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Research Paper

THE VIABILITY OF OIL PALM SEEDS DURING STORAGE AND HEATING

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Germination process of oil palm seeds is relatively difficult because they have hard and dormant skin layer so that oxygen and water absorption process which are needed for seeds germination is hindered. The problem faced by seeds supplier is that oil palm seeds after dormancy breaking period sometime can not be directly germinated so that they should be stored for certain period of time due to postphone buying from costumers. On the other hand, storage of oil palm seeds for long time period can decrease their viabilities so that seeds supplier has conduct some measures to maintain seeds quality in optimum level for the future germination. Postphoned germination of seeds are placed in storage chamber at temperature of 18 °C to 22 °C for certain time until the demand by customer had occurred. This research objective was to determine the effect of storage times and heating times on viability of oil palm seeds after dormancy breaking. The method used in this research was Factorial Randomized Block Design with three replications. The first factor was seed storage times which consisted of S_1 = 0-6 months, S_2 = 7-13 months, S_3 = 14-20 months and $S_4 \geq 21$ months, whereas the second factor was heating times which consisted of P_1 = 20 days, P_2 = 30 days, P_3 = 40 days, P_4 = 50 days, P_5 = 60 days, P_6 = 70 days, P_7 = 80 days and P_8 = 90 days, respectively. Each treatment combination used 100 seeds of oil palm. Data was analyzed by using SAS Program of version 6 and followed by Honestly Significant Different (HSD) as well as regression analysis. The results showed that oil palm seeds with maximum storage time of 20 months can still be used as normal quality seeds. The best heating time effect on seeds normal germination was in the range of 60 to 70 days. The best treatment was found on seeds storage time of 7 to 13 months and heating time of 70 days.

Keywords: Seeds, Sprout, Viability, Oil palm

INTRODUCTION

Oil palm crop (*Elaeis gunieensis* Jacq.) is one of chiefcommodity from Indonesia which has very fast development. The effort to increase production and productivity of oil palm crop require supply of superior seeds quality. Germination process of oil palm seeds is relatively difficult because they have hard and dormant skin layer so that oxygen and water absorption process which are needed for seeds

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germination is hindered. This dormancy condition has dictate that seeds should be specifically treated in order to slowly break the dormancy condition or should be provided with specific environment. Natural germination is rare for oil palm seeds because it needs about one year for oil palm seeds to germinate and usually with low germination percentage (Mangoensoekarjo and Semangun, 2005).

Physiological process is still occurred during seeds storage period so that a measure should be taken to control this process as minimum level as possible. The main objective of seeds storage is to maintain their viability during long storage period so that they will have similar viability when germinated than their previous viability before storage. The dormancy breaking for oil palm seeds by using heating treatment at temperature of 38°-40 °C for 60 days had showed good results (Chaerani, 1992; Haryani, 2005; and Oil Palm Research Center of North Sumatra, 2008). The problem which frequently faced by seeds supplier is that oil palm seeds after dormancy breaking period sometime can not be directly germinated so that they should be stored for certain period of time due to postphoned buying from costumers. On the other hand, storage of oil palm seeds for long time period can decrease their viabilities so that seeds supplier has conduct some measures to maintain seeds quality in optimum level for the future germination. Postphoned germination of seeds are placed in storage room at temperature of 18 °C to 22 °C for certain time until the customers had proposed their demand.

Seed viability of post dormancy breaking requires specific treatment after storage for certain period. In order to germinate, seed requires specific treatment such as reheating to accelerate its germination. After reheating treatment, seed was resoaking for 2 days in order to eliminate relatively high lignin content with magnitude of about 65.70% which act as an inhibitor. The soaking water is periodically changed or seed is placed within condition of flowing water (Nurmaila, 1999). Soaking within flowing water has function to wash substances that block germination and to soften seed's skin as well as to increase optimum water content for germination of oil palm seed at magnitude of about 23% (Schmidt, 2000; and Lubis, 2008). Seed can also be soaked within hot water at temperature of 80 °C and allowed to cool down (Farhana *et al.,* 2013). The other problem is no detail information available related to the effect of storage and reheating on viability of oil palm seed after dormancy breaking treatment. It is hoped that results of this research can give feedback for oil palm developer or oil palm seeds provider in seeking the effort to maintain good quality of seeds. The research objective was to determine the effect of storage time and heating time on viability of oil palm seeds after dormancy breaking.

