Jurnal Agroqua
Volume 22 No. 2 Tahun 2024

DOI: 10.32663/ja.v21i2.4916

SEED VIABILITY AND SEEDLING GROWTH OF SULAWESI 01 AND ICCRI 08 CACAO PLANT CLONES (*Theobroma* cacao L.)

(Viabilitas Benih dan Pertumbuhan Bibit Klon Tanaman Kakao Sulawesi 01 Dan ICCRI 08 (Theobroma cacao L.))

Canggih Nailil Maghfiroh*, Amalia Malik
Politeknik Negeri Jember. Jl. Mastrip, Jember - Jawa Timur- Indonesia
*Corresponding author, Email: canggih_nailil@polije.ac.id

ABSTRACT

Cocoa is one of the important agricultural commodities for various industrial activities such as cosmetics and food. Cocoa is widely consumed by the community, both in the form of instant chocolate and cocoa powder. Cocoa productivity is under its potential productivity, and have to enhance the cocoa production. The selection of clones for cocoa planting materials could determines the results of the plant. Plants convey genetic traits that can determine production capacity. Seedling viability and growth are indicators to determine whether plants can grow adeptly. Cocoa clones Sulawesi 01 and ICCRI 08 are superior clones that have the advantage of high productivity and are resistant to pests and diseases. The purpose of the study was to determine the viability of seeds and the growth of two cocoa clones Sulawesi 01 and ICCRI 08. The study design was a Completely Randomized Design with 2 levels and each had replications. The results of this study showed that the ICCRI 08 clone had the highest germinability of 92.1% and further the seedling growth parameters with a height of 6.6 cm at 21 days after planting. The highest vigor index measurement of 426.4 was in the ICCRI 08 clone and was significantly different compared to the Sulawesi 01 clone. The sigmoid curve showed the presence of growth initiation and exponential phases as indicated by increased growth as the plant age increased.

Keywords: cacao, Sulawesi 01 clone, ICCRI 08 clone, seed viability, seedling growth

INTRODUCTION

Indonesia is one of the largest cocoa producers in the world after Ivory Coast and Ghana. Cocoa production in Indonesia is mostly produced from smallholder plantations, with cocoa plants spread across various regions. Cocoa is an important agricultural commodity because it is useful for numerous industrial activities such as cosmetics and food. Cocoa is extensively consumed by the society, both in the form of instant chocolate and cocoa powder. The fairly high market demand demands an increase in the production of cocoa plants. The demand to develop cocoa plant products, but based on statistical data, there has been a decline in production in 2017 for 3 consecutive years. In 2024, there has been growth of 1.53%, according to BPS data in 2024, total cocoa production in Indonesia was 641.7 thousand tons.

Cocoa productivity is lower than its potential productivity. The growth and development of cocoa plants are influenced by various factors, for instance internal factors. The genetic characteristics of the plant and external factors, involving the climate conditions according to the method of cocoa cultivation. The productivity of cocoa plants is affected by seed quality and viability as a result of it plays a significant role in the early growth of seedlings. Seed quality is considerably regulated by seed viability. The higher the seed viability, the better the seed's

DOI: 10.32663/ja.v21i2.4916

ability to germinate and determine optimal seedlings (Baswarsiati, 2018). Several factors that affect seed viability are genetic clones, storage methods, and seed growth environments. Superior clones with high viability are one of the priorities in efforts to develop cocoa production in Indonesia (Syafaruddin et al., 2020). Storage with 30% humidity can have a good effect on seed viability and cocoa seedling growth (Tambunsaribu et al., 2017).

The selection of superior clones is carried out to provide optimal cocoa growth and development. The superior cocoa clone that has been recommended by the Indonesian Coffee and Cocoa Research Center is ICCRI 08, which is also one of the superior clones. The Sulawesi 01 clone is widely used because it can adapt well to tropical environments, while the ICCRI 08 clone has high yield potential and is tolerant to pests and diseases (Putra et al, 2019). It is important to identify the potential for seed growth based on the quality of the seeds used. This study aims to determine the viability of seeds and the growth of Sulawesi 01 and ICCRI 08. The results of this study are expected to support the development of cocoa seeds and support Indonesian cocoa productivity.

