Seed viability and growth of nutmeg (Myristica fragrans houtt.)

Adrianton*, Zainuddin, Mahfudz, Bahrudin

Department of Agrotechnology, Faculty of Agriculture, Tadulako University, Palu, Central Sulawesi Indonesia.

*Corresponding author

Abstract: The development of large-scale nutmeg (Myristica fragrans Houtt.) is primarily determined by the availability of quality seeds. Testing for viability and seedling growth can produce quality seeds for commercial plant development. This study aimed to obtain the best seed viability and growth of nutmeg from various seed origins. The research was conducted from November 2019 to May 2020 in Kasimbar Barat Village, Kasimbar District, Parigi Moutong Regency, Central Sulawesi Province, through the seed viability test nutmeg seed growth tests. The seed viability test used a completely randomized design (CRD) with one factor of seed origin from four districts: S1: Tolitoli seed origin, S2: Morowali seed origin, S3: Parigi Moutong seed origin and S4: Donggala seed origin. The seedling growth test used a different plot design (TPT) with the main plot of nutmeg seed S1: Tolitoli seed origin, S2: Morowali seed origin, S3: Parigi Moutong seed origin, S4: Donggala seed origin and subplot growth media M1: soil mixture and organic matter, M2: soil, M3: organic matter. The results showed that the nutmeg seeds from Parigi Moutong Regency had high viability with a percentage of the water content of 49.09% and a percentage of germination capacity of 95.55%. The best growth of nutmeg seedlings with the highest vigor index was from Parigi Moutong Regency's seeds using a growing medium of mixed soil and organic matter with a composition (1:1).

Keywords: Viability of seeds and growth of nutmeg seeds.

I. INTRODUCTION

The nutmeg plant (Myristica fragrans Houtt.) originates from the Maluku islands, chiefly Banda Island (Marzuki et al., 2008), play a significant role in people's economy in various regions, especially in the eastern Indonesia region (Rodiantawati et al., 2015). Apart from being the largest nutmeg producer globally, Indonesia is the largest supplier of nutmeg needs with a market share of 60-75% (Hasibuan et al., 2010). Other producing countries are Grenada at 20-25%, followed by India, Sri Lanka, and Malaysia (Sunanto et al., 2000).

Nutmeg is known as a spice with economic value and is multipurpose (Członka et al., 2020; Kiani et al., 2019). Nutmeg produces three products of high economic value, namely seeds, mace, and nutmeg. These three products have essential oils that can be used as raw materials for the beverage, medicine, and cosmetic industries. The essential oil from a mace is a food flavoring and food preservative (Burt, 2004; Holley & Patel, 2005). The community favors nutmeg pulp itself if processed into processed food, such as syrup, pickles, sweets, marmalade, nutmeg jam, lunkhead, and nutmeg crystal (Arrijani, 2005).

Central Sulawesi Province is one of the supply areas for nutmeg in Indonesia, with land area increasing every year in line with the increasing demand for fruit and nutmeg price (Rodiantawati et al., 2015). In 2015 the production of nutmeg was 200.62 tons with a nutmeg area of 12,216 hectares so that in 2017 the production of 406.68 tons of nutmeg planted area reached 16,551 hectares (Central Sulawesi BPS, 2017).

Nutmeg cultivation carried out by farmers still found weaknesses, long germination times (2 to 3 months), sometimes not uniform sprouts and long seed growth, and a low success rate of around 60% (Ruhnyat et al., 2015). Testing the viability of seeds is needed to produce nutmeg during germination and seed growth (Gordon, 2020). Based on the description above, research was carried out with the aim of obtaining the best seed viability and growth of nutmeg seeds from various seed origins in Central Sulawesi.

II. MATERIALS AND METHODS

The research was carried out in two stages: the seed viability test and the growth of nutmeg seeds from November 2019 to May 2020, carried out in Kasimbar Barat Village, Kasimbar District Parigi Moutong Regency, Central Sulawesi Province.

The seed viability test used a completely randomized design (CRD) with one factor of seed origin from four districts, namely S1: Tolitoli seed origin (TL09), S2: Morowali seed origin (MR13), S3: Parigi Moutong seed origin (PM01), and S4: origin Donggala seeds (DG02). Each treatment was repeated three times so that there were 12 experimental units and each experimental unit used 35 sources, so it needed 420 nutmeg seeds. The research was started by taking the germination medium using sand from the river flow sediment, then drying and sifting to obtain uniform sand grains. Injury to the seed shell using a sharp knife to make it easier for water to enter the seeds. Planting in a tub of sprouts rectangular to size; 50 cm long, 40 cm wide, and 20 cm high. Shade 90% of sunlight intensity, shade height of 2.5 meters from ground level. Watering is done every day based on the conditions of the germination medium. Observations included seed moisture content (%), germination capacity (%), and germination time (days).
The seed growth test used a different plot design (TPT). The main plot of nutmeg origin S1: Tolitoli seed origin (TL09), S2: Morowali seed origin (MR13), S3: Parigi Moutong seed origin (PM01), S4: Donggala seed origin (DG02), and subplots of M1: plant growing media; a mixture of soil and organic matter, M2: soil, M3: organic matter. The design obtained 12 treatment combinations that were repeated three times so that there were 36 experimental units, and each experimental team used ten seeds so that 360 nutmeg seeds were needed. The sources used were the results of viability test research. The implementation begins with transferring the nutmeg seeds in 1 kg polybags (20 cm high and 15 cm wide), using a mixture of soil and organic matter in the ratio of 1:1 (M1), soil (M2), and organic matter (M3). Use of 25% shade, 25% sunlight, shade height of 2.5 meters above ground level. Watering is done every day based on the conditions of the growth media for the nutmeg seedlings. Observations included plant height (cm), number of leaves (strands), stem diameter (mm), leaf area (cm2), plant dry weight (g), and hypothetical vigor index.