MATERIALS AND METHOD

This research was conducted at Seed Procesing Unit (SPU) PT. Bina Sawit Makmur Palembang from July to November 2016. Materials used in this study were consisted of oil palm seeds of Dura variety, transparentplastic bagwith sizes of 20 cm x 34 cm x 0.15 mm and 40 cm x 60 cm x 0.15 mm, fungicide (Dithane M-45), aquadestand bayclin (containing of 5.25% NaClO). Equipments used in this study were consisted of plastic tray, drying tray, heater, oven, desicator, sprayer, germination room, heating room, cutter, seed breaker, fan, soaking tankandbalance.

This research used Factorial Randomized Block Design consisting of 32 treatment combinations and 3 replications. The first factor was seed storage times which consisted of S_1 = 0-6 months, S_2 = 7-13 months, S_3 = 14-20 months and S_4 = >21 months, whereas the second factor was heating times which consisted of P_1 = 20 days, P_2 = 30 days, P_3 = 40 days, P_4 = 50 days, P_5 = 60 days, P_6 = 70 days, P_7 = 80 days and P_8 = 90 days, respectively.

Working Procedure

1. Seed used in this study was from PT. Bina Sawit Makmur with normal size more than 2 grams and each treatment was consisted of 100 seeds.
2. Five seeds had received embrio test and 10 seeds had used for TKA 1 samples. Seeds are then treated with first soaking within soaking tank for 7 days.
3. Washing process is done by using plastic buckets having capacity of 50 liters. The first bucket contains normal water, the second bucket contains water mixed with hyphochlorite solution (0.15%), the third bucket contains water mixed with fungicide M-45 solution (0.1%) and benstar solution (0.05%) for ± 3 minutes and then seeds are scattered on drying trays for 24 hours.
4. Seeds are taken from drying tray, moved into plastic trays, stored in heating room at temperature of 39-40 ºC with heating times in accordance to treatments. Seeds are taken out from heating room and was sprayed with aquadest for every 7 days. The objective is to provide aeration for seeds and to change air circulation for seeds as well as to identify whether or not seeds are attacked by mold. Seeds which are attacked by mold will be separated.
5. After storage time in heater is reached, then seeds are taken out and treated with the second soaking for 4 days in soaking tank. The washing process is relatively similar to the first drying, but concentration of fungicide solution is increased into 2% per liter of water.
6. Five seeds of TE and 10 seeds of TKA as samples are taken before seeds incubation. Seeds are weighed and seeds marking was done for each treatment. Seeds are then stored within incubation chamber at temperature of 27-35 ºC.
7. Seeds are sprayed with dhitane M-45 fungicide solution at concentration of 1% after 3 days storage within incubation chamber.
8. The first selection was done at 10-11 days after seeds are put into incubation chamber and then between 4-6 days until review 9. Selection process is seeds selection which had already showed distinct plumuleand radicule having form of T. Seeds which are not grow were stored again into incubation chamber until the last process. Sprouts resulting from the selection are kept into storing chamber of oil palm sprout at temperature of 18-22 ºC.

The Observed Parameters

Normal Seed (%)

Normal seed is a seed that has different forms of plumule and radicule. Plumule grows upward, whereas radicule grows downward. Normal seed can be calculated by using the following expression:

$$\text{Normal seed} = \frac{\text{normal seeds}}{\text{Numbers of germinated seeds}} \times 100\%$$

Abnormal Seed (%)

Abnormal seed is a seed that has inproportional forms of plumule and radicule. Abnormal seed can be calculated by using the following expression:

$$\text{Abnormal seed} = \frac{\text{abnormal seeds}}{\text{Numbers of germinated seeds}} \times 100\%$$

Mold Affected Seeds (%)

Mold measurement was done to determine attacking level of mold at eah treatment which was accumuated from dormancy and selection processes.

$$\text{Mold affected seeds} = \frac{\text{Mold affected seeds}}{\text{Numbers of germinated seeds}} \times 100\%$$

Germination Capacity (%)

Germination capacity is ability for seeds to germinate which is calculated by using the following expression:

$$\text{Germination capacity} = \frac{\text{normal seeds} + \text{abnormal seeds}}{\text{Numbers of germinated seeds}} \times 100\%$$

Growth Rate (% Normal Seed/Etmal)

Seed growth rate is calculated at each observation period per selection review.

$$\text{Kct} = \sum_{0}^{tn} (\text{kn}/\text{t}$$

Data Analysis

Data was analyzed by using analysis of variance with SAS Program version 6.0. If F-test results had significant effect, then it was followed by Honestly Significant Different (HSD) test and regression analysis.

