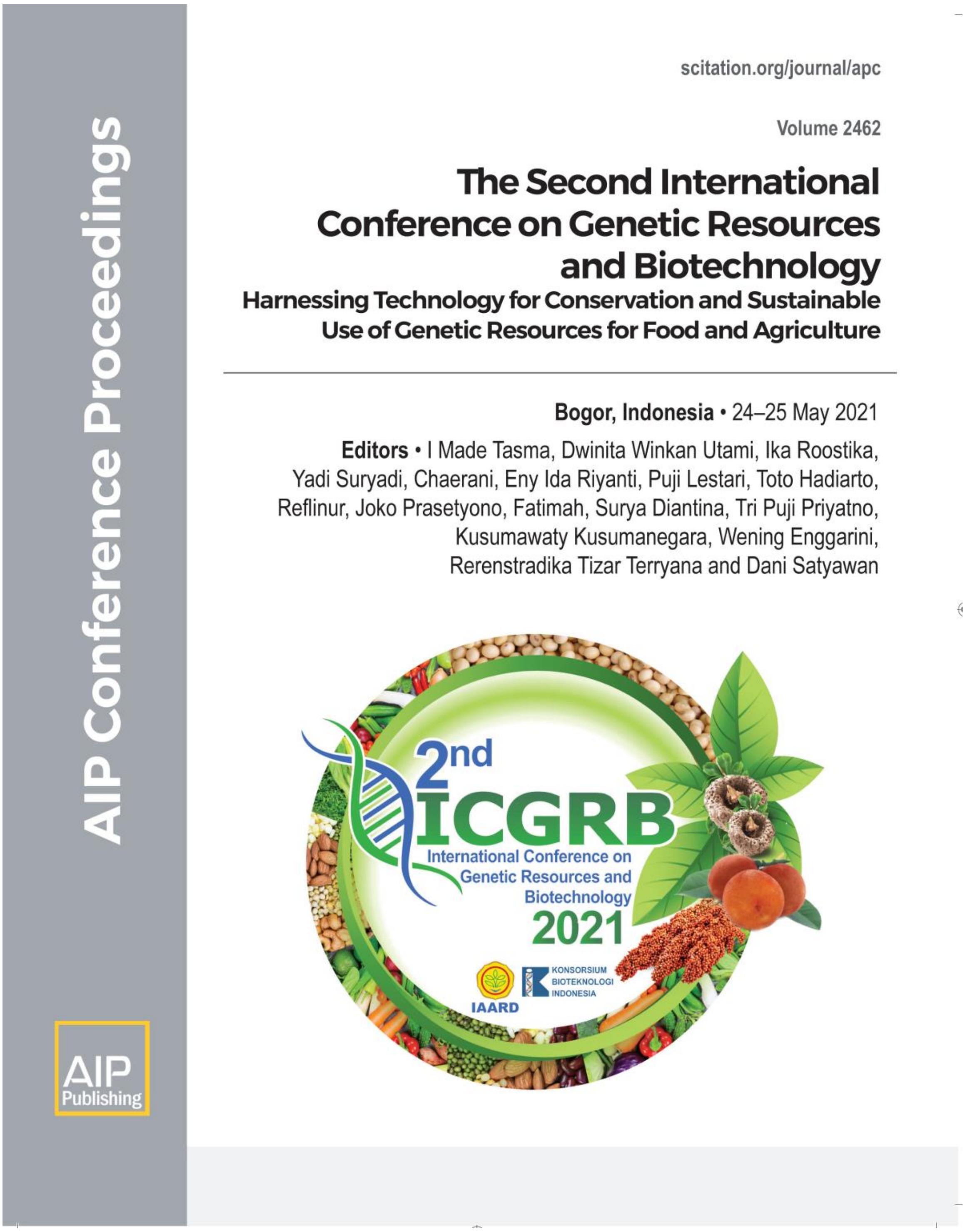

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THE SECOND INTERNATIONAL CONFERENCE ON GENETIC RESOURCES AND BIOTECHNOLOGY: Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture

Committees: The Second International Conference on Genetic Resources and Biotechnology

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Preface: The Second International Conference on Genetic Resources and Biotechnology

The Second International Conference on Genetic Resources and Biotechnology, which is the continuation of the first event held in 2018, focuses on topics related to advances in biotechnology to create more opportunities for effective conservation and sustainable utilization of genetic resources for food and agriculture. This year conference's theme is Harnessing Technology for Conservation and Sustainable Use of Genetic Resources for Food and Agriculture. The conference was organized by Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Indonesia, in collaboration with Indonesian Biotechnology Consortium and held on 24^{th}-25^{th} of May 2021virtually due to the pandemic of COVID-19.

