THE EFFECT DOSAGE FUNGI MYCHORIZA ARBUSKULAR (FMA) FOR GROWING SOME GENOTIPE AGARWOOD PLANTS (*Aquilaria* spp.) TO READY RELEASE

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ABSTRACT

Agarwood seeds from seedlings have a low growing power level of about 47% which growth constraints they are rooting a little, weak, and easily damaged. Root problems like this can be overcome by the use of Arbuscular Mycoriza Fungi (FMA) at the Acclimatization stage. FMA can increase root growth, root roaming area, so it can facilitate root absorb water and nutrients through external hypha. This study aims to examine the effective utilization of doses of FMA on Agarwood seed from seedling and their relationship to the infectivity of indigenous FMA. This research was conducted for 6 months, starting from April to early September 2017. This research is a Factorial experiment in Completely Randomized Design (RAL). The first factor is a genotype treatment with three levels: *Aquilaria malacensis*, *Aquilaria microcarpa* and *Aquilaria filarial*, while the second factor is the dosage of Arbuscular Mycoriza Fungi (FMA), which consists of 4 treatment levels: 10 g per polybag; 20 g per polybags; 30 g per polybags and 40 g per polybags with 3 replications, resulting in 36 experimental units and each experimental unit consisting of 10 samples so that the total unit of the 360-crop experiment; where Agarwood seed from seedling in acclimatization on soil acclimatization medium + charcoal husk + organic fertilizer super UPPO (product UPPO KKN PPM Unand, 2017). FMA used multi-spore type (glomus manihotis, gigaspora and aclospora). The observed variables included: percentage of seedlings, height of seedlings, number of leaves, leaf length increase, leaf width increase, root number and percentage of FMA infected root and percentage of ready-to-salt seedlings. The observed data were analyzed by various analysis with F-test and if F-count was greater than F-table 5% then continued with BNJ test at 5% real level. Based on the results of research that has been done can be concluded that: 1. there is interaction between genotype and dosage of Arbuscular Mycoriza Fungi (FMA) in influencing growth and development of genotipe Agarwood seedlings (Aquilarias pp) ready to release. The genotype *Aquilaria malacensis* L. gave the best response at 40 g per polybag FMA dose. The genotype *Aquilaria malaccensis* L. is the best growth and development genotype compared to the other 2 genotypes, which can be indicated by the percentage of high-grade seedlings of 95.00%, the best 40 g of Arbuscular (FMA) dosage Fungi (FMA) compared to the other doses, in infecting the roots genotype of Agarwood seeds (*Aquilaria* spp.) that is equal to 75.00%.

Keywords: Agarwood, dose, FMA, Genotype, seeds ready release

INTRODUCTION

Agarwood (*Aquilaria malaccensis* L.) is one commodity that has high economic value, and has many uses. Nowadays, the demand of Agarwood in the world market is increasing. The producers encounter obstacles in obtaining Agarwood from farmers, because farmers themselves have difficulty in finding and collecting Agarwood, due to the increasing scarcity of this plant. Another obstacle is the length of time required by this plant to be able to produce flowers or fruit, which is approximately 10 years, while the age of 5-8 years of farmers have harvested it, so we are difficult to get the seeds.

Agarwood plant propagation can be done both generatively (seeds) and vegetative such as grafts and cuttings. Propagation by seeds encounters constraints that require a long time to germinate (approximately 3 months), growth is not uniform and genetically have properties that are not equal to the parent. While conventionally with graft or cuttings, requires a lot of multiplication material and care that must be careful.

In relation to that, one of the alternatives to produce Agarwood seedlings in large quantities, relatively short time can be done with propagation of seedlings with tillers that are useful for the conservation of germplasm, so as to overcome the scarcity of a plant. Another obstacle after the propagation through chicks unplug, is the seed is still weak, because it has a little rooting, weak and easily damaged. Alternative problem solving can be done gradually acclimatization, starting from planting tillers on various media acclimatization room acclimatization Unand seedling, then inoculated with various doses of FMA on seeds that grow well on acclimatization media.

