Germination of Black Soy Bean Generation Mutan 4 (M4)

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Abstract. The seeds used are seeds that have undergone a storage process before being germinated. Seeds stored in the right conditions can reduce germination or viability, such as packaging material, temperature, and lack of moisture. This study aims to determine the germination after the storage process to be planted in field conditions. This research was conducted at the Politeknik negeri lampung green house in August 2022. The study used a completely randomized design with different genotype treatments consisting of 6 genotypes M4 resulted from selected by the M3 generation ((R1119 (G1), R2125 (G2), R2211 (G3), R221 (G4), R321 (G5), and R41119 (G6)), each treatment was four replicated. The observed variables were electrical conductivity, germination, maximum growth potential, vigor index, growth speed, Growth synchronously, plant height, and root length. Data were analyzed by F 5% test, if the genotype has a significant effect continued Least Significant Difference (LSD) test. The observations obtained were only the observed vigor index variables that had a significant effect. The result of this reseacrh is 6 genotypes still had high germination, which was above 80%, and genotype R321 has the lowest vigor index compared to genotype R1119, R2125, R221, and R41119.

1. Introduction

Indonesia since 1918-2016 has only released 11 varieties of black soybeans, this number is still very small compared to yellow soybeans. Black soybeans contain anthocyanin compounds that yellow soybeans do not have, which are beneficial for health. According to [1] , consumption of black soybeans can overcome degenerative diseases which are the biggest cause of death in the world. Black soybeans contain essential amino acids, vitamin E, saponins and are rich in antioxidants such as flavonoids, isoflavones and anthocyanins.

Efforts to increase the genetic diversity of black soybeans can use the physical mutation method, namely by gamma ray induction, then proceed to the selection stage until a promising mutant line is obtained. For plant cultivation, seeds with high germination power are needed, usually the seeds have undergone a storage process, if using the right packaging and storage temperature the seed germination can be maintained. The seeds used in this research material were the result of M3 selection for selection in the M4 generation which had undergone a 9 month storage process. [2] states that seeds that undergo a storage process before being planted in the field if not stored at inappropriate temperature, humidity and storage conditions can reduce seed germination.

Soybean seeds easily deteriorate during storage [3]. According to [4] Deterioration or deterioration of seeds becomes an obstacle in the storage of a seed. The process of deterioration is a process that cannot be returned, cannot be stopped and cannot be avoided. A seed has a shelf life which is influenced by environmental and genetic factors. So that the seeds that are stored for a long time will affect the decrease in the power of seed growth. A high vigor seed will hold up in storage.

The environment greatly changes the genetic potential for seed longevity, seed storage cannot improve seed quality, even under the best storage conditions, it can only maintain seed quality, so high-quality seeds are needed for storage [5] . This study aims to determine the germination after the storage process to be planted in field conditions.

2. Methods

This research was conducted in August, at the Politeknik Negeri Lampung green house. The materials used were the M4 genotype (selected by M3 which had been stored for 9 months, packaging using polyethylene plastic, stored at room temperature, seed moisture content 10%), and sand media

that had been sterilized. This study used a non-factorial completely randomized design consisting of six genotypes R1119 (G1), R2125 (G2), R2211 (G3), R221 (G4), R321 (G5), and R41119 (G6) which were repeated four times, so that obtained 24 experimental units. Seeds are germinated in sand media which is placed into the germination tray.

The observed variables in this study were electrical conductivity (μS/cm/g), germination (%),maximum growth potential (%), vigor index (%), growth speed (%), growth synchronously (%), plant height (cm), and root length (cm). The data for each variable were analyzed using analysis of variance with the F α 5% test, if the results had a significant effect, a further Least Significant Difference (LSD) test was carried out.

3. Results and Discussion

The results obtained, only the vigor index variable has a significant effect, while other variables have no significant effect. Seed germination of all genotypes was still high even though it had undergone a storage process. This is presumably because the stored seeds have high quality, this is in line with [5] statement, that to maintain seed quality during storage, high quality seeds are needed.

Table 1. Results of analysis of variance F test α 5%

The observed variables	Genotype
1. Ectrical conductivity ((μS/cm/g)	ns
2. Germination (%)	ns
3. Maximum growth potential (%)	ns
4. Vigor index (%)	*
5. Growth speed (%)	ns
6. Growth synchronously (%)	ns
7. Plant height (cm)	ns
8. Root length (cm)	ns

*Note: non significant (ns), * Significant*

In Figure 1, an abnormal M4 germination was found. Picture A normal germination and picture B abnormal germination (do not have primary leaves, epicotyl and short and thick hypocotyl). In the [6] study on M1 soybeans, the mutation-induced seeds had low germination, this indicated that there were abnormal germination. In the M4 generation, it is suspected that the effect of mutation induction has no effect on germination. According [7] research, the Grobogan variety has the highest or most sensitive radiosensitivity level and the Gepak Kuning variety has the lowest radiosensitivity level or the least sensitive to gamma ray irradiation.

Figure 1. Graph of antioxidant levels in Buffalo curd

In Figure 2, it can be seen that all genotypes still had germination capacity above 90%, this indicated that M4 germination chose high viability. The results of [2] research, several genotypes in M3 have germination above 80%. In the study [8] soybean seeds that were stored for 1 month were the best treatment for the viability of the seeds of the Anjasmoro variety with 90% germination. In the study [9], storage of soybean seeds of Anjasmoro variety at room temperature for 5 months had 88% germination, 94% for 3 months.