RESULTS AND DISCUSSION

Normal Seed (%)

Results of variance analysis showed that treatments of seed storing time (S), heating time (P) and their interactions had highly significant effect on normal seeds of oil palm crop. The results of Honestly Significant Different (HSD) test were shown in Table 1.

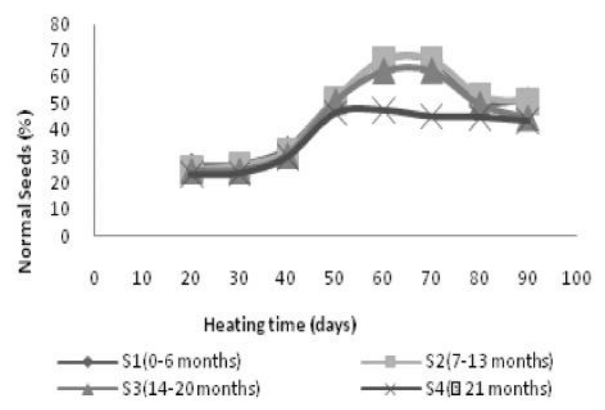
The results of HSD test showed that storing time of oil palm seeds for 14-20 months (S_3) was not significantly different than that of 0-6 months (S_1) and 7-13 months (S_2), but it was highly significantly different than that of $\geq$20 months (S_4). The best effect of heating time on normal seed germination was found on 60-70 days and starting to decrease along with the increase of heating time. S_2P_6 treatment (storage time of 7-13 monthswith heating time of 70 days) had produced the highest number of normal seeds with magnitude of 66.53% which was not significantly different than that of S_1P_5, S_1P_6, S_2P_5,

Table 1: The Effect of Storage Time, Heating Times and their Interactions on Normal Seeds of Oil Palm Crop (%)

Storage Times (S)	Heating Times								Average (S)
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
S_1	26.42a	26.88a	32.79a	51.47b	66.31c	66.21c	51.26b	51.26b	46.58b
S_2	25.43a	26.91a	32.10a	51.64b	66.30c	66.53c	53.06b	50.77b	46.59b
S_3	24.66a	24.79a	30.31a	50.88b	62.23c	62.31c	49.65b	44.55ab	43.67b
S_4	23.09a	23.58a	29.61a	46.16b	47.37b	44.95b	44.70b	43.29a	37.84a
Average (P)	24.90a	25.54a	31.20b	50.04c	60.55d	60.00d	49.67c	47.47c	
HSD 0.05	S = 2.96			P = 5.01			PS = 10.46		

Remarks: Numbers followed by the same letters in the same columns are not significantly different at testing level of 5%.

Figure 1: Normal Seeds of Oil Plam Crop with Treatments of Storage Times and Heating Times



S_3P_5 and S_3P_6 treatments, but it was significantly different than other treatments. This can be seen in Figure 1.

The effect of heating times on normal seeds of oil palm crop can be represented by the following models:

$Y_1 = 1.573X^2 + 19.04X + 0.977$ (r = 0.78)

$Y_2 = 1.620X^2 + 19.65X – 0.538$ (r = 0.79)

$Y_3 = 1.697X^2 + 19.68X – 1.594$ (r = 0.78)

$Y_4 = 0.942X^2 + 11.98X + 7.939$ (r = 0.86)

Oil palm seeds with maximum storage of 20 months can still be used as good seeds. This is due to the fact that nutrients storage is still available in seeds after the end of dormancy period becauseoil palm seeds can be classified as orthodox seeds which has slow deterioration characteristics. Oil palm seeds should be stored in order to germinate (Harran *et al.,* 2010).

Seeds heating up to 70 days had broke the dormancy of oil palm seeds because heating process can break the hard skin of seeds which block embrio outbreak so that substances that bond lignin can be overcome. According to Kamil (2001), dormancy of hard skin seeds such as oil palm can be broken by heating process which in turn will expand seed's skin so that seeds are permeable to water and air resulting in imbibition process as the initial stage for seeds germination. Heating process at high temperature can results in protein denaturation which produce the decrease of seeds viability (Kartika *et al.*, 2015).

