Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 201815(3):2019-2028. **OPEN ACCESS**

The performance of soybean genotypes as the result of hybridization on leaf rust disease

Mohammad Setyo Poerwoko[1], Nurul Sjamsijah [2], Kacung Hariyono [3], Slameto [4]

[1]Plant Breeding, Agronomy Study Program of Agriculture Faculty of Jember University, **Indonesia**
[2]Plant Breeding, Seed Technology, Polytechnic State Jember, **Indonesia**
[3]Plant Breeding, Agro technology Study Program, Faculty of Agriculture, Jember University, **Indonesia**
[4]Crop Physiology, Agronomy Study Program of Agriculture Faculty of Jember University, **Indonesia**

***Correspondence:** moh_setyo_poerwoko@yahoo.com **Accepted: 0**7 July. 2018 **Published online:** 26 Aug. 2018

Soybean is the third commodity of main food commodities after rice and corn. The demand for soybean every year is increasing, while soybean production is still low. One factor which might be the delimiter of soybean production is leaf rust disease caused by *Phakopsora pachyrhizi*, Syd. The purpose of this research is to know the performance from seven soybean genotypes as the result of F5 generation hybridization on leaf rust diseases. The experimental design used was Randomized Cluster Design (RCD) consisting of 13 genotypes with 3 replications. 1 Plot consists of 5 rows of plants. The research result showed that (GHJ-3 x Rajabasa) indicated a short-aged variety that was 86 hst compared to the other soybean genotype hybridizations, however Malabar was more short-aged than P3R that was 84 hst. The result of code rating showed that (GHJ-3 x Rajabasa), P3D (GHJ-3 x Dering), and P3P2 (GHJ-3 x GHJ-2) was 123 which meant R (Resistant), while the code rating of the other genotypes showed 111 which meant I (Immune).

Keywords: soybean, leaf rust, growth, production

INTRODUCTION

Soybean is the third commodity of main food commodities after rice and corn. The need for soybeans in Indonesia every year is always increasing along with the increase of population and the improvement of income per capita, while the production of soybean is still low or even decreasing. The domestic needs for soybeans every year indicates production 1.9 million tons of dried beans in average, but the national production capability has just reached 843.1 thousand tons or about 44.4% of it (*Kementrian Pertanian RI*, 2014).

To support the government program to increase soybean production, land utilization has been held on both rice fields and dry lands by using short-aged soybean variety. The cropping pattern on rice fields is rice-rice-soybean or rice-rice-soybean, while the cropping pattern on dry lands is rice- soybean or rice-other palawija. The rainfall on those cropping patterns is already low so that they are often threatened by drought and the period for soybean cultivation is relatively short, it is less than 80 days, so that short-aged soybean variety is needed (Asadi, 2013).

Leaf rust disease is one of the factors that inhibit the soybean production increase and stabilization in Indonesia. The existence of leaf rust disease is caused by Phakopsora pachyrhizi, Syd. The leaf rust attack can cause the photo-synthesis process agitated since the plant leaves do not work properly. If the photosynthesis process is agitated, it could decrease the soybean products in about 20-80%. The soybeans attacked by rust leave disease can cause economic losses.

High productivity is largely determined by the production power potential of the cultivated varieties. Variety plays an important role in soybean production because the genetic potential of variety gives greatly affection to gain high productivity. Every variety will show different appearance. This thing is caused by different genotype responses on different environments that cause appearance differences (phenotype) in every plant. Phenotype appearance is influenced by a different character from genetic or environ- ment (Mangoendidjojo, 2003). High productivity potential can be gained if superior varieties are cultivated on proper environments that support the plants growth.

The varieties used in this research were Rajabasa, Dering, GHJ-2, and GHJ-3. The result of their hybridi- zations was resistant to leaf rust disease on their F1 and there was only 1 that is categorized as slightly resis-tant, namely Dering. The soybean genotype which belonged to short-aged was the result of Rajabasa and Dering hybridization, Rajabasa and GHJ-2 hybridization, and Dering and GH-3 hybridization with the age of maturity of 73.00 days. The highest weight of the seed for each plant was gained from Rajabasa and Dering hybridization that was 53.32 g.

The soybean genotype on F2 showed that 1 genotype which is resistant to leaf rust disease is the result of Rajabasa and Dering hybridization. 5 genotypes belong to slightly vulnerable and 11 others belong to slightly resistant. The charac- teristic derivation from resistant to slightly resistant is caused by environment factor. The maturity age of soybean seed is 73-82 days. The genotype which belongs to short-aged is the result of GHJ-2 and Dering hybridization, GHJ-3 and Rajabasa hybridization, GHJ-3 and GHJ-2 hybridization with the maturity age of seed 73.67 days. The genotype of soybean on F2 generation indicated the production result of 2.95-4.43 t/ha. The result of GHJ-2 and GHJ-2 hybridization indicated the highest production result of 4.43 tons/hectare.