The conference aims to share and exchange current scientific information and technological developments on biotechnology and their applications for conservation and sustainable use of genetic, to encourage and promote quality, efficiency, and modernization of management and utilization of genetic resources, and to facilitate national and international collaboration among participants. There are five scopes discussed in this conference. They are effective management of conservation and sustainable use of genetic resources for food and agriculture, application of genomics and molecular markers for genetic resource conservation and crop adaptation to climate change, application of innovative crop improvement techniques for conservation and sustainable use of plant genetic resources for food and agriculture, plant cell and tissue culture for conservation and effective utilization of genetic resources, and the use of microbial genetic resources as biological control agents of agricultural pests and diseases, and for soil bioremediation.

Five speakers from the United States of America, Japan, India and Indonesia were invited to discuss about their expertise and knowledge on relevant subjects in the plenary sessions. This conference was attended by more than 100 participants including 75 presenters and 44 listeners worldwide. They came from diverse governmental, private, or academic institutions and also scientific communities. The presented materials have undergone peer review processes and only qualified papers were selected. Furthermore, all papers were subjected to double blind peer-review and expected to meet the scientific criteria of significance and academic excellence to be published in a conference proceedings indexed in a well-known, reputable service.

We would like to express our sincere gratitude to our speakers, presenters and all participants for their contributions in this conference. We would also like to express our appreciation for the generosity of our sponsors that support this conference: PT CropLife, PT ITS Science Indonesia, PT Fajar Mas Murni and PT Prima Instrument Analitika. Lastly, special thanks to all committee members for their exceptional work and contributions in the conference and publication.

Chair of Organizing Committee

Dr. Toto Hadiarto

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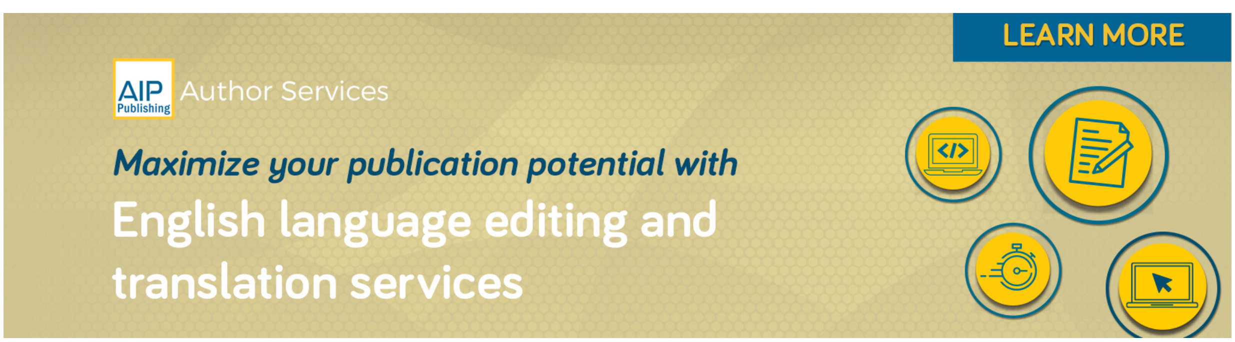

Characterization and Interrelationships of the Number of Vessel Bundles with Yield Components in Various Genotypes of Soybean (*Glycine max* [L.] Merrill)

Anna S. Karyawati[a)] and Dyah P. Fitrawantio

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Abstract. Soybean is the third most important source of vegetable protein and agricultural commodity in Indonesia. Physiological results of soybean crop are determined by the relationship source strength and sink capacity. Source is associated with assimilation of CO_2, and sink is associated with a photo-assimilate allocated to storage or plant growth. Physiological characters of the number of vessels there is the xylem-phloem tissue cannot be separated but has different functions, so affect growth and yield of crops. Therefore, to increase productivity of soybeans it is necessary to examined the relationship between number of vessels and soybeans yield. The purpose of this study was to assess the diversity of vessels number and correlation of vessel number and yield in 36 genotypes of soybean. Research was conducted in the Agro Techno Park, University of Brawijaya, Jatikerto, Kromengan District, Malang Regency, East Java Province from March to June 2020. The research used randomized block design with three replications. The observation of vessel number was conducted in Plant Breeding Laboratory, Faculty of Agriculture, University of Brawijaya. Data was analyzed using Scott-Knott's test facilitated by SASM-Agri application and the correlation analysis by OPSTAT application. The results showed that the number of vessels of soybean plants in the range of 10.5–17.5. Genotypes that have a large number of vessel bundles are genotypes Anjasmoro × Argopuro, Anjasmoro × UB2, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Tanggamus, Argopuro × Grobogan, Argopuro × UB1, Argopuro × UB2, Grobogan × UB2, UB1 × Tanggamus, UB1 × UB2, Anjasmoro, Argopuro, and Tanggamus. Moreover, it was discovered that the number of vessels was positively correlated with plant heigh ($r = 0.333$) and negatively correlated with the number of empty pods ($r = -0.365$). Although, number pod empty pods had no significant effect on the various soybean genotypes.

