Journal of Agricultural Sciences (Agrosci)
e-ISSN : xxxx-xxxx
p-ISSN : 3032-7547

Dormancy of Macadamia Nut Seeds (Macadamia Integrifolia) by Drying and Soaking Water

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Abstract. Macadamia nut seeds are orthodox seeds that result in a dormancy period, so breaking the seed dormancy period is necessary. This study aims to determine the effect of drying and water immersion on dormancy breaking and macadamia bean seed germination and which drying and water immersion had the best impact on dormancy breaking and macadamia bean seed germination. The research was conducted in the soil laboratory and screen house of the Faculty of Agriculture, Winaya Mukti University, Tanjungsari District, Sumedang Regency, from June to November 2022. The experimental design used was a simple randomized block design (RBD) with a combination of drying and soaking seeds with nine treatment combinations. Each was repeated three times, so there were 27 experimental units. A = P 40ºC + PA 45ºC, B = P 45ºC + PA 50ºC, C = P 50ºC + PA 55ºC, D = P 50ºC + PA 45ºC, E = P 40ºC + PA 50ºC, F = P 45ºC + PA 55ºC, G = P 45ºC + PA 45ºC, H = P 40ºC + PA 55ºC, I = P 50ºC + PA 50ºC. The results showed that drying and soaking in water treatments at different temperatures had no significant effect on seed moisture content, seed cracking percentage, germination percentage, radicle length, and plumula length.

Keywords: Dormancy, Drying, Macadamia Nuts, Soaking in Water

INTRODUCTION

Macadamia nut (Macadamia integrifolia) is a nut originating from the Australian continent that grows a lot in the coastal areas of Queensland and New South Wales called Queensland Nut (Ryan, 2006) quoted (Putra et al., 2019). Macadamia plantation products in Hawaii are mostly marketed to states in the United States and Japan, selling around Rp 100 million 500 million per hectare (KLHK, 2019).

Currently, the critical land area in Indonesia is estimated to reach 14 million hectares, threatening the sustainability of watershed functions. To overcome critical land and watershed damage, the government has carried out a Forest and Land Rehabilitation program with an annual target of 1.1 million hectares (Kemenko, 2019). Macadamia plants are adaptive plants in the field (Anas et al., 2020).

Macadamia has a high lipid content (1.4g/100g), so macadamia can be a high-energy food source (18kcal/100g). The high content of monounsaturated fatty acids muff (49.4-58.7mg/100g), mainly oleic (34.5-47.0 mg/100g) and palmitoleic (7.1-12.8 mg/100g). The mineral content in the form of Mg, Zn, Cu, and Mn reaches suitable concentrations according to nutritional standards (Mereles et al., 2017).

Macadamia can be bred generatively through seeds, but macadamia seeds are difficult to germinate. The germination of macadamia seeds takes a long time and has a low percentage of growth. From several research results, it can be concluded that macadamia germination takes about four weeks or even up to 6 months.

The primary purpose of the hatchery is to provide quality seeds with criteria. This is a determining factor for planting on land to get good growth. Macadamia hatchery techniques have not been widely studied (Qibtiyah et al., 2019). Some treatment can be applied to the seeds so that the dormancy rate can be lowered and the germination percentage remains high. Dormancy maintenance can be done by pretreating seeds with How to soak the seeds in cold or hot water (Yuniarti, 2015).

Soaking using hot water increases the permeability of the seed coat through the mechanism of rupture of the macrosclereid layer or the opening of the strophiole cap, thereby accelerating the entry of water into the seed through imbibition. The following process activates alpha-amylase, protease, and lipase enzymes that remodel carbohydrates, proteins, and fats into active compounds. This will encourage rapid seed germination (Putra et al., 2019).

METHOD

This research was carried out at the Soil Laboratory and Green House, Faculty of Agriculture, Winaya Mukti University, Tanjungsari District, Sumedang Regency in Appendix 20, with an altitude of 850 meters above sea level. This research was conducted in June - November 2022.