Opinion Khalil *et al.* (1994) suggests that the fungus was a positive response to plants that roots less well. Syarif (2001) found a positive response to gambir seedlings propagated by seed. According to Suhardi *et al.* (1997) it occurs because the FMA is able to expand root roaming areas and assist root growth, freeing up bound nutrients becomes available to plants and facilitates root absorbing nutrients and water from the soil (Simanungkalit, 2000). FMA accelerates the growth of seedlings thus reducing maintenance time in breeding, and improves root growth, P absorption in gambir seedlings (Syarif, 2001). Some studies have found that FMA has no significant effect on plant growth. According to Widden *et al.* (1999), the difference is related to the relationship between crop fit with FMA, and the growing environmental conditions.

The association between FMA and Agarwood seedlings that propagated by a child will run well if the relationship is synergistic between the one with another. The profits will be greater if Agarwood seeds are inoculated with FMA and placed on a growing medium that suits their needs for both the symbionts. Such relationships are suspected not only in the nursery, but may continue if the infected seeds of the FMA are transferred to the field. The publication of research in Indonesia regarding the utilization of FMA media grows on the growth of Agarwood seedlings from seedling has not existed, thus, the problem needs to be investigated. The purpose of this research is to get the standard method of guiding the three genotypes of Agarwood plants through the best multi-spore FMA dose treatment in order to obtain ready-to-salt seeds.

MATERIALS AND METHODS

The experiment was carried out in the nursery campus Unand Limau Manis Padang Schedule of activities started from April until early September 2017. The materials used are: Agarwood removal children from three genotypes (*Aquilaria* spp. L.) from field, soil, organic fertilizer sand, NPK fertilizer, polybags and soil and FMA inoculants. The tool used is filter paper, tissue paper, sieve 0.5 cm, plastic pot (10 cm x 15 cm and 15 cm x 20 cm), plastic sprouts 40 cm x 30 cm x 7.5 cm, microscope, measuring flask, filter paper, wood, paper bags, plastic bags, slipper, machetes and hoes.

This experiment was a Factorial experiment in Completely Randomized Design (CRD). The first factor was a genotype treatment with three levels: *Aquilaria malacensis*, *Aquilaria microcarpa* and *Aquilaria filarial*, while the second factor was FMA dosing, consisting of 4 treatment levels: 10 g per polybags; 20 g per polybag; 30 g per polybags and 40 g per polybags with 3 replications, obtained 36 experimental units and each experimental unit consisted of 10 samples so that the total unit of the 360 plant trial; where the Agarwood seedlings from children pull out in acclimatization on soil media + charcoal husk + organic fertilizer super UPPO (product UPPO KKN PPM Unand, 2017). FMA used multi-spore type (glomus manihotis, gigaspora and aclospora).

All tools for research purposes in semi-shadow ruminations are generally sterilized prior to use, including the best acclimatization media making tool based on the results of the first year of study, unless the FMA is not stylized. The medium grew for the best acclimatization (soil, sand, manure and charcoal husk) sterilized by using *eleciric soil sterilizer* by heating it for 3 hours at 100 °C. FMA inoculants are used in the form of propagules with a ketaping sand-containing material containing 50 g / l inoculant spores.

Space half shadow always kept clean. Seeds of aloes from the children pull out in the room half a shadow, watered every morning and evening until the medium is moist (field capacity). Fertilization with N. P, and K fertilizers was done every 2 months starting at 2 weeks before inoculated with FMA, with the same dose for each, ie 100 mg per pot. All fertilizers are given by immersing as deep as 3 cm at a distance of 2 cm around the stem of the seedlings. Cleaning of grass (weeds) is done intensively, and eradication of pests and diseases is done if the seeds seen symptoms of attack.

Observed variables: percentage of seedlings, height of seedlings, number of leaves, leaf length increase, leaf width increase, root number and percentage of FMA infected root and percentage of ready-to-salt seedlings. The observed data were analyzed by various analysis with F-test and if F-count was greater than F-table 5% then continued BNJ test.

RESULTS AND DISCUSSION

Percentage of Seed Hedging (%)

The result of observation of percentage of live seed of some aloe genotypes (*Aquilaria* sp.p) on the administration of various doses of FMA after analyzed by F test at 5% real level gives no significant different effect, the average of observation can be seen in Table 1.