INTRODUCTION

Soybean is a source of vegetable protein and the third most important agricultural commodity in Indonesia. National soybean production in Indonesia decreased in 2012–2013. The production was 843,153 tons in 2012, meanwhile it was 779,992 tons in 2013. In 2014 and 2015 soybean production increased to 954,997 tons and 963,193 tons, respectively. At this time domestic soybean production is able to meet 35% of soybean demand and imported soybeans have increased by an average of 7.73% per year [1].

Efforts to reduce imported soybeans can be done by increasing the soybean planting areas, soybean productivity, and production efficiency. Increasing productivity can be done by developing the superior soybean varieties that have high yield characteristics [2, 3]. The growth and production of soybeans has a broad concept in the field of physiology [4, 5].

Physiologically, soybean yields are determined by the source-strength and sink-capacity relationships [6, 7]. This source-sink relationship is very complex in the process of supplying photosynthate, its translocation, and the mobilization systems [8]. Research results by Sarawa *et al*. [9] showed that the distribution of photosynthate in soybeans is characterized by the accumulation of more photosynthate in the leaves. Leaves (source) that are still active, including organs capable of producing excess photosynthate, can affect the large sink capacity. The sink (seeds) response to source-sink changes during the seed filling period depends on the level of photosynthate in the

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seeds and the ability of the seeds to respond to changes in photosynthate supply [10–12]. Source-sink balance is an important factor in regulating photosynthesis [13].

Physiological characters in the form of the number of vascular bundles (vessels) in the xylem and phloem tissues have different functions. Xylem and phloem are tissues that play a role in the movement (transport) of substances in the plant body. The transport of xylem is mainly water and solutes (inorganic substances) and phloem translocate organic compounds (photosynthate) [14]. The vascular bundles in the xylem functions to transport water and mineral nutrients, while the phloem vessel functions to distribute photosynthetic results [15, 16]. The distribution of photosynthate to all parts of the plant affects plant growth and yield [17–19]. Therefore, this study was conducted to assess the diversity of vessels number and correlation of vessel number and yield in 36 genotypes of soybean.

MATERIALS AND METHODS

Research was conducted at the Agro Techno Park, University of Brawijaya, Jatikerto Village, Kromengan District, Malang Regency, East Java Province and at the Plant Breeding Laboratory, Faculty of Agriculture, University of Brawijaya. The research was carried out during March–June 2020.

The genetic materials were F_6 seeds resulting from the development of segregated population genotypes from the crosses of six parents in diallel crossing, which consisted of Anjasmoro (AJM), Tanggamus (TGM), Argopuro, Grobogan (GBG), Brawijaya-1 (UB1), and Brawijaya-2 (UB2).

The randomized block design (RBD) were applied of 36 treatments, namely 30 genotypes of F_6 and 6 parents, each of which was repeated three times. The observation of yield components on quantitative variables is based on the International Union for the Protection of New Varieties of Plants, UPOV-issued plant descriptors (Table 1).

Data Analysis

Data was analyzed using Scott-Knott's test facilitated by SASM-Agri application and the correlation analysis by OPSTAT application.

RESULTS AND DISCUSSIONS

Number of Stomata

Results of the analysis of variance showed that the 36 soybean genotypes tested show a significant variation in the number of stomata. The number of stomata from 36 genotypes showed a range of 25–47. The genotypes that have the most number of stomata are Anjasmoro × Tanggamus, Anjasmoro × UB2, Tanggamus × UB2, Argopuro × Anjasmoro, Argopuro × Tanggamus, Argopuro × Grobogan, Grobogan × Anjasmoro, Grobogan × Argopuro, UB1 × Anjasmoro, UB1 × Tanggamus, UB1 × Argopuro, UB1 × Grobogan, UB2 × Tanggamus, UB2 × Argopuro, Grobogan, and UB2 (Table 2).

The Vessels Diameter

The vessels diameter of the 36 soybean genotypes did not show significant variation (P = 0.321). The minimum value is 283.2 µm for the genotype AJM × UB2, and the maximum value is 537.2 µm for the Anjasmoro × Grobogan genotype (Table 2).

Chlorophyl Index

The chlorophyll index of the 36 soybean genotypes tested was in the range of 37.03–47.70. Genotypes that have a high chlorophyll index are Tanggamus × Argopuro, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Grobogan, Grobogan × Tanggamus, UB2 × Anjasmoro, and Argopuro (Table 2).

Chlorophyll index affects the photosynthetic capacity of the photosynthetic tissue [20, 21]. Increasing crop yields can be done with a strategy to increase source capacity, namely the rate of photosynthetic tissue [22].

TABLE 1. Quantitative characteristic parameters of soybean based on the International Union for the Protection of New Varieties of Plants.

