BIODIVERSITAS
Volume 18, Number 1, January 2017
Pages: 359-364

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d180147

The leaflet shape variation from several soybean genotypes in Indonesia

AYDA KRISNAWATI♥, M. MUCHLISH ADIE♥♥
[1]Indonesian Legumes and Tuber Crops Research Institutes, Jl. Raya Kendalpayak Km 8 Malang 65101, East Java, Indonesia. Tel./Fax.: +62-341-801468/+62-341-801496, ♥email: my_ayda@yahoo.com, ♥♥ mm_adie@yahoo.com.

Manuscript received: 13 July 2016. Revision accepted: 21 January 2017.

Abstract. *Krisnawati A, Adie MM. 2017. The leaflet shape variation from several soybean genotypes in Indonesia. Biodiversitas 18: 359-364.* Leaves are part of the plant organs which are of importance to sustain the plant's life. Generally, each plant has a varied leaflet shape depending on many factors. Soybean, as one of an important source of protein vegetable, has a diverse plant shape among its genotypes. The objective of the research was to evaluate the variation of leaflet shape of 150 soybean (*Glycine max* L.) genotypes and its relation to another growth and morphological characters. The leaflet shape of 150 soybean genotypes was intensively in Kendalpayak Research Station, Malang (Indonesia) from February to May 2016. This field experiment was conducted in randomized block design with two replicates. The leaf characterization of 150 soybean genotypes using LSI (Leaf Shape Index) method. Analysis of variance of observed soybean genotypes in terms of maturity traits and morphological attributes showed a significantly different among soybean genotypes, except for harvest index (HI) parameter. This indicates that there was variability in morphological characters among of 150 soybean genotypes. The LSI value ranged from 1.40 to 3.05, in average of 2.04. Of all observed soybean genotypes, most of their morphological performance was an intermediate size (110 genotypes), while another 17 genotypes was a broad leaflet, and the rest (23 genotypes) had a narrow leaflet. Genotypes with an intermediate leaflet apparently possessed the different morphological characters of seed in terms of size, weight/plant and yield compared to those leaflet shape of other genotypes. Among the broad leaflet group, accession No. 92 could be prospectively used as a gene donor for improving soybean yield potential in Indonesia due to its high yield production (3.05 t/ha), early maturity, and large seed size. In the group of intermediate leaflet, accession No. 18 could also be used as a potential gene donor showed in its high yield production (3.07 t/ha), early maturity, and large seed size. Meanwhile, the potential gene donor in narrow leaflet group, which could be further used were two genotypes (accession No. 20 and No. 22).

Keywords: *Glycine max*, LSI, morphological characters, gene donor

INTRODUCTION

Leaves are the plant main organs for photosynthesis. The size and shape of the leaves varies in each plant depending on various factors including genotypes and geographical region. Soybeans, for example, has the variety of leaflet shape in each different genotypes. Generally, the leaflet shape of local soybeans or an improved soybeans from Indonesia has an intermediate shape between ovate and lanceolate. This is different with soybeans originating from sub-tropical regions, which has an ovate shape. Sawada (1988) reported that the leaflet shape index (LSI) could be used to describe the size of the leaves. Leaf shape index is the ratio of length to width leaflet prior to leaflet shape and size indication. LSI has a correlation with the actual leaf area (Ilkaee et al. 2010).

Leaflet shape is considered as a qualitative trait and less influenced by environmental conditions (Sujata et al. 2011). Leaflet shape has attributed to a single gene, with the homozygous dominant (*LnLn*) and the recessive (*lnln*) genotypes resulting in broad and narrow-leaves (Bernard and Weiss 1973). Research on *G. soja* showed that one or two recessive genes controlling the leaflet narrow shape, which are not allelic to the *ln* gene (Porter 2000). Chen and Nelson (2004) has successfully classified the leaflet shape and size of 661 wild soybeans. Of those wild soybeans classification, they mostly had the length/width ratio ranging from 1.3 to 6.2, and length from 3 to 14 cm. In term of leaflet shape diversity, they were classified into five categories i.e. oval, ovate, lanceolate, linear, and ultra linear while in the leaflet classes, they were three classes i.e. small, intermediate, and large. In Japan, Sawada (1988) determined the limit of leaflet shape index was 2.6 to differentiate between broad and narrow leaflet shape. Leaflet shape and leaflet size are associated with geographical origin. Accessions from South Korea, for example, have the smaller leaflet size than those from China, Japan, and Russia. In addition, accessions from China had more diverse leaflet than those from South Korea or Japan although the biggest leaflet variety was obtained in those from Russia. Nearly all of the accessions with lanceolate and linear leaflets originated from Russia (Chen and Nelson 2004).

