JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 5 NO. 2 July 2023

DOI :https://doi.org/10.36378/juatika.v5i2.3112
eissn 2656-1727
pissn 2684-785X
Hal : 311 – 321

Increasing the Growth and Quality of Oil Palm Seeds (*Elaeis guineensis* Jacq) by Selecting the Position of Fruit Bunches and Dormancy Breaking Methods

Mansur Siregar, Devi Andriani Luta*, Najla Lubis
Universitas Pembangunan Panca Budi,
Jln.jendral gatot subroto KM 4,5 Medan, Indonesia
*Email : deviluta@dosen.pancabudi.ac.id

ABSTRACT

Oil palm reproduces by seeds and will germinate to grow further into plants. This study aims to determine the effect of the position of fruit bunches and various methods of breaking dormancy on the germination of coconut seeds palm. This study used a completely randomized design (CRD) factorial consisting of 2 factors with 18 combinations and 2 replications. The first factor is the position of the fruit on the oil palm bunch which consists of 6 positions of the fruit bunch, as follows: the base of the inner fruit bunch (PT), the base of the outer fruit bunch (PL), the middle of the inner fruit bunch (TD), the middle of the inner fruit bunch outer (TL), inner fruit bunch tip (UD), outer fruit bunch tip (UL) The second factor is various methods of breaking dormancy with the symbol (P), namely Ecoenzyme Soaking (P1), Gibberellin Soaking (P2), oven system (P3). Parameters observed included germination rate (%), percentage of normal sprouts (%), percentage of abnormal sprouts (%), radicle exit age (days), plumule exit age (days), radicle length (cm) and plumule length (cm). The results showed that the position of the oil palm fruit bunches and the dormancy breaking method gave a significant response to the germination parameters of 53.33% (fruit bunches) 49.33% (oven system), normal germination percentage 43.33% (fruit bunches) 38.89% (oven system), radicle exit age 36 days (bundle position) 37.17 days (oven system), plumule exit age 54.67 days (fruit bunches) 59.25 days (oven system), radicle length 1.98 cm (bunch position) 1.60 cm (oven system), and plumule length 1.78 cm (bunch position) 1.42 cm (oven system) and gave no significant response to the percentage of abnormal sprouts (%). The best treatment was the position of the deep base fruit bunches and oven system.

Keywords**:** *Seed, Dormancy, Oil palm, Method, Fruit bunches*

1. INTRODUCTION

Indonesia is a producer of palm oil. The development of the palm oil industry continues to increase from year to year, as evidenced by the increase in the area of oil palm plantations in Indonesia in 2022, specifically 12,009,911 ha for mature plants and production, specifically 46,854,457 tons (Direktorat Jendral Perkebunan Kementerian Pertanian Republik Indonesia, 2022). The increase in area was due to the relatively stable price of CPO on the global market, which provided producers with a promising income. As the area expands, there will inevitably be a rise in demand for superior oil palm seeds. The contribution of nurseries to optimal growth and production is crucial for achieving high yields. The potential for high-quality seeds to generate productive plants is greater. Seedlings with superior properties will be produced through improved parent selection, plant breeding, and cultivation techniques. Good seedlings have a high germination rate, a high germination rate, and a high germination rate. This directly contributes to the increase in crop production.

The ripe fruit of the oil palm is orange-red in color. Judging by the color, the fruit maturity in a single bunch is not uniform, with the base being less mature than the middle and the apex. In addition, the interior and exterior locations of the fruit are distinct, with the exterior fruit being more mature than the interior fruit. It is known that the location of the seeds on the fruit affects their vitality and viability. The study (Fadila et al., 2016) revealed that seeds from the center of the fruit produced the most viable and vigorous seeds. According to (Sudrajat et al., 2015), seeds from the second and third stalks have the greatest germination potential. When seeds attain physiological maturity, they are harvested for their high quality. The seeds have reached physiological maturity when the mother plant no longer meets their nutritional requirements. The supply of assimilates and other nutrients determines the maturation of a seed. When assimilate translocation ceases, the seed has sufficient reserves and optimal germination viability.