No.	Parameter	Implementation	Time
1	Plant height	Measurements were made from the base to the growing point	Observations were made at the growing phase of R3, soybean pods were formed
2	Number of branches	Calculated by counting the number of branches on the main stem	Observations were made at the growing phase of R3, soybean pods were formed
3	Number of fertile nodes	Observations were made by counting the total number of fertile nodes of plants that produce pods	Observations were made at the growing phase of R3, soybean pods were formed
4	Number of filled pods	Observations were made by manually counting the number of pods, filled pods	Executed postharvest
5	Number of empty pods	Observations were made by manually counting the number of empty pods (no seeds)	Executed postharvest
6	Number of pods per plant	Observations were made by adding up the number of empty pods with the number of filled pods	Executed postharvest
7	Seed weight per plant	Observations were made by weighing the total seeds produced by each plant	Executed postharvest
8	∑ Stomata	Observations were made by smearing the surface of the leaf with nail polish, attaching the insulation to the part that had been given nail polish, then removing it and observing it using a microscope	During destructive observations/observations were made during the R3 growing phase, soybean pods were formed
9	∑ Chlorophyll	Observations were made by taking the fourth leaf from above, mashed and filtered using filter paper, then observed the chlorophyll content on a spectrophotometer	During destructive observations/observations were made during the R3 growing phase, soybean pods were formed
10	∑ Vessel element	Observations were made by cutting the middle stem then observed under a microscope	Observations were made destructively/in the V3 and R3 phases, in the third book the leaf stalks on the fourth leaf have opened and are growing perfectly
11	Root length (root)	Observations were made by measuring the roots from the growing point of the root to the tip of the root	During destructive observations/while conducting observations during the R3 growing phase, soybean pods were formed
12	Plant wet weight	Observations were made by weighing the separated plant parts and then weighing them with an analytical balance	Executed postharvest
13	Plant dry weight	Observations were made by weighing the plant parts that has been in the oven	Executed postharvest
14	Yield (t/ha)	This is done by weighing the entire plant using a scale	Executed postharvest
15	Number of seeds per plant	Observations are carried out manually counting	Executed postharvest
16	Stem diameter	Observations were made by measuring the diameter of the stem with a caliper	During destructive observations/observations were made during the R3 growing phase, soybean pods were formed
17	Leaf area (leaf area meter/LAM)	Observations were made with LAM	Observations were carried out destructively/in the V3 phase, in the third book the leaf stalks on the fourth leaf have opened and are growing perfectly

Number of Vessels

The results of the analysis of the variance in the number of vessel bundles in the 36 soybean genotypes tested showed a significant difference. The number of vessels from 36 soybean genotypes showed variation in the range of 10.5–17.5. Genotypes that have a large number of vessel bundles are genotypes Anjasmoro × Argopuro, Anjasmoro × UB2, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Tanggamus, Argopuro × Grobogan, Argopuro × UB1, Argopuro × UB2, Grobogan × UB2, UB1 × Tanggamus, UB1 × UB2, Anjasmoro, Argopuro, and Tanggamus (Table 2).

TABLE 2. Average of stomata number, vessels diameter, chlorophyll index, and number of vessels of 36 soybean genotypes.

No.	Genotype	Number of stomata	Diameter of vessels (μm)	Chlorophyl index	Number of vessels
1.	AJM × TGM	43.50 b	470.7 a	42.57 a	14.0 a
2.	AJM × AGP	29.00 a	471.3 a	42.52 a	15.0 b
3.	AJM × GBG	34.50 a	537.2 a	44.73 b	13.5 a
4.	AJM × UB1	28.00 a	383.2 a	43.37 a	14.0 a
5.	AJM × UB2	46.00 b	283.2 a	43.15 a	14.5 b
6.	TGM × AJM	32.00 a	358.3 a	40.08 a	14.0 a
7.	TGM × AGP	36.50 a	420.6 a	47.70 b	13.0 a
8.	TGM × GBG	29.50 a	402.4 a	41.20 a	13.5 a
9.	TGM × UB1	32.00 a	417.4 a	45.08 b	15.5 b
10.	TGM × UB2	44.50 b	365.7 a	46.10 b	15.5 b
11.	AGP × AJM	38.50 b	437.4 a	43.47 a	14.0 a
12.	AGP × TGM	41.00 b	424.0 a	39.57 a	17.0 b
13.	AGP × GBG	38.00 b	370.6 a	45.90 b	17.5 b
14.	AGP × UB1	35.00 a	365.6 a	43.40 a	15.5 b
15.	AGP × UB2	34.00 a	422.1 a	40.28 a	16.0 b
16.	GBG × AJM	42.50 b	353.8 a	40.25 a	13.5 a
17.	GBG × TGM	33.00 a	460.3 a	46.67 b	14.0 a
18.	GBG × AGP	39.00 b	334.6 a	43.07 a	13.5 a
19.	GBG × UB1	30.50 a	389.7 a	43.55 a	14.0 a
20.	GBG × UB2	33.00 a	374.7 a	37.03 a	14.5 b
21.	UB1 × AJM	38.50 b	403.4 a	41.58 a	13.5 a
22.	UB1 × TGM	46.00 b	424.1 a	43.67 a	15.5 b
23.	UB1 × AGP	39.00 b	407.4 a	42.52 a	11.0 a
24.	UB1 × GBG	46.50 b	398.9 a	39.50 a	12.0 a
25.	UB1 × UB2	34.00 a	309.5 a	43.15 a	14.5 b
26.	UB2 × AJM	28.00 a	487.1 a	46.88 b	12.5 a
27.	UB2 × TGM	40.50 b	337.4 a	42.07 a	11.0 a
28.	UB2 × AGP	47.00 b	494.8 a	42.52 a	12.5 a
29.	UB2 × GBG	34.50 a	527.1 a	43.35 a	12.0 a
30.	UB2 × UB1	37.00 a	376.7 a	41.17 a	14.0 a
31.	AJM	25.00 a	393.4 a	43.20 a	15.5 b
32.	AGP	31.00 a	354.7 a	45.68 b	15.5 b
33.	GBG	47.00 b	398.0 a	47.50 b	10.5 a
34.	TGM	31.50 a	466.1 a	40.25 a	15.0 b
35.	UB1	32.00 a	438.2 a	40.30 a	13.5 a
36.	UB2	38.50 b	359.5 a	42.18 a	14.0 a
Min.		25.00	283.20	37.03	10.50
Max.		47.00	537.20	47.70	17.50
CV (%)		11.94	23.21	7.00	10.70