Leaflet shape associated with the morphological traits, it may also determine the performance of yield and yield components in soybean. A study conducted by You et al. (1995) in Southern China revealed that the lower number of soybean seeds per pod might be associated with the broader leaflet shape. Similarly, Jeong et al. (2012) also found that narrow leaflet soybean varieties apparently had more seeds per pod than those of broad leaflet varieties. This study has revealed a potential way to improve seed yield. Another study stated that narrow leaflet lines were favourable to yield at high plant population densities and broad leaflet varieties were more favourable to yield at lower plant population densities. A research to optimize the function of leaf area and leaf shape to the photosynthetic rate showed that cultivars with lanceolate leaflets and smaller leaf area possessed the better light distribution through the canopy leading to the higher photosynthetic rates than those with larger oval leaves. Those various facts provide opportunity to increase soybean yield through manipulation of leaf shape (You et al. 1995). Sujata et al (2011) also stated that the leaflet shape i.e. oval, ovate, lanceolate and linear leaflets exhibited considerable range of variation in the plant height, days to flowering, days to maturity, specific leaf weight, and number of pods per plant, harvest index and 100 seed weight. Narrow leaflet plants produced more seeds per pod, but the seed apparently has a small weight, compared to those of ovate leaflet plants, which produced less seeds per pod with the large weight (Dinkins et al. 2002). The availability of genetic variation through breeding program provides a basic selection. Moreover, a breeding program provides valuable information to select diverse parents for hybridization programme. Thus, characterization of genetic variation in several soybean genotypes corresponding to the database collection of soybean gene source is of importance to soybean improvement purposes.

The objective of the research was to evaluate the variation of leaflet shape of 150 soybean genotypes and its relation to another growth and morphological characters.

MATERIALS AND METHODS

The study was conducted at Kendalpayak Research Station, Malang, East Java, Indonesia, in the middle plains (at altitude 429 m above sea level). The field experiment was carried out in wetlands from February to May 2016. The experimental design was randomized block, 150 soybean genotypes as sample trait, and each genotype had two replication. Each genotype was planted in 1.2 m × 4.5 m plot size; 40 cm × 15 cm plant distance, two plants per hill. Fertilizer of 250 kg Phonska/ha with the addition of 100 kg SP 36 was applied after sowing the seeds. Plant maintenance was conducted including irrigation, optimal control of pest and disease and intensive weeding.

Morphological characters were observed on leaf length, leaf width, leaf shape index (LSI), days to flowering, days to maturity, plant height, number of filled pods/plant, number of empty pods/plant, number of branches/plant, number of nodes/plant, 100 seed weight (g), seed/plant (g), seed yield (t/ha), and harvest index (HI). The Leaflet Shape Index (LSI) defined as ratio of leaflet length to width was conducted by measuring the leaflet from the third node of the main stem when the condition of plants was categorized in physiological maturity (R7). An analysis of variance (ANOVA) was conducted for all observed parameters.

The grouping of leaflet shape consisted of: (i) Broad leaflet: $\bar{x}$-2SD, (ii) Intermediate leaflet: $\bar{x}$-1SD $<x<\bar{x}$+1SD, and (iii) Narrow leaflet: $\bar{x}$+1SD. With x = the genotype value, $\bar{x}$ = average value, SD = standard deviation.