The F3 generation shows that the criteria of resistance to leaf rust disease indicated that there are 2 criteria which are slightly resistant, they are Dering and the result of GHJ-3 and Dering hybridization. The genotypes which belong to short-aged variety are GHJ-2, the result of GHJ-2 and Dering hybridization, GHJ-3 and Dering hybridization, and GHJ-3 and GHJ-2 hybridization with maturity age of the seed 70 days. The F3 generation results 3.21-4.21 tons/hectare and the highest production is gained from GHJ-3 and Dering hybridization which values 4.21 tons/hectare.

This research uses 4 soybean varieties namely Rajabasa, Dering, GHJ-2, and GHJ-3, and some results of hybridization which have been selected from F4 generation. The results of those hybridizations are hoped can produce derivations whose characteristic short- aged, high productivity, and resistant to leaf rust disease. Therefore, the exami- nation on F5 generation should be done to know the performance of 7 results of hybridization between Rajabasa, GHJ-2, and GHJ-3.

The problems of the research can be formulated as follows. At what age are seven soybean genotypes of F5 generation hybridization harvested? How is the production process of seven soybean genotypes of F5 generation hybridi-zation? How is the resistance of seven soybean genotypes of F5 generation hybridization.

The objectives of the research can be stated as follows. First, seven soybean genotypes of F5 generation hybridization are hoped can produce short-aged derivations. Second, seven soybean genotypes of F5 generation hybridization are hoped can produce derivations with high produc- tivity. The last, seven soybean genotypes of F5 generation hybridization are hoped can produce derivations which are resistant to leaf rust disease.

The significance of the research is stated as follows. The result of this research can be used as beneficial input for farmers to know about the short- aged variety with high productivity and resistant to leaf rust disease, so that the economy of the farmers in Indonesia could be improved.

The hypotheses of the research are formulated as follows. First, seven soybean genotypes as the result of F5 generation hybridization show different ages of maturity. Second, seven soybean genotypes of F5 generation hybridization result show different resistances to leaf rust disease.

REVIEW OF RELATED LITERATURE

Nature of Soybean

Soybean is one of seasonal plants, the type of plants that can only be planted once and cannot be harvested repeatedly. Every soybean variety indicates different harvest age. Harvest age itself is influenced by some factors, for instance variety type and the height of cropping field. The maturity age of soybean is about 75-110 days, while the soybean that will be seed on the next cropping period can be picked at the age of 100-110 days, so that the maturity of the seeds really perfect and evenly. The maturity age of soybean can be classified as three groups, they are short-aged, middle-aged, and deep- aged. Soybean belongs to short-aged one if the maturity age of the soybean is about 75-85 dap, while 85-90 dap belongs to middle-aged, and the soybean with the maturity age more than 90 dap belongs to deepaged (Kilkoda, 2015).

One of the alternatives to increase the production results of soybean is by using superior varieties. To gain superior varieties it must be tested first. The appearance of a genotype in different environment will also result in different performance. The different performances of the plants on their growing environment are the effect of the interaction between their genetic factor and their environment. The performance of a plant variety is really helpful for plant breeding program because it can help to identify superior genotype. The common way used to recognize ideal genotype is by testing a set of genotypes or prospect furrows of some environments (Sumiasih et al., 2014).

The Important Definition on Leaf Rust Disease

Leaf rust disease is main disease in soybean cultivating. It usually infects the plants which have age in about 30 dap. Soybean plants which are infected by the disease before forming pods will greatly affect the pods formation, pods filling, and seeds formation, so that the products of soybean decrease. In contrast, if the disease attacks the plants after they have made and filled their pods, it will make the products relatively low. The infected leaved of the plant will inhibit the pods formation and finally it could cause the alleviation of the soybean seed quality and soybean products. It is happened due to the infected leaves that makes the plant cannot do photosynthesis process properly and undergo miscarriage earlier. The time of disease infection affects how large the loss, if the infection occurs earlier, the loss will be higher. Leaf rust disease can decrease the soybean products quite high at the phase of pods formation and pods filling. The infected soybean plants have smaller seed size than the healthy soybean plants have. The production loss caused by leaf rust disease could reach up to 29-90% (Suryanto, 2010).

The Symptoms and Causes of Leaf Rust Disease

Picture 1. Symptom of rust attack on the under surface of soybean leaf (Ramlan and Nurjanani, 2011)

According to Santoso and Sumarmi (2013), leaf rust disease attacks some plant parts like leaves, stalks and stems. The symptom of leaf rust disease occurs when little spots on the leaves consisting gray uredium will gradually turn into dark brown. Those spots are visible before the boils (postule) burst. The spots seem like having angles because of the leaf bones restriction especially near the infected leaves. The spots are surrounded by yellow halos/rings. Then, the spots start to get bigger or united and becomes to have dark brown color or even black when the plant starts to bloom (Picture 1). The symptom of leaf rust disease usually is started from the leaves on lower parts to the younger leaves. The spots are usually found on the under surface of leaves, but some of them are also found on top surface of the leaves. Leaf rust disease often attacks the old soybean plants. There will be color changing of the infected leaves from green to brown, and then the leaves become dry and fall out. The leaf rust attack on soybean seeds will cause the seeds become empty (Fachruddin, 2000).