AJM = Anjasmoro, AGP = Argopuro, GBG = Grobogan, TGM = Tanggamus, UB1= Brawijaya-1, UB2 = Brawijaya-2. Numbers followed by the same letter in one column are not significantly different in the Scott-Knott's test at P<0.05.

Da Silva *et al*. [23] reported that in soybeans plants, the sink tissues greatly affect the seed yield. CO_2 assimilation occurs in the sink tissues where photosynthate is allocated for growth or storage. Source and sink affect the size of the grain size and the grain yield of soybeans. The source and sink tissues correspond to the vascular bundle number, and the strength of the sinks to take up assimilates are also varied. Strong sinks get assimilates faster and more than weak sinks. Sink strength can be determined by size, activity, and growth stage of plant. During the plant growth phase, there may be environmental influences such as drought stress which can affect the xylem and phloem vascular tissues.

The diversity of the number of vessel bundles had a relationship with the character of soybeans yield components, such as seed weight per plant, number of seeds per plant, number of filled pods, number of pods per plant, and grain yield. The genotypes that had the highest number of vascular bundles and correlated with the yield components were Tanggamus × UB2, Grobogan × UB2, and UB1 × UB2 (Fig. 1).

(a) (b) (c)

FIGURE 1. Vessels of the soybean genotypes Tanggamus × UB2 (a), Grobogan × UB2 (b), and UB1 × UB2 (c).

Number of Pods per Plant

The number of pods per plant of the 36 soybean genotypes showed significant differences in the range of 41.00–108.75. The genotypes that have the most pods are Anjasmoro × Grobogan, Anjasmoro × UB1, Anjasmoro × UB2, Tanggamus × Anjasmoro, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Anjasmoro, Argopuro × Tanggamus, Grobogan × UB2, UB1 × Anjasmoro, UB1 × Argopuro , UB1 × Grobogan, UB1 × Tanggamus, UB1 × UB2, UB2 × Anjasmoro, UB2 × Tanggpamus, UB2 × Argopuro, UB2 × Grobogan, UB2 × UB1, Anjasmoro, Tanggamus, and UB2 (Table 3).

Number of Filled Pods per Plant

Results of the variance analysis on the number of filled pods of the 36 soybean genotypes showed significant variation in the range of 82.72–97.61. The genotypes that have the most filled pods are Anjasmoro × Grobogan, Anjasmoro × UB1, Anjasmoro × UB2, Tanggamus × Anjasmoro, Tanggamus × Argopuro, Tanggamus × Grobogan, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Anjasmoro, Argopuro × Tanggamus, Argopuro × UB1, Argopuro × UB2, Grobogan × Anjasmoro, Grobogan × UB2, UB1 × Anjasmoro, UB1 × Argopuro, UB1 × Grobogan, UB1 × Tanggamus, UB1 × UB2, UB2 × Anjasmoro, UB2 × Argopuro, UB2 × Grobogan, UB2 × UB1, Anjasmoro, Tanggamus, and UB2 (Table 3).

Number of Empty Pods

The number of empty pods did not show a significant variation ($P = 0.373$). The number of empty pods from 36 soybean genotypes showed a minimum value of 2.39 and a maximum value of 17.28. The highest number of empty pods was found in the Grobogan genotype (Table 3).

Number of Seeds per Plant

The results of variance analysis showed that 36 soybean genotypes showed a significant variation in the number of seeds. The number of seeds per plant shows a range of 72.00–255.83. The genotypes that have the most number of seeds per plant are the genotypes of Tanggamus × Anjasmoro, Tanggamus × UB1, Tanggamus × UB2, Argopuro

× Anjasmoro, Grobogan × UB2, UB1 × Argopuro, UB1 × Grobogan, UB1 × UB2, UB2 × Argopuro, UB2 × Grobogan, UB2 × UB1, and Tanggamus (Table 3).

