THE POTENCY OF OIL PALM FRUIT FIBER AS GROWTH MEDIA FOR KETAPANG (*Terminalia catappa)* SEEDLING

Enggar Apriyanto
Forestry Department
Bengkulu University, Indonesia, Jl Wr. Supratman Bengkulu, Indonesia.
E-mail: enggavan@yahoo.com

Sigit Sudjatmiko
Agroecotechnology Department,
Bengkulu University, Indonesia, Jl Wr. Supratman Bengkulu, Indonesia.
Email : s1g1t_@yahoo.com.

Agus Susatya
Forestry Department
Bengkulu University, Indonesia, Jl Wr. Supratman Bengkulu, Indonesia.
Email: satya1812@yahoo.com

Putranto BA Nugoho
Forestry Department
Bengkulu University, Indonesia, Jl Wr. Supratman Bengkulu, Indonesia.
Email: putranto@myself.com

Ella Aulia
Forestry Department
Bengkulu University, Indonesia, Jl Wr. Supratman Bengkulu, Indonesia.
Email : ella.aulia2014@gmail.com

ABSTRACT
Fruit fiber which be generated by the oil palm industries in Indonesia was about 4.319.820 ton year^{-1} 2016 (Ministry of Agriculture, 2017). However, this waste has a potential resource for a growth media to take over polybag, due to its light and compact characters, and keeping root system in a good condition. The aim of the study was to evaluate effect of oil palm fruit fiber growth media, root cutting, and its interaction on growth of Ketapang *seedling* (*Terminalia catappa)*. The study was conducted from May to August 2018, at the nursery of Forestry Department, Bengkulu University. The experiment was arranged as a complete randomized design with two factors, the mixed media of oil palm fruit fiber and cutting root. The media was top soil and mixture of new (±1 month) and old (± 6 month) oil palm fruit fiber waste, with ratio of 100:0, 80:20, 60:40, 20:80, and 0:100, respectively. Root cutting treatment was with cutting and without cutting. The measured growth parameters were height, diameter, leaf number, dry weight and chlorophyll of *Ketapang* seedling. Results showed that with and withoutroot cutting of Ketapang did not significantly different for all measured parameter. The diameter growth (0.45-0.48 cm), number of leave (5.1-6.0 leave), and chlorophyll density at 70 days old were not significantly different among media treatments. The seedling height, leaf and seedling dry weight were significantly different among treatments, in which growth of *Ketapang* seedling on soil was the highest (25.60 cm) comparing to all treatments (18.93-23.69 cm). The oil palm fruit fiber is a potential growth media for *Ketapang*. Fertilizer need to be added to fulfill nutrients for seedling. Its light and compact structure could prevent the *Ketapang* seedling root system from the damage during handling in the nursery and transporting to the field.
Key word: *seedling, oil palm fruit fiber, growth*

INTRODUCTON

Dealing with revegetation purposes, seedling quality is an important attribute for a seedling to survive and grow after out-planting (Duryea 1985). Growth media is an important aspect for generating good seedlings in nursery. A good media has to be able to supply nutrition, to protect root from damage and dryness, and to quarantee a better growth while seedlings in preparation, in the nursery, in the storage and during transportation. Good growth media should also be easy to handle, efficient, compatible with the plantation technique and tool, and assuring best survivability and growth of the trees after planting (Nyland, 2016).

In the nursery, top soil is generally used as growth potted media in the plastic (polibag) bag. Massive use of top soil for growth media may decrease soil fertility and degrade land ecosystem (Hendromono dan Durahim, 2004). Moreover, Hendromono (1988) stated that using top soil as growth media has some disadvantages, e.q, heavy, high cost for transportation, bad physical structure, and not compact.The use of polibags as containers may also create environmental problem in the field. The removal of polibag, when planting, may break up the soil and damage the root system.

In order to survive and grow better in the field, especially in marginal land and sandy soil, growth media with a good physical characteristic, compact and light is needed to keep a good root system during handling in the nursery, transportation and in plantation. Protection of root system from the destruction could maintain the connection between root and media, which is important for seedlings to adapt in the field (Nyland, 2016).