RESULTS AND DISCUSSION

Analysis of variance of soybean morphological characters

A significant leaflet variation was found in all observed morphological characters, except for the harvest index (HI) (Table 1). This result implies that there was a different morphological characters among soybean genotypes, which it can be seen from the value of coefficient of variation (CV) ranging from 5.24% to 87.47%. The variety results of the morphological characters among soybean genotypes could also reflect the genetic diversity of soybean. The genetic diversity study is of importance to characterize the morphological and genetic variation of the germplasm. Furthermore, it also crucial study for the establishment of a basis collection by eliminating the redundant accession and identifying the potential lines for future breeding programmes purposes.

Performance of morphological characters

The leaf morphological characters observed in this study consisted of leaf length, leaf width, leaf shape index (LSI). The average of those characters was 9.12 cm (in range of 6.10-11.58 cm), 4.59 cm (in range of 3.20-6.73 cm) and 2.04 (in range of 1.40-3.05), respectively (Table 2). Another plant age morphological characters in terms of the flowering period and maturity period had an average of 33 days (in range of 29.00-39.00 days) and 77 days (in range of 73.00-84 days), respectively. In Indonesia, the maturity period of soybean was grouped into three groups i.e. early maturity (< 80 days), medium maturity (80-90 days), and late maturity (> 90 days). These clustering of maturity period might be different with those of soybean production worldwide. Based on the result of days to maturity, it can be seen that most evaluated soybean genotypes (150 genotypes) had the capacity to obtain an early maturation.

Results of another growth parameters showed that the average of plant height was 55.45 cm (in range of 33.00-74.00 cm). In terms of pods observation, it showed that the average filled pods was 39.89 pod/plant (in range of 22.70-81.80 pods) and the average empty pods were 1.39 pod/plant (in range of 0.10-8.70 pods). Meanwhile, the average branches per plant were 2.88 branches (in range of 0.70-5.30 branches), and the average nodes per plant 10.19 nodes (in range of 7.50-15.50 nodes) (Table 2). In the tropical region, such as Indonesia, plant height reaching to 50 cm is an ideal plant height. Similarly, the number of pods attributing to plant productivity was in optimal conditions (40 pods/plant). Both morphological characters and also other growth morphological characters (number of nodes, number of branches, and number of empty pods) obtained in this study were importance to further create high yielding genotypes.

The morphological characters of soybean seeds observed in this study consisted of seed weight, seed weight per plant, and seed yield (t/ha) with the total samples was 100 seeds per genotype. The average of 100 seed weight was 16.60 g (in range of 13.07-22.65 g), average seed weight per plant was 13.41 g (in range of 6.48-25.78 g), and average seed yield was 2.31 t/ha (in range of 0.90-3.07 t/ha). Those seed morphological characters were in variety when it compared to all observed soybean genotypes. Based on seed size group of 150 soybean genotypes, those seeds were clustered from medium seeds (10-14 g/100 seeds) to large seed (> 14 g/100 seeds). Meanwhile, seed weight per plant and seed yield was in a fairly wide range, which give the possibility to obtain the prospective genetic material of soybean genotypes. The average harvest index (HI) obtained in this study was 0.38, in range of 0.25-0.44. The range of HI showed less variability among tested genotypes, showed in the insignificant result from statistical analysis using ANOVA (Table 1).

The grouping of leaflet shape

LSI defined as the ratio of length to width leaflet, could be used to determine the size and shape of leaves. Based on the leaf characterization of 150 soybean genotypes using LSI method, the results could be as follows: LSI < 1.67 classified as broad leaves, LSI value between 1.67-2.41 classified as intermediate, and LSI > 2.31 classified as narrow leaves. Among 150 soybean genotypes, mostly (110 genotypes) were intermediate, while the number of broad and narrow leaflet were 17 and 23 genotypes, respectively (Figure 1).

