Utilization of Genetic Variability in Mungbean as Food Industrial Raw Material in Indonesia

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***Abstract*—Mungbean is an important legume crops in Indonesia. Most of mungbean production in Indonesia is used for food. Variation seed size of mungbean association with its utilization for food industrial raw material. The aim of this research is to identify mungbean accession based on agronomic characters to meet food industrial raw material. A total of 275 accessions mungbean was grown in ILETRI research station in Malang, Indonesia. The results showed that 16 accessions classified into large seed size (> 6.5 g/100 seed), and 197 accessions classified as small seed size. Five best mungbean accessions showing the largest seed size were MLGV 1019 (7.95 g/100 seed), MLGV 1005 (7.85 g/100 seed), MLGV 0483 (7.83 g/100 seed), MLGV 1018 (7.74 g/100 seed) and MLGV 0508 (7.4 g/100 seed) suitable for food and beverage industry. The five smallest accessions were MLGV P-29 (2.14 g/100 seed), MLGV 0822 (2.24 g/100 seed), MLGV 0592 (2.28 g/100 seed), MLGV 0847 (2.46 g/100 seed), MLGV 0739 (2.61 g/100 seed). Those accessions are suitable for sprout industry.**

***Index Terms*—*Vigna radiata*, seed size, germplasm**

I. Introduction

Mungbean is one of important food crop legumes, after soybean and groundnut in Indonesia. Planting centre of mungbean located in Central Java, East Java, West Java, South Sulawesi, West and East Nusa Tenggara [1]. Most of mungbean production in Indonesia is used for food. The major portion is utilized as bean sprouts, porridge, flour products, beverage products, cakes, noodles, and a small portion of fodder. Traditional foods made from mungbean are bakpia, onde-onde and tauge. The mungbean seeds contain carbohydrates, mineral, and protein. The protein of Indonesian mungbean variety ranged from 18,3-28,02% [2]. According to Nurdiana [3] mungbean has easily digestible protein. Mungbean seeds also contain isoflavons [4].

Trustinah *et al*. [5] reported that each region in Indonesia has a typically preference for mungbean. Some production centers such as Central Java, East Java, West Nusa Tenggara and South Sulawesi, consumer characteristic interest are seed color (dull or glossy) and seed size (small or large). In the regions near to the food and beverage industry, farmers grow large seed mungbean. On the contrary, in the regions near mungbean sprouts industry, farmers grow small seed and green hypocotyls. It means, seed size plays important role for food industry as raw material in Indonesia.

According to Yimram *et al*. [6] 100-seed weight, seed weight per plant, plant height and number of pods per plant expressed high genetic variability with moderate to high heritability and expected genetic advance. Similar result reported by Hapsari [7] that 100-seeds weight and pod length have high heritability. It indicates that 100 seed weight is highly heritable.

In plant breeding program, genetic variability is the primary factor in developing a superior variety. Broad genetic variability allows superior variety can be developed faster. Plant breeders attempt to make their genetic material broader through many programs such as landraces exploration, artificial mutation, and germplasm introduction from other countries. The main targets of mungbean breeding in Indonesia are high yield, early maturing, tolerant to main pest and disease, and suitable for food industry (large or small seed size). Broad genetic diversity needed to achieve mungbean breeding purposes. Lestari *et al*. [8] reported that the collection of diverse local cultivar and their sub-sequent genotyping would enhance germplasm diversity and provide information, both of which are beneficial for developing collection strategies and breeding purposes with desirable agromorphological characteristics. The aim of this research is to identify mungbean accession based on agronomic characters to meet food industrial raw material.

II. Material and Method

The experiment was conducted at Kendalpayak Research Station in Malang. A total of 275 accessions of mungbean germplasm from ILETRI's collection were used in this study. Each accession was planted in plot 2 x 2.5 m with plant spacing of 40 x 15 cm, and two plants was maintained in every hole. Fertilization was done by adding 50 kg Urea, 75 kg SP36, and 75 kg KCl/ha at planting time. Water irrigation and weeding was managed based on soil condition. Insecticides were applied by periodically spraying every five days. Harvesting was undertaken when 95% of the filled pods have already matured. The data was collected on plant height (taken from average of 5 randomly sample plants), days to flowering (50%), days to maturity number of branches per plant (taken from average of 5 randomly sample plants), number of cluster (taken from average of

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5 randomly sample plants), filled pods number (taken from average of 5 randomly sample plants), pod length (taken from average of 5 randomly sample plants), number of seeds per pod (taken from average of 5 randomly sample plants) 100 seed weight, and seed yield per plant were observed.

