

The Response of Jabon Seeds Germination (*Anthocephalus cadamba* (Roxb.)Miq.) against the Duration of Combustion and Illumination

Vauzia*¹, Eliza Gusmira²

¹Biology Department, FMIPA Universitas Negeri Padang

²Biology Department, FMIPA, Universitas Negeri Padang

*Email : Vauzia.ivo@gmail.com

Abstract. The purpose of this research is to know the response of jabon seeds germination against combustion and illumination. The research is done at the laboratory and the wire spot in FMIPA UNP, started from January to June in 2018. The design that is used is RAL with 2 factors in it. The first is from the duration of combustion and the second is from the illumination treatment. Based on the design, there are 10 combination of treatments and every treatment will be done 3 times so there will be 30 experiments for the total. The parameter that is observed is the duration of jabon seed germinating and the length of jabon's root. The result of this research showed that the combustion factor, the illumination factor, and the interaction between combustion and illumination is mattered to the duration of jabon seed germinating. While the length of jabon's root depends with the combustion factor and the illumination factor. The interaction between the duration of combustion and illumination will not affect the length of jabon's root at all.

Keywords : Jabon (*Anthocephalus cadamba* (Roxb.) Miq.), germination, seeds, the length of root

1. Introduction

Forest has an important role in supporting human life, like produce the oxygen that is necessary for human beings and absorbing carbon dioxide as the outcome of every human being's activity. Besides, forest is well to protect and as a source of conservation at the same time, and also as the source of biodiversity, both for flora and fauna. Considering the importance of forest for human life so the it needs to be maintained and preserved well into cultural properties[1-14].

However, at this time, there are a lot of interruptions that cause the forest cannot be functioned as which it was supposed to be. One of them is the external disturbance in the form of a forest fire, and it comes with 2 factors, they are natural factor and human factor. Natural factor is the impact of el-nino that causes the drought tightened its grip prolonged [15]. While the human factor is the human behavior that goes uncontrolled in the use of the fire that caused the fire forests became one of the problems prone to[16].

A forest fire created an adverse impact for human life and other living creatures. A forest fire has caused the decline in biodiversity, decline in economic value in forestry and productivity land, climate change micro and ecological loss in the form of reduced an area of forest so that the availability of clean air will be diminished [15, 17].

Considering the increasing damage to forests, so it requires some forest rehabilitation efforts. This rehabilitation activity aims to restore, maintain, and improve forest functions so that they can be functioned normally again as a human life support system [18].

As for the forest rehabilitation, one of the ways that can be used is by selecting plants that are able to adapt in some damaged and critical lands. Based on Vauzia's (2017) research in Batang Alin Pasaman Barat, one of the plants that was able to adapt to the damaged and critical land was *Anthocephalus cadamba* (Roxb.) Miq.[19]

Anthocephalus cadamba (Roxb.) Miq. is one type of tree that has high prospects for critical land rehabilitation. This plant is known as Jabon[20]. Jabon is a large tree with a straight and cylindrical stem and has a high canopy like an umbrella with a typical horizontal branching system [22]. A round Jabon fruit has a size of 4-6 cm with a lot of seed chambers like compound fruit. Jabon seeds are brown in irregular shape with a hard membrane covering the seeds[21].

Jabon is a pioneer plant that can grow well in moist alluvial soils and it is generally found in secondary forests along river banks and swampy areas [20]. Growing environmental conditions that are needed by Jabon are clay, brown podsollic, and moist alluvial. In Kalimantan and Sumatra, Jabon is found in newly opened areas, namely in logged-over areas, ex-farms, and other open areas[23].

Considering from many potentials that come from Jabon plant, whether both has been known or not yet, the Jabon plant needs to be developed. In order to develop Jabon, it is necessary to supply large quantities of seeds. The problems encountered in the supply of Jabon seeds are the low percentage of Jabon seed germination. Mindawati (2015) states that it is because the membrane covering the Jabon seeds has hard skin so that water and O₂ are difficult to penetrate. To overcome these problems, certain treatments are needed to increase Jabon seed germination percentage[21].

The results of Vauzia's (2017) research in Batang Alin, West Pasaman, showed that Jabon was the dominant species growing in the ex-fire area with an INP (important value index) of 51.12%. Based on the data above, it is suspected that fire plays a role in stimulating the germination of Jabon seeds[19]. In addition, Keeley and Fotheringham (2000) state that combustion can trigger seed germination in some forest plant species and stimulate germination of dormant seeds in the soil [24]. Furthermore, Mulawarman et al. (2002) also stated that burning is one way to break seed dormancy and accelerate seed germination. In addition to fire, illumination also influences the germination process [25]. Yudarfis et al. (1990) stated that germination of seeds in an open place will make seeds germinate faster[13].