Table 1. Percentage of live seeds of several genotypes of agarwood plants (*Aquilaria* spp.) against the administration of various doses of FMA

Treatment	B1	B2	B3	B4	Average
	....	%	....		
A1	100	100	100	100	**100**
A2	100	100	100	100	**100**
A3	100	100	100	100	**100**
Average	**100**	**100**	**100**	**100**	
CV = 10.50%					

In Table 1 it can be seen that the percentage of live Agarwood plant life (*Aquilaria* spp.) that lives after sixteen weeks of observation on each treatment is 100 percent. The treatment of several genotypes of Agarwood plants (*Aquilaria* spp.) on the administration of various doses of FMA gave no significant effect on the percentage of Agarwood plant life seeds (*Aquilaria* spp.) due to the multiple doses of FMA in several genotypes of Agarwood seedlings (*Aquilaria* spp.) have the same percentage of life. This is because Agarwood plants (*Aquilaria* spp.) is a plant that has high life power in various environmental conditions. Requirements to grow well, Agarwood does not choose a special location. Generally aloes can still grow well in soil conditions with structures and textures are fertile, moderate, and ekstrem. Agarwood can be found in swamp forest, peat forest, lowland forest, or mountain forest with sandy soil texture. Even found also species of aloes that grow in the crevices of rock (Sumarna, 2007).

Ideally, suitable land for the development of Agarwood cultivation should take into account the ecological parameters of the growing place (temperature, humidity, and climate), soil structure and texture of the origin of Agarwood species to be developed. Ecologically, Agarwood plants in Indonesia grow in areas with an altitude of 0-2400 mdpl. Generally, good quality Agarwood grows in hot climates, with temperatures of 28-34 ºC, 60-80% humidity, and rainfall of 1000-2000 mm per year (Sumarna, 2007).

Higher Seedlings (cm)

The result of observation of the height increase of stems of several genotypes of aloes plant (*Aquilaria* spp.) on the administration of various doses of FMA after analyzed by F test at 5% significant level gave no significant different effect. The average of observations can be seen in Table 2 after BNJ advanced test at 5% real level.

Table 2. The increase of stem height of several genera of Agarwood plant (*Aquilaria* spp.) on the administration of various doses of FMA

Treatment	B1	B2	B3	B4	Average
	....	%	....		
A1	14.50	12.40	13.10	15.60	**13.90**
A2	11.00	14.50	13.40	14.50	**13.35**
A3	11.00	11.00	11.00	12.00	**11.25**
Average	**11.83**	**12.30**	**12.50**	**14.03**	
CV = 10.50					

Increase in Number and Length of Leaves (Strands)

The result of observation of leaf number and leaf length of several genotypes of aloes plant (*Aquilaria* spp) on the administration of various doses of FMA after analyzed with F test at 5% real level gave significant effect interaction effect, Average observation result can be seen in Table 3 and Table 4 after test more DMRT at the real level of 5%.

Table 3. Increasing number of leaves of several genotypes of agarwoods seedlings (*Aquilaria* spp.) on the administration of various doses of FMA

Treatment	B1	B2	B3	B4
A1	13.50b B	13.20b C	13.50b B	20.60a B
A2	11.50b B	10.30b B	10.60b A	17.20a A
A3	7.30c A	6.90c A	13.00b B	15.00a A
CV = 10.50 %				

Values in the same row followed by the same small letters and in the same column followed by the same capital ones are not significantly different according to the Tukey-test at α 0.05

Giving various doses of FMA to *Aquaharia* spp. showed a significantly different effect on leaf number increase (Table 3) and leaf length (Table 4). The increase of Agarwoods leaves (*Aquilaria malacensis*) (A1) with dose of FMA B4 (40.00 g) was higher than the other FMA dose ie 20.60 strands and leaf length increase. The increase of leaf number is in line with the high increase in the plant while the process of leaf formation and the increase of leaf length in the seedlings is dominated by the nutrient nitrogen (N) element, available nitrogen nutrients can be obtained from air plants through the nitrogen cycle in the soil. According to Lingga (1995), the main role of the nitrogen element is to stimulate the growth of the whole plant especially the stems, leaves, and the formation of leaf forages that play a role in the process of photosynthesis as well as the material of protein formation.