The materials used in this study were burnt husks, water, macadamia nut seeds (1 month after harvest) from the practicum garden of the Faculty of Agriculture, Winaya Mukti University, Sumedang regency, West Java, polybag with a size of 15 cm x 10 cm. The tools used in this study were thermometers, calipers, memory ovens, containers, mobile phone cameras, and stationery.

The environmental design used Group Random Design (RAK). This design consists of drying and soaking water (9 treatments), which are repeated three (3) times with the following

details:

A = Drying 40oC for 6 hours + Water Soaking 45oC for 18 hours (until the water cools);

B = Drying 45oC for 6 hours + Water Soaking 50oC for 18 hours (until the water cools);

C = Drying 50oC for 6 hours + Water Soaking 55oC for 18 hours (until the water becomes cools);

D = Drying 50oC for 6 hours + Water Soaking 45oC for 18 hours (until the water cools) ;

E = Drying 40oC for 6 hours + Water Soaking 50oC for 18 hours (until the water cools) ;

F = Drying 45oC for 6 hours + Water Soaking 55oC for 18 hours (until the water cools) ;

G = Drying 45oC for 6 hours + Water Soaking 45oC for 18 hours (until the water cools) ;

H = Drying 50oC for 6 hours + Water Soaking 50oC for 18 hours (until the water cools) ;

I = Drying 40oC for 6 hours + Water Soaking 55oC for 18 hours (until the water cools).

Each experimental unit is represented by 10 plants in 1 treatment. The observation samples used for data analysis are 10 experimental unit samples. If Fh > 0.05, a follow-up test is carried out using the Duncan Multiple Distance Test at an actual level of 5%.

DISCUSSION

Based on the results of the analysis before the experiment, data were obtained in the form of the diameter of macadamia seeds as attached to Appendix 5. Macadamia nut seeds have a round shape with an average diameter of 2 cm (Mahardika, 2021). The size of the seeds varies, the largest 2.70 cm and the smallest 2.01 cm. The average size of macadamia nuts is about 2.28 cm.

Based on the results of the analysis before the experiment, the health of healthy macadamia seeds is brownish-yellow, smooth, and free from pest attacks (Mahardika, 2021). Seeds with holes are not used because it is feared that there are animals in the seeds, causing the seeds not to germinate.

Seed size diversity Before the experiment, seeds were weighed with digital scales and seeds that were light or floating in water were not used because it was feared that there were no seeds in them, so they could not germinate. The seeds used are medium in size (Mahardika, 2021). The most significant seed weight is 12.60 grams, and the smallest is 6.08 grams with an average weight of 8.37 grams.

The temperature and humidity during the experiment in 20 October to 10 November 2022 in the average screen house attached at (Appendix 3) were around 21.8°C to 22.0°C. Air

humidity is about 87.1% to 89.0%. Temperature is very influential on plant growth and development. Meanwhile, the optimum temperature for macadamia plant growth averages around 15°C to 32°C (Mahardika, 2021).

Seed moisture content

The results of statistical analysis of seed moisture content show no effect between drying treatment and water immersion on the moisture content of macadamia bean seeds. The moisture content of the seeds after treatment is 11.27%–13.83%, meaning that the ability of the seeds to absorb water is in that range. It is suspected that macadamia seeds are known to have sufficient moisture content for germination still, so different seed moisture tests do not give condemnation results which are different (Putra et al., 2019).

Once the critical moisture content of the seeds is reached, then the seeds begin germination. The results were obtained (Agustin & Prananda, 2017) using saga seeds and (Indraeni, 2017) using jamblang seeds. Both studies concluded that the use of fixed high-temperature drying methods for determining seed moisture content requires special seed treatment in the form of cutting or slicing seeds before drying is carried out.