MATERIAL AND METHODS

This research was conducted in September 2024 at the Cocoa Plantation Field Laboratory, Jember State Polytechnic. The tools used were a nursery tub, watering can, knife, hand sprayer, measuring cup, ruler, digital scale, solder, and stopwatch. The materials used were fungicide (dithane M-45), Sulawesi 01 and ICCRI 08 cocoa fruit varieties, dry leaves, kitchen ash, water, soil and fine sand. This study used a completely randomized design (CRD) with two treatments, using Sulawesi 01 and ICCRI 08 clones. Research stages with seed preparation. Seed selection was based on intact fruit, uniform size, and no damage due to pests and diseases. Seed processing was carried out by removing pulp using ash to facilitate the germination process. Viability testing was carried out before the seeds were sown using a germination test in a germination tank. Seeds were sown to germinate for 7-14 days at room temperature of 28oC. The parameters observed were total seeds, germinated seeds, germination style, plant height, and vigor index. Observations on seedling growth were carried out by providing basic care, including fertilization, watering, pest and disease management. The data obtained were then measured by ANOVA (Analysis of Variance) test analysis and further testing with Duncan's Multiple Range Test (DMRT) using SPSS software.

RESULTS AND DISCUSSION

Table 1. Germination rate of cocoa seeds from Sulawesi 01 and ICCRI 08 Clones

Clones	Germinating Seeds			Total Seeds			Germinability (%)			Average Germinability (%)
	1	2	3	1	2	3	1	2	3	
Sulawesi 01	38	36	36	40	46	40	95	78,26	90	87,75333333 a
ICCRI 08	27	40	30	27	42	37	100	95,23	81,08	92,10333333 a

Note: Numbers that are not followed by the same letter in a column are said to be significantly different in the DMRT test at the 0.05 level.

Based on Table 1. Shows the data of germinated seeds compared to the total germinated seeds. The germination force between Sulawesi 01 and ICCRI 08 clones

DOI: 10.32663/ja.v21i2.4916

shows that ICCRI has a higher germination force. According to further statistical tests, there was no significant difference for each clone tested. Seed viability between Sulawesi 01 and ICCRI 08 did not have a significant difference. Based on table 1, Sulawesi 01 clone showed a germination force in the first, second, and third repetitions of 95%, 78.26%, and 90%, respectively, while ICCRI 08 clone had a germination force of 100%, 95.23%, and 81.08%. In ICCRI 08 clone, the average germination force was higher, the value showed no significance when tested statistically. Based on germination power, it is quite high for clones so that it is indicated that Sulawesi 01 and ICCRI 08 clone seeds have good viability.

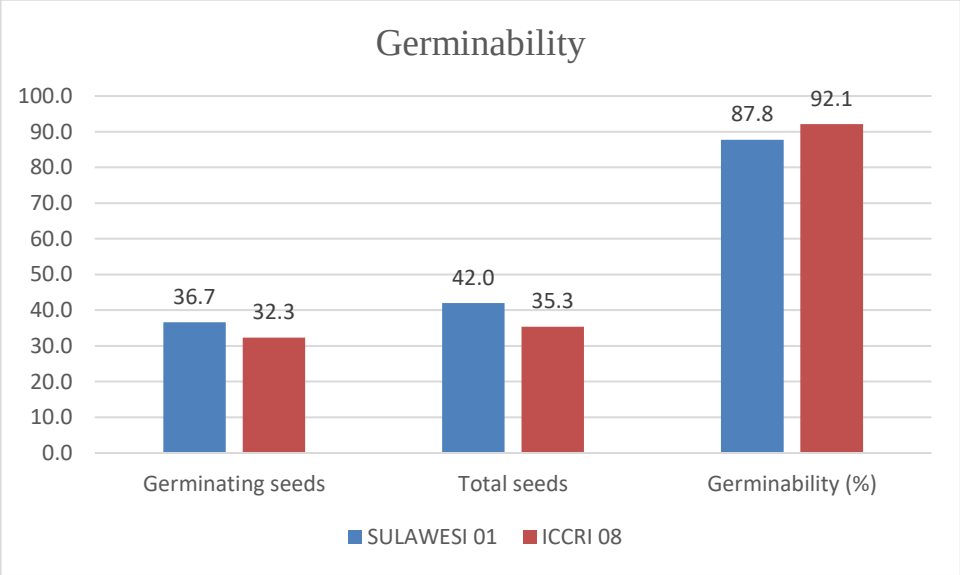

Figure 1. Germinability of cacao Sulawesi 01 and ICCRI 08 Clones

Based on graph 1 shows the viability of cocoa seeds for Sulawesi 01 and ICCRI 08 clones respectively are 36.7 and 32.3. While the total seeds germinated for Sulawesi 01 and ICCRI 08 clones are 42 and 35.3. The germination power for Sulawesi 01 clones (87.8%) and ICCRI 08 (92.1%) has a difference of 4.3%. This indicates that both have good seeds to be developed.