Oil palm industry produce a lot of fruit fibers as unwanted waste. The oil palm industry could generate fruit fibers approximately 11.5% in weight of its fresh fruit bunch. (Yunindanova *et al* 2013). Fruit fibers that be generated by the oil palm industries in Indonesia was about 4.023.361 and 4.319.820 ton year^{-1} on 2015 dan 2016 (Ministry of Agriculture, 2017). In Malaysia, palm oil mill produced about 11,4 juta ton fruit fiber (Hoe,2014). It create environmental problem (Sreekala *et al*, 1997). The fruit fiber has mainly used for a recycle energy and agricultural input (Hoe, 2014). However, this waste has a potential resource for a growth media to take over polybag, due to its light and compact characters, and keeping root system in a good condition.The fruit fiber, as organic material, is also potential for organic compost. The nutrient content of oil palm fruit fiber is N (0,32 %), P (0,08 %), K (0,47 Mg (0,02 %), and Ca (11 %) (*Direktorat Pengolahan Hasil Pertanian*. 2006). Mesocarp fiber of palm oil was able to be a cultivate media for chili (Lyana, 2015) and banana (Hoe,2014).

An alternative way to replace the disadvantages of polybag is to utilize container based on organic material (organic pot) that being environmentally friendly and providing adequate nutrients. The utilization of oil palm fruit fiber as growth media is a practical way because it could be planted directly in the field. Many researchers have shown that integrating organic material positively affect seedlings quality. Organic material may repair soil structure by increasing soil organic content and keeping water content in the soil (Isro'i, 2007). Apriyanto *et al*., (2016) showed that *Cassuarina equisetifolia* could grow well in oil palm fruit fiber media. Oil palm fruit fiber based media was an effective media to replace soil media for banana seedling due to some advantages, such as free of soil borne pathogen, lighter material, and higher workability (Hoe, 2014).

Ketapang (Terminalia catappa) is a native plant to South East Asia and generally found in coastal area. The plant could reach 35 m in height and 60 cm of diameter. Ketapang is an important species for native people, especially who live in the coastal area. Ketapang's seed is edible and contains 40% of oil that can be used as a raw material for vegetable oil (Delima, 2014). The seed also contains protein, sugar, fiber, and carbohydrateat about 25.30, 16.0, 11.75, and 5,8 in weight, respectively (Lia, *et al*. 2010).Traditionally, the leaf is used as medicine to cure scabies skin diseases and the flesh of its fruit is used for curing rheumaticc or joint pain. Mostly, Ketapang grows and regenerates naturally along the coast but some communities have tried to propagate in local community nursery.

A good seedling is an important aspect to assure that seedling could adapt and grow well in the field. The fruit fiber waste from oil palm industryis a potential material to be used as growth media. The aim of the study was to evaluate effect of oil palm fruit fiber growth media, root cutting, and its interaction on growth of Ketapang (*Terminalia catappa*) seedling.

MATERIAL AND METHODS

The study was conducted from March to August 2018, in the nursery at the Department of Forestry, University of Bengkulu, Indonesia. Materials and equipments which had been used were oil palm fruit fiber, Ketapang seedlings, paralon, glue, caliper, measure glass, analytical balance, digital camera, rules, dug cow, soil, rice dusk charcoal, polybag, and oven.

The experiment was a factorial design containing two factors, root cutting (with and without root cutting) and media composition (P1; 100% one-month old palm fruit fiber waste, P2;100% of six-month old oil palm fruit fiber waste, P3;50%:50% mixture of six-month and one-month old palm fruit fiber waste, P4; 70%:30% mixture of one-month and six-month old palm fruit fiber waste, P5; 30%:70% of one-month and six-month old palm fruit fiber waste, P6; 80%:20% one-month and six-month old palm fruit fiber waste, P7; 20%:80% one-month and six-month old palm fruit fiber waste, and K; Control/soil), with five replications, arranged as a Completely Randomize Design. Height, diameter and number of leaf were measured at 14, 28, 42, 56, and 70 days after transplanting. Seedling biomass, stomatae density and leaf chlorophyl density were measured at the end of the experiment (70 days after transplanting). Data was analyzed using analyses of variance at α=5% and Duncant Multi Range Test (DMRT), if significant occur.

