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Vigor Testing of 15 Lots of Soybean (*Glycine max* L.) Seeds Stored for 12 Months at Low Temperatures

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ABSTRACT

The purpose of this study was to determine the vigor growth strength of Anjasmoro, Grobogan, and Burangrang seed varieties based on three doses categories of SP-36 fertilizer stored for 12 months. The treatment was done separately by separating 15 seed lots. The mean value was determined using the Orthogonal contrast test. The results showed that the large-seeded soybean varieties (Grobogan and Burangrang) had higher seed vigor compared to the small-seeded soybean varieties (Anjasmoro) based on the variables of the germination speed, vigor index, normal dry weight, germination growth, and maximum growth potential. The Grobogan variety produced higher seed vigor than Burangrang variety based on vigor index and germination. Anjasmoro and Grobogan varieties without fertilization produced a lower vigor compared to the one with recommended fertilizer doses (100 and 150 kg/ha) and above the recommended fertilizer doses (200 and 250 kg/ha) based on the rate of germination growth and the vigor index. Grobogan variety with recommended fertilizer dose (100 kg/ha) had the highest seed vigor compared to other varieties.

Pengujian Vigor 15 Lot Benih Kedelai (Glycine Max L.) Yang Disimpan 12 Bulan Pada Suhu Rendah

ABSTRAK: *Tujuan penelitian ini untuk Mengetahui vigor kekuatan tumbuh benih kombinasi Varietas Anjasmoro, Grobogan, dan Burangrang pada tiga kategori dosis pupuk SP-36 yang telah disimpan 12 bulan. Rancangan perlakuan disusun secara tunggal yaitu 15 lot benih dan pemisahan nilai tengah menggunakan uji Orthogonal contrass. Hasil penelitian menunjukan varietas kedelai berbiji besar (Grobogan dan burangrang) lebih tinggi vigor benihnya dari varietas kedelai berbiji kecil (Anjasmoro) berdasarkan variabel kecepatan perkecamabahan, indeks vigor, bobot kering kecambah normal, daya berkecamabah dan potensi tumbuh maksimum. Perbandingan varietas Grobogan menghasilkan vigor benih yang lebih tinggi dari varietas Burangrang berdasarkan variabel indeks vigor dan daya berkecambah. Varietas Anjasmoro dan Grobogan tanpa pemupukan menghasilkan vigor yang lebih rendah dibandingkan dengan penambahan dosis pupuk rekomendasi (100 dan 150 kg/ha) dan diatas rekomendasi (200 dan 250 kg/ha) berdasrkan variavel kecepatan perkecmabahan dan indeks vigor. Varietas Grobogan dengan*

penambahan dosis rekomendasi (100 kg/ha) memiliki vigor benih yang paling tinggi dibandingkan perbandingan lainnya.

INTRODUCTION

Soybean (*Glycine max.* L) production in Indonesia has increased from year to year to meet industrial demands and animal feed (Pratama dkk., 2017; Siti dkk., 2016; Tatipata dkk., 2010). Soybeans are the most important component of concentrate feed (Astuti dkk., 2008; Sudaryanto & Swastika, 2007). Therefore, the development of the soybean-based food industry and the feed industry has caused demand for soybeans to continue to increase far beyond domestic production (meliza sari, 2015; Sudaryanto & Swastika, 2007; Swastika dkk., 2011).

Efforts to increase optimal soybean production are achieved through the use of superior quality varieties of seeds and proper fertilization (Nainggolan, 2014; Tengah dkk., 2015). Soybean seeds in the tropics have a faster deteriorating rate during storage (Anggraeni & Suwarno, 2014; Tatipata dkk., 2010), thereby, reducing the supply of high-quality seeds. The environment and method of storage need to be considered because they will affect seeds' vigor quickly and slowly (Kolo & Tefa, 2016; Lesilolo dkk., 2018).

The deteriorating rate of soybean seeds during storage is faster compared to other seeds (Terryana dkk., 2016; Umar, 2012; Rohandi, dkk., 2016), caused by rapid loss of vigor which causes the decrease in seed germination (Lesilolo dkk., 2018; Tresniawati dkk., 2014; Umar, 2012), Thus, soybean seeds must be stored in a low-temperature environment so that the quality of the seeds remains high until the end of storage (Enen dkk., 2014; Sucahyono, 2014; , dkk., 2016).