According to the states above, a research has been done due to the response of Jabon seed germination to the duration of combustion and illumination.

2. Research Methods

The research is held at the laboratory and wire spot in FMIPA UNP started from January to June in 2018. The design that is used is RAL factorial 5 x2 with 3 times replay in it. The first is from the duration of combustion (A) that consists of: A0 (without combustion), A1 (combustion along 12,5 minutes), A2 (combustion along 15 minutes), A3 (combustion along 17,5 minutes), and A4 (combustion along 20 minutes). While the second is from the illumination (B) that consists of: B1 (exposed) and B2 (hidden). So that it obtained 30 units of experiment (5 x 2 x 3).

The observation data were analyzed by ANOVA test and if there were real differences, then continued with DNMR test at 5% real level.

2.1. Materials and Tools

In this research, the tools that will be used were stationery, cameras, digital scales, zinc, filters, baskets, rulers, sprayers. While the material that is used in this research is Jabon seeds that is obtained from PT Permata Agro Lestari in Dhamasraya, polybags size (15x21) cm, clear plastic, labels, ropes, growing media (soil), straw.

2.2. Research Procedure

1. Prepare some seeds and germination containers. The seed must be weighted around 0.2 grams. The media that will be used is pure soil, while the germination container that will be used is a polybag measured around 15 x 21 cm and a basket. Polybags are filled with soil and arranged in baskets to facilitate germination of Jabon.

2. Prepare zinc which is used as a container when burning straw and Jabon seeds. Then stack 6 small piles of sand in the zinc bag.

3. Each pile of sand contains 0.2 grams of Jabon seeds. Then it has to be covered with straw and is burned for a long time in accordance with the treatment that has been designed.

4. After taking a long time, the combustion treatment has been achieved, then the Jabon seeds which are burned under straw are taken and stocked on the planting medium.

5. The distribution of Jabon seeds on the planting medium requires a help from a filter so that the Jabon seeds are spread evenly and not accumulated in one place.

6. After the seeds are spread on the planting medium, then the media is doused again with water until the media is becoming so moist.

7. Then, before being placed in an exposed and sheltered place in accordance with the treatment that has been determined, polybag jabon which is in the basket needs to be covered with clear plastic and tied with a rope around the basket. It aims to maintain moisture until the seeds appear on the ground.

8. During the process of germination, the seeds are watered twice a day, by the morning and evening or depending on the weather. Watering should not be too moist because it will cause mold and rotten seeds.

9. To prevent the onset of mold, Jabon seeds are watered with antracol fungicide once a week at a dose of 1 gram to 2 liters of water.

The parameters that is observed in this study, that is the time to germinate Jabon seeds and the length of Jabon root.

3. Results and Discussions

Germination Time (Depended on the observation that had been done for 4 weeks). Before the observation that had been done for 4 weeks, it was found that the duration of combustion factor, illumination factor and interaction between burning time and illumination had a significant effect on the time of germination of Jabon seeds. The average germination time in each treatment can be seen in Table 1.

Tabel 1. The average germination time in each treatment

Factor A	Factor B		The Average
	B1	B2	
A0	24,33 ^d	18,85 ^b	21,59 ^b
A1	23,19 ^c _d	16,80 ^a	19,99 ^a
A2	22,78 ^c _d	16,63 ^a	19,70 ^a
A3	23,02 ^c _d	21,06 ^c	22,04 ^b
A4	26,37 ^e	22,11 ^c _d	24,24 ^c
The Average	23,94 ^b	19,09 ^a	
Duncan 5%			

P.s.: Numbers that are followed by the same letter in the same row/column of each treatment are not significantly different in Duncan's test level of 5%.

According to table 1 it can be seen that the seeds which were given an combustion treatment for 15 minutes (A2) had the fastest germination time of 19.70 days and were not significantly different from the combustion treatment of 12.5 minutes (A1) which was 19.99 days, but significantly different from treatment without combustion (A0), burning for 17.5 minutes (A3) and 20 minutes combustion treatment (A4) which only gave germination time respectively 21.59 days, 22.04 days and 24.24 days. In table 1, it can be seen that the longer the combustion, the faster the time to germinate Jabon seeds, to the point where the time to germinate Jabon seeds begins to fall again. This is presumably because the seeds of Jabon have dormancy properties caused by hard seed skin [8], so that by giving combustion treatment can accelerate the appearance of Jabon seeds to the soil surface compared to without having any combustion treatment.

