Response Germination of Kuranji Acid Seed (*Dialium Indum* L.) to Scarification and Concentration of Potassium Nitrate (KNO_3)

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Abstract. Kuranji acid is a plant that naturally grows in the mountains of tropical forests. It has tough seeds. Therefore, it is necessary to break seed dormancy. This research was aimed to know the response Germination of kuranji acid seed (*Dialium indum* L.) to scarification and concentration of potassium nitrate (KNO_3). This research was conducted in tissue culture laboratory and *Greenhouse* of Kawasan Sistem Pertanian Terpadu (Sitandu) Serang Banten Province from February until April 2020. The research design used a Randomized Completely Block Design (RCBD) with two factors. The first factor was scarification, consisted of three levels were without scarification, cutting of seeds, and sanding of seeds. The second factor was the consentration of potassium nitrate solution, consisted of three levels were concentration of 0.3%, 0.4%, and 0.5%. The treatment combination was repeated 3 times. The Parameters observed were: day of germination, maximum growth potential, power of germination, growth rate, normal sprout, and abnormal sprout. The results showed that the scarification treatment that sanding seed showed the best effect to parameters: day of germination (12.22 days), maximum growth potential (76.67%), power of age of germination (86.67%), growth rate (0.10%/day), normal sprout (62.22%) and abnormal sprout (14.46%). Concentration of potassium nitrate (KNO_3) 0.3% showed tend better to pamaters:. Day of germination (22.89 days), growth rate (0.08%/day %), maximum growth potential (61.11%), and normal sprout (47.78%). There was no interaction between the scarification and the concentrations of potassium nitrate to all parameters observed.

Keywords: Germination · Kuranji Acid · Potassium Nitrate · Scarification

1 Introduction

Keranji acid (*Dialium indum* L.) or called Keranji, Luk Yee, Tamarind Plum, Velvet Tamarind, belongs to the Fabaceae or Leguminosae family. This plant naturally grows in the mountains of tropical forests with an altitude of 1,200 above sea level. Usually also found on hillsides and mountains (Ismuhajaroh 2014).

The nutritional composition per 100 g is edible, the fruit contains: energy 126 kcal, moisture 63.8%, protein 1.2%, fat 0.3%, carbohydrates 29.7%, raw fiber 0.2%, ash

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4.8%, P 29 mg, K 438 mg, Ca 4 mg, Mg 4 mg, Fe 1.1 mg, Mn 18 ug, Cu 3.3 g, Zn 9.1 g, and vitamin C 1.2 mg. Judging from the chemical content of the tamarind fruit, namely the leaves and fruit contain saponins, flavonoids and polyphenols, the flesh of the fruit is efficacious as a medicine for canker sores, bleeding gums and diarrhea, while the decoction of the leaves is for washing rusty iron. From the chemical content in the tamarind fruit, this fruit has the ability as a corrosion inhibitor (Lim 2012).

The tamarind tree belongs to the *Leguminosae* family, according to Sutopo (2002), this plant includes a seed-producing type of dormancy or the so-called "hard seed". Outermost and inner has a waxy layer of cuticle material.

To break seed dormancy, seed pretreatment is required before germination. There are several treatments that can break dormancy, namely mechanical treatment, chemical treatment, water immersion treatment, treatment of certain temperatures, and treatment using light (Sutopo 2002).

The treatment of breaking the dormancy of kangaroo acid can be done by scarification. Scarification (wounding the seed coat) is a way to provide impermeable to permeable seed conditions through burning, breaking, filing and scraping with the help of knives, needles, nail cutters, paper, sandpaper, and other tools. Others (Juhanda *et al.*, 2013).

Treatment using chemicals is often done to break dormancy in seeds. According to Mistian (2012), the purpose of chemical treatment is to make the seed coat more accessible to water during the imbibition process. Meanwhile, according tycoon (2016), the use of scarification methods combined with soaking the seeds in a solution of KNO_3 will increase the viability and vigor.

Potassium nitrate (KNO_3) is an inorganic salt which is specifically referred to as a chemical that has a major effect on the treatment of breaking dormancy. Potassium nitrate (KNO_3) is a chemical compound that is often used to stimulate germination (Widhityarini *et al.*, 2011). Based on the research of Nurmiaty *et al.* (2014) that mechanical scarification by wounding the seeds using nail clippers showed the highest viability of sweet saga seeds; germination rate of 100%, germination rate of 23.22% per day. Meanwhile, the research results of Situmorang *et al.* (2015), showed that tamarind seeds treated with KNO_3 solution with a concentration of 0.4% for 24 h were able to produce an average percentage of germinating seeds of 93%.