Plants must be fertilized with the right dose of SP-36 (Hayati dkk., 2009; meliza sari, 2015; Silahooy, 2008; Soplanit & Soplanit, 2018). As for the seeds, optimal fertilization efforts are needed for the viability and vigor during storage. Seed food reserves need to be increased to maintain the vigor of soybean seeds that have been stored for 12 months at low temperatures (Kolo & Tefa, 2016).

This research was the development of research conducted by (Sari, 2015) on the germination speed of seeds that had been stored for 6 months based on the vigor and the normal dry weight (Nurussintani dkk., 2013; Wulananggraeni dkk., 2016). This research was to find out the vigor of the seeds of three soybean varieties (Anjasmoro, Grobogan, and Burangrang) derived from SP-36 fertilization which has been stored for 12 months.

METHOD

This research was conducted at the Integrated Field Laboratory (LTPD) Faculty of Agriculture, the University of Lampung from November to December 2018. The type of land used was dry land with limited water which usually expected from rainfall. The land had been cleared of weed and debris and the minimum tillage was fixed using a hoe which then the land plotting was conducted. Three replications were carried out by randomly picking up 50 seeds for each repetition of each plastic unit experiment. Then, the seeds were planted in the field of 5 x 3 m plot sizes with 2 cm planting holes. Fifteen lots of soybean seeds were planted lengthwise with a spacing of 15 x 8 cm.

The homogeneity of the variances was tested using the Bartlett test and data additivity was tested by the Tukey test as the assumption for the variance analysis of the randomized group design. If the assumptions of the analysis of the variance have been fulfilled, then the separation of the mean values should be continued using the orthogonal contrast test at the significance level of 5%.

RESULTS AND DISCUSSION

Germination rate is the speed of seed to germinate normally. This test was also carried out within 3 replications by taking 50 seeds randomly for each test from each plastic unit of the experiment which then planted in the field like normal seeds germination test. Observation of the germination speed was carried out at 2-7 DAP (Days after Planting).

Grobogan and Burangrang varieties had a better germination speed than Anjasmoro variety by 7.29%. Overall comparison of the Anjasmoro variety combination resulted in no different speed of germination. Grobogan variety with the recommended addition doses of SP-36 (100 and 150kg/ha) resulted in a better germination speed compared to the addition of the above-recommended doses (200 and 250 kg/ha) with a difference of 10.58%. in the Grobogan variety, the addition of 100 kg/ha of SP-36 fertilizer was better than the addition of 150 kg/ha with a difference of 8.11%. Each comparison on the Burangrang variety resulted in no different germination rate.

The vigor index is the percentage of normal sprouts on the first observations and also serves as an indicator to determine the speed and uniformity of germination. The results of the comparison of the Vigor Index on 15 lots of seeds fertilized by SP-36 can be seen in Table 1.

Table1.The Orthogonal Contrast Test Results of Vigor Index on 15 Soybean Seed Lots

Comparison	Vigor Index		
	Q	Difference %	$F_{observed}$
The Effects of Three Soybean Varieties			
P1: Anjasmoro +SP-36VS Grobogan + SP-36 dan Burangrang +SP-36	0,48	2,14	7,90
P2: Grobogan +SP-36 VS Burangrang +36	-0,3	2,64	9,26
The Combination Effects of Anjasmoro Variety and SP-36 Fertilizer			
P3: Anjasmro without fertilization VS recommended fertilization dosage (100 and 150 kg/ha)	0,68	26,56	23,80
P4: Anjasmoro+recommended SP-36 dosage (100 dan 150 kg/ha) VS over the recommended dosage (200 dan 250 kg/ha)	0,04		0,41
P5: Anjasomoro +recommended SP-36 dosage (100kg/ha) VS recommended dosage (150kg/ha)	0,08		3,29
P6: Anjasmoro + over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	0,04		0,82
The Combination Effects of Grobogan Variety and SP-36 Fertilizer			
P7: Grobogan without fertilization VS recommended fertilization dosage (100 and 150 kg/ha)	-0,13		0,87
P8: Grobogan + recommended SP-36 dosage (100 dan 150 kg/ha) VS over the recommended dosage (200 dan 250 kg/ha)	-0,01		0,02
P9: Grobogan +recommended SP-36 dosage (100kg/ha) VS recommended dosage (150kg/ha)	-0,02		0,02
P10: Grobogan + over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	-0,03		0,46
The Combination Effects of Burangrang Variety and SP-36 Fertilizer			
P11: Buragrang without fertilization VS recommended and over the recommended dosages	-0,13		0,87
P12: Burangrang + recommended SP-36 dosage	0,05		0,64
P13: Buragrang+ recommended SP-36 dosage (100kg/ha) VS recommended SP-36 dosage (150kg/ha)	0,07		2,52
P14: Burangrang +over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	-0,04		0,82