The temperature that is generated in the combustion process results a tear on the seed skin, so that water and gas will enter the seeds. This event will accelerate the activity of enzymes that cause the germination process more quickly [26]. Some seeds were well-scarified due to fires and the result was a rapid recovery in the area after a fire like what happened in the Batang Alin forest, Pasaman Barat. But having the combustion treatment for too long will cause some seeds to be damaged and fail to germinate. Cushwa et al (1967) stated that as the temperature increases, the germination will increase and will reach the point where the temperature will damage the seed which then decreases the germination rate due to the lethal effect of high temperatures[27].

According to the aspect of illumination, in table 1 shows that the germinated seed in the sheltered place gives the fastest germination time of 19.09 days and is significantly different from the treatment at the exposed place which only gives time to germinate 23.94 days. This is presumably because during the germination, Jabon does not need direct sunillumination to stimulate germination because it can inhibit seed germination [29].

In the germination process, the seeds need illumination to stimulate germination, but not all seeds need illumination. Some species even inhibit germination in bright conditions [28]. Sutopo (1988), states that infrared wavelengths in sunillumination almost always inhibit germination because if the seeds that are in the process of giving infrared illumination, the infrared illumination will turn into red illumination which will cause the germination to be inhibited[29].

Compared to the duration of combustion only, or the effect of illumination only, the interaction between the duration of combustion and illumination gives faster time to germinate, namely in the treatment of burning for 15 minutes with germination in the shaded place (A2B2) giving germination time of 16.63 days and not significantly different from Combustion treatment 12.5 minutes with germination in shaded places (A1B2) but significantly different from other treatments. This is presumably because even though the burning treatment is given the same time, the germination of the cell elongation is accelerated with the help of auxin hormones, whereas in the exposed area cell elongation is inhibited due to damage to auxin hormones due to illumination. Lakitan (1996), states that in excessive sunillumination intensity auxin hormone performance will be inhibited [30]. Therefore the combination of combustion and shade treatment is more effective to accelerate the time of Jabon seed germination.

3.1. The length of root (cm)

Based on the observations that have been made for 4 weeks, the results of the long combustion and illumination factors have an effect on the length of the root of Jabon, but the interaction between the duration of combustion and illumination does not affect the root length. The average root length for each treatment can be seen in Table 2

Tabel 2. The average length of jabon's root (cm)

Factor A	Factor B		The Average
	B1	B2	
A0	1,04	1,8	1,42 ^{ab}
A1	0,80	2,68	1,73 ^a
A2	1,57	2,30	1,93 ^a
A3	1,72	2,27	1,99 ^a
A4	0,60	1,65	1,13 ^b
The Average	1,14 ^b	2,14 ^a	

Duncan
5%

P.s.: The numbers that are followed by the same letter in the same row / column of each treatment are not significantly different in Duncan's test level of 5%.

From table 1, it is known that the combustion treatment for 17.5 minutes has the longest root length of 1.99 cm but not significantly different from the combustion treatment for 15 minutes and 12.5 minutes which has a root length of 1.93 cm respectively and 1.73 cm. However, it was significantly different from the combustion treatment for 20 minutes and

without combustion which only had a root length of 1.42 cm and 1.12 cm. Based on this, it can be seen that the longer the combustion of seeds, the longer the root of the sprouts. This may be due to the length of combustion treatment which makes the hard seed skin damaged quickly so that the radicle first comes out in the combustion treatment compared to the treatment without burning, and the root of the sprout from the combustion treatment will also be longer. This root lengthening is related to the appearance of the radicle. Salisbury (1995) states that in germination the seeds are affected by temperature in breaking the seed coat so that the radicle can break out and oxygen and water can enter the seeds and stimulate the maturation of the embryo[28].

Furthermore, in terms of the aspect of illumination, germination treatment at the shade site has the longest root length of 2.14 cm and is significantly different from germination at the site which only has a root length of 1.14 cm. The treatment in the shaded place has a root length that is significantly different from the exposed place, namely the difference in length of 1 cm. According to Lakitan (1996) the process of radicular lengthening has taken place before the tearing of the seed skin. The root elongation begins with the radicle from the seeds. Radicular lengthening takes place in 2 phases, namely the initial phase that lasts slowly and the second phase which lasts faster. In the initial phase cell elongation is only affected by the process of water absorption and in phase 2 elongation of the radicle is affected by new compounds which accelerate cell elongation[30].