LSI and morphological characters

The performance of morphological characters in each group of LSI value was presented in Table 3. There was highly difference among the average of morphological characters in each LSI group. Results from days to flowering, days to maturity, and HI were equivalent to three groups of LSI. Based on plant height character, soybean genotypes grouped of LSI < 1.47 or broad leaflet, had a higher stem performance than other two LSI groups. A similar performance also showed by number of filled pod per plant and seed weight per plant of genotypes in the group of LSI < 1.47. In the group of LSI 1.47-2.41 (intermediate leaflet), the number of branches, number of nodes and weight of 100 seeds were higher than those

Table 1. Analysis of variance of morphological characters 150 soybean genotypes planted at Kendalpayak Research Station, Malang, East Java, Indonesia in 2016

Parameter	Mean Square		CV (%)
	Replication	Genotype	
Leaf length (cm)	27.16826**	1.90471*	12.80
Leaf width (cm)	2.91658*	0.89452**	16.76
Leaf shape index (LSI)	0.26107^{ns}	0.22017**	16.28
Days to flowering (day)	74.00333**	9.08682**	5.24
Days to maturity (day)	88.56333**	11.85031**	2.49
Plant height (cm)	1942.80211^{ns}	112.79102*	16.25
Number of filled pods/plant	1.41453^{ns}	193.43034**	23.29
Number of empty pods/plant	0.03853^{ns}	2.50960**	87.47
Number of branches/plant	1.77100^{ns}	1.08040**	29.09
Number of nodes/plant	1.61333^{ns}	3.17145**	14.50
100 seed weight (g)	10.37880*	5.55585**	7.52
Seed/plant (g)	72.42253**	21.47234**	23.61
Seed yield (t/ha)	28.58253**	0.34471**	18.47
Harvest index (HI)	0.00136^{ns}	0.00173^{ns}	11.23

Note: ns = not significant, ** = significant at 1% probability level (p<0.01), * = significant at 5% probability level (p<0.05)

Table 2. The mean and range value of morphological characters of 150 soybean genotypes planted at Kendalpayak Research Station, Malang, East Java, Indonesia in 2016

Parameter	Mean	Range	Standard Deviation
Leaf length (cm)	9.12	6.10-11.58	1.22
Leaf width (cm)	4.59	3.20-6.73	0.76
Leaf shape index (LSI)	2.04	1.40-3.05	0.37
Days to flowering (day)	33	29.00-39.00	3.38
Days to maturity (day)	77	73.00-84.00	6.69
Plant height (cm)	55.45	33.70-74.00	8.71
Number of filled pods/plant	39.89	22.70-81.80	10.29
Number of empty pods/plant	1.39	0.10-8.70	1.12
Number of branches/plant	2.88	0.70-5.30	0.77
Number of nodes/plant	10.19	7.50-15.50	1.50
100 seed weight (g)	16.60	13.07-22.65	2.13
Seed/plant (g)	13.41	6.48-25.78	3.43
Seed yield (t/ha)	2.31	0.90-3.07	0.45
Harvest index (HI)	0.38	0.25-0.44	0.04

Table 3. Performance of morphological characters in each LSI group of soybean genotypes planted at Kendalpayak Research Station, Malang, East Java, Indonesia in 2016

Parameter	LSI					
	< 1.47		1.47 <x< 2.41		> 2.41	
	Mean	Range	Mean	Range	Mean	Range
Leaf length (cm)	8.24	6.10-10.23	9.14	7.03-11.05	9.68	8.28-11.58
Leaf width (cm)	5.24	3.80-6.73	4.66	3.50-6.05	3.75	3.20-4.30
Leaf shape index (LSI)	1.59	1.40-1.66	1.99	1.69-2.40	2.63	2.42-3.05
Days to flowering (day)	33.00	30.0-38.0	32.00	29.00-39.00	33.00	30.00-37.00
Days to maturity (day)	77.00	74.00-83.00	77.00	73.00-84.00	77.00	74.00- 82.00
Plant height (cm)	56.99	46.00-73.70	55.19	33.70-74.00	55.78	42.60-68.05
Number of filled pods/plant	42.01	24.10-59.30	40.54	22.70-81.80	35.18	25.30-48.90
Number of empty pods/plant	1.60	0.60-4.00	1.39	0.10-8.70	1.23	0.30-3.70
Number of branches/plant	2.86	0.70-4.20	2.91	1.30-5.30	2.73	1.60-3.73
Number of nodes/plant	10.18	7.50-13.50	10.25	7.50-15.50	9.89	7.50-12.00
100 seed weight (g)	16.06	13.95-18.93	16.69	13.27-22.65	16.55	13.07-20.23
Seed/plant (g)	14.06	8.29-21.76	13.29	6.48-25.78	13.54	7.42-19.82
Seed yield (t/ha)	2.31	1.70-3.05	2.30	0.90-3.07	2.38	1.81-2.87
Harvest index (HI)	0.39	0.34-0.41	0.38	0.25-0.44	0.39	0.35-0.43

