**BIOVALENTIA : BIOLOGICAL RESEARCH JOURNAL**
***e*-ISSN: 2477-1392**
**Vol. 4 No. 1, May 2018**

# SETTINGS of TEMPERATURE and TIME SAVING on SEED GERMINATION of Champak (*Magnolia champaca* (L.) Baill. ex Pierre)

Odetta Maudy Nuradinda,[1*] Sri Pertiwi Estuningsih,[2] Harmida [2]

*1 Student of Environmental Management Pascasarjana Sriwijaya University.*

*2 Departement of Biology, Faculty of Mathematic and Natural Sciences, Sriwijaya University, South Sumatra 30662, Indonesia.*

**Corresponding author.*
*E-mail address: odettamaudy@student.pps.unsri.ac.id (Odetta).*
*Peer review under responsibility of Biology Department Sriwijaya University*

## Abstract

*Setting storage space temperature and time saving become an important application in supporting the development of plantations to provide seeds as needed and sustainable. The purpose of this research is to delay the rapid of seed germination in Champak by assessing the effect of various suspend temperatures and times saving on seed germination of Champak. The research was conducted in Plant Physiology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Sriwijaya University in February until June 2016. The method was used completely randomized design pattern Factorial by 3 factors with 12 treatments and 3 replications with the temperature: temperatures ± 31°C, temperatures ± 25 °C, temperatures ± 18 °C, temperatures ± 4 °C and the retention of time 0 week, 2 weeks , 4 weeks and 6 weeks. The parameters include the observation of germination rate, germination, vigor index and germination morphology. The result of this research shows the treatment of interaction of temperature and time saving significantly affected on germination rate, germination and seed vigor index of Champak. Germination rate, germination and vigor index were both produced by the treatment of storage at a temperatures of ± 18 °C and a temperatures of ± 25 °C at all times to keep (2 weeks, 4 weeks, 6 weeks) compared to control treatment. A normal germination produced in temperatures treatment ± 18 °C and ± 25 °C temperatures ranges between 90 - 93%. An abnormal germination produced in control treatment (0 week) by 25%. Measurement of moisture content and physiological maturity level of Champak seed needs to be done before it is stored and germinated for testing the viability of seeds of germinations..*

*Keywords: Temperature, Time Saving,Germination, Magnolia camphaca (L.) Baill. ex Pierre*

*Received: 29 March 2018, Accepted: 24 April 2018*

## 1. Introduction

Champak (*Magnolia camphaca* (L.) Baill. ex. Pierre) is a local wood species of local superiority from South Sumatra found in Lahat, Empat Lawang and Pagar Alam (R. Effendi *et al*., 2012) This indicates that Champak promises to be developed widely in the development of plantations. In the development of Champak as plantation forest, the factor that needs to be paid attention is the availability of crop material, is seeds. The seed of Champak is a type of recalcitrant seed that has high moisture content during harvest time, is intolerant to low temperature and humidity and is sensitive to the decrease in water content. The speed of the decrease in water content may affect the physiological and biochemical changes of recalcitrant seeds as the recalcitrant recruitment metabolism process continues (A. Wibowo, 2009).

One example of recalcitrant seed type is ramin seed (*Gonystylus bancanus*). Ramin seeds stored in an AC chamber (18 $^{o}$C until 20 $^{o}$C) use a plastic bag storage container with a damp sawdust mixer, sustained viability above 80% after being stored for 8 weeks (S. Nurhasybi dan . The results of tests conducted by (A. Wibowo, 2009), indicating that Champak wood beans can be stored in plastic containers in refrigerator temperatures 3 $^{o}$C for 4 weeks, germination after storing reach 68.5%. In addition, research conducted (R. Effendi *et al*., 2012) said that, Champak seeds have a high water content during the harvest is 90% with 70% germination. Storage of seeds with high water content may cause seed attack risk of fungi.