Oil palm reproduces by seeds and will germinate to further grow into plants. Oil palm sprouts come from embryos that come out of the seed coat and will develop in two directions. The movement straight up (phototrophy) is called a plumula which will then become the stem and leaves of the oil palm. The direction perpendicular to the bottom (geotrophy) is called the radicle which will then become the root. The plumule will appear after the radicle has grown by about one centimeter.

Germinating oil palm seeds is difficult due to the seeds' hard, quiescent shells. Dormancy is a condition in which seeds fail to germinate despite optimal environmental conditions. Generally, impediments in the hard seed coat are the cause of germination problems in seeds. Hard-shelled seeds can inhibit germination because the seed coat prevents water absorption and exchange of gases required for germination. Certain treatments, such as scarification or the use of chemicals to make it simpler for water and gas to enter the seeds, are required to overcome the problem of dormancy.

Methods for cracking the seeds include immersing them in water, using chemicals, and baking. According to research (Farhana et al., 2013), immersing seeds in 80°C water for three times twenty-four hours increases germination. Using 100 ppm gibberellin can help increase the length of the radicle and plumula in oil palm seeds, according to research conducted by Kartika et al. (2015) using the scarification technique.

Ecoenzymes are multifunctional solutions or liquids produced by fermenting a mixture of organic waste residue (fruits and vegetables), sugar cane, and water. The color is brownish (young/old) and the aroma is sweet and acidic, similar to that of fermented tape or rice wine.

In order to enhance seed germination, the use of growth regulators can increase endogenous hormone concentrations. (Norsazwan et al. 2020) and (Nuraini et al. 2016) reported the use of gibberellin as a germination agent for oil palm seeds with a germination percentage of 67.78% and a relatively lengthy germination time (50 days).

An oven typically breaks dormancy between 40 and 600 degrees Celsius. The elimination of oil palm seed dormancy with a 400°C oven system is designed to sustain normal seed conditions and prevent mutations in oil palm seeds.

This investigation seeks to determine the influence of fruit bunch position and various dormancy-breaking techniques on oil palm seed germination.

2. RESEARCH METHOD

This study was conducted at the Panca Budi Development University Laboratory in the province of North Sumatra between November 2022 and February 2023.

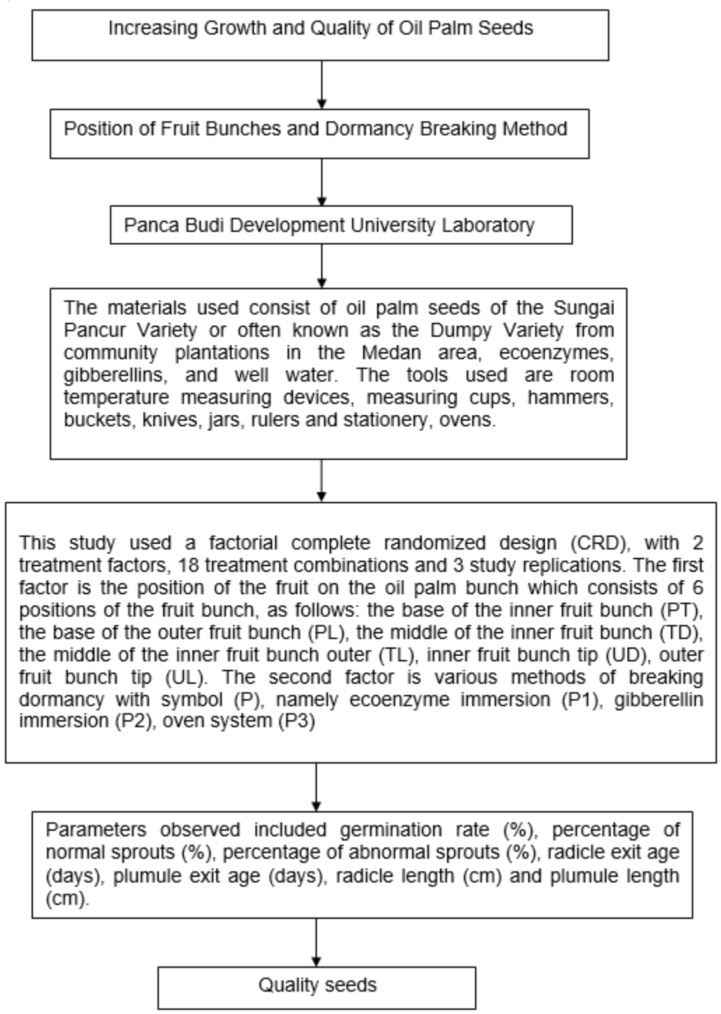

Figure 1. Research Flowchart

Figure 2. Oil Palm Seeds

(a) (b)