III. RESULTS AND DISCUSSION

Seed Moisture Content

Germination is the initial process of growing a new individual in a plant that begins with radicles and plumules. Germination is strongly influenced by the availability of water in the germination medium. Water will be absorbed and used to stimulate the activity of metabolic enzymes in germination. This study it began by measuring the moisture content of the seeds (Figure 1).

![Figure 1. Seed moisture content (%) of various seed origins](image)

The results of testing the seeds of nutmeg from various seed origins showed that the seeds' highest moisture content was 49.09%, which came from Parigi Moutong Regency, while the lowest seed moisture content was 44.39% from Morowali Regency (Figure 1). When harvested, the nutmeg plant has a high percentage of moisture content. The portion of seed moisture content if stored will experience a drastic decrease.

In recalcitrant seeds, there is a relationship between germination capacity and the moisture content of the sources. At harvest time, the nutmeg seed moisture content reaches a maximum, and if it is germinated, it will increase the percentage of germination capacity, but if the moisture content of the seeds decreases during storage, it will reduce the germination power of the nutmeg seeds. Nutmeg is a type of recalcitrant seed, which is seeds that break down quickly, and their viability decreases when their moisture content is lowered (Sukarman and Melatt, 2015).

In general, mature nutmeg seeds' characteristics have a seed moisture content percentage of 35-40% (Marzuki et al., 2008). Moisture content is the presentation of a substance's water content, which has a profound effect on a seed. In Tanjung et al. (2016) research, nutmeg seeds that maintained their moisture content of 39.69% were able to increase germination capacity and maximum growth potential. The water content of 20% can be stated that the water content is heavy and is not resistant to pest and disease stress (Kastanja, 2007). Compared with the moisture content of the seeds used in this study, the percentage of water content is still higher. This shows that the sources from Parigi Moutong Regency meet the requirements as seeds for nutmeg germination.

Germination

The seeds from Parigi Moutong produced the highest germination capacity of 95.55% (Table 1). This study is almost the same as the research results by Darma et al. (2015), which resulted in the germination of 96.66% of nutmeg in a full scarification treatment with natural ZPT sanding and immersion. Compared with the results of research by La Mante et al. (2020), it is lower with a percentage of 35% germination and Tony et al's (2015) research, with a portion of 34.29% germination.

<table>
<thead>
<tr>
<th>Origin of Seeds</th>
<th>Germination (%)</th>
<th>BNI 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toli-Toli</td>
<td>88.89ab</td>
<td></td>
</tr>
<tr>
<td>Morowali</td>
<td>82.22 b</td>
<td>11.36</td>
</tr>
<tr>
<td>Parigi Moutong</td>
<td>95.55 a</td>
<td></td>
</tr>
<tr>
<td>Donggala</td>
<td>82.22 b</td>
<td></td>
</tr>
</tbody>
</table>

Note: The average followed by the same letter in the same column is not different in the BNI 5% test.

Germination is affected by the nutmeg seed coat. The hard seed coat (shell) can impact germination. Parigi Moutong Regency's nutmeg seeds had the best germination percentage of 95.55% (Table 1). This is thought to be because the origin of the sources in this study carried out an injury to the base of the seed (scarification), which could allow the imbibition process to occur more quickly, water and oxygen could enter the sources and accelerate seed germination, besides that the food reserves of the embryos were sufficient. The support of growing media was good, right.

The germination capacity of seeds can provide an overview of the germination capacity of seeds during germination. The
The ability of the sources to be stored gradually decreases due to the deterioration of the seeds. The seeds that experience wear are marked by delayed germination, followed by a decrease in germination rate, simultaneous germination, and germination capacity (Sadjad et al., 1999).

**Germination Time**

The seeds from Parigi Moutong Regency produced the fastest germinating time of 33.34 days (Figure 2). Compared with research by Febriyan et al. (2015), the emergence time of shoots was 59.74 days. This shows that the seeds from Parigi Moutong Regency have the best germination capacity and germination time.