RESULTS AND DISCUSSION

HEIGHT

All seedlings were able to grow on the oil palm fruit fiber waste until the end of the study. Height of seedlings with and without cutting increased slightly in the first 28 days after transplanting (both 0.90 cm), then increased dramatically from day 28 to 70(9.21 and 11.31 cm), respectively to reach height of about 20.28 and 22.18 cm respectively (Figure 1).

Althought, average seedling with root cutting was lower than whithout root cutting, analysis of variance showed that there was no significant different on height betweenseedlings with and without root cutting at 14,28,42,56 and 70 days after transplanting. Louk and Raharjo (2017) also found that cutting root of *Aleurites moluccana* seedling did not affect height.

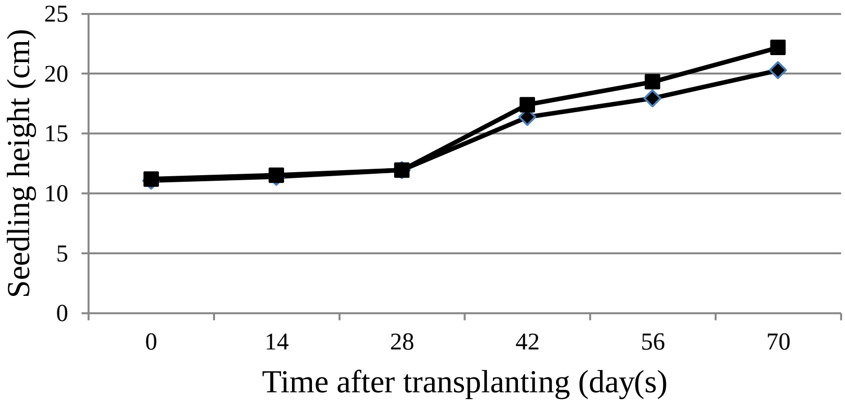

Figure 1. Average height of Ketapang seedlings with (◆) and without root cutting (■) grown on oil palm fruit fiber media

The growth of Ketapang seedling was very slow within two weeks after transplanting. It showed that the seedling was still in the periode of adaptation to survive on the media of oil palm fruit fiber. The seedling height at all treatments increased slightly in the beginning then increased sharply after 28 days. Until 56 days after transplanting, the height among treatments did not significantly different, however it was significantly different at age 70 days (Table 1). At day 70, the height of seedling grown in the soil media (control) was the highest (25.69 cm). It was due to the nutrients in the soil media being able to fulfill the seeding need for nutrients.The effect of media composition of oil palm fruit fiber height was not significantly different. The seedling average heights of P1, P2, P3, P4, P5, P6 and P7 at day 70 were 20.50, 20.63, 18.93, 20.63, 19.75, 23.69 and 20.06 cm, subsequently. It indicated that the nutrients avalaible in oil palm fruit fiber was only able to support Ketapang seedling up to age 56 days. Fertilizer was not applied to the experiment so that the seedling grown in oil palm fiber grew slower than those in soil (control). Oil palm fruit fiber based media was enough of P and Mg nutrients, however it need to be added N and K nutrients (Hoe, 2014)

Table1. Height of *Ketapang* seedlings grown on the mixed media of the oil palm fruit fiber and control.

	Seedling age (days after transplanting)					
Treatments	0	14	28	42	56	70
P1	11.09a	11.51a	12.44a	15.8a	17.16a	20.50 bcdef
P2	11.32a	11.30a	11.44a	16.97a	18.73a	20.63 bcd
P3	11.19a	11.58a	11.98a	17.2a	18.75a	18.93 bcdefgh
P4	10.98a	11.42a	12.26a	18.07a	19.19a	20.63 bcde
P5	11.23a	11.54a	11.72a	14.8a	16.3a	19.75 bcdefgh
P6	11.01a	11.4a	11.92a	17.5a	19.25a	23.69 ab
P7	11.13a	11.47a	11.96a	16.05a	17.53a	20.06 bcdefg
K	11.1a	11.42a	11.84a	18.75a	22.14a	25.69 a

It indicated that fertilizer was needed to support the height growth of Ketapang. Hoe (2014) oil palm fruit fiber medi need to be added N and K nutrients in order to fulfill the fertilizer. The growth of seedlings in the nursery mostly depend on the condition of the growth media, especially on the availability of nutrition (Durahim dan Hendromono, 2001).