TABLE 3. Some agronomic characters of 36 genotypes and the parents of soybean.

No.	Genotypes	Pod number per plant	Number of filled pods (%)	Number of empty pods (%)	Number of seeds per plant	Seeds weight per plant (kg)	Weight of 100 seeds (g)	Yield (t/ha)
1.	AJM × TGM	61.33 a	97.15 a	2.85 a	131.83 a	16.31 a	12.70 b	2.09 a
2.	AJM × AGP	66.83 a	95.01 a	4.99 a	142.25 a	14.76 a	12.57 b	1.89 a
3.	AJM × GBG	76.58 b	96.84 b	3.16 a	162.92 a	22.53 a	14.73 b	2.88 a
4.	AJM × UB1	76.50 b	96.95 b	3.05 a	164.58 a	24.64 a	13.52 b	3.16 a
5.	AJM × UB2	81.67 b	96.43 b	3.57 a	160.67 a	17.92 a	12.52 b	2.29 a
6.	TGM × AJM	108.75 b	96.78 b	3.22 a	255.83 b	28.53 a	11.31 a	3.65 a
7.	TGM × AGP	50.08 a	95.34 b	4.55 a	117.92 a	20.56 a	18.45 c	2.63 a
8.	TGM × GBG	62.33 a	95.99 b	4.01 a	141.33 a	19.94 a	12.96 b	2.55 a
9.	TGM × UB1	84.08 b	96.83 b	3.17 a	181.58 b	23.00 a	11.91 a	2.95 a
10	TGM × UB2	82.33 b	95.75 b	4.25 a	198.83 b	25.06 a	12.84 b	3.21 a
11	AGP × AJM	80.83 b	97.22 b	2.78 a	204.08 b	22.83 a	12.01 a	2.92 a
12	AGP × TGM	72.92 b	96.34 b	3.66 a	146.58 a	20.09 a	14.96 b	2.57 a
13	AGP × GBG	45.92 a	94.37 a	5.63 a	100.00 a	15.96 a	14.80 b	2.04 a
14	AGP × UB1	64.67 a	95.88 b	4.12 a	144.17 a	18.18 a	11.94 a	2.33 a
15	AGP × UB2	64.75 a	95.37 b	4.63 a	141.33 a	16.03 a	13.40 b	2.05 a
16	GBG × AJM	68.58 a	96.48 b	3.52 a	172.83 a	23.10 a	12.94 b	2.96 a
17	GBG × TGM	52.58 a	96.20 a	3.80 a	103.67 a	19.93 a	18.06 c	2.55 a
18	GBG × AGP	57.58 a	95.22 a	4.78 a	126.92 a	19.99 a	18.41 c	2.56 a
19	GBG × UB1	57.33 a	92.30 a	7.70 a	118.25 a	17.39 a	17.37 c	2.23 a
20	GBG × UB2	76.00 b	95.29 a	4.71 a	191.75 b	25.54 a	13.28 b	3.27 a
21	UB1 × AJM	80.17 b	96.26 b	2.70 a	172.08 a	18.20 a	11.08 a	2.33 a
22	UB1 × TGM	73.08 b	95.32 b	4.68 a	139.67 a	20.64 a	12.00 a	2.64 a
23	UB1 × AGP	83.33 b	96.10 b	3.90 a	227.25 b	26.95 a	11.77 a	3.45 a
24	UB1 × GBG	87.17 b	96.46 b	3.54 a	210.42 b	24.37 a	11.38 a	3.12 a
25	UB1 × UB2	79.75 b	96.34 b	3.66 a	209.58 b	25.06 a	12.65 b	3.21 a
26	UB2 × AJM	71.50 b	95.45 b	4.55 a	145.42 a	19.76 a	12.45 b	2.53 a
27	UB2 × TGM	71.75 b	94.08 a	5.92 a	158.67 a	20.29 a	12.20 b	2.60 a
28	UB2 × AGP	105.50 b	96.60 b	3.40 a	232.92 b	21.58 a	10.34 a	2.76 a
29	UB2 × GBG	99.00 b	97.47 b	2.53 a	241.67 b	26.70 a	10.60 a	3.42 a
30	UB2 × UB1	82.08 b	96.35 b	3.65 a	210.33 b	22.78 a	10.58 a	2.92 a
31	AJM	72.83 b	95.54 b	4.46 a	143.67 a	21.84 a	14.65 b	2.80 a
32	AGP	53.33 a	94.84 a	5.16 a	126.42 a	17.55 a	13.35 b	2.24 a
33	GBG	41.00 a	82.72 a	17.28 a	72.00 a	18.19 a	20.30 c	2.33 a
34	TGM	88.25 b	96.41 b	3.59 a	181.25 b	18.57 a	10.14 a	2.37 a
35	UB1	62.42 a	94.41 a	5.34 a	157.08 a	22.48 a	14.14 b	2.88 a
36	UB2	73.08 b	97.61 b	2.39 a	165.92 a	24.29 a	13.83 b	3.11 a
	Min.	41.00	82.72	2.39	72.00	14.76	10.14	2.04
	Max.	108.75	97.61	17.28	255.83	28.53	20.30	3.65
	cv (%)	20.80	22.07	55.95	25.92	23.18	9.96	23.18