![Germination Time (days)](image)

The benchmarks for germination and germination time are affected by the germination medium. The use of sand media for seeds from Parigi Moutong produces profitable growth because sand media makes it easy for the roots of newly formed nutmeg plants to grow; besides, sand can absorb water quickly during plant germination. The research results by Febriyan et al. (2015) showed that sand media showed better results based on benchmarks for germination and shoot height of nutmeg. Sumiarasi’s research (2006) stated that the germination of ebony seeds in plants on sand media produced good roots because the medium had high porosity so that the roots of ebony sprouts were penetrated. Research by Lestari et al. (2011) states that sand media is perfect for the growth of salak seedlings because it provides aeration for root formation.

**Plant height**

The seeds from Parigi Moutong Regency and the use of mixed soil and organic matter media produced the best growth of nutmeg seedlings at the age of 20 WAP on the observation of plant height (Table 2).

![Origin of Seeds](image)

Table 2. Average plant height at 20 WAP in the original seed treatment and growth media

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Growing Media</th>
<th>BNJ 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin of Seeds</td>
<td>Soil and Organic Matter</td>
<td>Soil</td>
</tr>
<tr>
<td>Tolitoli</td>
<td>r 29.73 a</td>
<td>p 29.27 a</td>
</tr>
<tr>
<td>Morowali</td>
<td>q 31.13 a</td>
<td>p 28.63 b</td>
</tr>
<tr>
<td>Parigi Moutong</td>
<td>p 33.27 a</td>
<td>p 29.87 b</td>
</tr>
<tr>
<td>Donggala</td>
<td>r 28.87 a</td>
<td>p 29.23 a</td>
</tr>
<tr>
<td>BNJ 5%</td>
<td>1.31</td>
<td></td>
</tr>
</tbody>
</table>

Note: The average followed by the same letter on the same row (a, b) or column (p, q) is not different in the 5% BNJ test.

Nutmeg seeds from Parigi Moutong and mixed soil and organic matter media showed the best plant height; this is supported by faster germination and germination time; besides, Parigi Moutong are thought to have adequate food reserves. Early plant growth, such as plant height, uses seeds as an energy source such as water content in grains, protein, carbohydrates, and growth regulators. After the roots develop correctly, plants take nutrients from the environment as sources of energy (Zheng et al., 2011).

In addition to supporting food reserves in seeds, the use of mixed soil and organic matter media can produce high growth of nutmeg seeds. Research by Magdoff et al. (2009) states that the combination of dirt and organic matter can improve soil properties, physical and biological properties. Also, it can also improve soil chemical properties such as decreasing the solubility of aluminum, increasing the availability of N, P, K nutrients in the soil, and growing soil CEC through active carboxyl groups. Organic material can play a role when it is completely decomposed to increase plant growth.

**Number of Leaves**

The seeds from Parigi Moutong and the use of a mixture of soil and organic matter media showed a more significant number of plant leaves at the age of 20 MST (Table 3). It is assumed that Parigi Moutong has the best growth at the time of germination and growth of nutmeg seedlings. Plants that produce higher heights will directly make a higher number of leaves. Gardner et al. (1991) stated that plant growth is defined as cell division and enlargement due to the interaction between internal and external factors. Internal factors include the rate of photosynthesis, respiration, the sharing of the results of assimilation and nitrogen, the capacity to store food reserves, and other enzyme activities.

Apart from internal factors, external factors also support plant growth, such as using mixed soil and organic matter media. Organic fertilizers contain complete macro and micronutrients but in small amounts and can improve the soil structure so that the ground becomes loose, has a greater water retention capacity (Prihandini et al., 2007). Research by Sari et al. (2015) stated that the provision of organic matter at a dose of
30g/ polybag could provide the nutrient N needed by plants to increase the number of leaves. Maruapey's research (2015) states that the use of mixed soil and bokashi media can provide growth of salak plant seeds by producing the highest number of leaves and roots.

Table 3. The average number of leaves aged 20 (MST) in the treatment of seed origin and growth media.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Growing Media</th>
<th>BNJ 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin of Seeds</td>
<td>Soil and Organic Matter</td>
<td>Soil</td>
</tr>
<tr>
<td>Tolitoli</td>
<td>q 6.03 a</td>
<td>p 6.13 a</td>
</tr>
<tr>
<td>Morowali</td>
<td>q 6.17 a</td>
<td>p 6.33 a</td>
</tr>
<tr>
<td>Parigi Moutong</td>
<td>p 6.87 a</td>
<td>p 6.23 b</td>
</tr>
<tr>
<td>Donggala</td>
<td>q 6.27 a</td>
<td>p 6.27 a</td>
</tr>
<tr>
<td>BNJ 5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The average followed by the same letter on the same row (a, b) or column (p, q) is not different in the 5% BNJ test.

IV. CONCLUSION

Based on the research results, it can be concluded that the nutmeg seeds from Parigi Moutong Regency have high viability with a percentage of the water content of 49.09% and a percentage of germination capacity of 95.55%, and the fastest germination time of 33.34 days. The best growth of nutmeg seedlings with the highest vigor index was from Parigi Moutong Regency’s seeds using a growing medium of mixed soil and organic matter with a composition (1: 1).

REFERENCES