Storage treatment is done to overcome the germination of seed Champak that is too fast. Storage temperature settings play a role in maintaining seed viability during storage. Storage temperature plays a role in maintaining seed viability during storage. The lower the storage tem-

perature, the decrease in seed viability can be further reduced. The duration of storage affects the decreasing of moisture content and seed germination (U. Qulsum, 2011). Storage space while recalcitrant seeds can use room temperature chamber (25 ºC until 30 ºC) (Standar Nasional Indonesia, 2014).

The purpose of this research is to delay germination of Champak seeds by examining the influence of various temperature and time chamber of storage of seed germination Champak. This research is expected to be able to overcome the rapid constraints of the bean germinations Champak given the various treatment of room temperature and time saving to be a good solution to produce the number of seeds as needed, uniform seeds and the availability of sustainable seeds.

## 2. Materials and Method

The research was conducted in Physiology Laboratory of Biology Department, Faculty of Mathematics and Natural Sciences, Sriwijaya University from February to June 2016. The tools used during this research were stationery, anymometer, sand sieve, tub of size 25 cm x 20 cm x 10 cm, bamboo for running, camera, refrigerator, label, analytical balance, ruler, thin plastic with thickness 0,1 mm - 0,25 mm, and sparyer. The materials used are water, Champak seeds, Dithane M-45 and sterile sand. This study used a Completely Randomized Design Factorial Pattern with 2 factors with 12 treatments and added one combination of control treatment as a comparison which then each repeated 3 times so that 39 experiments were obtained.

**Setting Room Temperature Saving**

Storage space ± 31 °C (room temperature), ± 25 °C and ± 18 °C (room temperature AC), and ± 4 °C (refrigerator temperature).

**Provision of Seeds**

Seeds are collected from 33 years old trees based on uniform seed size with fruit skins that are reddish-brown and red flesh. Collecting seeds is done by climbing the parent tree by the residents. Seed transport is carried out by packing the seeds in a sack with air holes to avoid damage to seeds / fruit during transport [6]. Champak seed is taken in Lesung Batu Village, Kota Agung District, Lahat Regency, South Sumatera Province.

**Seed Extraction and Sorting**

Seeds Champak seeds removed from the skin of the fruit using a knife to obtain seeds Champak still coated by the flesh. Fill the stick is removed by soaking in a container of cold water (4 ºC) for 2 days before until the flesh of mushy fruit and peel, then knead under the running water and obtained the seeds are clean, after clean and then the seeds dried up in room temperature for 24 hours. Sorting the seeds of Champak is done by removing the empty seeds, damaged, young and seeds with abnormal size (A. Wibowo, 2009). Extracted beans are black with rough and wrinkled surfaces.

**Storage Duration**

The length of storage of Champak seeds in accordance with the treatment includes 2 weeks, 4 weeks and 6 weeks by storing seeds in a thin plastic bag with a thickness of 0.1 mm - 0.25 mm in each treatment room. Plastic packing amounted to 42, each plastic containing 50 grains of seeds saving.

**Preparation of Spilled Media**

The type of sow media used is sterile sand. Before drying the sand sieved with sand sieve. Sand is dried in the sun for 2 days to remove contaminants from the fungus. Tub sow length 25 cm x width 20 cm x height 10 cm with a height of sand 5 cm from high tub of sow (Nurlia, interview, 19th November 2015).

**Planting Seeds**

Seed germination testing activity is done by using direct method that is by seed seeding on planting media at end of period of save. Seeds sown directly in the sand medium in the tub with a flat position, in 1 tub sown 50 seeds Champak with sowing horizontal 8 seeds with spacing 4 cm and vertical seeding 7 seeds with spacing between 3 cm seed. Seeds are placed on each array made by drawing lines to form a hole to plant seeds, then seeds covered with thin sand (Nurlia, interview, 20th November, 2015).

Maintenance

Maintenance that needs to be considered is watering twice a day in the morning and afternoon with a sprayer and spraying uses D-MF45 Dithane fungicide to avoid the growth of mushrooms in a spray-tub that is sprayed every 1 week. During maintenance it is accompanied by observation until all the seeds germinate (A. Wibowo, 2009).