Table 2. Plant height 7-28 day after plant

Clones	Plant Height (cm)			
	7 DAP	14 DAP	21 DAP	28 DAP
Sulawesi 01	0	2,3	4,8	6,3
ICCRI 08	0	2,9	4,4	6,6

Note: Numbers that are not followed by the same letter in a column are said to be significantly different in the DMRT test at the 0.05 level.

Plant height is shown from the data in table 2, observations were made 4 times up to 28 days after planting. At 7 hst, it showed that the plants had not experienced crown growth, so there was no plant height that could be measured. In the second week for the Sulawesi 01 and ICCRI 08 clones, they were 23 cm and 2.9 cm, respectively. In the third week, observations showed an increase in each clone, namely Sulawesi 01 4.8 cm and ICCRI 08 4.4. In observations in the last week, ICCRI 08 had the best growth for plant

DOI: 10.32663/ja.v21i2.4916

height parameters, but not too far from the Sulawesi 01 clone.

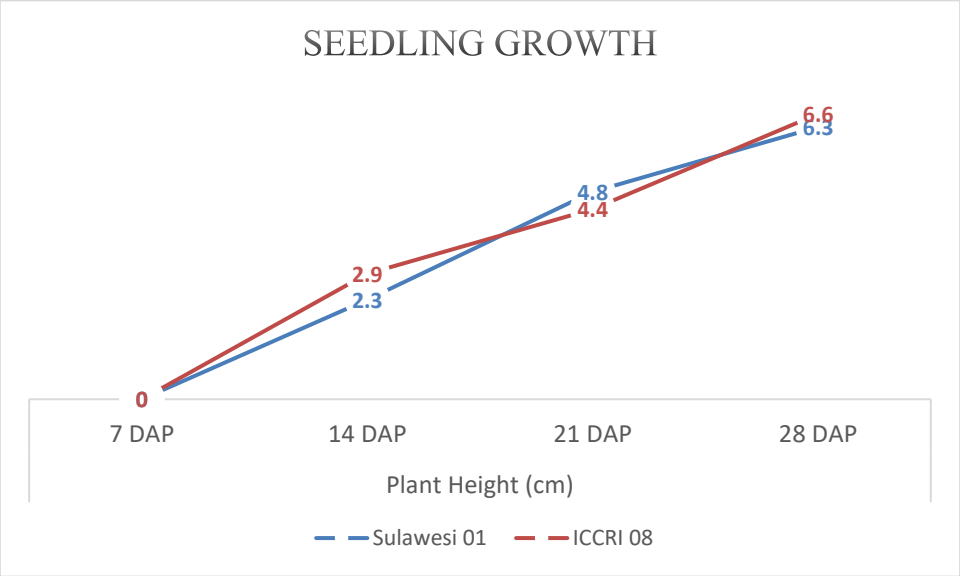

Figure 2. Seedling growth

At the age of 7 hst plants is a lag stage where plant growth is still very little, this causes the height of the plant to still be at 0 cm. In the second week the plants for the Sulawesi 01 and ICCRI 08 clones had a height of 2.3 cm and 2.9 cm respectively. When the plant age was 21 hst for the Sulawesi 01 clone was 4.4 while for the ICCRI 08 clone it had a height of 4.8 cm. In the last week of observation it had a height of 6.6 cm for the ICCRI 08 clone and 6.3 cm for the Sulawesi 01 clone.

Table 3. Vigor index

Clones	Average Plant Height (cm)	Vigor Index
Sulawesi 01	4,47 a	392,2 b
ICCRI 08	4,63 a	426,4 a

Keterangan: Angka yang tidak diikuti dengan huruf yang sama pada kolom dikatakan berbeda nyata pada uji DMRT taraf 0,05.