Grobogan and Burangrang varieties had better vigor index values than Anjasmoro variety with a difference of 2.14%. Grobogan variety had a better vigor

index compared to the Burangrang variety with a difference of 2.64%. Anjasmoro variety given the recommended dosage of SP-36 fertilizer (100 and 150 kg/ha) and over the recommended dosage (200 and 250 kg/ha) produced a higher vigor index compared to the one without fertilization with a difference of 26.56%. the other comparisons generated no difference vigor index.

The dry weight of normal sprouts was measured by the normal seed sprout test. The sprouts that grew normally from each experimental unit were separated from the cotyledons which then wrapped and dried in a Mammert type oven at 80^{o}C for 3 x 24 hours or until the dry weight reached a constant value. The weighing process was done by Ohaus type analytical balance.

The comparison results of the dry weight of 15 lots of normal sprouts given the SP-36 fertilizer can be seen in Table 2.

Table2. The Orthogonal Contrast Test Results Oon Dry Weight on 15 Soybean Seed Lots

Comparison	Vigor Index		
	Q	Difference %	$F_{observed}$
The Effects of Three Soybean Varieties			
P1: Anjasmoro +SP-36VS Grobogan + SP-36 dan Burangrang +SP-36	0,001		0,0361
P2: Grobogan +SP-36 VS Burangrang +36	0,001		0,1083
The Combination Effects of Anjasmoro Variety and SP-36 Fertilizer			
P3: Anjasmro without fertilization VS recommended fertilization dosage (100 and 150 kg/ha)	0,001		0,3661
P4: Anjasmoro+recommended SP-36 dosage (100 dan 150 kg/ha) VS over the recommended dosage (200 dan 250 kg/ha)	0,001		0,2708
P5: Anjasomoro +recommended SP-36 dosage (100kg/ha) VS recommended dosage (150kg/ha)	0,001		0,7799
P6: Anjasmoro + over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	-0,001		0,5416
The Combination Effects of Grobogan Variety and SP-36 Fertilizer			
P7: Grobogan without fertilization VS recommended fertilization dosage (100 and 150 kg/ha)	0,001		0,0195
P8: Grobogan + recommended SP-36 dosage (100 dan 150 kg/ha) VS over the recommended dosage (200 dan 250 kg/ha)	0,001		1,1307
P9: Grobogan +recommended SP-36 dosage (100kg/ha) VS recommended dosage (150kg/ha)	0,000		0,3466
P10: Grobogan + over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	-0,001		1,0616
The Combination Effects of Burangrang Variety and SP-36 Fertilizer			
P11: Buragrang without fertilization VS recommended and over the recommended dosages	-0,002		0,6261
P12: Burangrang + recommended SP-36 dosage	0,001		0,0108
P13: Buragrang+ recommended SP-36 dosage (100kg/ha) VS recommended SP-36 dosage (150kg/ha)	0,001		0,7799
P14: Burangrang +over the recommended SP-36 dosage (200kg/ha) VS over the recommended dosage (250kg/ha)	-0,001		1,0616

Fifteen lots of seeds from each ratio did not produce the same normal dry weights germination. The fifteen lots of seeds were the combination of three superior varieties (Anjasmoro, Grobogan, and Burangrang). Three categories of SP-36 fertilizer dosages were applied, namely without fertilization (0 kg/ha), the recommended dosage (100 and 150 kg/ha), and over the recommended dosage (200 and 250 kg/ha). The seeds had been stored for 12 months at low temperatures (16.42 - 19.58ºC) and RH (50.8 - 69.2%). The vigor test was done under suboptimum environmental conditions (lack of water) where the environmental conditions (wind,

temperature, humidity, and light) could not be controlled. To meet the water needs, the soybean plants were watered in the morning and the evening. Fifteen lots of seeds were planted on humus soil type which is soil formed from weathering leaves and tree trunks, has dark soil characteristics, loose, and highly fertile.