DIAMETER

The diameter of seedling with and without root cutting increased slowly from age zero to 28 day after transplanting(0.03 and 0,02 cm), then increased moderately from day 28 to 42 (0.06 and 0.08 cm); after that the seedlings grew very slow up to the age 70 day.The diameter of Ketapang at 70 days after transplanting were about 0.47 and 0.46 cm for seedlings with and without root cutting consecutively. Althought the analysis of variance indicated that seedling diameter of Ketapang was not significantly different between root treatments,seedling with root cutting tended to a little bit better growwing than those without root cutting. It indicated that root system of seedling with root cutting grew better to support the seedling.

The diameter of seedlings planted in the different growth media grew slowly during 28 days after transplanting, then grew fast from day 28 to day 42. After that the diameter growth were remain constant (Figure 2). The effect of K, P1, P2, P3, P4, P5, P6 and P7 treatments to diameter were not significantly different along 70 days observations. It indicated that oil palm fruit fiber is suitable, as an alternative for soil, for growing *Ketapang* seedling. Apriyanto *et al*., (2016) stated that oil palm fruit fiber with moderate density showed a good impact on diameter of *Casuarina equisetifolia*.

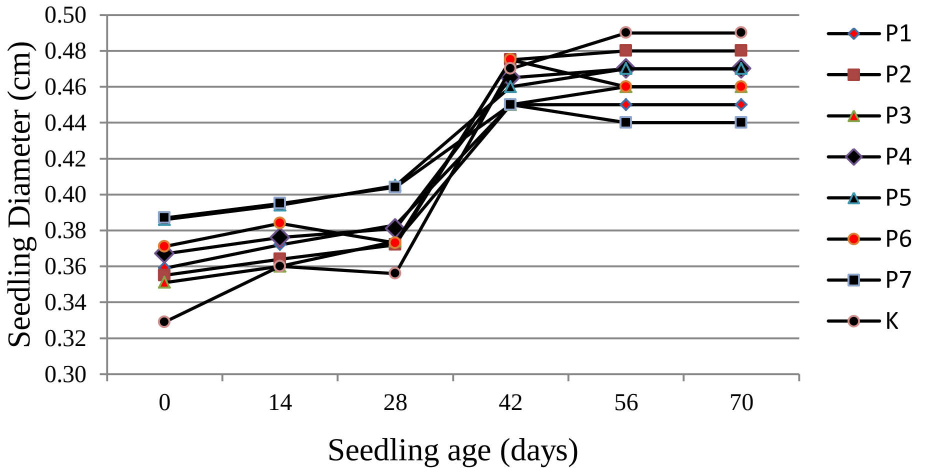

Figure2. Seedlings diameter of Ketapang grown inmedia of the oil palm fruit fiber and control

LEAVES

Result showed that seedling leaf number of all treatments increased during 42 days after transplanting and then decreased slightly until 70 days after transplanting (Figure 3). The dicline of leaf number after 43 days was due to lack of nutrition in media. Fertilizer should be added to the media based on fruit fiber in order to support better growth of seedling (Hoe, 2014). The availability of nutrition on the growth media is important to support the plant growth (Nursyamsi and Tikupadang, 2014).

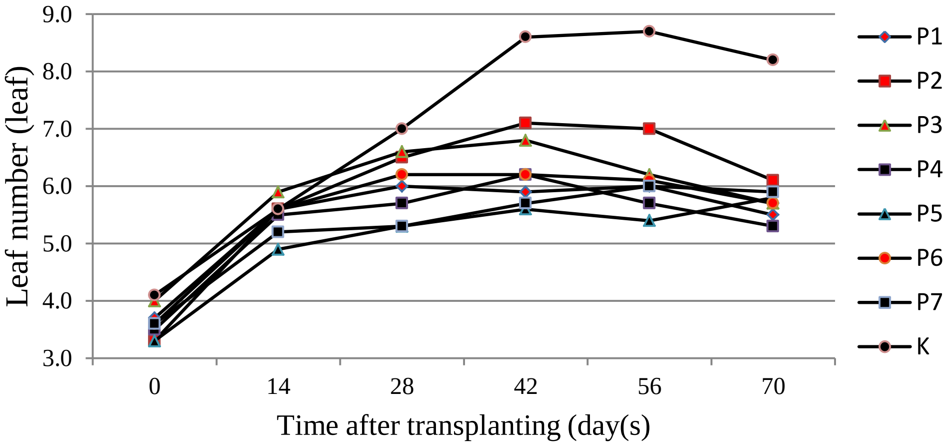

Figure 3. Leaf number of Ketapang seedlings grown on mixed Media of oil palm fruit fiber and control.