Proper standard of oil palm seeds is as follows: minimum weight of 0.8 gram, length of radicule and plumule of ±2 cm, radicule and plumule have yellowish white color, radicule and plumule have opposite growth direction (Manurung, 2013). Normal seed of oil palm has the following characteristics: radicule (root prospective) has yellowish color and plumule (stem prospective) has whitish color, radicule is higher than plumule, radicule and plumule have straight growth and in opposite direction, the maximum length of radicule is 5 cm and the maximum length of plumule is 3 cm (Syahfitri, 2007; and Sumatera Utara, 2008).

Abnormal Seed (%)

Results of variance analysis showed that treatments of seed storing time (S), heating time (P) and their interactions had highly significant effect on abnormal seeds of oil palm crop. The results of Honestly Significant Different (HSD) test were shown in Table 2. Results of variance analysis showed that treatments of seed storing time (S), heating time (P) and their interactions had highly significant effect on all treatments. The longer the storage time and heating time, the higher was the abnormal seeds.

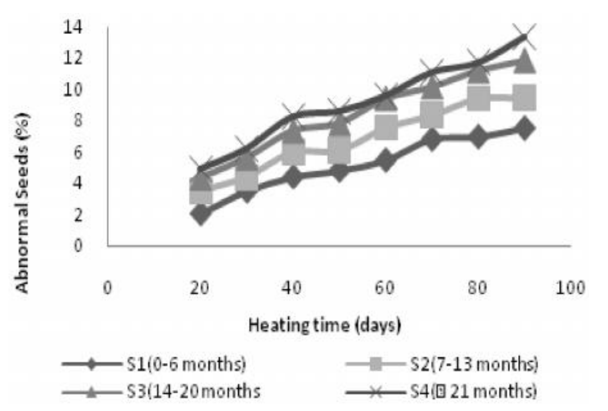
The highest abnormal seed was found on S4P8 treatment with magnitude of 13.33% which was significantly different than other treatment combinations, whereas the lowest abnormal sprout was found on S_1P_1 treatment with magnitude of 2.03%. This was shown in Figure 2.

Table 2: The Effect of Storage Time, Heating Times and their Interactions on Abnormal Seeds of Oil Palm Crop (%)

Storage Times (S)	Heating Times								Average (S)
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
S_1	2,03a	3,48a	4,38a	4,80b	5,45b	6,79b	6,94b	7,49c	5,17a
S_2	3,49a	4,39a	5,98b	6,08b	7,53c	8,33c	9,39c	9,45c	6,83b
S_3	4,32a	5,61b	7,34c	7,83c	9,42c	10,17d	11,22d	11,88d	8,47c
S_4	4,88b	6,19b	8,22c	8,58c	9,56c	11,06d	11,69d	13,33e	9,19d
Average (P)	3,68a	4,92b	6,48c	6,82c	7,99d	9,09d	9,81e	10,54e	
HSD 0.05	S = 0,70			P = 1,17			SP = 2,46		

Remarks: Numbers followed by the same letters in the same columns are not significantly different at testing level of 5%.

Figure 2: Abnormal Seeds of Oil Plam Crop with Treatments of Storage Times and Heating Times



The effect of heating times on abnormal seeds of oil palm crop can be represented by the following models:

$Y_1 = 0.075X + 1.018$ (r = 0.97)

$Y_2 = 0.089X + 1.904$ (r = 0.97)

$Y_3 = 0.108X + 2.512$ (r = 0.98)

$Y_4 = 0.114X + 2.893$ (r = 0.98)

Prolong storage time of seed can destroy embrio and decrease of nutrients supply, whereas prolong heating time of seed can make seed's skin become more permeable which destroy embrio resulting in abnormal sprout of seed (Haryadi, 2001). According to Sutopo (2004), if hard skin seeds are stored and heated for longer period, then these processes can destroy seeds organ especially at growth point area as the location of meristematic cells.