**Variable Observations**

The observation parameters included germination rate, germination, vigor index, normal and abnormal germinations analyzed by variance analysis (ANAVA) SPSS 16. If there is significant difference with Duncan Multiple Range Test (DMRT) at α 5%. Qualitative data is presented also in the form of images and then described.

## 3. Results And Discussion

**Germination Rate**

Based on the result of variance analysis (ANAVA) the interaction treatment of room temperature and save time significantly affected the germination rate, germination, and vigor index of Champak seed at (5% level) during

30 days of observation. Further test results of DMRT α 5% in each treatment of temperature interaction save space and time save on germination rate of beans Champak more presented in Table 1.

Table 1. Effect of temperature interaction of space and time save on the rate of germination Champak (M. camphaca)

| No | Interaction Temperature and Time Saving | Germination Rate (day) |
|---|---|---|
| 1. | Temperatures ± 31 ºC : 6 weeks | 0,00 [a] |
| 2. | Temperatures ± 31 ºC : 2 weeks | 10,33 [b] |
| 3. | Temperatures ± 31 ºC : 4 weeks | 13,17 [b] |
| 4. | Control : 0 week | 23,07 [bc] |
| 5. | Temperatures ± 4 ºC : 2 weeks | 23,17 [bc] |
| 6. | Temperatures ± 25 ºC : 6 weeks | 33,18 [bc] |
| 7. | Temperatures ± 4 ºC : 6 weeks | 35,77 [bc] |
| 8. | Temperatures ± 18 ºC : 4 weeks | 38,65 [cd] |
| 9. | Temperatures ± 25 ºC : 2 weeks | 39,66 [cd] |
| 10. | Temperatures ± 25 ºC : 4 weeks | 42,94 [cd] |
| 11. | Temperatures ± 4 ºC : 4 weeks | 46,58 [d] |
| 12. | Temperatures ± 18 ºC : 6 weeks | 49,72 [d] |
| 13. | Temperatures ± 18 ºC : 2 weeks | 50,09 [d] |

Information : Figures followed by the same letter show an unreal (*non significant different*) difference in Duncan Multiple Area Test of 5%

The ± 31 ºC temperatures treatment at 6 weeks time saving resulted in a germination rate that was different from other treatments because the seeds did not germinate. The seeds of the lanang are stored at ± 31 °C at 6 weeks saving time, which decreases the moisture content that affects physiological and biochemical changes during storage, causing seed quality to decline and then death. According to [7], the quality of the seeds that have decreased causes the growth of seeds is very slow and gradually die. This is due to the death of the embryo on the old seed treatment is stored so as not to experience growth.

Seeds stored at ± 31 ºC temperatures of 2 weeks time saving resulted in 10.33 days germination rate and ± 31 oC temperatures of 4 weeks saving time resulted in germination rates of 13.17 days, germinating faster than the treatment of room temperature and other time deposits. This is presumably because the temperature of storage space is high compared to other room temperature with high moisture content of Champak so that the germination process is not hampered in a long time. According to Halimursyadah (2012), at the time of storage of recalcitrant seeds, normal metabolism occurs which is followed by the division of cells at the growing points and seed germination.

The ± 31 ºC temperatures treatment at 6 weeks saving time resulted in a germination rate that was different from other treatments because the seeds did not germinate. Seeds of lanang are stored at ± 31 °C at 6 weeks saving time which can decrease the water content that influence physiological and biochemical changes during storage, this causes the quality of the seeds to decrease and then death. According to [7], the quality of the seeds that have decreased causes the growth of seeds is very slow and gradually die. This is due to the death of the embryo on the maintenance of long-stored seeds because the seed do not grow.

Seeds stored at ± 31 ºC temperatures of 2 weeks saving time resulted in a maximum velocity of 10.33 days and temperatures of ± 31 oC of 4 weeks saving time resulted in germination rates of 13.17 days, germinating faster than other room temperature and time deposits. It is required because the temperature of storage space is high compared to room temperature with the moisture content of Champak is high the germination process is not hampered in a long time. According to Halimursyadah (2012), at the time of storage of recalcitrant seeds, the usual metabolism occurs with the division of cells at the growing points and seed germination.