III. Result and Discussion

The descriptive statistics of 275 mungbean accessions can be seen in Table I. Plant height has the highest range with a standard deviation 20.19 while number of pod cluster and number of branch per plant almost having similar value with standard deviation 0.7 and 0.8. Plant height was highly varied, ranged from 22.5-146.6 cm. High intensity of rainfall during experiment caused plants become taller and some of them fall down. This condition also makes maturing time become late. Number of branch ranged between 0-5 branch per plant with average 1.8. Number of cluster was 3.8-24.4 (average 9.9), number of pod per cluster was 0-4.8 (average 2.6), pod length was 5.92-11.72 (average 8.5), number of seed per plant was 5.6-14.12 (average 11.2), 100 seed weight was 2.14-7.95 (average 4.3), seed yield per plant was 0.97-17.84 (average 8.84).

Character of mungbean 100 seed weight reflects its seed size. Mungbean seed size in Indonesia was divided into three categories, small seed size (< 5 g per 100 seed), medium seed size (5-6.5 g per 100 seed), and large seed size (>6.5 g per 100 seed). In this study, 197 accessions having small seed size, 62 accessions having medium seed size and 16 accessions having large seed size (Fig. 1). Large seed size is one of agronomical characters that used as one criterion in selecting mungbean for food and beverage industry. On the contrary small seed size preferably by sprout industry [5].

TABLE I. Descriptive Statistics of 275 Mungbean Accessions

Characters	Min	Max	Mean	StDev
Plant height (cm)	22.50	146.60	85.81	20.19
Days to flowering	31.00	57.00	41.54	5.46
Days to maturity	60.00	98.00	78.09	10.26
Number of branches per plant	0.00	5.00	1.89	0.81
Number of cluster	3.80	24.40	9.89	4.33
Number of pod per cluster	0.00	4.80	2.65	0.72
Pod length (cm)	5.92	11.72	8.49	1.08
Number of seeds per plant	5.60	14.12	11.22	1.15
100-seed weight (g)	2.14	7.95	4.35	1.27
Seed yield per plant (g)	0.97	17.84	8.84	3.16

Five best mungbean accessions showing the largest seed size were MLGV 1019 (7.95 g/100 seed), MLGV 1005 (7.85 g/100 seed), MLGV 0483 (7.83 g/100 seed), MLGV 1018 (7.74 g/100 seed) and MLGV 0508 (7.4 g/100 seed). All the accessions have green seed coat color and glossy luster, except MLGV 0508 which has dull luster. These accessions are suitable for food and beverage industry. The five smallest accessions were MLGV P-29 (2.14 g/100 seed), MLGV 0822 (2.24 g/100 seed), MLGV 0592 (2.28 g/100 seed), MLGV 0847 (2.46 g/100 seed), MLGV 0739 (2.61 g/100 seed). These accessions are suitable for sprout industry.