Abnormal seed is the one that has not show potential to be developed into normal sprout. The characteristics of abnormal seed are as follows: it has curly growth, roots and stem's prospective have brown color (brown germ), broken roots and stems calon, has advance germination and very long root's prospective. The proper time for planting when seeds is 1.5 cm in length (overgrown), has brown color on tips of root and stem's prospective (chill damage), root and stem prospectives are attacked by molds (rotting), plumule and radicule are grow in the same direction, dwarfsprout, only has radicule or plumule and attacked by disease.

Mold Affected Seeds (%)

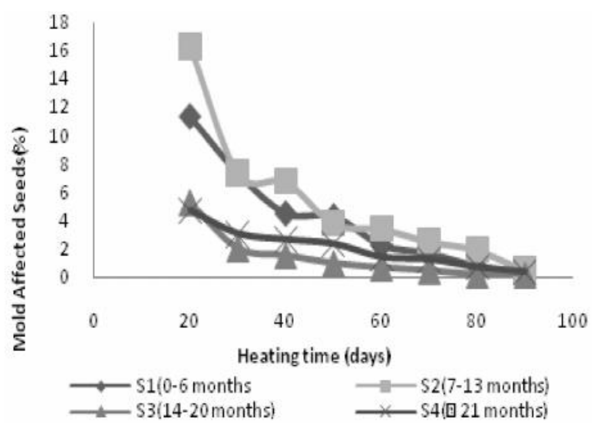
Results of variance analysis showed that treatments of seed storing time (S), heating time (P) and their interactions had highly significant effect on percentage of mold-affected seeds of oil palm. The results of Honestly Significant Different (HSD) test were shown in Table 3.

Table 3: The Effect of Storage Time, Heating Times and their Interactions on Mold-Affected Seeds of Oil Palm Crop (%)

Storage Times (S)	Heating Times								Average (S)
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
S_1	11.38e	7.36d	4.53c	4.32c	2.27b	1.67b	0.76a	0.15a	2.63c
S_2	16.36f	7.36d	6.77d	3.80c	3.42c	2.53b	1.93b	0.45a	5.33d
S_3	5.24d	2.02b	1.52b	0.96a	0.66a	0.45a	0.15a	0.15a	1.39a
S_4	4.70c	3.06b	2.65b	2.34b	1.41a	1.25a	0.71a	0.37a	2.06b
Average (P)	9.42f	4.95e	3.87d	2.86c	1.94b	1.48b	0.89a	0.28a	
HSD 0.05	S = 0.35			P = 0.61			PS = 1.27		

Remarks: Numbers followed by the same letters in the same columns are not significantly different at testing level of 5%.

Figure 3: Mold Affected Seeds of Oil Plam Crop with Treatments of Storage Times and Heating Times



Results of variance analysis showed that treatments of seed storage time (S), heating time (P) and their interactions had highly significant effect on all treatments. Seeds were highly attacked by molds at storage time of 7-13 months (S_2). The effect of heating time showed that the longer the heating time, the lower was the numbers of mold affected seeds. The highest numbers of mold affected seeds was found on S_2P_1 treatment with magnitude of 16.36% which was significantly different than other treatment combination, whereas the lowest numbers of mold affected seeds was found on S_1P_8 treatment with magnitude of 0.15%. This can be seen in Figure 3.

The effect of heating times on mold affected seeds of oil palm crop can be represented by the following models:

Y_1 = -0.145X + 12.05 (r = 0.89)

Y_2 = -0.180X + 15.25 (r = 0.77)

Y_3 = -0.577X + 3.991 (r = 0.72)

Y_4 = -0.561X + 4.589 (r = 0.94)

Water content of seeds is closely related to the percentage of mold affected seeds. Molds frequently attack seeds that have higher moisture content (Farhana *et al.*, 2013). Other components which made seeds easily attacked by molds are lignin, starch and pectin that available in seeds after washing and soaking processes. These substances are good media for mold growth in seeds (Paterson, 2007). The structural components of plant's cell wall are also good media for mold growth such as cellulose which comprised the biggest part with magnitude of 39-55% followed by lignin with magnitude of 18-33% and hemicellulose with magnitude of 21-24% (Martawijaya *et al.*, 2005). The main energy for molds growth is consisted of cellulose, starch

Table 4: The Effect of Storage Time, Heating Times and their Interactions on Percentage of Germination Capacity of Oil Palm Seeds (%)