The number of leaf of Ketapang during 70 days after transplanting was not significantly different for all media treatment. At age 70 days, Seedlings that planted in K, P1, P2, P3, P4, P5, P6 and P7 had 8.12 ± 1.39, 5.45 ± 0.97, 6.01 ± 0.99, 5.67 ± 0.68, 5.23 ± 0.82, 5.78 ± 1.22, 5.77, 0.48, and 5.89 ± 0.99 leaves, respectively.

The number of leaf of Ketapang with and without root cutting also grew dramatically during 42 days after transplanting and decreased slightly after that (Figure 4). The number of leaf might corelate to the growth of seedling height and diameter. An enhancement of the number of leaf was followed by increasing seedlings height and diameter, and vice versa. Leaf, where photosynthesis processes take place, is an important part of plant. The number of *Ketapang* leaf with and without root cutting were about 6.25 and 6.25, at 70 days after transplanting. There was no significantly different between with and without root cutting treatments.

The chlorophyll density of K, P1, P2, P3, P4, P5, P6 and P7 treatment on were34.83 ± 1.6, 31,21 ± 1.96, 32,33 ± 3.05, 30,03 ± 2.58, 31,65 ± 2.74, 31.83 ± 2.91, 32.20 ± 3.28, and 32.20 ± 3.28per 5 mm^2 respectively.

Seedling grown in soil media numerically gave the highest value on number of leave and chlorophyll density. The leaf and chlorophyll play an important role in the photosynthesis process. Seedlings with a lot of leaf and high chlorophyll density tend to grow highest. However, the chlorophyll densities was not significantly different between with and without root cuttingtreatments, about 32.4 ± 2.76 and 31.6 ± 3.00 per 5 mm^2.respectively.

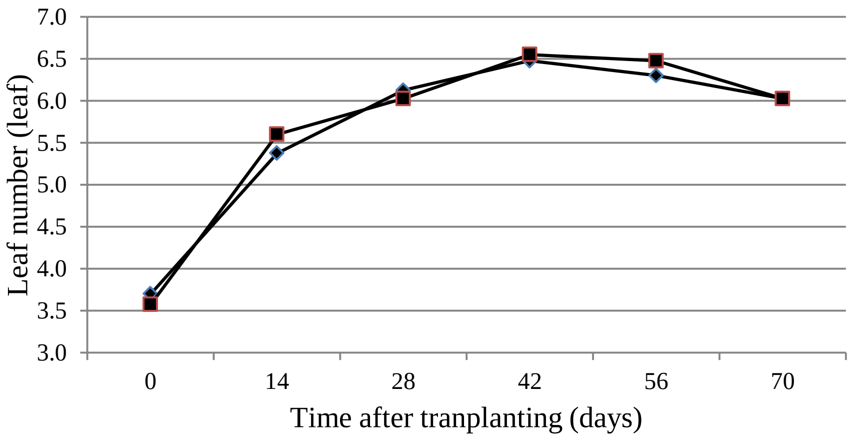

Figure 4. The effect of with(◆) and without (■)root cutting treatments on number of leaf of Ketapang grown on oil palm fruit fiber.

ROOT

The measurement showed that root lengthof. Ketapang with and without root cutting at 70 days after transplanting were 16.56± 2.62 and 15.66 ± 2.62 cm. Analysis of variance indicated that root length of Ketapang seedling was not significantly different between root treatments. The growth media treatments did not show the effect on root length of Ketapang seedling at the age of 70 days either. It indicated that oil palm fruit fiber can be used as media for growing root system of *Ketapang*. The seedling root was tightly sticked on the media so that the root system was kept in a good condition, even when it was droped from one meter above the ground. This condition will support seedling to survive and grow well in the field, especially in marginal land.