Unlimited bead seeds at 23.02 days, slower 12.69 and 9.85 days depending on storage at ± 31 °C. This happens because the seeds continue to perform the metabolic process without rest activity. According to [8], continuous metabolism increases vigor when seeds are added, seeds remain metabolized that break down food to transit to growth points including embryos, so that the embryo is better prepared to germinate when seeds are added.

Storage temperatures ± 4 ºC at 2 weeks save time increased 23.17 days, 4 weeks saving time resulted in 46.58 days germination rate and 6 weeks saving time resulted in 35.77 days germination rate. These treatments can be stored germination of 0.15 days, 23.56 days and 12.75 days respectively compared to. It can be treated with low speed and can be high. According to Asmoro (2016), storage at low temperatures reduces respiration and metabolism, slowing down the aging process and preventing air loss so that seed viability is still possible. Research conducted [8], Garcinia dulcis good response report on storage conditions temperatures ± 25 oC with 4 weeks storage time requires 25 days to add.

Temperatures ± 25 ºC at 2 weeks saving time resulted maximum rate 39.66 day, 4 weeks saving time yielding germination 42.94 days and save time 6 weeks yielding maximum speed 33.18 days. These treatments can be stored germination 16.64 days, 19.92 days and 10.16 days respectively compared to. Temperatures ± 18 oC with 2 weeks saving time resulted 50.09 additional velocity, 4 weeks saving time resulted in 38.65 days germination rate and 6 weeks saving time resulted 49.72 days germination rate which was good and no different. These treatments can be stored germination of respectively 27.07 days, 15.63 days and 26.25 days when compared with. This applies to low storage room temperatures which can retain moisture content of the seed during storage. According to [9], low temperatures (18 until 25 ºC) can maintain moisture content of the seed during storage. This is done active metabo-

lism back on when dikecambahkan. Storage of seeds with low moisture content due to metabolic reactions and the activity of enzymes in the beans runs very slowly. Low water content is a very important factor in the inactivation of seeds before being added.

Germination

Further test results of DMRT α 5% in each treatment of temperature interaction save and time to the overall germination are presented in Table 2.

Table 2. Influence of room temperature saving and time saving to germination out seed strength Champak (*M. camphaca*).

| No | Interaction Temperature and Time Saving | Germination Rate (day) |
|---|---|---|
| 1. | Temperatures ± 31 ºC : 6 weeks | 0,00 [a] |
| 2. | Temperatures ± 31 ºC : 2 weeks | 0,66 [a] |
| 3. | Temperatures ± 31 ºC : 4 weeks | 2,66 [ab] |
| 4. | Temperatures ± 4 ºC : 2 weeks | 3,33 [ab] |
| 5. | Control : 0 week | 6,21 [b] |
| 6. | Temperatures ± 4 ºC : 4 weeks | 6,66 [b] |
| 7. | Temperatures ± 25 ºC : 2 weeks | 8,00 [b] |
| 8. | Temperatures ± 18 ºC : 2 weeks | 9,33 [b] |
| 9. | Temperatures ± 18 ºC : 6 weeks | 12,66 [c] |
| 10. | Temperatures ± 25 ºC: 4 weeks | 18,66 [c] |
| 11. | Temperatures ± 18 ºC : 4 weeks | 19,33 [c] |
| 12. | Temperatures ± 25 ºC : 6 weeks | 36,66 [d] |
| 13. | Temperatures ± 4 ºC : 6 weeks | 39,33 [d] |

Information : Figures followed by the same letter show an unreal (non significant different) difference in Duncan Multiple Area Test of 5%

Temperatures ± 31 oC at 6 weeks saving time produces 0.00% germination that differ from other treatments because the seeds are not germinated. It is thought that the seeds have been damaged embryo during storage so that they can not afford to germinate because of high room temperature and long storage time. According [10], the higher temperature the more water contents in air and temperature can increase the metabolism reaction in the seeds. The decrease of seed quality occurs faster at higher temperatures, this is influenced by faster reaction rate constants compared to low temperatures.