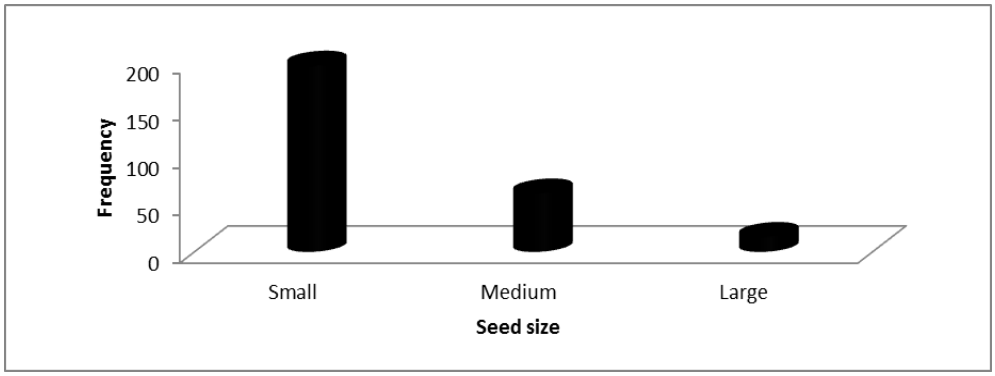

Figure 1. Histogram of seed size of 275 mungbean accessions

Result of correlation analysis showed that seed size had significant positive correlation with pod length but also had significant negative correlation with plant height, number of branch, number of cluster, number of seed per pod, days to flowering, and days to maturity (Table II). It indicates that the more pod length will be followed by increase seed sized. Similar result is also reported by Gul et al [9] where 100-grain weight gave significant positive correlation with pods plant-1 but had significant negative correlation with days to maturity, seeds pods-1 and plant height. Hakim [10] also reported that seed size had negatively correlated with grain yield.

A scatter plot of seed size versus the seed yield was presented in Fig. 2. Medium seed sizes (5-6.5 g per 100 seed) had more possibility to get high yielding compared with large seed size (>6.5 g per 100 seed). Our result in line with Hakim [10] who reported that large seed size tends to possess low yield. Seed size variation including small and large seed size prospective for source of bakery or sprout material or it can be used as gen donor for mungbean breeding purpose related to food industry.

TABLE II. CORRELATION AMONG AGRONOMIC CHARACTERS OF 275 MUNGBEAN ACCESSIONS

Characters	PH	NBR	NCL	PCL	PL	NSP	SYP	FLO	MAT	100SW
PH	1									
NBR	0.171**	1								
NCL	0.475**	0.553**	1							
PCL	0.222**	0.313**	0.163**	1						
PL	-0.071^{ns}	-0.121*	0.313**	-0.21**	1					
NSP	0.288**	-0.124*	0.077^{ns}	0.178**	0.137*	1				
SYP	-0.108^{ns}	0.151*	0.35**	0.434**	-0.05^{ns}	0.232**	1			
FLO	0.627**	0.278**	0.387**	0.352ns	-0.035^{ns}	0.105ns	0.334**	1		
MAT	0.655**	0.28**	0.469**	0.284**	-0.083^{ns}	0.202**	0.181**	0.717**	1	
100SW	0.532**	-0.31**	0.545**	0.021ns	0.571**	-0.21**	0.084ns	0.511**	0.539**	1

PH: plant height, NBR: number of branch, NCL: number of cluster, PCL: number of pod per cluster, PL; pod lenght, NSP: number of seed per pod, SYP: seed yield per plant, FLO: days to 50% flowering, MAT: days to maturing, 100 SW: weight of 100 grains.

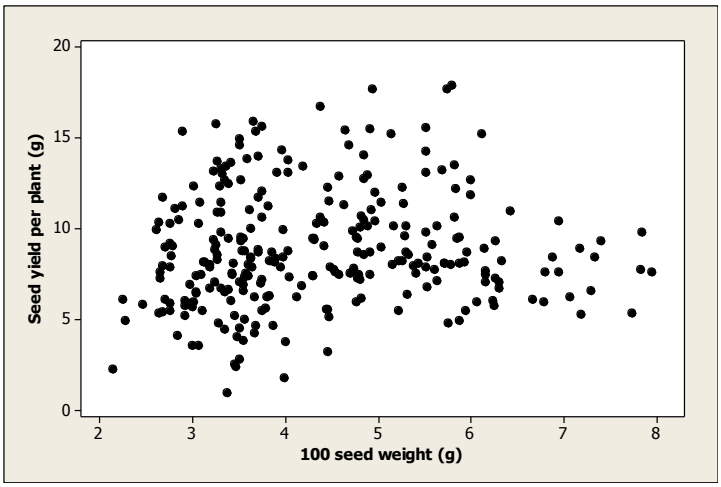

Figure 2. Scater of 100 seed weight vs seed yield 0f 275 mungbean accessions.

IV. CONCLUSION

1. Seed size has significant positive correlation with pod length

2. Seed size variation including small and large seed size prospective for source of bakery or sprout material or it can be used as gen donor for mungbean breeding purpose related to food industry.

3. Five best mungbean accessions showing the largest seed size were MLGV 1019 (7.95 g/100 seed), MLGV 1005 (7.85 g/100 seed), MLGV 0483 (7.83 g/100 seed), MLGV 1018 (7.74 g/100 seed) and MLGV 0508 (7.4 g/100 seed) suitable for food and beverage industry.

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