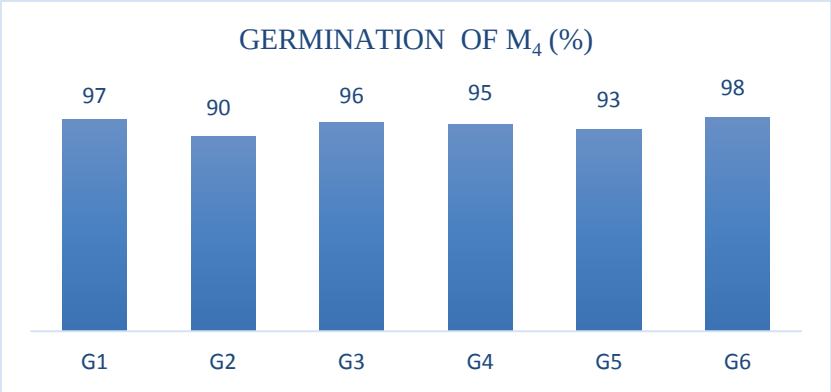

Figure 2. Average germination of each genotype

The results of the LSD test calculations in Table 2 show that the R321 (G5) genotype has a lower vigor index than the G1, G2, G4 and G6 genotypes. The vigor index is one of the observed variables of vigor or growing strength. According to [10] Seeds with high vigor are those that are able to germinate normally under sub-optimal conditions and above normal under optimum conditions. Seeds with high vigor will be able to produce normally at sub-optimum conditions and above normal conditions, have the ability to grow simultaneously and quickly, and are more resistant to storage under conditions that are not ideal.

Table 2. The result LSD test 5% vigor index observation variables

Genotipe	vigor index (%)
1. R1119 (G1)	72a
2. R2125 (G2)	71a
3. R2211 (G3)	64ab
3. R2211 (G3)	70a
5. R321 (G5)	50b
5. R321 (G5)	71a
LSD	15.05

Note: Different letters in the column indicate significantly different

The results of [11] research on M1 percentage of soybean seed germination until day 14, a dose of 200-500 Gy had a germination percentage below 80%. The results of [12] research that different doses of gamma rays affect the germination and growth of soybean sprouts (Glycine max L.cv. Ring 1) gamma rays with very low to low doses (5-320 Gy) can be used to study the increase in soybean diversity, in M1 research by [6] and [12] on the leaves there are spots of chlorosis on the true leaves of M1, but in this research of M4 generation it is not found chlorosis on the true leaves.

4. Conclusions

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6. References

[1] Wardani, K. W. , dan Ika. R. W., "Eksplorasi Potensi Kedelai Hitam untuk Produksi Minimum Fungsional Sebagai Upaya Meningkatkan Kesehatan Masyarakat," Jurnal Pangan dan Agroindustri, vol. 2, pp. 58–67, 2014.

[2] Andini, S. N. , Miranda. F. S. , Septiana. "Seed Conductivity Test on Some Genotype of Black Soybean Mutant Third Generation (M3)," Jurnal Planta Simbiosa, vol. 3, pp. 1–6, 2021.

[3] Noviana, I. , A. D. , A. O. , and Faiza. C. S. "Estimation of soybean seed (Glycine max L. Merr) deterioration during storage," Jurnal Pertanian Agros, vol. 19, pp. 1–12, 2017.

[4] Nova, T. "Pengaruh lama penyimpanan terhadap daya berkecambah leci (Litchi chinensis, Sonn.)." Jurnal teknologi terapan, vol. 5, pp. 346–352, 2021.

[5] Copeland, L.O., Miller, M. B.., Principles of Seed Science and Technology, 4th Editio. London (USA): Kluwer Academic Publishers, 2001.

[6] Andini, S. N. "Viabilitas dan vigor benih kedelai hitam (Glycine max (L) Merill) Hasil iradiasi sinar gamma.," Jurnal planta simbiosa, vol. 2, pp. 11–20, 2020.

[7] Indriani F. C. , Heru. K. , Ratri, T. H. dan A. Supeno., "Radiosensitivitas beberapa varietas kedelai terhadap iradiasi sinar gamma," in Prosiding seminar hasil penelitian tanaman aneka kacang dan umbi, 2012, pp. 97–104.

[8] Hayati, N. , and Setiono. "Effect Of Storage Time On Viability Soybean Seeds (Glycine max (L) Merrill) Anjasmoro Variety," Jurnal Sains Agro, vol. 6, pp. 66–76, 2021.

[9] Azharini, R. , O. C. P. Pradana. A. Wahyuni. "Storability of Soybean Seed (Glycine max (L.) Merrill) Anjasmoro Variety in Different Storage Conditions," vol. 2, pp. 53–63, 2020.

[10] Yuniarti, N. , Muhammad, Z. , Megawati., dan Budi, L. "The Comparison of Seed Vigority of Acacia mangium on breeding and unbreeding Seed," Jurnal penelitian kehutanan wallacea, vol. 3, pp. 57–64, 2014.

[11] Ozdinc and Sevil, Y. "Effect of Gamma Radiation on different Soybean Varieties (Glycine max L. Merrill) in M1 Generation," Journal of Environmental and Agricultural Science. , vol. 19, pp. 01-09., 2019.

[12] Kusmiati, F., Sutarno. , M. G. A. Sas. Bagus. H. "Mutagenic effects of gamma rays on soybean (Glycine max L.) germination and seedlings," in IOP Conf. Series: Earth and Environmental Science , 2017, p. 102.