets that have a large number of interrelated and observable variables from many dimensions. PCA will be quite effective

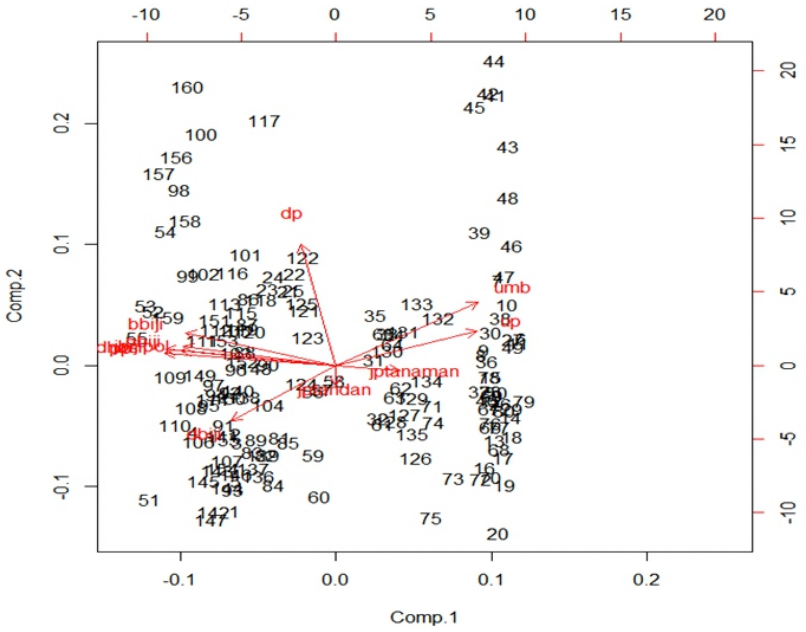

Figure 1. Results of PCA Analysis

if the original variables have a high enough correlation. The specific objectives of PCA are: 1) to summarize the pattern of correlations between observed variables, 2) reduce a large number of variables to a small number of factors, 3) provide an operational definition (a regression equation) the basic dimensions of the use of the observed variable, 4) test the theory the underlying (Lin, 2006). In Figure 1, the results of the PCA analysis show that the accession numbers analyzed have been marked with the numbers 1-170 which was the total number of individuals (from 34 treatments each taken 5 replications). Farmers basically like yardlong beans with an early age, have a pod length between 40-60 cm, and high productivity (Ameriana, 1998). In Figure 1, accessions can be selected with the desired component of the outcome based on the location of the data points towards the direction of the arrow on the PCA graphic. For the days to 75% of flowering, if the direction of arrow is getting up, the longer the period of flowering. In the yield component of days to first harvest, if the arrows go up, the longer the harvest will last, so to choose the accession with the shortest days to first harvest, the data points that are closest to zero or away from the negative direction are selected. For the other components of the result, the direction of the arrow leads to an increasingly large value, so the data points are selected that move away from zero in the negative direction. Squeezed arrows indicated high correlations between variables. Arrows followed by abbreviated letters indicate the value of the yardlong bean yield component whichwere number of pods per bunch (jptandan), days to 75% of flowering (umb), days to first harvest (up), number of pods per plant (jptanam), potential yield pods per hectare (dhasil), pod diameter (dp), diameter of seed (dbiji) , pod length (pp), weight of 100 seeds (seed), seed length (pbiji), number of seeds per pod (jbp). Accessions number 113, 134, 135 and 137 were chosen because they have the best yield components for yardlong beans based on early maturity and yield value of potential yield pods per hectare which have high value.

CONCLUSION

1. Pods length has a wide genetic diversity. Days to 75% of flowering, days to the first harvest, pod length, pod diameter, number of pods per bunch, number of pods per plant, number of seeds per pod, weight of 100 seeds, seed length, diameter of seed and potential yield pods per hectare have varying heritability. Days to 75% of flowering, days to the first harvest, pod length, pod diameter, number of pods per bunch, number of pods per plant, number of seeds per pod, the weight of 100 seeds, the diameter of seed, and potential yield pods per hectare have high heritability. Heritability of seed length is in the medium category.
2. Pod length, number of pods per plant, and potential yield pods per hectare can be the defining characteristic of the yardlong beans yield component.
3. Accessions of yardlong beans with high yield are accessions with numbers 113, 134, 135, and 137.

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