AJM = Anjasmoro, AGP = Argopuro, GBG = Grobogan, TGM = Tanggamus, UB1 = Brawijaya-1, UB2 = Brawijaya-2. Numbers followed by the same letter in one column are not significantly different in the Scott-Knott's test at P<0.05.

Seed Weight per Plant

Of the 36 soybean genotypes analysed, the weight of seeds per plant did not vary. The minimum seed weight per plant is 14.76 kg and the maximum value is 28.53 kg. The genotype with the highest seed weight per plant was the Tanggamus × Anjasmoro (Table 3) (P = 0.657).

Weight of 100 seeds

The weight of 100 seeds of the 36 soybean genotypes studied showed the significant variation. Value of the 100 seeds weight shows a range of 10.14–20.30 g. The genotypes with the highest weight of 100 seeds are Tanggamus × Argopuro, Grobogan × Tanggamus, Grobogan × Argopuro, Grobogan × UB1, and Grobogan (Table 3).

Grain Yield

Results of the analysis of variance showed that the 36 soybean genotypes tested showed no significant variation in grain (seeds) yield. The seed yield of 36 genotypes showed a minimum value of 2.04 t/ha and a maximum value of 3.65 t/ha. The genotype with the highest seed yield was Tanggamus × Anjasmoro (Table 3) (P = 0.242).

The Tanggamus elder has superior character in terms of number of seeds per plant, number of pods per plant, filled pods, seed yield, and seed weight per plant. This is in line with the results of research by Dwiputra *et al*. [24] that the Tanggamus elders are superior cultivars with high yields and high adaptability. The weight of 100 seeds and empty pods in Grobogan parents was heavier and had more empty pods. This is in line with Susanto *et al*. [25] who state that the Grobogan variety has large size seeds, weight of 100 seeds >15 g. The number of empty pods in soybean plants is influenced by environmental factors. Planting in the dry season, soybeans are very sensitive to pod losses, as well as when it rains during the generative growth phase [26].

Correlation of Vessels and Yield Component of Soybeans

The results of the correlation analysis showed that the number of vessels had a significant positive correlation with the plant height (r = 0.333) (Table 4). This is because the stage of plant growth depends on the location of the meristem. Secondary growth occurs because root and shoot growth activities take place progressively, and cause plant size increases [27]. Parenchyma cells in the stem separate the vessel bundles and fuse with cortical cells [28].

TABLE 4. Correlation of the vessels number and other characters of 36 soybean genotypes.

Characters	NFN	NB	PH	SY	W100	WSP	NFP	NEP	NPP	NSP
NFN	1									
NB	-0.060 ns	1								
PH	0.427**	-0.251 ns	1							
SY	-0.169 ns	0.331*	-0.082 ns	1						
W100	-0.264 ns	-0.417*	-0.165 ns	-0.280 ns	1					
WSP	-0.169 ns	0.330*	-0.082 ns	1.000**	-0.281 ns	1				
NFP	0.137 ns	0.513**	0.045 ns	0.636**	-0.774**	0.637**	1			
NEP	-0.148 ns	-0.145 ns	-0.431**	-0.073 ns	0.283 ns	-0.074 ns	-0.182 ns	1		
NPP	0.126 ns	0.520**	0.017 ns	0.626**	-0.765**	0.627**	0.997**	-0.128 ns	1	
NSP	0.010 ns	0.516**	0.005 ns	0.754**	-0.745**	0.755**	0.937**	-0.166 ns	0.929**	1
NV	0.213 ns	-0.036 ns	0.333*	-0.310 ns	-0.059 ns	-0.309 ns	-0.120 ns	-0.365*	-0.128 ns	-0.203 ns

NFN = Number of fertile nodes, NB = Number of branches, PH = Plant height, SY = Seed yield, W100 = Weight of 100 seeds, WSP = Weight of seeds per plant, NFP = Number of filled pods, NEP = Number of empty pods, NPP = Number of pods per plant, NSP = Number of seeds per plant, NV = Number of vessels, ns = not significant, * = significant at P=0.05, ** = significant at P=0.01

The number of vascular bundles was significantly negatively correlated with the number of empty pods (r = -0.365) (Table 4). The greater the number of bundle vessels, the less empty pods. The formation of these empty pods is due to the limited amount of photosynthate allocated for pod and seed formation during the pod development phase. The source and sink of photosynthate correspond to the bundle of vessels, and the power of the sink to uptake assimilates. Strong sinks acquire faster and more assimilate than weak sinks. The strength of the sink is related to the size, activity, and stage of plant growth [23].