Table 1. The Effect of Seed Moisture Content on Macadamia Bean Seeds

Treatment	Average Seed Moisture Content %
A	11,27 a
B	12,90 a
C	12,70 a
D	13,60 a
E	13,83 a
F	11,40 a
G	11,80 a
H	12,30 a
I	12,43 a

Description: The average number followed by the same letter shows an unreal difference according to the Scott-Knott group test at an actual level of 5%

Seed Cracking

Based on Table 2, the drying treatment and soaking of seed water showed results that did not affect the percentage of macadamia seed cracking. This shows that continuous drying and soaking treatment does not affect the percentage of seed cracking. (Putra et al., 2019). The percentage of cracking with drying and soaking of water of different temperatures does not give an influential result. In general, increasing drying temperatures tends to increase the percentage of seed cracking continuously, which will accelerate the cracking of macadamia seeds (Putra et

al., 2019). On the first day of drying, some seeds have cracked, but when soaking is done, the seeds shrink again. Just as a tile exposed to sunlight will crack, then when exposed to rainwater, it will regroup. Soaking uses hot water to increase the permeability of the seed coat to accelerate the entry of water into the seed through the process of imbibition.

Table 2. The Effect of Seed Cracking Percentage on Days 1, 2, 3, and 4 on Macadamia Bean Seeds

Treatment	Average Cracking Percentage %			
	H 1	H 2	H 3	H 4
A	0,429 a	0,571 a	0,714 a	0,857 a
B	0,286 a	0,476 a	0,571 a	0,762 a
C	0,143 a	0,429 a	0,666 a	0,809 a
D	0,333 a	0,524 a	0,666 a	0,809 a
E	0,381 a	0,571 a	0,666 a	0,857 a
F	0,238 a	0,333 a	0,619 a	0,762 a
G	0,190 a	0,333 a	0,619 a	0,857 a
H	0,238 a	0,524 a	0,714 a	0,952 a
I	0,286 a	0,476 a	0,666 a	0,905 a

Description: The average number followed by the same letter shows an unreal difference according to the scott-knott group test at a real level of 5%

Based on Table 3, the treatment of drying and soaking seed water has no effect on the rate of cracking of macadamia bean seeds. The rate of cracking shows observations that have no effect on macadamia seeds. According to (Putra et al., 2019) the application of soaking water temperature and drying temperature carried out in rotation can accelerate the cracking of macadamia seeds. According to (Putra et al., 2019) the application of soaking water temperature and drying temperature carried out in rotation can accelerate the cracking of macadamia seeds. Thus with the results of research (Kholibrina et al., 2019) stated that the treatment of softening the seed coat through soaking can facilitate the entry of water into the seed so that the embryo can immediately grow without obstacles. Continuous high-temperature and low-temperature treatment can cause seeds to crack due to shrinking and development.

Soaking until the seed coat cracks does not significantly affect the percentage of germination, since a greater amount of water is absorbed through the cracked seed coat. This condition can increase imbibition. The process further increases the activity of amylase, protease, and lipase enzymes for the conversion of carbohydrates, proteins, and fats into active compounds (Putra et al., 2019).

Table 3. The effect of seed cracking rate on macadamia seed

Treatment	Average Cracking Rate (%)
A	1,7143 a
B	1,6667 a
C	2,1429 a
D	1,7143 a
E	1,8095 a
F	1,9524 a
G	2,6429 a
H	2,3333 a
I	3,2872 a

Description: The average number followed by the same letter shows an unreal difference according to the scott-knott group test at a real level of 5%

Seed Germination

Based on Table 4, the application of drying treatment and water soaking showed results that did not affect the percentage of macadamia seed germination. This is thought to be due to the imbibition process is less than optimal in soaking seeds for 18 hours. Soaking until the seed coat cracks does not significantly affect the percentage of germination, since a greater amount of water is absorbed through the cracked seed coat. This condition can increase imbibition. The process further increases the activity of amylase, protease, and lipase enzymes for the conversion of carbohydrates, proteins, and fats into active compounds (Putra et al., 2019).