Resistant to Leaf Rust Disease of Soybean Superior Variety

The types of varieties that can be used to result soybean superior varieties are Rajabasa and Dering 1. According to Badan Litbang Pertanian (2012), Rajabasa variety belongs to one of the superior varieties which is slightly resistant to leaf rust disease. Rajabasa is also resistant to buckle and adaptive to sour lands. Raja basa is middle-aged in about 85 days and the weight of Rajabasa seeds is 15 g/100 seeds. Rajabasa has potential to produce 3.90 tons/hectare. The size of Rajabasa seeds is big.

Balai Penelitian Kacang-kacangan and Umbi-umbian (in Badan Litbang Pertanian, 2013) states that Dering 1 is the result of mono hybridization between superior variety Davros and MLG 2984. The variety of Dering 1 has characteristic that resistant to buckle and leaf rust disease P. Pachyrhizi. The maturity age of Dering 1 is 81 days. The excellence of Dering 1 is that it has the potential to produce high results until 2.8 tons/hectare with the seed weight 10.7 gram/100 seeds. The shape of Dering seeds is oval. Dering 1 cultivation is prospective when it is developed in dry season (MKII) on former rice fields or soybean production centers with limited water availability.

GHJ-2 is the result of hybridization between Malabar and Unej 1. It is determination type. The maturity age of GHJ-2 is about ±74 days. GHJ-2 produces weight about ±16.38 g/100 seeds with average production about ±2.17 tons/hectare. The shape of GHJ-2 soybean seeds is round oval.

GHJ-3 is the result of hybridization between Unej 2 and Malabar. It is determination type. The maturity age of GHJ-3 is about ±73 days. GHJ-3 produces weight about ±15.58 g/100 seeds with average production about ±2.27 tons/hectare. The shape of GHJ-3 soybean seeds is round oval.

The varieties of soybean that can be used for comparing the short age to leaf rust resistance are Malabar and Ringgit. According to Badan Penelitian and Pengem-bangan Pertanian (2007a), Malabar is the result of hybridization between variety No. 1592 and Wilis. The age for blooming is 31 days and the maturity age of the pods is 70 days. Malabar can be used to compare to short-aged. Its weight for every 100 seeds is 12 gs. Malabar is slightly resistant to leaf rust disease. Ringgit is the selected hybridization result number 87/num-ber 69. It has potential to produce 1.0-1.5 tons/ha. Ringgit variety is used as comparer to superior variety which is resistant to leaf rust disease because Ringgit variety is very susceptive to leaf rust diseas according to Badan Penelitian and Pengemba-ngan Pertanian (2007b).

MATERIALS AND METHODS

Time and Place

This research was conducted on experimental lands at Politeknik Negeri Jember with the height of the place is about 89 meters above the sea level. The research was held since December 2015 until March 2016.

Research Materials and Tools

The tools used in this research were water, roll meter, hoe, raffia strap, tugal tool, watering can, sprayer (knapsack), scissors, fabric meter, and analytic scales. The research materials used are markers, paper envelopes, Phonska fertilizer, SP36, KCl, manure, Gandasil D, Gandasil B, Decis, Demolish, Marshal, and 13 genotypes consisting of:

Land Preparation

The land used in this research was prepared 7 days before planting. The land preparation covered soil eruption, plowing, and basic fertilizer application. After that, the next step was making the plots to make the beds easier. The beds used have size 2m x 1m with the length of space between the beds is about 50 cm and the depth of irrigation canal is 25 cm.

Planting Preparation

Planting is done by planting the seeds which were prepared. The plant distance that was used is 40 cm x 20cm. Before planted, the seeds were given Marshall with dose 100 g Marshall used for 5 kg seeds. Every hole was filled by 2-3 seeds in depth 3-5 cm, then the seeds were covered by soil. The plant stit-ching and thinning was done maximum on 7 HST. Stitching was done to died plants or the holes with no plants inside. While thinning was done to the plants in which the hole consisted of 3 plants so it will get 2 plants for each hole.

Tabel 1. Soybean Genotypes used in the Research

No	Genotype	Note
1	R	Rajabasa
2	D	Dering
3	P2	GHJ-2
4	P3	GHJ-3
5	RD	Rajabasa x Dering
6	P2R	GHJ-2 x Rajabasa
7	P2D	GHJ-2 x Dering
8	P2P3	GHJ-2 x GHJ-3
9	P3R	GHJ-3 x Rajabasa
10	P3D	GHJ-3 x Dering
11	P3P2	GHJ-3 x GHJ-2
12	Ri	Ringgit
13	M	Malabar

Planting Preparation

Planting is done by planting the seeds which were prepared.