Based on table 3 shows the vigor index value of each clone tested. Clone Sulawesi 01 (4.47 cm) and clone ICCRI 08 (4.63 cm) showed results that were not significantly different in the average plant height parameter. Calculation of the vigor index showed that for clone Sulawesi 01 it was significantly different compared to clone ICCRI 08, with vigor index values of 392.2 and 426.4 respectively.

Sulawesi 01 clone according to the Decree of the Minister of Agriculture No. 694/Kpts/SR.120/12/2008 has the advantage of high productivity with a yield of 2.5 tons/ha and is resistant to VSD disease. The quality of dry cocoa beans of the Sulawesi 01 clone is 1.1 gr, with a seed fat content of 48-50%. Another clone used in this study is ICCRI 08 H, based on the Decree of the Minister of Agriculture No. 108/Kpts/KB/010/2/2017 stating that the clone is a cross between Sul 1 x KEE 2. The advantage of this clone is that it has high productivity reaching 2.5 tons/ha. The seed quality parameters of the ICCRI 08 clone are dry seed weight of 1-1.2 g/seed,

DOI: 10.32663/ja.v21i2.4916

seed coat content of 10.2-11.6%, fat content of 54.1-54.8%. Another advantage of this clone is that it is resistant to fruit rot and VSD. The germination power of Sulawesi 01 clone is higher with a value of 87.8% while ICCRI 08 is 92.1%. There is a difference of 4.3% indicating that the potential viability of Sulawesi 01 clone is higher than that of ICCRI 08 clone, but the difference is not significant based on statistical tests.

According to the regulation of the Minister of Agriculture (2013), seed viability of at least 80% can be classified as good seeds and has a high chance for plants to grow optimally. Seed viability is influenced by various factors, including seed content, seed water content, proper storage methods, and the planting media used. Cocoa seeds are recalcitrant seeds with deviations in room conditions that have high humidity between 70% -90%. Cocoa seeds are not resistant to drying and are sensitive to low temperatures and humidity (Tambunsaribu et al, 2017).

Cocoa seeds are prioritized to have water content and well-developed embryos so that they will have high viability and vigor. Too high water content makes plants susceptible to fungi and insects (Rafli, 2019). Germination is the initial phase of growth that involves internal and external conditions. Cocoa is classified as a seed with epigeal germination. Based on the data, it is stated that at 7 hst, cocoa plant seedlings have not experienced crown elongation. This is likely still in the seed germination phase. Germination obstacles can be caused by the presence of pupl in cocoa seeds.

In this study, the process of removing pulp with ash has been carried out. This cleaning will have an effect on accelerating germination because of the loss of obstacles during the imbibition process. Imbibition occurs when water enters the seed coat and diffuses into the tissue in the seed. Cell enlargement occurs when water enters the tissue. The presence of water in the tissue makes the skin permeable and oxygen and carbon dioxide gases can diffuse. This process supports seeds to carry out respiration which produces energy for germination (Gaol et al, 2023). Normal cocoa bean sprouts are a requirement for seeds to be transplanted in the nursery process. Storage that is too long will cause the seeds to become abnormal so that in the germination process some seeds cannot grow. Another factor that causes seeds to fail to germinate is because the structure of the sprouts is defective (Indarwati et al, 2024).

Based on the available data, a sigmoid curve is made which describes the growth of the life cycle of a plant. There are various stages of growth patterns, the first is the lag stage where the plants are still in a state of adaptation to the environment. This causes the plants not to experience significant growth. In the next stage is logarithmic or exponential, which is between 14 to 21 hst, the plant experiences accelerated growth. In the Sulawesi 01 clone, it increased by 2.3 cm to 4.8 cm for 21 hst. In ICCRI it also experienced from 2.9 cm for 14 hst to 21 hst. The exponential phase occurs because there is a plant capacity that facilitates rapid growth. Optimal environment such as availability of nutrients, light, and sufficient growing space (Nugraheni et al, 2018).

Essential macronutrients, especially N, P, K, are very important for the growth and development of cocoa. Nitrogen plays a role in cell division, phosphate elements increase respiration and metabolism to be optimal. This can increase the synthesis of amino acids and proteins that are important in cell formation. New cells initiate plant height so

DOI: 10.32663/ja.v21i2.4916

that growth occurs. Giving Potassium to plants also plays an important role in the photosynthesis process, so that plants can produce photosynthate (Buwono, 2016). Water loss in plants and gas exchange through stomata regulate the process of photosynthesis and stomatal conductance in plants (Maghfiroh et al, 2020). In the sigomoid curve, the flattening phase where the growth rate begins to slow down, for this phase the plant approaches optimal, but in this study this phase has not occurred. Plant height is one parameter that can be used to determine whether a clone is well adapted to an environment. Plant height increases due to the absorption of nutrients from the soil through plant roots. Roots condition plants to get a supply of water and nutrients to regulate function normally. The vessels of plant roots are also the main components in translocating and absorbing nutrients (Maghfiroh et al, 2020).