Table 4. Added leaf length of some genotipe of Agarwoods plants (*Aquilaria* spp.) on the administration of various doses of FMA

Treatment	B1	B2	B3	B4
	.... cm			
A1	1.91a B	1.50b A	1.30b A	2.50a B
A2	1.50a B	1.70a A	1.60a B	1.55a A
A3	1.29b A	2.30a B	2.00a B	2.20a B
CV = 20.90 %				

Values in the same row followed by the same small letters and in the same column followed by the same capital ones are not significantly different according to the Tukey-test at α 0.05

In line with the research of Goldsworthy and Fisher (1992), states that in addition to nutrient factor nitrogen (N), the number of leaves will be influenced by plant height. With the increase in plant height the number of nodes will increase so that the number of leaves is also increased because the leaves out of the node. Based on high data of plants showing a different number of real, then the number of leaf blade is also significantly different.

According to Prawiranata *et al.* (1981), physiologically leaves have limited growth if they have reached the maximum shape and size, the size will not increase anymore. In its growth, many leaves require nutrients such as N which is very influential on leaf surface development, while the elements of P and K also play a role in supporting the growth of the length and width of the leaves (Suwandi *et al.*, 1982). According to Setyamidjaja (1986) and Dwidjoseputro (1994), the nitrogen (N) element makes the leaves greener because they contain lots of chlorophyll, besides that a balanced nitrogen will speed up cell division.

Number of Roots (Fruit)

The result of observation of root of several genotypes of aloes plant (*Aquilaria* spp.) on the administration of various single-phase FMA doses, after analyzed by F test at 5% significant level gives a significant different effect. The average observation result can be seen in Table 5 after BNJ advanced test at 5% real level.

In Table 5 it can be seen that the number of roots of several genotypes of Agarwoods-producing plants (*Aquilaria* spp.) and as the first factor with various doses of FMA as the second factor shows significantly different effect on the dose of FMA. This is allegedly because the different genotypes of Agarwoods-producing plants (*Aquilaria* spp.) will give different morphological and anatomical growth as well, including the number of roots. Khalil *et al.* (1994) suggests that the fungus positively respond to poorly rooted plants. Sharif (2001) found a positive response to seedlings gambir that was propagated by seeds. According to Suhardi *et al.* (1997) it happened because FMA is able to expand root roaming area and assist root growth, freeing up bound nutrients become available for plants and facilitate root absorbing nutrients and water from the soil (Simanungkalit, 2000). FMA accelerates seedling growth, reduces maintenance time in the nursery, and increases root growth, P absorption of gambir seedlings (Syarif, 2001).

Table 5. Number of Roots of several genotypes of agarwood plants (*Aquilaria* spp.) against administration of various doses of FMA

Treatment	B1	B2	B3	B4	Average
	....	%	....		
A1	10.70	12.30	13.00	14.70	12.61 a
A2	8.30	9.40	7.70	13.30	9.68 b
A3	9.00	8.70	8.30	12.00	9.50 b
Average	9.30 A	10.13 A	9.70 A	13.33 B	
CV = 10.50%					

Values in the same column followed by the same small letters and in the same row followed by the same capital ones are not significantly different according to the Tukey-test at α 0.05

Percentage of Infected Roots FMA and Seeds Ready to Salt (%)

Result of observation percentage of infected root of FMA and seed ready saliva several genotypes of Agarwoods-producing plants (*Aquilaria* spp) against administration of various doses of FMA after analyzed with F test at a real level of 5% providing a distinctly different effect interaction. Average observations can be seen in Table 6 and Table 7 after BNJ advanced test at 5% real level. Percentage of root infected by aloe plant Aquilaria malacensis with dose FMA B4

(40 g per polyibag) and ready seeded seed percentage on Aquilaria genotype malacensis with a dose of FMA 40 g per polybag showed different effects real.

The high of root infections is also influenced by the suitability of the plant with the type of FMA inoculant given. Each given FMA gives different responses to certain types of plants this is because each plant produces a different root exudate to stimulate the growth of FMA. Rizky (2003) the rate of FMA infection is determined by the suitability of the Mychoriza with the host plant. An appropriate FMA will rapidly infect the roots and assist in the effectiveness of nutrient uptake in the soil.

According to Lakitan (2007) and Setiadi (1992), mycorrhiza literally means root-fungus. In this context the Mychoriza is a symbiotic and mutualistic relationship between no-pathogenic fungi with living root cells, especially epidermal cells. The infected plant part system is a young plant root part. The results of Husin's (2003) study, showed that HMA exudate FMA contains auxin which is useful for root growth and dissolves phosphate element so it can be absorbed by plant roots. The response of tea seedlings to FMA has begun to be seen at age 7 months, although it is still not very clear (Rahman & Husin, 2002) .Setiadi 1998 cit. Budiman (2000) stated that to infect the rooting of plantation crops takes 6 months after giving.