The plant distance that was used is 40 cm x 20cm. Before planted, the seeds were given Marshall with dose 100 g Marshall used for 5 kg seeds. Every hole was filled by 2-3 seeds in depth 3-5 cm, then the seeds were covered by soil. The plant stitching and thinning was done maximum on 7 HST. Stitching was done to died plants or the holes with no plants inside. While thinning was done to the plants in which the hole consisted of 3 plants so it will get 2 plants for each hole.

The application of fertilizer conti-nued by using 250 kg/hectare Phonska, 100 kg/hectare SP36, and 5 t/ha. manure that all of them were given 1 week after planting. Those fertilizers were applied by spreading them on the ground. Gandasil was also applied to stimulate vegetative growth. Gandasil was applied by spraying it on the plants.

The breeding of the plants covered weeding, showering, and pest and disease controlling. Weeding was done when the weeds surrounding the plant. Showering was done properly minimum 2 times a day. OPT controlling was done when amount of the pests and diseases on the ground more than economic threshold limit. The types of pesticide used were Decis and Demolish.

Harvesting was done when the plant was physiologically ripped, that was when most of the leaves colored tawny (90-95%) and then fell, the stems were dry with brownish yellow colored and barren, and the pods changed color from green to tawny and cracked or seemed old. Harvesting was done by using scissors or sickles. The soybean plants were harvested by cutting down the butt of the stems and leaving the roots of the plants. The process of cutting should be done carefully because the old soybeans were easy to fall out.

Design of the Experiment

Soybean in this research was planted on experimental plots by using Randomized Block Design (RBD) which consisted of 13 genotypes and 3 replications. 1 plot consisted of 5 rows. The size of experimental plots was 2 m x 1 m. the obtained data was analyzed by using variety analysis. If the obtained data were different from the reality, the experiment would be continue tested by using DMRT (Duncan Multiple Range Test) with the level of errors 5%.

Observation

1. Height, measuring the height of the plant after harvesting. The height of the plant was measured from the butt of the stem to the tip of the stem.
2. Blooming age, measuring the age of blooming based on the first flower which has opened its joint.
3. Maturity age of pods, measuring the maturity age of the pods based on the time when most of the leaves had already colored tawny (90-95%), the stems were already dry and brownish yellow colored and bare, and also the pods had changed color from green to brownish yellow and cracked or seemed old.
4. Number of fertile joints, measuring the number of fertile joints that produce pods on the main stems and measured when the plant was nearly harvested.
5. Number or pods in every plant, measuring the number of the filled pods in every plant when harvesting.
6. Weight of seed per plant (g), scaling all seeds per plant from the sample plant.
7. Weight of 100 seeds (g), scaling 100 seeds of the plant from the sample plant and then scale them.
8. IWGSR calculation, leaf rust disease observation was done when the age of the plant was 30, 40, 50, 60, and 70 dap by using International Working Group on
9. Soybean Rust (IWGSR). The observation based on IWGSR system according to Yang (1977) in Santosa (2003) was detailed as follows.

The first number states the position of soybean leaf

Value 1 = 1/3 part of the leaf at the bottom
Value 2 = 1/3 part of the leaf at the middle
Value 3 = 1/3 part of the leaf at the top

The second number states the density of rust spots on leaves

Value 1 = no spots at all
Value 2 = few rust spots (1-8 spots/cm)
Value 3 = few rust spots (9-16 spots/cm)
Value 4 = few rust spots (more than 16 spots/cm)

The third number states the leaf reaction on the rust disease

Value 1 = without pustula (spots)
Value 2 = spots without spores
Value 3 = spots with spores (uredospora)

According to Ratma and Kuswadi (1996), the next step after doing scoring is determining the soybean plant reaction on leaf rust disease by using IWGSR scoring system with three-number notation as follows.

Immune	I	111
Resistant	R	122, 123, 132, 133, 222, 223
Moderate resistant	MR	142, 143, 232, 233, 242, 243, 322, 323
Moderate susceptive	MS	332, 333, 343
Suceptible	S	

RESULTS AND DISCUSION

Based on the result of analysis by using variance (anova), the RCD design on the 13 genotypes agronomic variables can be showed as follows. The variance result of some product components showed that blooming age, plant height, number of fertile joints, and weight of 100 seeds have very real different influences on the observed treatment. From the variance result, it could be concluded that every genotype has different response because the character of every soybean genotype is also different. This statement matched to Milani et al., (2013)'s statement that genetic factors really determine the appearance of varieties. The difference of genetic factors caused the difference of plant fenotype appearances with different special characteristics. The response of genotype on its environment could be seen from the plant fenotypic appearance, like on its growing phase. The other characteristics were also real influenced by each treatment, this thing could be seen from the maturity age of the pods. Some other characteristics like number of pods and weight of seed per plant showed that they were not real different. The weight of seed per plant really correlate positive to the number of pods per plant (Wijayanti et al., 2014).