The result germination rate was ± 31 ºC at 2 weeks saving time of 0.66% and 4 weeks germination yield 2.66% lower than other treatments. This is suspected when the high temperature of the enzyme becomes active so that the metabolic process runs fast. Rapid metabolic processes such as respiration produce inhibitory metabolites. According [11], storage at high temperatures can accelerate the activity of respiratory enzymes. Reform of food stocks in the form of kerbohydrate, protein and fat from respiration, produces metabolite materials that some metabolites inhibit or poison other metabolism that can lead to loss of germination.

Seeds Champak directly added to produce sprouts by 6%. This is presumably because the seeds of Champak requires time to save for several days although the harvested seeds are old, the seeds need adjustment first with the environment to survive. According to [12], the seed of Champak germinates the fastest on the 7 days and the longest on the 30 days. Based on observations in the field of Champak seeds germinate on the 23 days so that the seeds require storage process first before to germination to adjust its life cycle with the environment.

The germination produced by temperatures ± 18 ºC stored at 2 weeks saving time of 9,33% and temperatures ± 25 ºC 2 weeks saving time of 8.00% can increase germination compared to room temperature at all time saving. Similarly, the germination rate of ± 18 oC temperatures treatment at 4 weeks saving time of 19.33% and temperatures ± 25 ºC at 4 weeks saving time of 18.66% has no difference. This is thought to be a low water content at room temperature storage AC so that the rate of respiration and metabolism is slow and the germination rate generated is large. According to [13], seed storage at low moisture contents for long periods of time (> 1 month) is able to minimize damage to seeds when stored. The lower the moisture content of the seeds, the lower the respiration rate, so that the seeds can still be added when stored for long periods of time.

The shelf time of 6 weeks at temperatures ± 25 ºC and temperatures of ± 4 ºC yields germination equal to 36,66% and 39,33%. Allegedly able to inhibit the germination process if the seeds are stored longer at low room temperature, with low moisture content, the resulting germination remains high because the metabolic process is inhibited so that enzymes are not damaged. According to [14], low temperatures to the rate of appearance of germination indicate that enzymes are not damaged so they can do their activity in the metabolism of germination growth. Research conducted [11], to produce soybean seeds stored at low temperatures 21 ºC - 23 ºC slow the activity of respiratory enzymes.

**Vigor Index**

Further test results of DMRT α 5% on each treatment of temperature interaction save space and time store on the complete vigor index presented in Table 3.

Tabel 3. Table 3. Effect of interaction of room temperature and time of storage on bean germination seed of Champak (M. camphaca).

| No | Interaction Temperature and Time Saving | Germination Rate (day) |
|---|---|---|
| 1. | Temperatures ± 31 ºC : 6 weeks | 0,00 [a] |
| 2. | Temperatures ± 31 ºC : 2 weeks | 0,23 [a] |

| | | |
|---|---|---|
| 3. | Temperatures ± 31 ºC : 4 weeks | 0,35 [a] |
| 4. | Temperatures ± 4 ºC : 2 weeks | 0,85 [b] |
| 5. | Temperatures ± 18 ºC : 2 weeks | 0,99 [b] |
| 6. | Temperatures ± 4 ºC : 4 weeks | 1,09 [b] |
| 7. | Temperatures ± 25 ºC : 2 weeks | 1,94 [b] |
| 8. | Control : 0 week | 2,65 [b] |
| 9. | Temperatures ± 18 ºC : 6 weeks | 2,68 [c] |
| 10. | Temperatures ± 18 ºC : 4 weeks | 3,83 [c] |
| 11. | Temperatures ± 25 ºC : 4 weeks | 4,94 [c] |
| 12. | Temperatures ± 4 ºC : 6 weeks | 12,89 [d] |
| 13. | Temperatures ± 25 ºC : 6 weeks | 14,17 [d] |

Information : Figures followed by the same letter show an unreal (non significant different) difference in Duncan Multiple Area Test of 5%

Temperatures ± 31 ºC at the time of saving 6 weeks produces a vigor index of 0. This is thought to occur damage to seeds due to a slight moisture content during the storage process resulting in the decline of seeds due to disruption of metabolic processes. According to Halimursyadah (2012), water plays a role in maintaining stability membranes and macromolecules. Decreasing moisture levels during the storage process cause metabolic disturbances that lead to the decline of seeds and eventually the seeds experience death.