Table 6. Percentage of infected root FMA several genotype Agarwoods (*Aquilaria* spp.) on the administration of various doses of FMA

Treatment	B1	B2	B3	B4
	....	cm	....	
A1	55.00c B	65.00b B	70.00ab B	75.00a B
A2	35.00b A	36.00b A	37.00b A	50.00a A
A3	37.00b A	36.00b A	40.00b A	55.00a A
CV = 33.09%				

Values in the same row followed by the same small letters and in the same column followed by the same capital ones are not significantly different according to the Tukey-test at α 0.05

In Table 7 it can be seen that the percentage of ready-to-salt seeds of several genotypes of Agarwoods plants (*Aquilaria* spp.) on the administration of various doses of Arbuscular Fungi Mycorrhizal (FMA) did not affect the percentage of ready-to-salt seeds of Agarwoods-raising plants (*Aquilaria* spp.) due to multiple doses of FMA in some genotype of Agarwoods seedlings (*Aquilaria* spp.) have different effect not significant. This is because Agarwoods plants (*Aquilaria* spp.) is a plant that has high life power in various environmental conditions. Generally aloes can still grow well in soil conditions with fertile structures and textures, medium, and extreme. Agarwoods can also be found in the swamp forest, peat forest, lowland forest, or mountain forest with sandy soil texture. Even found also Agarwoods species that grow in the crevices of rock (Sumarna, 2007).

Khalil opinion (1994) suggests that mushrooms give positive response to less rooted plants. Syarif (2001) found a positive response to the seeds of gambir spread with seeds. According to Suhardi *et al.* (1997) it happens because FMA is able to share root roots and help root growth, release nutrients available for plants and the availability of nutrients and air from the soil (Simanungkalit, 2000). FMA accelerates the growth of seedlings so as to reduce the time in the breeding, and increase root growth, P absorption of gambir seedlings (Sharif, 2001). Many studies have shown that Arbuscular Mycorrhizal Fungus is useful for: (1) improving nutrient uptake, especially phosphorus, (2) protecting plants from root pathogens, (3) preventing crops from drought, and (4) preventing crops to avoid heavy metal poisoning. Based on its function in plants, the inoculation of FMA in plants, at the very nursery Help this plant if it has grown in the field (Muin, 2002).

Table 7. Percentage of ready-to-salt seeds of several genera of aloes plant (*Aquilaria* spp.) on the administration of various doses of FMA

Treatment	B1	B2	B3	B4
	....	.... %	....	....
A1	60.00b B	65.00b B	70.00ab B	75.00a B
A2	50.00b A	45.00b A	45.00b A	65.00a A
A3	45.00c A	45.00b A	50.00b A	60.00a A
CV = 22.13%				

Values in the same row followed by the same small letters and in the same column followed by the same capital ones are not significantly different according to the Tukey-test at α 0.05.

CONCLUSION

Based on the results of the study, there is interaction between genotype and arbuscular mycorrhizal fungi (FMA) in increasing leaf length, number of leaves, percentage of root infections and ready-to-eat seeds in Agarwoods-producing plants (*Aquilaria* spp.). *Aquilaria malaccensis* Lotypes L is the best-growing genotype compare to others against the dose of FMA 40 g per polybag. FMA can help the growth of Agarwoods-producing plants (*Aquilaria* spp). It need to use Mikoriza Arbuscopy Mushroom (FMA) 40 g / polybag for Agarwoods plant seed *Aquilaria malaccensis* L.