Table 2. Resume of the F-Count Value Variance Treatment of Some Soybean Products Component Parameters

Parameter	Notation
Blooming Age	37.663 **
Pods Maturity Age	2.627 *
Plant Height	3.323 **
Fertile Joint	8.648 **
Number of Pods	0.825 ns
Weight of Seeds per Plant	1.699 ns
Weight of 100 Seeds	17.998 **

** = Higly significant different,
* = Significant different,
ns = Non Significant different

The result of variance resume which have real different value and very real different value would be continue tested by using Duncan Test with 5 % level. It could be seen from Table 3 in blooming age parameter that there were some differences between one genotype and the others. The blooming age could be seen from the first flower that bloomed on the main stem. The genotype of hybridization result which had flower bloomed first was P3R (GHJ-3 x Rajabasa) and P3P2 (GHJ-3 x GHJ-2) with age 36 hst, while RD (Rajabasa x Dering) had the longest blooming age of 43 hst. The soybean genotype which had flower bloomed first from those 13 genotypes was on (GHJ-2), P3R (GHJ3 x Rajabasa), and P3P2 (GHJ-3 x GHJ-2) with age 36 dap, while Ri (Ringgit) had the lowest blooming age of 51 dap. Short-aged characteristic is determined from maturity age of the pods. The genotype that was used as the short-aged comparer was M (Malabar) which showed the maturity age of the pods of 75 hst. The genotype of hybridization result that had the shortest maturity age of pods was P3R (GHJ-3 x Rajabasa) with age 77 hst, from those 13 genotypes however, it was showed that R (Rajabasa) had the shortest maturity age of pods of 72 hst. This sowed that R (Rajabasa) was more short-aged than M (Malabar), and Malabar was more short-aged than P3R (GHJ-3 x Rajabasa).

The result of the research showed that the genotypes tested had different blooming age and maturity age of pods. The earlier blooming age indicated the earlier maturity age of pods, as same as the longer the blooming age indicated the longer maturity age of pods. From the results of hybridization, the earliest blooming age and maturity age of the pods were owned by genotype P3R (GHJ-3 x Rajabasa), while the longest blooming age and maturity age of pods were owned by genotype RD (Rajabasa x Dering). This statement was in accordance with Chandrasari et al. (2012) who stated that the faster the blooming age the faster the time to harvest. Vise versa, the longer the blooming age the longer the time to harvest.

Table 3. The Result of Genotype Influence Duncan Test on Observation Variables with 5% Level

Geno-type	Bloo-ming Age (dap.)	Maturity Age of Pods (dap.)	Maturity Age of Pods (hst) Scott Knott	Plant Height (cm)	Plant Height (cm)	Fer-tile Joint	Numb er of Pods	Weight of 100 Seeds (g)
R	38 cd	81 e	81 b	79.98 abcd	79.98 abcd	13 cd	52 a	10.23 ab
D	37 cd	91 abcd	91 a	72.68 cd	72.68 cd	12 d	56 a	9.29 bcd
P2	36 d	88 bcde	88 b	67.83 d	67.83 d	12 d	56 a	9.29 bcd
P3	39 c	98 a	98 a	91.67 a	91.67 a	13 cd	68 a	8.24 d
RD	43 b	93 abc	93 a	86.08 abc	86.08 abc	15 ab	61 a	7.00 e
P2R	38 cd	87 bcde	87 b	73.09 cd	73.09 cd	13 cd	66 a	9.32 bcd
P2D	37 cd	89 bcde	89 b	75.52 bcd	75.52 bcd	12 d	58 a	8.82 cd
P2P3	37 cd	89 bcde	89 b	71.28 d	71.28 d	13 cd	51 a	8.99 cd
P3R	36 d	86 cde	86 b	71.05 d	71.05 d	14 bc	63 a	8.96 cd
P3D	39 c	93 abc	93 a	88.26 ab	88.26 ab	15 ab	74 a	8.77 cd
P3P2	36 d	88 bcde	88 b	72.54 cd	72.54 cd	12 d	58 a	9.41 bc
Ri	51 a	94 ab	94 a	92.15 a	92.15 a	16 a	70 a	5.03 f
M	39 c	84 de	84 b	74.49 bcd	74.49 bcd	13 cd	66 a	10.89 a

R (Rajabasa), D (Dering), P2 (GHJ-2), P3 (GHJ-03), RD (Rajabasa x Dering), P2R (GHJ-2 x Rajabasa), P2D (GHJ-2 x Dering), P2P3 (GHJ-2 x GHJ-3), P3R (GHJ-3 x Rajabasa), P3D (GHJ-3 x Dering), P3P2 (GHJ-3 x GHJ- 2), Ri (Ringgit), M (Malabar)

Table 4.Resistance Level of Soybean Genotype on Leaf Rust Disease Based on IWGSR Rating Code