2 Methods

The research was conducted at the Tissue Culture and *Seedllingnet* Laboratory of the Integrated Agricultural System (Sitandu) Banten Province. The research used a factorial Randomized Completely Block Design (RCBD) consisting of two factors. The first factor was scarification (A) which consisted of 3 levels: no scarification (A_0), Shearing seeds (A_1), and Sanding seeds (A_2). The second factor was the concentration of potassium nitrate solution (KNO_3), which consisted of 3 levels: 0,3% (B_1), 0,4% (B_2) dan 0,5% (B_3) with 3 replications so there were 27 experimental units.

To determine the effect of each treatment, variance (F test) was performed at the 5% level. If the results of the variance show that they are significantly different or very significant, further tests are carried out. In this study, the *Duncan Multiple Range Test* (DMRT) was used at the 5% level.

Table 1. Recapitulation of Variety Effect of Scarification and Concentration of Potassium Nitrate (KNO_3) Solution on Germination of Kuranji Acid (*Dialium indum* L.) Seeds

No	Observation Parameter	Scarification	Potassium Nitrate (KNO_3)	Interaction	CD (%)
1.	Germination Age (day)	**	ns	ns	15.327
2.	Maximum Growth Potential (%)	**	ns	ns	25.862
3.	Germination (%)	**	ns	ns	26.777
4.	Growth Speed (%/day)	**	ns	ns	20.978
5.	Percentage of Normal Sprouts (%)	**	ns	ns	20.977
6.	Percentage of Abnormal Sprouts (%)	**	ns	ns	20.799 [a]

Description: ** : Very significant effect at 5% level

ns : non significant
CD : Coefficient of Diversity
a : Data transformed 2 times

3 Results and Discussion

The results of variance in Table 1 showed that the first factor, namely scarification, showed a very significant effect on all parameters, namely germination age (days), maximum growth potential (%), germination capacity, growth speed (%/day), percentage of normal germination (%), and percentage of abnormal germination (%). As for the second factor was the level of concentration of the solution KNO_3 and interaction showed no real effect on all parameters of observation.

3.1 Germination Age (Days)

The use of a solution of KNO_3 is able to accelerate the germination of seeds Kuranji acid. Kuranji acid seeds are classified as seeds that require special handling to maintain their viability. As stated by Wahidah, *et al.*, (2014) in their research results, seed germination decreases in line with the age and shelf life of the seed, the longer the seed is stored, the lower the growth power of the seed, and the younger the age of the seed, the longer the seed's growth power. Meanwhile, according to Situmorang, *et al.*, (2015) potassium nitrate used in his research with concentrations of 0.2%, 0.3%, and 0.4% showed that the results were not significantly different from soaking tamarind seeds in fresh water on the average. Average day to germinate. This is because the tamarind seeds used have very good seed viability and have the ability to supply their own food for the germination process (Table 2).

In a treatment with scarification showed an average age of germination faster than the treatment without scarification. According to (Hartawan 2016) Scarification treatment causes a wider surface of the seed in contact with water so that the imbibition process is faster. This causes KNO_3 more easily enter the seed, then K^+ ions in KNO_3 can increase

Table 2. Effect of Scarification and Concentration of Potassium Nitrate (KNO_3) Solution on Average Germination Age (Days).

Scarification	Potassium Nitrate (KNO_3)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
	------------------------------- Day -----------------			-------------
A_0 No Scarification	51.00	50.00	46.33	49.11b
A_1 Seed Shearing	12.33	12.33	11.67	12.11a
A_2 Sanding Seeds	13.33	12.67	10.67	12.22a
Average	25.56	25.00	22.89	24.48

Note: the numbers followed by the same letter in the same column showed no significant difference in the 5% DMRT test.

Table 3. Effect of scarification and Concentration Solution Potassium nitrate (KNO_3) to Average Maximum Potential Growth (%).

Scarification	Potassium Nitrate (KNO_3)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
---	------------------------------- % -----------------			-------------
A_0 No Scarification	16.67	26.67	23.33	22.22c
A_1 Seed Shearing	83.33	76.67	73.33	77.78a
A_2 Sanding Seeds	83.33	73.33	73.33	76.67a
Average	61.11	58.89	56.67	58.89

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% DMRT test.

the protoplasm's ability to absorb water. In this study, there is no interaction between treatment scarification and the level of concentration of the solution KNO_3 with days to germinate. So, it can be interpreted that the treatment effect of each factor stands alone.

3.2 Maximum Growth Potential (%)

Table 3 shows that the average results of the analysis of the maximum growth potential data in the scarification treatment showed a very significant effect with the maximum growth potential value, namely seed sanding (76.67%), seed cutting scarification (77.78%) and the effect of the treatment with the lowest value. That is without giving any scarification (22.22%). While the treatment of various concentrations of KNO_3 solution showed no significant difference in the parameters of maximum growth

Table 4. Effect of scarification and Concentration Solution Potassium nitrate (KNO $_3$) against the average germination percentage (%).