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FOOD COLOURINGS AS FILMING MATERIAL ON OIL PALM SEEDS AND GERMINATED SEEDS

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ABSTRACT

During the last 5 decades, oil palm area in Indonesia has shown rapid growth, which indicates that oil palm plant material is still in high demand. However, increasing number of licensed germinated oil palm seed producers in Indonesia, as well as possibility of seed import from surrounding countries, forcing every oil palm seed producer in Indonesia to be more competitive. Diversification of germinated oil palm seeds by adding colorings on the surface of the plant materials is expected to be able to attract consumers. Nonetheless, seed germination as well as seedling growth must not be effected due to the application. The research applied film coating on oil palm seed and germinated seed surfaces by utilizing common food colorings. As the results, it was shown that the film coating did not effect on seed germination as well as on germinated seed development onto seedlings. Moreover, the application on germinated oil palm seeds showed that the applied food colorings were absorbed more on the radicle of the germinated seeds, allowing consumers to be able to distinguish between plumule and radicle in ease. It is believed that culling due to upturned planting during pre-nursery stage, will be reduced caused by this occurrence. It was also shown that growth and development of the applied germinated seeds onto seedlings, were not inhibited by the filming application. It is concluded that filming application by utilizing food colorings on the surface of germinated oil palm seeds is potential to be applied as product diversification.

Keywords: coating, filming, film coating, germinated seeds, oil palm, seed

INTRODUCTION

Oil palm (*Elaeis guineensis* (L.) Jacq), plant species which produces the highest oil per hectare area compared to other oil producing plants (Wahid *et al*., 2011), shows tremendous acreage growth in Indonesia. Data, which was presented by Lubis (2008) and Amalia *et al*. (2012), shows that in 1967 there were only 105,000 hectare of oil palm plantations in the country. However, approximately five decades after, in 2015, Direktorat Jenderal Perkebunan Kementrian Republik Indonesia (2014) estimated that the number rocketed 109 times, to 11.44 million ha.

Increasing acreage of oil palm plantation in Indonesia is believed highly related to increase on world population which requires palm oil as one of basic needs, in addition to capability of the oil to be modified onto several products. Darmosarkoro (2013) stated that approximately 75% of palm oil, which was produced in Indonesia, was utilized for frying oil, margarine, and shortening. While rest of the product was converted onto oleo-chemical products and natural oil based fuel (biodiesel). Moreover, the writer declared that oil palm has become tree of life due to its broad roles to the human life.

It is believed that the higher the demand on palm oil products, the higher the need on plant material of the species. Darmosarkoro (2013) noted that out of 230 million germinated seeds produced by 10 certified producers in Indonesia, most of them were absorbed by domestic market. Nevertheless, marketing data on germinated seed sales in 2013 and 2014 at the 10 producers, showed decline feature compared to the data in previous years (Purba, 2014). The occurrence may have effects on income, especially for those where plant materials provide substantial portion on income of the company (Darmosarkoro, 2013).

It is believed that the decreasing pattern of germinated seed sales was not indicating that demand on oil palm plant materials was low. By using interview method to smallholders, Purba *et al*. (2014) concluded that approximately 22% of smallholders in Aceh province, 28% in Bengkulu province, and 63% of smallholders in West Sumatera utilized illegitimate germinated seeds as their planting materials. Furthermore, even with decline pattern, the 10 legitimate seed producers were still able to market their germinated seeds (Purba, 2014), indicating that market of oil palm planting materials was still widely open, even with competition between seed producers as well as between legitimate seed producers to the illegitimate ones. Halmer (2000) stated that filming application by using colorings may attract consumers and can be a tool to distinguish different seed groups, there are possibilities that filming application on oil palm seeds may affect germination percentage, and alter markings that have been given on seed surface. While filming application on germinated oil palm seeds may lessen affect seedling growth and development.

By utilizing food colorings as filming material, this research was aimed to evaluate effects of film coating on germination rate of oil palm seeds, as well as seedling growth and development of treated germinated oil palm seeds.

MATERIALS AND METHODS

The research utilized filming method as described by Halmer (2000). Oil palm seeds and germinated seeds, as research materials, were film coated by soaking the materials in 2% (v/v) solution of food colorings for 10 minutes. After the soaking process, the materials were air-dried for 5 - 8 hours for seeds or 5 - 10 minutes for germinated seeds.

Film coating treatment on seeds was done on 3 seed crossings which dormancy had been broken. Each crossings was divided into 2, one seed set as treated while the other as control with no filming treatment. All the experimental units were then placed in seed germination room with room temperature as described on working instruction of Seed Production Division of Indonesian Oil Palm Research Institute (IOPRI) (PPKS, 2007). First selection was conducted 2 - 3 weeks after the seeds were placed in the germination room, while next selection process was done 3 to 4 days after the previous selection. The selection was done up until 12 selection processes.