Table 4. The effect of seed germination percentage on macadamia bean seeds

Treatment	Average Germination Rate (% ethmal)			
	H 4	H 5	H 6	H 7
A	0,095 a	0,2381 a	0,3333 a	0,5714 a
B	0,000 a	0,2381 a	0,3810 a	0,4286 a
C	0,048 a	0,0952 a	0,2381 a	0,3810 a
D	0,095 a	0,2381 a	0,3333 a	0,3810 a
E	0,143 a	0,3810 a	0,3810 a	0,4286 a
F	0,000 a	0,1905 a	0,3333 a	0,4286 a
G	0,143 a	0,1905 a	0,3333 a	0,4286 a
H	0,095 a	0,1905 a	0,3810 a	0,4762 a
I	0,095 a	0,1429 a	0,3333 a	0,4286 a

Description: The average number followed by the same letter shows an unreal difference according to the scott-knott group test at a real level of 5%

Based on Table 5, the treatment of drying and soaking seeds showed different results not against the germination rate of macadamia bean seeds. If the drying temperature is too high, it will make the seeds die because the seeds are too dry. This also applies to the water immersion treatment given is not appropriate to accelerate the rate of seed germination. ineffective in stimulating seed germination.

Table 5. The effect of seed germination rate on macadamia bean seeds

Treatment	Average Germination Rate (% ethmal)
A	9,333 a
B	8,750 a
C	6,750 a
D	5,500 a
E	10,583 a
F	6,667 a
G	7,083 a
H	8,333 a
I	6,750 a

Description: The average number followed by the same letter shows an unreal difference according to the Scott-Knott group test at a real rate of 5%.

Radicles and Plumules

Based on Table 6, the application of drying treatment and water immersion has no effect on the radicle length of macadamia seeds. This is thought to be due to the lack of water absorption in the seeds due to drying, which affects the process of imbibition or absorption the low water content in the plant causes the seeds difficult to germinate, so it has an unreal effect on the length of the radicule**.** This can be caused because the content of food reserves in the endosperm in each macadamia seed is not much different (Putra et al., 2019). (Yuni Ekowati et al., 2020) seed soaking treatment with too long time can also negatively affect seed viability caused by soaking too long can reduce the availability of oxygen needed in the seed respiration process. The metabolic process in seed germination is slow because the availability of water needed by seeds is not sufficient.

Table 6. Effect of Seed Radicle Length on Macadamia Bean Seeds

Treatment	Average Radicle Length (cm)
A	3,500 a
B	2,944 a
C	2,722 a
D	3,222 a
E	2,833 a
F	3,500 a
G	2,611 a
H	3,055 a
I	2,166 a

Description: The average number followed by the same letter shows an unreal difference according to the scott-knott group test at a real level of 5%

Based on Table 7, the application of drying treatment and water immersion has no effect on the length of macadamia seed plumula. Good root growth will have an impact on plumula growth. The function of roots in providing water and nutrients in the soil will be used for the metabolic process of growth. According to the results of research on nagara bean seeds by (Wahdah & Susanti, 2020) states that the emergence of radicles is not influenced by the length of soaking. This indicates that the ability to sprout sprouts is initially the same. So that the soaking time for 18 hours is less able to make the seeds germinate normally.

Table 7. The Effect of Seed Plumula Length on Macadamia Nut Seeds

Treatment	Average Plumula Length (cm)
A	2,2222 a
B	2,6667 a
C	2,2778 a
D	2,0556 a
E	2,0000 a
F	1,8889 a
G	2,0556 a
H	2,1111 a
I	1,7222 a

Description: The average number followed by the same letter shows an unreal difference at a real rate of 5% according to the Scott-Knott group test.

CONCLUSION

The application of drying treatment and soaking water with different temperatures does not affect the moisture content of seeds, percentage of seed cracking, seed cracking rate, germination percentage, germination rate, radicle length and plumula length. There was no best effect on the drying and water immersion treatment on all observed parameters.

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