Figure 3. Breaking of dormancy (a) Ecoenzyme and Gibberellin (b) oven system

3. RESEULT AND DISCUSSION

Germination (%)

The results of the average germination rate (%) of fruit bunch position and various methods of breaking dormancy at 5, 7 and 9 weeks after soaking (MSP) can be seen in Table 1.

Table 1. Average Germination of Fruit Bunches Position and Various Methods of Breaking Dormancy at 5, 7 and 9 Weeks After Soaking (MSP)

Treatment	Germination		
	5 MSP	**7 MSP**	**9 MSP**
TB = Fruit Bunches			
TBPD = Deep Base Fruit Bunches	36.67 a	43.33 a	53.33 a
TBPL= Outer Base Fruit Bunches	35.56 a	42.22 a	52.22 a
TBTD= Central Fruit Bunches	27.78 b	34.44 b	42.22 b
TBTL= Outer Middle Fruit Bunches	26.67 b	33.33 b	41.11 b
TBUD= Inner End Fruit Bunches	23.33 c	28.89 c	36.67 c
TBUL= Outer End Fruit Bunches	22.22 c	27.78 c	35.56 c
P = Breaking Method			
P1 = Ecoenzyme	23.33 a	28.89 c	37.78 c
P2 = Gibberellins	28.33 b	35.00 b	43.33 b
P3 = Oven System	34.44 a	41.11 a	49.44 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The treatment of fruit bunch position and immersion produced a considerable germination response with an average value below 60%, as shown in Table 1. Even though the obtained results were statistically significant, bunch position and immersion were deemed insignificant because satisfactory germination exceeded 80%. This is because the majority of seeds remain latent. The limited germination of seeds results from an asynchronous imbibition process in the seeds, which means that the development of seeds into normal sprouts is not synchronized. The oil palm seed is protected by a seed shell impermeable to water and oxygen, as is common knowledge. Evaluation is still required, including duration or temperature changes.

In a previous study (Gustrianda et al. 2021), the best results were found in the middle of the deep spikelet bunches (43.63%), whereas in this study, the best results were found in the middle of the deep stem fruit bunches (53.33%). Where the variety of seed used and various methods of breaking dormancy influence germination yield. This study's results were superior to those of the previous study. Morphologically, seed germination is the transition from embryo to sprout. Physiologically, seed germination is the resumption of metabolic processes and the growth of previously delayed embryonic structures, which is indicated by their emergence through the seed coat.

Percentage of Normal Sprouts (%)

The results of the average normal sprouts (%) of fruit bunch position and various methods of breaking dormancy can be seen in Table 2.

Table 2. Average Normal Sprouts for Fruit Bunch Position and Various Methods of Breaking Dormancy

Treatment	Normal Sprouts (%)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	43.33 a
TBPL= Outer Base Fruit Bunches	40.00 a
TBTD = Central Fruit Bunches	31.11 b
TBTL= Outer Middle Fruit Bunches	28.89 b
TBUD = Inner End Fruit Bunches	24.44 c
TBUL = Outer End Fruit Bunches	21.11 c
P = Breaking Method	
P1 = Ecoenzyme	25.56 c
P2 = Gibberellins	30.00 b
P3 = Oven System	38.89 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The position of fruit clusters and soaking significantly affected the percentage of normal seedlings (%), as shown in Table 2. The oil palm reproduces via seeds, which germinate and develop into plants. Sprouts of oil palm originate from embryos that emerge from the seed coat and develop in two directions. In contrast to the research conducted by (Panggabean 2020), where gibberellin was the highest treatment, normal seedlings were the highest in this study, indicating that the oven system was on oil palm seeds, gibberellin was not the highest treatment in this study. This technique was used frequently in the oil palm plantation industry to increase the proportion of normal seedlings. This technique involves exposing the kernels to elevated temperatures for several days, typically between 40 and 45 degrees Celsius. The oven system is designed to disrupt seed dormancy and promote germination. According to the research (Aminarni, 2015), the oven system method for several days can increase oil palm seed germination.