Film coating treatment on germinated seeds was conducted by soaking germinated seeds, which derived from 1 variety, with 3 different colorings (red, yellow, and pink) while another set was prepared as control with no film coating treatment. The utilized colorings were food colorings with 2 % (v/v) concentration and 10 minutes of soaking process. After the soaking treatment, the germinated seeds were then air-dried for another 10 minutes and planted in pre nursery polyethylene bags as described on standard operational procedure of nursery at IOPRI (Lubis, 2008; Sulistyo *et al.*, 2010). After being planted, monthly observation was done on 3 vegetative characters of oil palm seedlings, i.e. seedling height, trunk diameter, and generated frond number.

RESULTS AND DISCUSSION

Film Coating on Germinated Seeds

On treated germinated oil palm seeds, it was demonstrated that the colors applied on the seed surface show different strength. The happening is believed due to oil palm shell is dominated by black, so that only certain parts of the seeds affected by the application. However, colorings was exposed strongly on radicle part of the germinated seeds than that on plumule part (Figure 1). The happening can be an advantage since by that, consumers can differentiate plumule and radicle in ease so that number of future rejected seedlings caused by upturned planting – an occurrence where planters fail to differentiate plumule and radicle, and plant the germinated seeds in upside down way where plumule is facing down while radicle is facing up – can be diminished.

Figure 1. Color strengths on germinated seed surface are different depend on color which is applied. However, color is well exposed on radicle so that consumers can be easily differentiate between plumule and radicle. Left to right: Pink, yellow, red

In addition, film coating with applied colors (red, yellow, and pink) did not cover the 'PPKS' marking, which have been applied on the seed surface as legal marking of the company. By that reason, the filming application is believed will not interfere the current germinated seed production process.

Figure 2. Color strengths on seed surface are different depend on color which is applied. However, the applied colors can endure even after spraying application to maintain seed water level. Left to right: red, pink, yellow

After the process, filmed germinated seeds gathered with control germinated seeds, were than planted in pre-nursery polybags and three vegetative characters of seedlings, i.e. seedling height, trunk diameter, and generated frond number, were observed. Data analysis result on the three characters (Table 1) indicates that film coating application did not inhibit seedling growth. Moreover, seedlings which were derived from yellow color film coated seeds showed higher numbers of trunk diameter and frond number which were significantly different to those on control and on other applied colors. It is believed that the happenings were caused by different ingredient composition where red and pink dyes contain thickener, i.e. propylene glycol, and basic ingredient color, while the yellow dye also contain glucose as one of its ingredients. Nonetheless, further research is required to assure that the glucose content caused the occurrence.

Table 1. Coloring effects on three vegetative characters of 3 month seedlings

Treatment	Plant height (cm)	Frond number	Trunk diameter (cm)
Control	16.79 a	3.88 ab	5.10 a
Dye 1	17.14 a	4.01 b	5.59 bc
Dye 2	16.72 a	4.15 c	5.71 c
Dye 3	16.82 a	3.85 a	5.34 ab

Values followed with same letter on the same column indicating that the numbers are not significantly different based on DMRT 5 %

Film Coating on Seeds

Result of the activity showed that as it was conducted on germinated seeds, film coating on seeds provides different color strength depends on the applied color. In addition, after several days of application, the applied colors did not fade out, even with spraying application, which was conducted three days after the seeds are placed in the germination room for the water content to be increased.

Table 2. Descriptive data of germination percentage on seed filming by using colorings

Treatment	Mean	Std. Deviation
Control	63.52	22.66
Filming	74.39	5.69
Total	68.96	15.93

At the end, germinated seeds were selected up to 64 days after the seeds were placed in the germination room. Data analysis indicated that film coating by using colorings on seeds, which dormancy had been broken, did not affect on germination percentage, even with high mean (74.4%) compared to that on control (63.5%) with p=0.46 (Table 2).

CONCLUSION

Color strength showed on filmed seed and germinated seed surfaces, depends on the color applied. Besides coloring the shell, film coating application also colors radicle and plumule of the germinated seeds, which occurrence is believed ease consumers to differentiate between the two ornaments. In addition, the research displayed that film coating by using the colorings did not affect germination percentage of the treated seeds, neither to seedling growth and development when the method is applied on germinated seeds. It is suggested for further research to be done to acknowledge ingredients of the film coating which affect most to growth and development of the formed seedlings.

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