Soybean Genotype	Blooming Phase	Notation	Pods Filling	Notation
R(Rajabasa)	111	I	111	I
D(Dering)	111	I	111	I
P2(Polije 2)	111	I	111	I
P3(Polije 3)	111	I	111	I
RD(Rajabasa x Dering)	111	I	111	I
P2R(Polije 2 x Rajabasa)	111	I	111	I
P2D(Polije 2 x Dering)	111	I	111	I
P2P3(Polije 2 x Polije 3)	111	I	111	I
P3R(Polije 3 x Rajabasa)	111	I	123	R
P3D(Polije 3 x Dering)	111	I	123	R
P3P2(Polije 3 x Polije 2)	111	I	123	R
Ri (Ringgit)	111	I	123	R
M (Malabar)	111	I	111	I

Note: 111 (there are rust spots without pustules on 1/3 part of leaf under surface), 123 (there are few rust spots on 1/3 part of leaf under surface (1-8 spots/cm) and the spots have spores), I (Immune), R (Resistant)

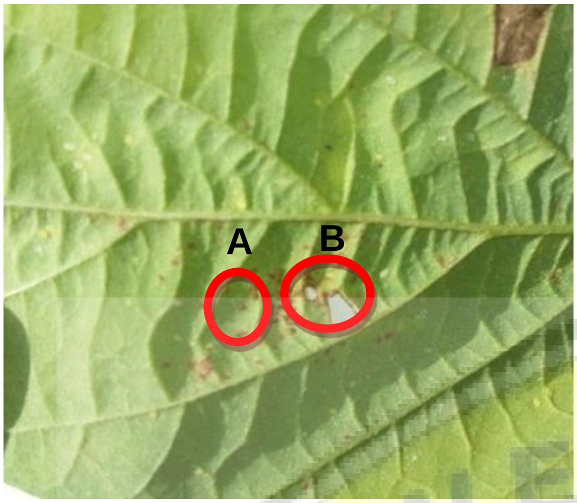
Blooming age and maturity age of the pods in soybeans are the important factors. The blooming age and the maturity age of the pods determine the adaptability of a cultivar on where the cultivar is cultivated. The blooming age of common plant species is the result of the interaction between environment factor and internal factor of the plant. Environment factor defines how long the day is and the temperature, while plant internal factor defines the plant genetic components namely the gen which controls the time of blooming (Tasma, 2013).

Plant height is the significant charac-teristic that influences the number of fertile joints. Genotype of the hybridization result which had the tallest plant height was in P3D (GHJ-3 x Dering) with height 88.26 cms and the shortest one was owned by P3R (GHJ-3 x Rajabasa) with height 71.05 cms. The tallest plant height parameter was owned by genotype Ri (Ringgit) with height 92.15 cms and the shortest value was owned by genotype P2 (GHJ-2) with height 67.83 cms. The genotype of hybridization result which had the most number of fertile joints was in RD (Rajabasa x Dering) and P3D (GHJ-3 x Dering) with total 15 joints and the fewest was in genotype P2D (Polije 2 x Dering) with total 12 joints. The parameter of the most number of fertile joints, by seeing on 13 genotypes, was genotype in Ri (Ringgit) with total 16 joints, while the fewest umber of fertile joints was owned by genotype D (Dering), P2 (GHJ-2), P2D (GHJ-2 x Dering), and P3P2 (GHJ-3 x GHJ-2) with total 12 joints. The research result showed that P3D (GHJ-3 x Dering) had the tallest plant height and the most number of fertile joints compared to the other genotypes. The more number of the fertile joints will be gained by the plant which has the taller plant height (Isnatin et al., 2015).

The genotype of hybridization result on weight of 100 seeds parameter which had the highest value was on P3P2 (GHJ-3 x GHJ-2) with value 9.41 gs and the lowest value was on genotype RD (Rajabasa x Dering) with value 7 gs. By looking at the 13 genotypes, it was known that genotype M (Malabar) had the highest value of 10.89 g, while the lowest value was owned by genotype Ri (Ringgit) with value 5.03 g. Genotypes that produce seeds in large quantities, when calculated from the weight of 100 seeds do not necessarily have weight with a large number of products also. Similarly, the genotypes that produce a small number of seeds may not produce weight with a small number of products. This is caused by the quality of the seeds which may be wrecked, for instance the existence of fungus of soybean seeds. The weight of 100 seeds calcu-lation could be used as one of the indicators to evaluate the quality of harvested soybean seeds. The correlation between the seed weight and the seed quality could be seen from the food reserves inside the seed. This statement was in line with Damanik et al., (2013) stated that the content of food reserves will affect the weight of a seed, so it can affect the amount of production and the speed of seed growth. The seed that heavy with food reserves will produces the bigger energy in germination process. The food reserves inside the seed also affect how big the sprout is and how heavy the weight of the plant when harvesting. The speed of the sprout growth will also increase in line with the increase of the seed.