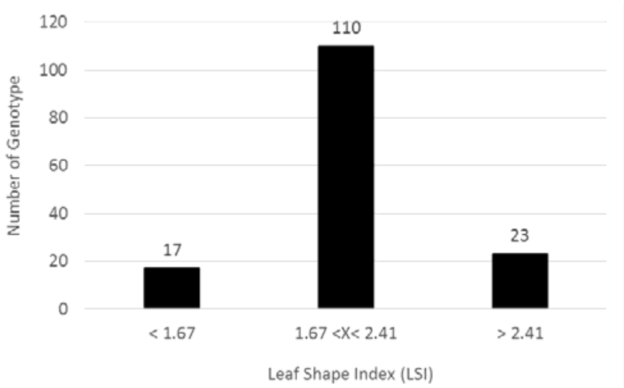

Figure 1. The grouping of LSI from 150 soybean genotypes (Malang, East Java, Indonesia 2016)

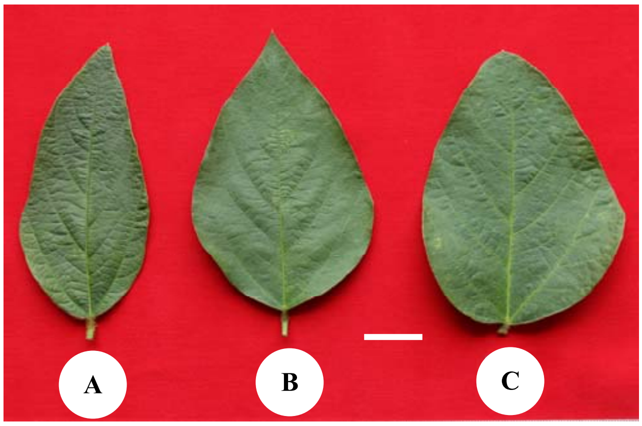

Figure 2. Variation in leaflet shape among 150 soybean genotypes. A = narrow leaflet, B = intermediate leaflet, C = broad leaflet. Bar = 2 cm

obtained in the group of broad and narrow leaflet. Genotypes with narrow leaflet (LSI > 2.41) have less number of empty pods and higher yield than those obtained in genotypes with broad and intermediate leaflet.

The analysis of the maximum value of morphological characters, particularly related to the character of 100 seed weight, seed weight per plant, and seed yield was observed. In the group of intermediate leaflet, genotypes with those observed seed characters possessed a higher value than those in broad or narrow leaflet. The maximal value of seed characters in the group of intermediate leaflet was 100 seed weight (22.65 g), seed weight per plant (25.78 g), and seed yield (3.07 t/ha). The characterization of LSI value was associated with the performance of the morphological characters. This LSI characterization was of importance to determine superior genotypes, which useful to broaden the genetic diversity. Furthermore, it also gives possibility to create a new improved variety, which could properly grow in tropical country such as in Indonesia.

Discussion

Genetic variability is of fundamental asset to improve the economic value of a cultivar including the high seed yield. In addition, the availability of genetic diversity can increase the genetic population, and also become an interest study to plant breeders. Various studies in several countries indicate that the existing varieties in a country become less wide of genetic diversity. Navabi et al. (2014) who studied in all dry bean varieties released from 1930 to 2010, stated the presence narrow genetic diversity of Canadian dry beans, hence the breeding efforts by introducing a new genetic diversity was needed to broaden its variability. The similar pattern also showed by Oda et al. (2015) who studied soybean breeding for 40 years. They concluded that the presence of the varietal diversity was the result of lack of genetic diversity from the parental varieties. In Indonesia, the government, so far, has released 84 soybean varieties. Based on the examination of the genetic background of the parental, those varieties also showed a possibility to have a narrow genetic diversity. Therefore, the richness of soybean genetic diversity is of importance to broaden the diversity of the release varieties.