Temperatures ± 31 ºC produces lower vigor at 2 weeks saving time of 0.23% and 4 weeks saving time of 0.35% of storage of AC temperature and refrigerator temperature at all storage times. It is suspected that the process of respiration that occurs continuously in room temperature causes the process of decline of seed occurs with the increase of old cells in the seed during storage, so that when the seeds are added, the vigor index decreases. According [11], the decline of seeds lead to leakage of cell membrane resulting in an accelerated vigor decline. The longer the seeds are stored at room temperature, the older the seed cells so that the leakage of the membrane of the higher seed cells and the permeability of the cell also decreases.

Seeds Champak unsaved seeds produce a value of vigor index of 2.64%, greater than the temperature of the room saving AC and other storage room temperature with a refrigerator time saving for 2 weeks. It is presumably because the seeds continue to perform the metabolic process without resting. According to Halimursyadah (2012), on recalcitrant seeds there is no mechanism of cessation of metabolism when the plant is released from its parent, so the metabolism remains active to increase the vigor of the seed when it is added.

Vigor index value generated temperatures ± 18 oC at 2 weeks saving time of 0.99% and temperatures ± 25 oC at 2% saving time equal to 1.94% also value of vigor index produced ± 18 oC temperatures at 4 weeks saving time 3.83% and temperatures ± 25 oC at 4 weeks saving time 4.94% each treatment of save room and time store have no different value. It is presumed that low room temperature is used to cause slow respiration process so that when the seeds are stored the power of germination and seed vigor can still be maintained because the food reserves in the body of the seed is still large. According to [15], the seeds in the AC store temperature produce a vigor index greater than the seed at room temperature. This suggests that low temperatures in seed storage may affect the increased vigor index of seeds. This is in line with a study conducted by Handayani (2003), reported that Bruguiera gymnorrhiza seeds stored for 2 and 4 weeks at room temperature 18 oC until 20 oC able to maintain viability of seeds Bruguiera gymnorrhiza up to 4 weeks of storage with 40% germinations.

High vigor index value produced temperature treatment ± 4 oC at 6 weeks save time of 12.89% and temperature ± 25 oC at 6 weeks time saving of 14.17%. It is assumed that the low storage space temperature and the longer time saving cause the metabolism process can be slower so that the resulting germination rate remains large which is indicated by high vigor index value. According to [15], a decrease in seed storage temperatures may have an effect on increasing seed vigor index. The saving period will affect the seed vigor, which decreases with time.

**Morphology of Germination**

Normal germination are the longest produced by ± 18 oC temperatures treatment and ± 25 oC temperatures ranging from 90 to 93% normal germinations. It is presumed that storage at room temperature of AC metabolism process runs slower with the deactivation of respiratory enzymes so that the reshuffle of food can be reserved slowly and produce normally sprouts in the field. According to [13], seed germination occurs due to respiration that requires enzymes which has its respective functions in the reshuffle of food reserves in seeds. At low temperatures the respiration can be slowed down so that the sprout appearance can be normal in many fields.

The more abnormal abnormalities appear in the control treatment (0 weeks) by 25%. It is presumed that the seeds of Champak require a resting phase for several days before the seeds are added even when the seeding process is old, so when the seeds are directly added the seed vigor increases and produces the dominant abnormal germination. According to [8], on the seeds are directly added seed vigor increased so that the metabolism process is still running without rest activity and produce abnormal germination.