Storage Times (S)	Heating Times								Average (S)
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
S_1	28.68a	30.26a	36.87a	56.7b	61.76b	73.00c	59.14b	58.73b	50.64b
S_2	28.92a	31.23a	38.10a	57.72b	73.83c	74.86c	62.41b	60.22b	53.41b
S_3	28.98a	30.40a	37.85a	58.71b	71.65c	72.48c	60.87b	56.43b	52.17b
S_4	27.98a	29.77a	37.83a	54.74b	56.93b	56.01b	56.39b	56.62b	47.03a
Average (P)	28.64a	30.42a	37.66b	56.96c	66.04d	69.09d	59.70c	58c	
HSD 0.05	S = 3.02			P = 5.60			PS = 10.64		

Remarks: Numbers followed by the same letters in the same columns are not significantly different at testing level of 5%.

and pectine after lignine component is degraded by phenol oxydase enzim system such as polyphenoloxydase, lactase and tyrosinase (Susanto, 2002; and Paterson, 2007).

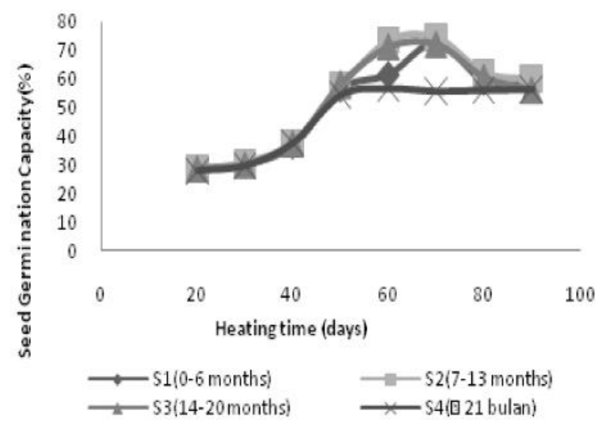
Seed Germination Capacity (%)

Results of variance analysis showed that treatments of seed storage time (S), heating time (P) and their interactions had highly significant effect on percentage of seed germination capacity (%) of oil palm. The results of Honestly Significant Different (HSD) test were shown in Table 4.

The results of Honestly Significant Different (HSD) test showed that storage time of oil palm seeds of 14-20 months (S_3) was not significantly different than that of 0-6 months (S_1) and 7-13 months (S_2), but it was significantly different than storage time of oil palm seeds of more than 20 months. The proper treatment of heating time on seeds germination capacity was 60-70 days and seeds germination capacity would be decreased for longer heating time.

Treatment of S_2P_6 (storage time of 7-13 months and heating time of 70 days) had produced the highest seeds germination capacity with magnitude of 74.68% and it was not significantly different than that of S_1P_6, S_2P_5, S_3P_5 and S_3P_6 treatments, but it was significantly different than that of other treatments. This can be seen in Figure 4.

Figure 4: Germination Capacity Percentage of Oil Palm Seeds Using Storage Time and Heating Time Treatments



The effect of heating times on seed germination capacity of oil palm crop can be represented by the following models:

$$Y_1 = -0.013X^2 + 2.001X - 12.83 \ (r = 0.85)$$

$$Y_2 = -0.016X^2 + 2.423X - 20.93 \ (r = 0.83)$$

$$Y_3 = -0.013X^2 + 2.001X - 12.83 \ (r = 0.85)$$

$$Y_4 = -0.009X^2 + 1.522X - 2.556 \ (r = 0.91)$$

Germination capacity or growth capacity is criteria for potential viability of seed. Determination of germination capacity is one of method to determine physiological quality of seed. We can estimated number of seeds that will grow in the near future from knowing the germination capacity. Germination capacity will be high if nutrients supply is available in sufficient quantity (Kamil, 2001). The first root that emerge from the growing seed (sprout) is radicule that can achieve 15 cm in length and capable to withstand up to 6 months. Other roots emerge from radicule which have function to absorb water and other nutrients from the growing media as well as the aid from nutrients supply available in endosperm. The function of these roots subsequently will be taken over by primary roots (main roots) which emerge several months later from bottom part of stem (bulb). These roots grow 45 degree vertically downward that have function to absorb water and other nutrients. The secondary roots will emerge from the primary roots in horizontal direction, whereas tertiary and quartery roots which located near the soil surface will grow from secondary roots. These tertiary and quartery roots are the most active part in absorbing water and other nutrients from soil (Lubis, 2008).