BIOMASS

Both *Ketapang* seedlings with and without root cutting grew quite good on oil palm fruit fiber. The dry weight of root, leaf, stem and total seedlings were not significantly different to each other, however the *Ketapang* with root cutting numerically produce a little bit higher on root, leaf, stem and total seedling dry weight than that of without cutting. Total biomass of Ketapang seedling with and without root cutting were 2.47± 0.83 g and 2.28 ± 0.61 g, respectively. The root development of *Ketapang* with and without root cutting seedling were subsequently about 26.32 and 27.63 % of total biomass, whilethe dry weight of seedling leaf was 37.71 and 38.46 % for Ketapang seedling with and without root cutting. (Table. 2). Louk Raharjo (2017) found that rooted cutting of *Aleurite*s *moluccana* could increase the dry weight of seedling about 298.7 %.

Table 2. Average dry weight and standart deviation of *Ketapang* seedings with and without root cutting

	Seedling Weight (g)			
Treatments	Root	Leaf	Stem	Total
Without root cutting	0.63 ± 0.14	0.86 ± 0.36	0.79 ± 0.31	2.28 ± 0.61
With root cutting	0.65± 0.30	0.95 ± 0.40	0.87± 0.37	2.47± 0.83

The effect of growth media was significantly different on the total dry and leaf weight of Ketapang seedling, but not on root and stem dry weight. Compared to other treatments, *Ketapang* seedling planted in the soil media significantly produced the highest total dry weight (3.97 ± 0.40 g) and mostly located at leaf (Table 3). According Hoe (2014) fertilizer, especially N and K should be added to media based on the oil palm fruit fiber in order to fulfill nutrients for seedling. However, The composition of mix-media of new and old oil palm fruit fiber treatments did not show significant different on dry weight.

Table 3 . The dry weight of Ketapang planted in several growth media

	Seedling Weight (g)			
Treatments	Root	stem	Leaf	Total (whole seedling)
P1	0.76 ± 0.25a	0.68 ± 0.30a	0.67 ± 0.14bcdefg	2.11 ± 0.71bcd
P2	0.58 ± 0.25a	0.51± 0.63a	0.77 ± 0.38bcde	1.86 ± 0.81bcdefg
P3	0.73 ± 0.25a	1.10 ± 0.35a	0.86± 0.16bcd	2.69 ± 0.42b
P4	0.51 ± 0.18a	0.98 ± 0.26a	0.68 ± 0.11bcdef	2.17 ± 0.54bcdef
P5	0.58 ± 0.28a	0.58± 0.11a	0.62 ± 0.01bcdefg	1.78 ± 0.23bcdefg
P6	0.58 ± 0.29a	1.01 ± 0.51a	0.96 ± 0.31b	2.55 ± 1.10bc
P7	0.46 ± 0.10a	0.67± 0.23a	0.88 ± 0.09bc	2.01 ± 0.41bcde
K	0.86 ± 0.19a	1.31 ± 0.13a	1.80 ± 0.15a	3.97 ± 0.40a

The result showed that oil palm fruit fiber is potential media, as an alternative of soil, to support the development of root and stem of *Ketapang*. The root dry weight of *T Ketapang* was about 21.66 up to 32.50% of the total biomass for all treatments. This condition allowed seedling to have a good root system to support nutrient absorption (Nyland 2002). Seedling with a good root system would able to survive better in the field. Media based on 25% oil palm fruit fiber and 75% soil resulted in sufficient growth media for oil palm seedling in Nigeria (Ekator, *et al*, 2018)

CONCLUSION

Media based on oil palm fruit fiber provided a good media for *Ketapang* seedling to grow until 70 days after transplanting. Fertilizer could be added into the media to support seedling growth. The oil palm fruit fiber media was able to keep root system stick on the growth media and provide protection from physical movement. Root cutting did not affect of *Ketapang* seedling in all of measured growth parameters. There was no interaction between root cutting and media treatments on the *Katapang* seedling growth.

REFERENCES

Apriyanto E, Nugroho P.B.A, dan Saputra L. 2016. *The growth of Casuarina equisetiofolia seedling On various growth media densities of oil palm fruit fiber*. Paper presented at The 2nd International Multidiscplinary Conference (2nd IMC) 2016.University of Muhamadiyah, Jakarta, Indonesia 24.