Disease rate, normal vigor index, and normal dry weight germination are the benchmarks in seed vigor testing (Nurussintani dkk., 2013). Germination and maximum growth potential serve as the supporting variable.

The best result was found in Grobogan variety with 100 kg/ha SP-36 fertilizer dosage based on the variables of germination speed and the vigor index. The lowest combination result was found in Anjasmoro and Grobogan varieties without fertilization based on the germination speed and the vigor index. The combination between Grobogan variety and recommended fertilizer dosage (100 and 150 kg/ha) produced higher seed vigor than the over the recommended dosage (200 and 250 kg/ha) based on germination speed variable. The other comparisons were not significantly different in producing seeds' vigor.

Grobogan and Burangrang varieties had a higher vigor than Anjasmoro variety based on germination speed and the vigor index variables. The results were also supported by the germination speed and maximum growth potential. Furthermore, Grobogan variety produced higher vigor compared to varieties with the vigor index based on the vigor index and germination variables.

This research supports the statement of (Rahmawati, 2018) who states that phytin is a form of storage of phosphorus in seeds. Within seeds, phytin is used as a source of food reserves and seed energy during the germination period. The increase in the content of seed food reserves will increase the speed of germination, vigor index, and other components of seed quality.

This study also supports the research conducted by Thoyyibah *et al*., (2014) who reveals that phosphorus could increase the weight of 100 soybean seeds (Komponen dkk., 2013) and larger-sized seeds contain more food reserves to increase seeds' vigor (Anggraeni & Suwarno, 2014; Nuraini dkk., 2016; Wulandari dkk., 2015). The research conducted by (Siti dkk., 2016) revealed that 25 kg/ha fertilizer can increase the growth rates of Grobogan variety and 50 kg/ha of P fertilizer decreased the growth rate of Anjasmoro and Agromulyo varieties. The Burangrang variety did not affect by the P fertilizer.

The plants' growth suppression rate after being given the P fertilizer at a dose of 50 kg/ha occurred because the required nutrients exceeded the plants' needs so that the nutrients cannot be utilized optimally by the plants. Meanwhile, the root canopy ratio indicated that there was a difference in the response of the varieties to the application of P fertilizer. The Grobogan's root canopy increased almost twice after being given p fertilizer 50 kg/ha while the Anjasmoro' root canopy ratio was better without fertilization. The fertilized did not affect Burangrang and Agromulyo varieties. It can be concluded that fertilization had different genetic responses between variables. Each variety also had different responses to external factors, such as administering a certain dose of macro fertilizer (Floratek, 2010). reveals that the combination of several soybean varieties and high phosphate fertilizer affects the growth and yield of production (Jayasumatra, 2012).

Only a small amount of phosphorus content is needed and absorbed into soybean seeds, which is around 10-20%. Thus, optimum fertilization does not always correlate with seed quality (Rasyid, 2013). Several environmental factors that influenced the growth of soybean seeds are temperature, light, rainfall, soil moisture, and nutrients.these factors are very important because they will affect the

quality of seeds during seed formation and ripening.

This research is beneficial to know the combination between the varieties and dosage of SP-36 fertilizer related to vigor. This research was the continuation of research conducted by (meliza sari, 2015) who discovered that 15 lots of seeds within 6 months storage produced 94% germination capacity, 38% of germination rate, and 9% of moisture content. Further research was carried out to see the growth rate and vigor after the soybean had been stored for 12 months at low temperatures (18 ± 1.58ºC) and humidity (60 ± 9.2%). The vigor index, germination rate, and the normal dry weight are the benchmark in seeds' vigor testing (Swastika dkk., 2011).

CONCLUSIONS AND SUGGESTIONS

Based on the results of research and discussion, the following conclusions are generated: Grobogan and Burangrang varieties have higher seed vigor than Anjasmoro variety**.** The combination of the Grobogan variety and SP-36 fertilizer at the dosage of 100 kg/ha yielded the highest seed vigor. The combination of the Anjasmoro, Grobogan, and Burangrang varieties without fertilization showed the lowest seed vigor based on the germination speed, vigor index, germination capacity, and maximum growth potential.

It is recommended to store the soybean seeds in a low-temperature storage room. Grobogan variety should be combined with SP-36 fertilizer dosages of 100 kg/ha because the addition of fertilizer doses does not increase seeds' vigor. It is recommended for further researchers to make this study as reference material.

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