Dharma et al. (2015), states that the length of the radicle is related to the germination time because the faster the sprouts appear, the radicle will also grow faster so the roots of the sprouts will also be longer[31]. In addition, in a sheltered condition there is a hormone that will cause cell elongation, namely hormone auxin. Sprouts that get excessive intensity of sun illumination affect the performance of auxin hormones, thus causing a high increase in inhibited sprouts [30]. Other hormones that influence the process of cell elongation are the gibberellin hormone. The embryo in the seeds secretes gibberellin which encourages germination by utilizing the food reserves contained in the seeds [34]. This Gibberellin will then encourage cell elongation so that the radicle can penetrate the endosperm of the seed skin which limits growth. Gibberellin will then stimulate auxin synthesis which is needed for root growth [28].

4. Conclusion

Based on the results of the research that has been done, it can be concluded that the illumination factor, the duration of combustion, and the interaction between the duration of combustion and illumination affect the time of germination of Jabon seeds. While the root length is impacted by the long combustion factor and the illumination factor. The interaction between the duration of combustion and illumination does not affect the length of the root of Jabon.

References

- [1] Poudyal M, Rakotonarivo OS, Razafimanahaka JH, Hockley N, Jones JPG. 2018. Household economy, forest dependency & opportunity costs of conservation in eastern rainforests of Madagascar. *Scientific data* 5:180225
- [2] Souza RG, Dan ML, Dias-Guimaraes MA, Guimaraes L, Braga JMA. 2018. Fruits of the Brazilian Atlantic Forest: allying biodiversity conservation and food security. *Anais da Academia Brasileira de Ciencias*

- [3] Delevaux JMS, Jupiter SD, Stamoulis KA, Bremer LL, Wenger AS, et al. 2018. Scenario planning with linked land-sea models inform where forest conservation actions will promote coral reef resilience. *Scientific reports* 8:12465
- [4] Latta SC, Brouwer NL, Mejia DA, Paulino MM. 2018. Avian community characteristics and demographics reveal how conservation value of regenerating tropical dry forest changes with forest age. *PeerJ* 6:e5217
- [5] Poudyal M, Jones JPG, Rakotonarivo OS, Hockley N, Gibbons JM, et al. 2018. Who bears the cost of forest conservation? *PeerJ* 6:e5106
- [6] Iranah P, Lal P, Wolde BT, Burli P. 2018. Valuing visitor access to forested areas and exploring willingness to pay for forest conservation and restoration finance: The case of small island developing state of Mauritius. *Journal of environmental management* 223:868-77
- [7] Kleinschroth F, Garcia C, Ghazoul J. 2018. Reconciling certification and intact forest landscape conservation. *Ambio*
- [8] Van de Perre F, Willig MR, Presley SJ, Bapeamoni Andemwana F, Beeckman H, et al. 2018. Reconciling biodiversity and carbon stock conservation in an Afrotropical forest landscape. *Science advances* 4:ear6603
- [9] Naumov V, Manton M, Elbakidze M, Rendenieks Z, Priednieks J, et al. 2018. How to reconcile wood production and biodiversity conservation? The Pan-European boreal forest history gradient as an "experiment". *Journal of environmental management* 218:1-13
- [10] Paneque-Galvez J, Perez-Llorente I, Luz AC, Gueze M, Mas JF, et al. 2018. High overlap between traditional ecological knowledge and forest conservation found in the Bolivian Amazon. *Ambio*
- [11] Monroy-Ortiz C, Garcia-Moya E, Romero-Manzanares A, Luna-Cavazos M, Monroy R. 2018. Traditional and formal ecological knowledge to assess harvesting and conservation of a Mexican Tropical Dry Forest. *Journal of environmental management* 214:56-65
- [12] Ramberg E, Strengbom J, Granath G. 2018. Coordination through databases can improve prescribed burning as a conservation tool to promote forest biodiversity. *Ambio* 47:298-306
- [13] Ni Q, Liang Z, Xie M, Xu H, Yao Y, et al. 2018. Microhabitat use of the western black-crested gibbon inhabiting an isolated forest fragment in southern Yunnan, China: implications for conservation of an endangered species. *Primates; journal of primatology* 59:45-54
- [14] Darusman, D., Eva, F., Muhammad, M.Y., Triyono, P.. *Hutan Rakyat: Sumbangsih Masyarakat untuk Hutan Tanaman*. 2014. Yogyakarta: PT Kanisius.
- [15] Rasyid, F.. 2014. Permasalahan dan Dampak Kebakaran Hutan. *Jurnal Lingkar Widyaiswara*. 1(4): 47-59.
- [16] Naemah, D.. 2011. Identifikasi Sumber Api Penyebab Kebakaran, Riam Kanan Kalimantan Selatan. *Laporan Penelitian*. Fakultas Kehutanan Universitas Lambung Mangkurat Banjarbaru.
- [17] Apriani, I., Meridian, A.H., Nanggara, S.G., Purba, C.P.P., Ratriyono, M., Rodalina, L., Sari, N.A.. 2013. *Potret Keadaan Indonesia Periode 2009-2013*. Bogor: Forest Watch Indonesia.