The observation of morphology of germination Champak observed is normal and abnormal germination, hypokotil, epicotil, and cotyledon. The following morphological observations of Champak germinations (observation days 30) can be seen in the pictures below:

Picture 1. Normal Germinatio of Champak

Picture 2. Abnormal germination of Champak

Information : (Pic. 1.) has 3 leaves and 1 green leaf and a high stem and a green color. (Pic. 2.) the hypocotyl and epicotyl parts are decomposed with torn ore shells, having a high stem and pale color.

Normal sprouts are produced by the control and interaction of room temperatures treatment ± 25 oC, ± 18 oC, ± 31 oC, ± 4 oC at all shelf time 2 weeks, 4 weeks and 6 weeks. The abnormal germination is produced by the control and interaction of room temperatures treatment ± 25 oC at 2 weeks of saving time, room temperatures ± 25 oC, ± 18 oC and ± 4 oC at 4 weeks of saving time and room temperatures ± 25 oC, ± 31 oC, ± 4 oC at 6 weeks of saving time. Normal germination generally have green stems while the abnormal germination have a pale green stem.

## 4. Conclusion

The interaction treatment of room temperature and time saving significantly affect the germination rate, germination and vigor index of Champak seeds. Temperatures ± 18 oC is able to delay germination of beans Champak at 2 weeks by saving time of 27.07 days, 4 weeks of 15.63 days and 6 weeks of 26.25 days, which is not different with the temperatures ± 25 oC and it is able to delay the germination of seeds of Champak for 2 weeks by saving time of 16.64 days, 4 weeks of 19.92 days and 6 weeks of 10.16 days with the germination quality and vigor index remained good when it is compared with the control treatment. The germination rate, germination and good vigor index were generated by storage treatment at ± 18 ° and ± 25 °C at all shelf times (2 weeks, 4 weeks, 6 weeks) compared with control treatment. Normal germination produce more ± 18 oC temperature treatment and ± 25 ºC temperature ranges from 90 to 93%. Abnormal germination resulted more control treatment (0 weeks) by 25%.

## References


Ali, A. 2011. Pengaruh Penyimpanan Biji pada Suhu Ruang Dingin dan Beku terhadap Viabilitas Biji Belimbing (*Averrhoa carambola* L.) Kultuvar "Dewa Baru" Asal Kecamatan Cimanggis, Depok. Skripsi FMIPA. Universitas Indonesia. 55 hlm.

Andhi, TC, Aziz, P, Prapto, Y. 2011. Studi Aspek Fisiologis dan Biokimia Perkecambahan Benih Jagung (*Zea mays* L.) pada Umur Penyimpanan Benih yang Berbeda. *Jurnal* Pertanian. Fakultas Pertanian Universitas Gadja Mada. Yogyakarta. 1-11.

Asmoro, HP. 2016. Kajian Penyimpanan Kentang (*Solanum tuberosum* L.) pada Suhu Rendah dan Tingkat Kelembapan Relatif yang Berbeda. Institut Pertanian Bogor. Bogor. 1–7.

Bramasto, Y, Evayusvita, R, Endang, P, Nurin W, Muhammad, Z. 2013. Variasi Morfologi Buah, Benih dan Daun Champak (*Michelia champaca*) dari Berbagai Lokasi Tempat Tumbuh. Prosiding Seminar Hasil-hasil Penelitian. Balai Penelitian Teknologi Pembenihan Tanaman Hutan.

Halimursyadah. 2012. Pengaruh Kondisi Simpan terhadap Viabilitas dan Vigor Benih *Avicennia marina* (Forsk.) Vierh. pada Beberapa Periode Simpan. *Jurnal Agrotropika*. Fakultas Pertanian Universitas Syah Kuala. Banda Aceh. Vol. 17 No. 2. 43-51.

Handayani. 2003. Pengaruh Media Simpan, Ruang Simpan dan Lama Penyimpanan terhadap Viabilitas Propagul *Bruguiera gymnorrhiza*. Skripsi Fakultas Kehutanan. Institut Pertanian Bogor. Bogor.