Direktorat Pengolahan Hasil Pertanian. 2006. *Pedoman Pengelolaan Limbah Industri Kelapa Sawit*. *Departement pertanian*. (in Indonesian)

Delima ,D. 2013. *Pengaruh Substitusi Tepung Biji Ketapang (Terminalia cattapa L) Terhadap Kualitas Cookies.* Food Science and Culinary Education Journal, 2, 16-1. http://journal.unnes.ac.id/sju/index.php/fsce. (in Indonesian).

Durahim and Hendromono, 2001. Kemungkinan penggunaan limbah organic saabut kelapa sawit dan sekam sebagai campuran top soil untuk media pertumbuhan bibit mahoni (Swietenia macrophylla. King). Bul. Penelitian Hutan dan Konservasi Alam 628:13-26

Duryea M.L. 1985. Evaluating seedling quality: importance to reforestation. In: Duryea M.L.(ed.), Evaluating Seedling Quality: Principles, Procedures, and Predictive Abilities of MajorTests. Forest Research Laboratory, Oregon State University, Corvallis, pp. 1–6.

Ekator, F, Ogundipe, O.A., Ikuenobe, C.E. 2018. Response of oil palm nursery seedlings to soil amended with oil palm mesocarp fibre. International Journal of Agronomy and Agricultural Research (IJAAR) ISSN: 2223-7054 (Print) 2225-3610 (Online)

Hendromono and Durahim. 2004. *Pemanfaatan limbah serabut kelapa sawit dan sekam padi sebagai medium perkecambahan bibit Mahoni afrika (Khaya anthoteca.C.DC). Buletin Penelitian Hutan*. N0.644. (in Indonesian)

Hendromono. 1988. *Pengaruh Media Organik danTanah Mineral terhadap Mutu Bibit Pterygot aalata* Roxb. Buletin Penelitian Hutan.617:55-64. (in Indonesian).

Hoe, T. K. 2014. Utilization of Oil Palm Fruits Mesocarp Fibres Waste as Growing Media for Banana Tissue Culture Seedling in Malaysia. Journal of Advanced Agricultural Technologies Vol. 1, No. 1:52-5 p

Isro'i. 2007. *Pengomposan Limbah Kakao.*Paper presented at Pelatihan TOT Budidaya Kopi dan Kakao. Cofee and Cacao Research Center. Jember. Indonesia 25-30 Juni 2007 (in Indonesian)

Lyana, N. 2015. Potential Of Oil Palm Emp1y Fruit Bunch And Mesocarp Fibre As Possible Coco Peat Substitute In Fertigation System. http://eprints.ums.edu.my/17086/1/Potential_of_oil_palm_empty_fruit_bunch_and_mesocarp_fiber.pdf

Ministry of Agriculture, 2017. Agricultural Statistics, Centre of Agricultural Data and Information System, Ministry of Agriculture, Republic of Indonesia, 362 pg

Nyland RD. 2016. Silviculture concepts and applications. 3rd ed. Mc Graw-Hill.

Lia N H, Meivitasari and Pradekatiwi. 2010. *Tempe dari Biji Ketapan.* Bachelor thesis,Faculty of Science State University of Yogyakarta, Indonesia. (in Indonesian)

Louk M. and Raharjo, K.T.P. 2017. *Pengaruh Pemangkasan Akar dan Waktu Penyapihan Terhadap Pertumbuhan Bibit Tanaman Kemiri (Aleurites moluccana,* Willd*) Asal Stum.* Savana Cendana 2 (1) 11-14. (in Indonesian).

Sreekala, M. S., Kumaran, M. G., Thomas, S. 1997. Oil palm fibres: Morphology, chemical composition, surface modification, and mechanical properties.. *App/.Pol. Sci.* 66(5): 821-835.

Yunindanova, M.B., Agusta, H., and Asmono, D. 2013. *Pengaruh tingkat kematangan kompos tandan kosong sawit dan mulsa limbah padat kelapa sawit terhadap produksi tanaman tomat* (Lycopersicon esculentum Mill.) PADA TANAH ULTISOL (The Effect of Maturity Level of Empty Fruit Bunch Compost and Mulch from Palm Oil Waste to Tomato Productivity in Ultisol Soil). Jurnal Ilmu Tanah dan Agroklimatologi 10 (2) 2013. 91-100