CONCLUSION

The number of vascular bundles (vessels) of 30 genotypes and 6 parents varies widely, in each genotype of soybean plants in the range of 10.5–17.5. Genotypes that have a large number of vessel bundles are genotypes Anjasmoro × Argopuro, Anjasmoro × UB2, Tanggamus × UB1, Tanggamus × UB2, Argopuro × Tanggamus, Argopuro × Grobogan, Argopuro × UB1, Argopuro × UB2, Grobogan × UB2, UB1 × Tanggamus, UB1 × UB2, Anjasmoro, Argopuro, and Tanggamus. Moreover, it was discovered that the number of vessels was positively correlated with plant heigh (r = 0.333), but negatively correlated with the number of empty pods (r = -0.365). Although, number pod empty pods had no significant effect on the various soybean genotypes.

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REFERENCES

1. I. H. Ningrum, H. Irianto and E. W. Riptanti, IOP Conf. Ser. Earth Environ. Sci. **142**, 1–8 (2018).
2. X. X. Hao, H. L. Jiang and J. J. Wu, Agric. Sci. **2**, 4–7 (2000).
3. Y. Alia, A. Baihaki, N. Hermiati and Y. Yuwaria, Zuriat **15**, 4–30 (2004).
4. S. Gay, D. B. Egli and D. A. Reicosky, Agron. J. **72**, 387–391 (1980).
5. J. E. Specht, D. J. Hume and S.V. Kumudini, Crop Sci. **39(6)**, 1560–1570 (1999).
6. H. Zhao and H. Zheng, Soybean Sci. **28**, 736–738 (2009).
7. L. Xie and D. Huang, *Advanced Engineering and Technology* (CRC Press, London, 2014), 740 p.
8. P. Basuchaudhuri, Indian J. Plant Sci. **5(2)**, 19–25 (2016).
9. Sarawa, A. A. Anas and Asrida, J. Agroteknos **4(1)**, 26–31 (2014).
10. D. B. Egli and J. E. Leggett, Agronomy J. **68(2)**, 371–374 (1976).
11. M. M. Peet and P. J. Kramer, Plant Cell Environ. **3(3)**, 201–206 (2006).
12. J. M. Fu, G. L. Zhang, F. Su, Z. L. Wang, Y. Dong and C.Y. Shi, Acta Agron. Sin. **25**, 169–173 (1999).
13. J. Kaur, "Physiological evaluation of source-sink relationships in soybean (*Glycine max* L. Merrill) genotypes under variable photoperiods," Master thesis, Punjab Agricultural University, 2014.
14. D. F. Cutler, C. E. J. Botha, D. W. Stevenson and D. William, *Plant Anatomy: An Applied Approach* (Wiley-Blackwell Publishing, Hoboken, 2008), 302 p.
15. S. Carlquist, Brittonia **65(2)**, 477–495 (2013).
16. S. Payvandi, K. R. Daly, D. Jones, P. Talboys, K. C. Zygalakis and T. Roose, Bull. Math. Biol. **76**, 566–596 (2014).
17. K. E. Koch and L. E. Schrader, Plant Physiol. **75(4)**, 1040–1043 (1984).
18. T. R. K. Rao and M. C. Ghildiyal, Indian J. Plant Physiol. **28(2)**, 135–144 (1985).
19. Y. Chen, J. Anhui Agric. Sci. **35**, 2251–2258 (2007).
20. B. R. Buttery and R. I. Buzzell, Can. J. Plant Sci. **57(1)**, 1–5 (1977).
21. F. B. Fritschi and J. D. Ray, Photosynthetica **45**, 92–98 (2007).
22. Mastur, Bul. Tan. Tembakau Serat Minyak Indon. **7(1)**, 52–68 (2015).
23. A. J. Silva, J. R. M. Filho, C. R. G. Sales, R. C. M. Pires and E. C. Machado, Bragantia **77(1)**, 23–35 (2018).
24. A. H. Dwiputra, D. Indradewa and E. T. Susila, Vegetalika **4(3)**, 14–28 (2015).
25. G. W. A. Susanto, N. Nugrahaeni, *Pengenalan dan Karakteristik Varietas Unggul Kedelai* (Balai Penelitian Tanaman Aneka Kacang dan Umbi, Malang, 2017), pp. 17–28.

26. H. Semangun, *Penyakit-Penyakit Tanaman Pangan di Indonesia* (Gadjah Mada University Press, Yogyakarta, 1991), 451 p.
27. J. Maghfiroh, "Pengaruh intensitas cahaya terhadap pertumbuhan tanaman," in *Prosiding Seminar Nasional Pendidikan Biologi dan Biologi* (Universitas Negeri Yogyakarta, Yogyakarta, 2017), pp. 51–57.
28. G. Singh, *The Soybean: Botany, Production and Uses* (CABI International, Wallingford, 2010), 494 p.