Herdiana, N. 2009. Kajian Teknologi Perbenihan Jenis Lokal Sumatera Selatan. Prosiding Seminar Hasil-hasil Penelitian Balai Penelitian Kehutanan, Palembang, 11 November 2008. Balai Penelitian Kehutanan Palembang.

Kristianti, S. 2012. Kajian Suhu dan Kadar Air Terhadap Kualitas Benih Kedelai ***(****Glycine max (L.) Merril****)*** Selama Penyimpanan. Makalah Seminar Umum. Universitas Gadja Mada. Yogyakarta. 1-14.

Lukman, AH. 2012. Status Budidaya Champak dalam Pengusahaan Kayu Rakyat Di Sumatera Selatan. Prosiding Seminar Hasil-hasil Penelitian Balai Penelitian Kehutanan, Palembang, 23 Oktober 2012. Balai Penelitian Kehutanan Palembang.

Meilani. 2003. Uji Penyimpanan dan Daya Kecambah *Garcinia* spp. (Clusiaceae) : Pengaruh Suhu, Media dan Waktu Penyimpanan dalam Upaya Konservasi. Jurnal. Institut Pertanian Bogor. Bogor. 1–35.

Nurlia, A. 2011. Analisis Sosial dan Kebijakan Pembangunan Hutan Tanaman Jenis Champak. Prosiding Seminar Hasil-hasil Penelitian Balai Penelitian Kehutanan, Musi Rawas, 13 Juli 2011. Balai Penelitian Kehutanan Palembang.

Nurlia, A. 2015. Persiapan Media Tabur dan Penanaman

Benih Champak. wawancara personal. Balai Pembenihan Tanaman Hutan Palembang. Palembang.

Nurhasybi, Edy, TK, Evalin, S. 2010. *Manual Monitoring Musim Berbunga-Berbuah dan Produksi Benih Ramin (Gonystylus bancanus).* Pusat Penelitian dan Pengembangan Hutan dan Konservasi Alam. Bogor. 28 hlm.

Purwanti, S. 2004. Kajian Suhu Ruang Simpan Terhadap Kualitas Benih Kedelai Hitam dan Kedelai Kuning. Jurnal Ilmu Pertanian. Universitas Gadja Mada. Yogyakarta. Vol. 11 No. 1: 23-31.

Qulsum, U. 2011. Pengaruh Suhu dan Lama Penyimpanan terhadap Viabilitas Benih Kacang Hijau (*Phaseolus radiatus* L.). Skripsi Fakultas Sains dan Teknologi. UIN Maulana Malik Ibrahim. Malang.

Rahman, A, Anne, N, Nursuhud. 2014. Pengaruh Kadar Air Awal Benih dan Suhu Ruang Simpan terhadap Viabilitas, Vigor, dan Pertumbuhan Benih Sirsak (*Annona muricata*). *Jurnal Agroekoteknologi.* Universitas Padjajaran. Bandung. Vol. 1 No. 4: 1-11.

Rahmi, S. 2016. Pendugaan Umur Simpan Benih Kedelai Menggunakan Metode *Accelerated Shelf-life Testing* (ASLT). Jurnal Keteknikan Pertanian. Institut Pertanian Bogor. Bogor. Vol. 4 No.1 p: 75-80.

Siahaan, H, Nanang, H, Nasrun, Jon,i M, Rahman, TS. 2013. Teknik Silvikultur Champak. *Prosiding Seminar Hasil-hasil Penelitian Balai Penelitian Kehutanan*, Palembang, 2 Oktober 2013. Balai Penelitian Kehutanan Palembang.

[SNI] Standar Nasional Indonesia. Penanganan Benih. 2014. *Penanganan Benih Generatif Tanaman Hutan.* PT 65-01 Pengelolaan Hutan: Jakarta. 1-56.

Sunyoto, Liza, O. 2013. *Kajian Pengaruh Suhu Simpan dan Metode Pematahan Dormansi Terhadap Viabilitas Benih Pepaya Merah Delima*. 2013. Balai Penelitian Tanaman Buah Tropika: Sumatera Barat. 1-10.