Growth Rate (%)

Results of variance analysis showed that treatments of seed storage time (S), heating time (P) and their interactions had highly significant effect on seeds growth rate (%) of oil palm. The results of Honestly Significant Different (HSD) test were shown in Table 5.

The results of Honestly Significant Different (HSD) test showed that storage time of oil palm seeds was not significantly different for all treatments. The proper treatment of heating time on seeds growth rate was 60-70 days and would be decreased for longer heating time. Treatment of S_2P_6 (storage time 7-13 months and heating time of 70 days) had produced the highest seeds growth rate with magnitude of 11.08% and was not significantly different than that of S_1P_5, S_2P_5 and S_1P_6 treatments, but it was significantly different than that of other treatments. This can be seen in Figure 5.

The effect of heating times on seed growth rate of oil palm crop can be represented by the following models:

$Y_1 = -0.002X^2 + 0.370X – 3.287$ (r = 0.77)

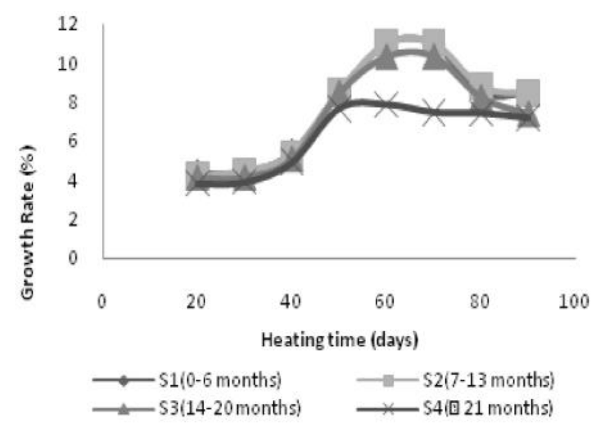
$Y_2 = -0.002X^2 + 0.381X – 3.628$ (r = 0.79)

Table 5: The Effect of Storage Time, Heating Times and their Interactions on Growth Rate of Oil Palm Seeds (%)

Storage Times (S)	Heating Times								Average (S)
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	
S_1	4.40a	4.48a	5.46a	8.58c	11.05d	11.03d	8.54c	8.52c	7.76a
S_2	4.24a	4.41a	5.35a	8.61c	11.05d	11.08d	8.84c	8.46c	7.77a
S_3	4.11a	4.13a	5.08a	8.48c	10.37c	10.38c	9.27c	7.42c	7.41a
S_4	3.84a	3.93a	4.94a	7.69c	7.89c	7.49c	7.45c	7.21c	6.31a
Average (P)	4.15a	4.26a	5.21a	8.34b	10.09c	9.99c	8.53b	7.90b	
HSD 0.05	S = 3.62			P = 1.64			PS = 3.42		

Remarks: Numbers followed by the same letters in the same columns are not significantly different at testing level of 5%.

Figure 5: Growth Rate Percentage of Oil Palm Seeds Using Storage Time and Heating Time Treatments



$$Y_3 = -0.002X^2 + 0.384X - 3.828 \ (r = 0.78)$$

$$Y_4 = -0.001X^2 + 0.231X - 0.843 \ (r = 0.86)$$

Seeds will grow quickly if nutrients supply is available and water as well as air can imbibiteand seeds have exceed their dormancy period (Hardjadi, 2001). The measuement of germination rate is used as one of vigor paramater because there was correlation between germination rate and production levels of crop (Sutopo, 2004). Seeds that have growth rate higher than 30% will have strong growth rate vigor (Sadjad,1993). Low vigor of seeds can affect seeds growth rate and their growth become abnormal (Doijode, 2001). The higher the germination rate, the higher was the seeds vigor and the seeds will germinate faster (Rofik and Murniati, 2008). Seeds growth at the first weeks will highly depend on nutrients supply within endosperm (kernel lipid). This nutrients supply contains carbohydrate, lipid and protein (Pahan, 2008).

CONCLUSION

1. Storage of oil palm seeds up to 20 months could still be germinated into normal seeds.
2. The optimum heating of seeds germination was 60 to 70 days.
3. The best treatment for oil palm seeds germination was found on treatment of storage time of 7-13 months with heating time of 70 days, respectively.

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