Percentage of Abnormal Sprouts (%)

The average results of abnormal sprouts (%) of fruit bunch position and various methods of breaking dormancy can be seen in Table 3.

Table 3. Means of Abnormal Sprouts for Fruit Bunch Position and Various Methods of Breaking Dormancy

Treatment	Abnormal Sprouts (%)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	10.00
TBPL= Outer Base Fruit Bunches	12.22
TBTD = Central Fruit Bunches	11.11
TBTL= Outer Middle Fruit Bunches	12.22
TBUD = Inner End Fruit Bunches	12.22
TBUL = Outer End Fruit Bunches	14.44
P = Breaking Method	
P1 = Ecoenzyme	12.22
P2 = Gibberellins	13.33
P3 = Oven System	10.56

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The position of fruit clusters and soaking had no significant effect on the percentage of abnormal seedlings (%), as shown in Table 3. In a previous study (Gustrianda et al. 2021), the yield in the middle of the inner spikelet cluster was 17.34%, whereas in this study, it was 12.22% for the inner outer center fruit cluster. This can also result from the seedlings' morphological response to environmental conditions. When the first shoot appeared, the sprout was unable to distinguish between the radicle and the plumule. However, when the radicle appeared at the apex of the shoot, the sprout adapted to deflect the radicle in response to gravity, and vice versa for the plumule.

Radicle exit age (days)

The results of the average age at which the radicle emerges (days), the position of the fruit bunches and various methods of breaking dormancy can be seen in Table 4.

Table 4. The average age of radicle exit on Fruit Bunch Position and Various Dormancy Breaking Methods

Treatment	radicle exit Radikula (hari)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	36.00 a
TBPL= Outer Base Fruit Bunches	36.17 a
TBTD = Central Fruit Bunches	38.33 b
TBTL= Outer Middle Fruit Bunches	38.50 b
TBUD = Inner End Fruit Bunches	40.17 c
TBUL = Outer End Fruit Bunches	41.33 c
P = Breaking Method	
P1 = Ecoenzyme	40.42 b
P2 = Gibberellins	37.67 a
P3 = Oven System	37.17 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

Table 4 reveals that the position of the fruit clusters and submerging significantly affected the age (in days) at which the radicle emerged. As is well known, the oil palm seed is protected by a seed shell impervious to water and oxygen, causing it to have a distinct response and necessitating the breaking of dormancy. According to research (Dewi, 2019), the oven system demonstrated a quicker increase in the age of radicle exit, which was consistent with the research conducted. According to (Widajati et al., 2013), hormones stimulate the production of hydrolysis-related enzymes like -amylase. This -amylase enzyme will break down carbohydrates to generate germination energy (ATP). Enzyme activity in oil palm seeds can be enhanced by baking at the optimal temperature. In the oven system, the stimulation of the activity of these enzymes plays a role in converting reserve substances in the seeds into nutrients that the embryo can use for growth. With increased enzyme activity, the seeds' nutrients can be converted into a more accessible form for the embryo, including radicle growth.

Plumule Exit Age (days)

The results of the average age of plumule release (days) the position of the fruit bunches and various methods of breaking dormancy can be seen in Table 5.