Different plant height, number of fertile joints, number of pods, weight of seed per plant, and weight of 100 seeds were occurred in every genotype caused by environment and genetic factor. This thing is in accordance with Efendi et al., (2012), stated that those differences occurred because every genotype has different genetic factor and characteristic, in other words, the gen controls the characteristic of the genotype. Besides, genotype was also influenced by environment factor that can cause gen mutation. Gen mutation occurred when a genotype or a variety is planted on the areas with low temperature then the products were reproduced on the areas with high temperature. Plants will grow and produce optimally if they are planted on the places that appropriate with their growth requirements, for examples, climate factor and soil characteristic like pH, the presence of nutrients, KTK, etc. If the environment factor is in optimal condition, the growth and products will be limited by its genetic characteristics (Jamilah dan Safridar, 2012).

The genotype which was used as the comparer to leaf rust disease was Ri (Ringgit). On blooming phase at the age of 30-40 dap, every genotype showed the immune on leaf rust disease. The Immune category in this research did not mean that the plants were not attacked by leaf rust disease. It could be seen that at the age of 50 dap. all genotypes showed leaf rust symptoms. Soybean plants at the age of 30-40 dap did not show any leaf rust symptoms because there was no inoculums resources for P. Pachyrhizy or because the environment did not support growth of pathogens. According to Abadi (2003), the cause of a disease could be the interaction between the three components: they are the host vulnerability, the degree of a pathogen virulence, and environmental factor that support the occurrence of a disease On pods filling phase (50-70 hst), it was showed that genotype P3R (GHJ-3 x Rajabasa), P3D (GHJ-3 x Dering), P3P2 (GHJ-3 x GHJ-2), and Ri (Ringgit) were resistant to leaf rust disease, while the other genotypes showed immune to leaf rust disease. The difference of those resistances was caused by different gen of each genotype that controlled the resistance. Genomes of plants have receptors that can recognize the pathogens that enter the cells then lead to resistance response. Mechanism of resistance is actively occurred after the plat was attacked by pathogens. Qualitative resistance is usually monogenic or oligogenic since the resistance characteristics are merged to variety that will be regenerated or durability enhanced (Gunaeni and Purwati, 2013).



Picture 2. A. Leaf rust symptoms in this research, B. Rust symptoms on the under surface of soybean leaf based on Ramlan and Nurjanani (2011)

The first sign of leaf rust symptoms in this research was the emergence of gray spots which were getting bigger and changed color to dark brown. Those spots were on the under surface of the leaves. This case matched the statement by Fachruddin (2000) that leaf rust attack is signed by the existence of gray small spots filled with uredium that slowly change color into dark brown and those spots are surrounded by yellow halos/rings. Leaf rust disease attacked the under surface of leaves first. The leaf rust symptoms which were brown colored on the under surface of leaves were the colony of fungi P. Pachyrhizy urediospores (Pradikta et al., 2013).

CONCLUSION

. Based on the research results and discussion, it can be concluded that:

1. P3R (GHJ-3 x Rajabasa) showed more short-aged, that was 86 dap, than the other genotypes of hybridization result, but Malabar was more short-aged than P3R (GHJ-3 x Rajabasa), that was 84 dap.
2. The production showed the results were not real different on those seven genotypes of hybridization result.
3. Leaf rust disease started to attack at the age of 50 hst. The result of code rating showed that P3R (GHJ- 3 x Rajabasa), P3D (GHJ-3 x Dering), and P3P2 (GHJ-3 x GHJ-2) was 123 which meant they were R (resistant), while the other genotypes showed value 111 which meant I (Immune).

Suggestion

P. Pachyrhizy inoculation should be done in this research because there might not be inoculums P. Pachyrhizy on every places. It is suggested to the future researchers to do observation on leaf rust disease with range 7 days and the observation should be done until the plant is going to be harvested.

CONFLICT OF INTEREST

This study was conducted without any conflict of interest

ACKNOWLEDGEMENT

Thank you for the expenses incurred for “Badan Litbang Pertanian” research from KKP3N

AUTHOR CONTRIBUTIONS

Moh. Setyo Poerwoko designed his plant breeding program as a whole. Nurul Sjamsijah and Kacung Haryono prepared laboratory of plant breeding. Slameto prepared crop physiology as a whole..

REFERENCES

Abadi, A.L. 2003. *Ilmu Penyakit Tumbuhan*. Malang: Bayumedia.

Asadi. 2013. Pemuliaan Mutasi untuk Perbaikan terhadap Umur dan Produktivitas pada Kedelai. *AgroBiogen*, 9(3):135-142.

Badan Litbang Pertanian. 2012. *Teknologi Budidaya Kedelai pada Lahan Sawah.* Makassar: Balai Pengkajian Teknologi Pertanian.

Badan Litbang Pertanian. 2013. “Dering 1” *Varietas Kedelai Toleran Kekeringan*. Kendari: Balai Pengkajian Teknologi Pertanian.

Badan Penelitian dan Pengembangan Pertanian. 2007a. *Deskripsi Kedelai Varietas Malabar.* Bogor: Pusat Penelitian dan Pengembangan Tanaman Pangan.