The grouping of leaflet shape based on LSI value of 150 soybean genotypes has resulted in three groups of leaflet size, i.e. broad leaflet (17 genotypes), intermediate leaflet (110 genotypes), and narrow leaflet (23 genotypes). Broad leaflet has the value of LSI < 1.67, while intermediate leaflet has value of LSI in range from 1.67 to 2.41, and the rest, narrow leaflet, has the value of LSI > 2.41. In Japan, Sawada (1988) who studied the crossing result between broad leaflet soybean and narrow one, found that the value of LSI < 2.6 was constantly used to classify the broad leaflet while the value of LSI > 2.6 was used to classify the narrow leaflet. Porter et al. (2000) classified the leaf shape into ovate and narrow leaflet, but Dinkins et al. (2002) used different classification of the leaf shape, which is used in this study i.e. narrow, intermediate, and ovate leaflet. Standardization of LSI value to classify the leaflet shape depends on use of the genetic material and the country of origin. This was consistence with study conducted by Porter et al. (2000) who reported that narrow leaflet trait is mostly found in some Asian cultivars. Chen and Nelson (2004) also stated that leaflet shape and leaflet size are associated with geographical origin. Accessions from South Korea were generally smaller than those from China, Japan, and Russia. Accessions from China had more leaflet variation than those from South Korea or Japan but those from Russia were the most variable leaflet shape among the mentioned countries. Apparently, all of the accessions with lanceolate and linear leaflets originated from Russia.

The leaflet shape was qualitatively inherited. Sawada (1988) who crossed the broad leaflet soybean cultivars (‘Kitakomachi’) with narrow (‘Isuzu’ and ‘Toiku 187’), has successfully obtained the broad and intermediate F2 phenotypes with a perfect ratio of 3: 1. Previous study conducted by Bernard and Weiss (1973) has found that the leaflet shape was attributed to a single gene, with the homozygous dominant (*LnLn*) and the recessive (*lnln*) genotypes, which phenotypically showed in broad and narrow-leaved, respectively. The heterozygote (*Lnln*) was subjected to intermediate leaflet. Bernard and Weiss assigned a new gene symbol, *ln*, to the narrow leaflet trait. Similarly, Dinkins et al. (2002) reported that leaflet types were genotypically marked as follows: narrow leaflet (*ln/ln*), intermediate leaflet (*Ln/ln)*, and ovate leaflet (*Ln/Ln*).

One of the important characters in the plant is the leaf, regardless of the size, shape, and position of leaves in plants. Leaf area is directly related to basic plant metabolic system, especially photosynthesis and respiration. The measurement of leaf area at several stages during the life cycle of the plant is needed to quantify the analysis of several growth parameters. The variation in the amount number of assimilates synthesis (source capacity), in the capacity for storage of assimilates (sink size), and in the efficiency of the transport system may resulted in the variety of crop yields (Bueno 1979). Classification of leaflet shape of 150 Indonesian soybean genotype resulted in the diverse leaflet shape, which can be seen in the various morphological characters in each leaflet shape group. Seed yield in soybean is of complex characters, which are determined by various morphological components, mutually depending on one or more characters. To acquire the economically value of genotype in each leaflet shape group, it would be reasonable if it only focused on the maximum value of each of morphological characters in each leaf shape group. Economically, the valuable characters for soybean in Indonesia could be divided into two groups. The first character is directly related to seed characters i.e. 100 seed weight, seed yield per plant, and seed yield per hectare. The second group is plant height, plant age, and number of pods. In this study, the first group based on the seed characters was obtained in the intermediate leaflet group. The highest 100 seed weight was 22.65 g, the highest seed yield per plant was 25.78 g, and the highest seed yield/ha was 3.07 t/ha. In second group, the days to maturity of three leaflet shape group was apparently the same amount of time around 73 days. Plant height between broad and intermediate leaflet group were also similar, while narrow leaflet group tended to produce a lower plant height. The highest number of pods was produced by genotype with intermediate leaflet shape. Based on the results, high seed yield in soybeans might be related to a high stem (plant height), because it might stimulate the increased number of pods and the harvest index value.