- [18] Faida, L.R.W, Jatmiko, A., dan Sadono, R. dan. 2012. Evaluasi Kegiatan Rehabilitasi Hutan dan Lahan Menggunakan analisis Multikriteria (Studi Kasus di Desa Butuh Kidul Kecamatan Kalikajar, Kabupaten Wonosobo, Jawa Tengah). *Jurnal Ilmu Kehutanan*. 6(1): 30-44.
- [19] Vauzia. 2017. Keanekaragaman Komunitas Tumbuhan Pasca Kebakaran Hutan Rawa Gambut di Batang Alin-Pasaman Barat. *Disertasi*. Program Pascasarjana Universitas Andalas.
- [20] Mindawati, N., Mansur, I., dan Setio, P.. 2015. Teknologi Pembenihan dan Pembibitan Jabon Putih (*Neolamarckia cadamba* (Roxb.) Bosser). Bogor: Forda Press.
- [21] Orwa, C., Mutua, A., Kindt, R., Jamnadass, R. and Anthony, S.. 2009. Agroforestry Tree Database: A Tree Reference and selection Guide Version 4.0. http://www.worldagroforestry.org/treedb/AFTPDFS/Anthocephalus_cadamba.PDF, diakses 15 Oktober 2017.
- [22] Mansur, I., dan Tuheteru, F.D.. 2011. *Kayu Jabon*. Jakarta: Penebar Swadaya.
- [23] Keeley, J.E., and Fotheringham, C.J.. 2000. *Seeds: The Ecology of Regeneration in Plant Communities 2 nd Edition (ed M. Furner)*. 311-330.
- [24] Mulawarman, Roshetko, J., Sasongko, S.M., dan Irianto, D.. 2002. *Pengelolaan Benih Pohon, Sumber Benih, Pengumpulan dan Penanganan Benih: Pedoman Lapangan untuk Petugas Lapang dan Petani*. Bogor: International Centre for Research in Agroforestry and Winrock International.
- [25] Yudarfis, Djisbar, A., dan Ramadhan, M.. 1990. Pengaruh Pembakaran dan Naungan terhadap Perkecambahan Benih Kemiri (*Aleurites moluccana* WILLD). *Buletin. Litro*. 5(2): 101-105.
- [26] Cushwa, C.T., Martin, R.E., and Miller, R.L.. 1967. The Effects of Fire on Seed Germination. *Journal of Twentieth Annual Meeting in American Society of Range Management*. 250-254.
- [27] Salisbury, F. B dan C. W, Ross. 1995. *Fisiologi Tumbuhan*. Bandung: ITB Press.
- [28] Sutopo, L.. 1988. *Teknologi Benih*. Jakarta: CV Rajawali.
- [29] Lakitan, B.. 1996. *Fisiologi Pertumbuhan dan Perkembangan Tanaman*. Jakarta: Raja Grafindo Persada.
- [30] Dharma, I.P.E.S., Samudin, S., dan Adrianton. 2015. Perkecambahan Benih Pala (*Myristica fragrans* Houtt.) dengan Metode Skarifikasi dan Perendaman ZPT Alami. *e- Jurnal Agroteknologi bisnis*. 3(2): 158-167.
- [31] Krisnawati, H., Kallio, M., dan Kanninen, M.. 2011. *Anthocephalus cadamba* Miq.: *Ekologi, Silvikultur dan Produktivitas*. Bogor: Center for International Forestry Research.
- [21] Advinda, L..2018. *Dasar-dasar Fisiologi Tumbuhan*. Yogyakarta: Deepublish