Badan Penelitian dan Pengembangan Pertanian. 2007b. *Deskripsi Kedelai Varietas Ringgit.*

Bogor: Pusat Penelitian dan Pengembangan Tanaman Pangan.

Chandrasari, S.E., Nasrullah, and Sutardi. 2012. Uji Daya Hasil Delapan Galur Harapan Padi Sawah (*Oryza sativa* L.). *Vegetalika*, 1(2): 1-9.

Damanik, A.F., Rosmayati , H. Hasyim. 2013. Respons Pertumbuhan dan Produksi Kedelai terhadap Pemberian Mikoriza dan Penggunaan Ukuran Biji pada Tanah Salin. *Agroekoteknologi,* 1(2): 142-153.

Efendi, Halimursyadah, and H.R. Simajuntak. 2012. Respon Pertumbuhan dan Produksi Plasma Nutfah Padi Lokal Aceh terhadap Sistem Budidaya Aerob. *Agrista*, 16(3): 114-121.

Fachruddin, L. 2000. *Budi Daya Kacang-Kacangan.* Yogyakarta: Kanisius.

Gunaeni, N dan E. Purwati. 2013. Uji Ketahanan terhadap *Tomato Yellow Leaf Curl Virus* pada Beberapa Galur Tomat. *Hort*, 23(1): 65-71.

Isnatin, U., D. Waluyo, Parjanto, and H. Kuswantoro. Keragaan Galur Kedelai Hasil Persilangan Varietas Tanggamus x Anjasmoro dan Tanggamus x Burangrang di Tanah Entisol dan Inceptisol. *El-Vivo,* 3(1): 72-80.

Jamilah and N. Safridar. 2012. Pengaruh Dosis Urea, Arang Aktif dan Zeolit terhadap Pertumbuhan dan Hasil Padi Sawah (*Oryza sativa* L.). *Agrista*, 16(3): 153-162.

Kementerian Pertanian RI. 2014. Kementan Gandeng TNI-AD Tingkatkan Produksi Kedelai. *www.pertanian.go.id.* Diakses 13 Oktober 2014.

Kiloda, A.B. 2015. Respon Allelopati Gulma *Ageratum conyzoides* dan *Borreria alata* terhadap Pertumbuhan dan Hasil Tiga Varietas Kedelai (*Glycine max*). *Agro*, 2(1): 39-49.

Mangoendidjojo, W. 2003. *Dasar-Dasar Pemuliaan Tanaman.* Yogyakarta: Kanisius.

Milani, A., Rosmayati, and L.A.M. Siregar. 2013. Pertumbuhan dan Produksi Beberapa Varetas Kedelai terhadap Inokulasi *Bradyrhizobium. Agroekotek-nologi,* 1(2): 15-23.

Pradikta, A., S. Rasminah, A. Cholil, M. Cholil M. 2013. Tingkat Produktivitas dan Ketahanan Beberapa Galur dan Satu Varietas Unggul Kacang Hijau (*Vigna Radiata*) terhadap Penyakit Karat (*Phakopsora Pachyrhizy*). *HPT,* 1 (3): 41-49.

Ramlan and Nurjanani. 2011. Pengenalan Penyakit Karat Daun (*Phakopsora pachyrhizi*) dan Pengelolaannya pada Kedelai. *Suara Perlindungan Tanaman,* 1(4): 9-15.

Ratma, R and A.N. Kuswadi. 1996. *Ketahanan terhadap Penyakit Karat Daun (Phakopsora pachirizi Syd) Galur Mutan Kedelai Genjah No 157/PSJ dan No 325/PSJ Dibandingkan Varietas Lokon serta Tidar.* Batan: Pusat Aplikasi Isotop dan Radiasi.

Santosa, B. 2003. Penyaringan Galur Kedelai terhadap Penyakit Karat Daun Isolat Arjasari di Rumah Kaca. *Plasma Nutfah*, 9(1): 26-32.

Santoso, S.J and Sumarmi. 2013. Pengendalian Hayati Patogen Karat Daun dan Antraknosa padaTanaman Kedelai (*Glicyne max* Merr) dengan Mikrobia Filoplen. *Inovasi Pertanian*, 11(1): 35-43.

Sumiasih, Murniati, and Deviona. 2014. Keragaan Karakter Agronomi Beberapa Genotipe Tomat (*Lycopersicum esculentum* Mill.) di Dataran Rendah. *Jom Faperta,* 1(2): 1-11.

Suryanto, W.A. 2010. *Hama dan Penyakit Tanaman Pangan, Hortikultura, dan Perkebunan*. Yogyakarta: Kanisius.

Tasma, I.M. 2013. Gen dan QTL Pengendali Umur pada Kedelai. *AgroBiogen*, 9(2):85-96.

Wijayati, R.W., S. Purwanti, and M.M. Adie. 2014. Hubungan Hasil dan Komponen Hasil Kedelai (*Glycine max* (L.) Merr.) Populasi F5. *Vegetalika*, 3(4): 88-97.