Numerous studies attributed to leaf size and morphology characters have been conducted on various plants, although the results are different depending on the genetic resources used. Sammour (2014) who studied morphological, cytological and biochemical characterization of soybean germplasm reported that soybean accessions from different collection resulted in a wide range of phenotypic variation including morphological and yield traits. This variation was useful traits for determining: (i) the gene pool in each different collected of accession, and (ii) the tolerant genotypes to drought stress and other abiotic stress limiting the soybean yield. Mandl and Buss (1981) found the seed weight differences between broad and narrow leaflet soybean isolines. Narrow leaflet plants consistently had smaller seeds than broad leaflet plants. Bernard and Weiss (1973) found that a new gene symbol, *ln*, is responsible for lanceolate leaflets and a high number of seeds per pod in soybeans. Yan et al (2014) also found that accessions with round leaves were primarily characterized by obvious characters in terms of main stems, gray pubescence, white flowers, non-sooty seed coats, yellow seed coats, brown hilum, high 100-seed weight, low protein content and high oil content. In contrast, accessions with line leaflet shape was shown in the morphological performances such as twining stems, brown pubescence, purple flowers, sooty seed coats, black seed coats, black hilum, low 100-seed weight, high protein content and low oil content. Positive correlations were significantly observed between seed weight and leaf area, which was categorized as unifoliate (r=0.80**), first trifoliate (r=0.75**) and third trifoliate (r=0.67**), respectively (Park et al. 2013).

The correlation between the leaf sizes and photosynthesis efficiency has been reported in many researches. A study conducted by Suh et al. (2000), found that most of the progenies possessed more lanceolate leaf type than oval leaf types. Cultivars having lanceolate leaflets and smaller leaf area produced a better light distribution through the canopy and higher photosynthetic rates than those with larger leaf area and oval leaves. You et al. (1995) who studied soybean leaflet shape and its correlation to the number of seeds per pod concluded that its positive correlation was useful to improve seed yield in southern China. Narrow leaflet lines were favourable to produce yield in the high plant population densities, but on the contrary, broad leaflet varieties were more favourable to yield at lower plant population densities. Furthermore, narrow leaflet plants could also be used to improve canopy architecture and enhance the number of seeds per pod, of favourable cultivars in southern China to increase seed yields. Wells et al. (1993) also reported that narrow leaflet shape in soybean also provides an opportunity to substantially alter the canopy architecture, by genetically manipulating canopy structure genetically in order to change light environments leading to the increase level of plant productivity. In Indonesia, soybean planted using monoculture and intercropping system, even more of them was planted under annual crops. Hence, narrow-leaved soybean genotypes could potentially be used as a source of genes for the improvement of soybean production on those conditions.

Based on this research, it can be concluded that of the 150 observed genotypes, mostly (110 genotypes) had intermediate leaflet shape, 17 genotypes with broad leaflet shape, and 23 genotypes were narrow leaflet shape. Soybean genotypes with intermediate leaflet shape had the advantage of many characters such as seed size, seed weight per plant, and seed yield. Among the broad leaflet group, accession No. 92 was prospectively used as gene donor for improving soybean yield potential in Indonesia with yield production reached 3.05 t/ha, early maturity (79 days), and large seed size (16.48 g/100 seed). In the group of intermediate leaflet, accession No. 18 was prospective line to be further developed with the yield production reached 3.07 t/ha, the days to maturity around 75 days, and large seed size (16.92 g/100 seed). Meanwhile, in narrow leaflet group, there were two genotypes, which could be of value as gene donor, i.e. accession No. 22 (seed yield 2.87 t/ha, maturity period to 82 days, seed size 3.93 g/100 seed), and accession No. 20 (seed yield 2.69 t/ha, the maturity period for 76 days, and seed size 17.11 g).

ACKNOWLEDGEMENTS

We thank Antony who has helped during the field research, and all persons who give valuable input in order to improve this manuscript. This research was supported by Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture RI.

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