CONCLUSION

The results of this study indicate that the ICCRI 08 clone has the highest germination force of 92.1% and also the seedling growth parameter with a height of 6.6 cm at 21 days after planting. The measurement of the vigor index of 426.4 is the highest in the ICCRI 08 clone and is significantly different when compared to the Sulawesi 01 clone. The sigmoid curve shows the initiation and exponential phases of growth which are indicated by increased growth as the plant ages.

REFERENCES

Baswarsiati. (2018). *Teknologi Produksi Benih Tanaman Perkebunan*. Universitas Brawijaya Press.

Buwono, G.R., Erlida., &Ariani. Pertumbuhan bibit kakao (*Theobroma cacao* L.) dengan pemberian abu janjang kelapa sawit dan pupuk NPK pada medium gambut. *Jurnal Online Mahasiswa Universitas Riau.*

Indarwati, D. N. A., T. Fatimah., T. B. Irawan., A. Nuraisyah. (2024). Vigor benih kakao (*Theobroma cacao* L.) klon ICCRI 08H terhadap berbagai jenis kemasan dan lama penyimpanan. Agroposs National Conference Proceedings of Agriculture. DOI: 10.25047/agropross.2024.691

Gaol, E.U. L., Sugiatno., A. Edy, & H. Susanto. (2023). Pengaruh lama perendaman banih dalam larutan $CaCO_3$ terhadap pertumbuhan bibit kakao (*Theobroma cacao* L.) pada media tanam yang berbeda. *Jurnal Agrotropika*, 22(1), 47-54. DOI: http://dx.doi.org/10.23960/ja.v22i1.7432

Kementerian Pertanian. (2021). *Statistik Kakao Indonesia Tahun 2021*. Direktorat Jenderal Perkebunan, Kementerian Pertanian RI.

Maghfiroh, C.N., E.T.S. Putra. (2020). Morphological characters of root and yiekd of three cocoa (*Theobroma cacao* L.). *Jurnal Ilmu Pertanian (Agricultural Science)*, 5 (2), 58-65. DOI: doi.org/10.22146/ipas.51284

Maghfiroh, C.N., E.T.S. Putra., E.S.Dewi HS. (2020). Root detection by resistivity imaging and physiological activity with the dead-end trench on three clones of cocoa (Theobroma cacao). *Biodiversitas*, 21 (6), 2794-2803. DOI: 10.13057/biodiv/d210656

Nugraheni, F. T., S. Haryanti., & E. Prihastanti. (2018). Pengaruh perbedaan tanam dan voume air terhadap perkecambahan dan pertumbuhan benih sorgum (*Shorghum bicolor* L. Moench). *Buletin Anatomi dan Fisiologi*.

Putra, D. S., Wibawa, A., & Andoko, A. (2019). Evaluasi klon unggul kakao untuk pengembangan tanaman kakao

DOI: 10.32663/ja.v21i2.4916

berkelanjutan. *Jurnal Penelitian Kakao Indonesia*, 11(2), 23-30.

Rafli, M. (2019). Respon viabilitas dan vigor benih kakao (Theobroma cacao L.) pada perbedaan letak biji dalam buah dan lama pengeringan benih. *Jurnal Agrium*, 16 (1),43. DOI: 10.29103/agrium.v16i1.1341.

Syafaruddin, Sriyati, & Haryanto, T. (2020). Viabilitas benih dan pengaruhnya terhadap pertumbuhan bibit tanaman perkebunan. *Jurnal Agronomi Indonesia*, 48(1), 45-52.

Tambunsaribu, D.W., S. Anwar., & D.R. Lukiwati. (2017). Viabilitas benih dan pertumbuhan bibit kakao (*Theoborma cacao* L.) pada beberapa jenis media simpan dan tingkat kelembaban. *Journal Agro Complex*, 1 (3), 135-142. DOI:https://doi.org/10.14710/joac.1.3. 135-142.