Table 5. Average Plumule Exit Age for Fruit Bunch Position and Various Dormancy Breaking Methods

Treatment	Plumule Exit Age (days)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	54.67 a
TBPL= Outer Base Fruit Bunches	55.67 a
TBTD = Central Fruit Bunches	61.17 b
TBTL= Outer Middle Fruit Bunches	61.33 b
TBUD = Inner End Fruit Bunches	65.00 c
TBUL = Outer End Fruit Bunches	65.17 c
P = Breaking Method	
P1 = Ecoenzyme	62.00 b
P2 = Gibberellins	60.25 a
P3 = Oven System	59.25 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The position of the fruit clusters and submerging significantly affected the age (in days) at which the plumule was released, as shown in Table 5. According to research (Dewi, 2019), the oven system demonstrated an increase in the age of the plumule coming out quicker, which is consistent with the research conducted. The plumule typically follows the radicle. This is consistent with the assertion (Bastos et al., 2017) that the radicle is the first visible sign of germination in Arecaceae species with attached germination. Oil palm seed dormancy can be broken and enzyme activity stimulated by a predetermined temperature in the oven. This process prepares the seed for germination and promotes rapid radicle growth once the seed is deposited. However, baking does not enhance the plumula's shelf life directly. After the radicle has grown and undergone the initial phase of germination, the plumule will emerge and develop into a larger shoot. Humidity, temperature, and adequate nutrition will play a significant role in determining the growth rate of plumule.

Radicle Length (cm)

The results of the average radicle length (cm) of fruit bunch positions and various dormancy-breaking methods can be seen in Table 6.

Table 6. Mean Radicle Length to Fruit Bunch Position and Various Methods of Breaking Dormancy

Treatment	Radicle Length (cm)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	1.98 a
TBPL= Outer Base Fruit Bunches	1.93 a
TBTD = Central Fruit Bunches	1.42 b
TBTL= Outer Middle Fruit Bunches	1.38 b
TBUD = Inner End Fruit Bunches	1.15 c
TBUL = Outer End Fruit Bunches	1.08 c
P = Breaking Method	
P1 = Ecoenzyme	1.41 b
P2 = Gibberellins	1.47 b
P3 = Oven System	1.60 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The position of the fruit clusters and immersion significantly affected the length of the radicle, as shown in Table 6. According to research (Dewi, 2019), the oven system exhibited a quicker increase in radicle length, consistent with the research. According to research (Nuraini et al., 2016), the oven system is superior to gibberellin, and the conducted research supports this. The oven system causes the seed sheath to expand, allowing it to absorb water for imbibition and germination. Seed germination is controlled by a series of hormones that operate in stages. Low concentrations of gibberellin can affect plant growth and development, whereas high concentrations have no effect or negative effect on plants.

Plumule Length(cm)

The results of the average plumula length (cm) of fruit bunch positions and various methods of breaking dormancy can be seen in Table 7.

Table 7. Mean Plumule Length to Fruit Bunch Position and Various Dormancy Breaking Methods

Treatment	Plumule Length(cm) (cm)
TB = Fruit Bunches	
TBPD = Deep Base Fruit Bunches	1.78 a
TBPL= Outer Base Fruit Bunches	1.73 a
TBTD = Central Fruit Bunches	1.25 b
TBTL= Outer Middle Fruit Bunches	1.20 b
TBUD = Inner End Fruit Bunches	0.98 c
TBUL = Outer End Fruit Bunches	0.93 c
P = Breaking Method	
P1 = Ecoenzyme	1.23 b
P2 = Gibberellins	1.29 b
P3 = Oven System	1.42 a

Note: Numbers in the same column followed by the same letter show no significant difference at the 5% level (lowercase letters)

The position of the fruit clusters and immersion significantly affected the length of the plumula, as shown in Table 6. According to research (Nuraini et al., 2016), the oven system is superior to gibberellin, which is appropriate for researching plumula length. This is because the radicle develops linearly, so the faster the radicle emerges, the longer the plumule grows. This is consistent with Hadi's (2012) assertion that the plumule will not emerge from the embryonic axis until the radicle length is 1 cm. Differences in plumula growth between treatments may be influenced by variables such as the concentration of immersion used, the oil palm shells, environmental conditions, and the condition of the seeds utilized in the experiment or study.

4. CONCLUSION

The results demonstrated that the position of the oil palm fruit bunches and the procedure for breaking dormancy provided an accurate response to the research parameters. Germination yielded results of 53.33 percent (fruit clusters) and 49.33 percent (oven system). The proportion of normal seedlings is 43.33 percent (fruit clusters) and 38.89 percent (oven system). The departure age of radicles was 36 days (bunch position) and 37.17 days (oven system), whereas the exit age of plumula was 54.67 days (fruit bunches) and 59.25 days (oven system). Radicle length was 1.98 centimeters (bundle position) and 1.60 centimeters (oven system), and plumule length was 1.78 centimeters (bundle position) and 1.42 centimeters (oven system) with no significant correlation to the percentage of abnormal seedlings (%). The optimal treatment consisted of placing the deep-rooted fruit clusters and the oven system.

ACKNOWLEDGMENT

I would like to express my gratitude to Allah SWT, my parents, and the entire team who have launched, supported, and contributed to my writing until its completion.

REFERENCE

Aminarni L. 2015. Pematahan Dormansi Benih Kelapa Sawit (Elaeis guineensis Jacq) Dengan Perendaman Dalam Air Panas Dan Giberelin. Institut Pertanian Bogor.

Bastos LLS, Ferraz IDK, Junior MJVL, Pritchard HW. 2017. Variation in limits to germination temperature and rates across the seed-seedling transition in the palm Oenocarpus bataua from the Brazilian Amazon. *Seed Sci Technol*. 45(1):1–13. doi:10.15258/sst.2017.45.1.05.

Dewi EP. 2019. Pengaruh Lama Pemanasan Dan Perendaman Dalam Giberelin (Ga3) Terhadap Pematahan Dormansi Benih Kelapa Sawit (Elaeis guineensis Jacq.). Volume ke-561.

Direktorat Jendral Perkebunan Kementerian Pertanian Republik Indonesia. 2022. *Statistik Perkebunan Unggulan Nasional 2020-2022*.

Fadila N, Syamsuddin, Hayati R. 2016. Pengaruh Tingkat Kekerasan Buah Dan Letak Benih Dalam Buah Terhadap Viabilitas Dan Vigor Benih Kakao (Theobroma cacao L.). *JFloratek*. 11(1):59–65.

Farhana B, Ilyas S, Budiman LF. 2013. Pematahan Dormansi Benih Kelapa Sawit (Elaeis guineensis Jacq .) dengan Perendaman dalam Air Panas dan Variasi Konsentrasi Ethephon. *Bul Agrohorti*. 1(1):72–78.

Gustrianda M, Anwar A, Zainal A. 2021. Perkecambahan Benih kelapa sawit (Elaeis guineensis jacq.) berdasarkan Posisi Buah Pada Tandan. *Agrohita J Agroteknologi*. 6(1):83–88. http://jurnal.um-tapsel.ac.id/index.php/agrohita.

Hadi P. 2012. Aplikasi enzim ligninase dan selulase untuk meningkatkan perkecambahan benih kelapa sawit (Elaeis guinnensis Jacq.).

Kartika, M Surahman, M Susanti. 2015. Pematahan dormansi benih kelapa sawit (Elaeis guineensis Jacq.) menggunakan KNO3 dan skarifikasi. *J Enviagro Pertan dan Lingkung*. 8(2):48–55.

Norsazwan MG, Sinniah UR, Puteh AB, Namasivayam P, Mohaimi M, Aminuddin IA. 2020. Temperature fluctuation improves oil palm (Elaeis guineensis) dura × pisifera seed germination . *Seed Sci Technol*. 48(1):49–55. doi:10.15258/sst.2020.48.1.07.

Nuraini A, Pangaribuan IF, Suherman C. 2016. Pemecahan Dormansi Benih Kelapa Sawit Dengan Metode Dry Heat Treatmentdan Pemberian Giberelin. *Agrin*. 20(2):99–106.

Panggabean NH. 2020. Pematahan Dormansi Benih Kelapa Sawit (Elaeis Guineensis Jacq.). Menggunakan Metode Skarifikasi Dan Giberelin. *KlorofiL J Ilmu Biol dan Terap*. 4(2):62–70. doi:10.30821/kfl:jibt.v4i2.8786.

Sudrajat DJ, Nurhasybi, Bramasto Y. 2015. *Standar Pengujian dan Mutu Benih Tanaman Hutan*.

Widajati E, E. M, ER P, T K, M S, A Q. 2013. *Dasar Ilmu dan Teknologi Benih*.