Scarification	Potassium Nitrate (KNO $_3$)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
	---------------------------------%------------------ -------------			
A_0 No Scarification	20.00	33.33	30.00	27.78c
A_1 Seed Shearing	73.33	63.33	86.67	74.44b
A_2 Sanding Seeds	96.67	86.67	76.67	86.67a
Average	63.33	61.11	64.44	62.96

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% DMRT test

potential. In the treatment the concentration of KNO $_3$ solution with a concentration of 0.3% (61.11%), 0.4% concentration (58.89%), and 0.5% (56.67%) concentration.

In this research, the treatment without scarification showed that the average yield of maximum growth potential was lower than the scarification treatment, because the seeds.

Kuranji acid includes hard seeds, so it is necessary to injure the seeds so that water and gas (oxygen) enters the seed. In the treatment without scarification, the seeds experienced impermeability to water and gas (oxygen) so that the seeds took a very long time to germinate. According to Anwar *et al.* (2008) by giving KNO $_3$ to the seeds there was a change in the concentration of inhibitory substances and germination stimulating substances in the seeds. In this case, the amount of stimulating agent increases and the amount of inhibiting agent remains, resulting in germination. In this study, there is no interaction between treatment scarification and the level of concentration of the solution KNO $_3$ to the maximum growth potential. So, it can be interpreted that the treatment effect of each factor stands alone.

3.3 Germination (%)

In this research, scarification provided a higher germination rate than without scarification. Without scarification, it is difficult for water and oxygen to penetrate the seeds, making it difficult for the seeds to germinate. Scarification is done by injuring the seeds so that there are gaps where water and oxygen can enter and leave. According to Nurmiaty *et al.* (2014) scarification was able to provide impermeable conditions to the seed coat (which was initially impermeable) so that the seeds could absorb water. Water entering the seed causes enzyme activation, reshuffle of food reserves, molecular transport, increased respiration and assimilation, initiation of cell division and enlargement, and elongation of radicle cells followed by the emergence of radicles from the seed coat. The water not only accelerates the emergence of the radicle but also increases the growth of

Table 5. Effect of scarification and Concentration Solution Potassium nitrate (KNO_3) to Average Speed Growth (% / day).

Scarification	Potassium Nitrate (KNO_3)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
	----------------------------%/Day	-----------------	---------	
A_0 No Scarification	0.03	0.04	0.04	0.04c
A_1 Seed Shearing	0.09	0.08	0.10	0.09b
A_2 Sanding Seeds	0.12	0.11	0.09	0.10a
Average	0.08	0.08	0.08	0.08

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% DMRT test.

other parts of the embryo. This was indicated by the highest germination yield of the scarification treatment (Table 4).

According to Kusumawarhani (1997) *in* Husain (2012) that with 0.2% KNO_3 treatment on candlenut seeds produced germination which was not significantly different from the control. According to Rosalina (2003) *in* Kartika (2015) that $KNO_{3\text{ is}}$ only effective on seeds that have low dormancy intensity. Breaking dormancy will be effective when combined with heating at a temperature of 50 ^{o} C for 48 h, this method can break dormancy effectively in several rice varieties. The results also showed that giving 0.2% KNO_3 gave no significant results with 0% KNO_3 administration. In this study, there was no interaction between scarification treatment and the concentration level of KNO_3 solution on germination. So, it can be interpreted that the treatment effect of each factor stands alone.

3.4 Growth Speed (%/day)

Table 5 showed that the scarification treatment with sanding gave better results than other scarification treatments, namely 0.10%/day. This is in accordance with the statement of Widyawati *et al.* (2009) that scarification by sanding makes it easier for water to enter the seeds because more and more.

The skin that has been removed from lignin has a larger area than other scarification techniques so that more water enters the seeds and the germination process takes place quickly.

Kuranji acid seeds have a thick and hard skin that is *impermeable* to water and gases so that it inhibits germination. The low vigor of curanji acid seeds is thought to be due to the seeds having a thick and rather hard *seed coat*, so that the germination process takes a long time for potential roots to penetrate the seed coat. According to Justice and Bass (2002), the rate of decline in vigor and seed viability depends on several factors, including genetic factors of the species or cultivar, seed conditions, storage conditions, uniformity of seed lots and fungal storage, if storage conditions allow for growth.

In the treatment the concentration level of the KNO_3 solution gave an average result that was not significantly different from the growth speed parameter. According

Table 6. Effect of Scarification and Concentration of Potassium Nitrate (KNO_3) on Average Percentage of Normal Sprouts (%).

Scarification	Potassium Nitrate (KNO_3)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
	---------------------------------%	-----------------		------------
A_0 No Scarification	16.67	26.67	23.33	22.22c
A_1 Seed Shearing	56.67	50.00	60.00	55.56b
A_2 Sanding Seeds	70.00	63.33	53.33	62.22a
Average	47.78	46.67	45.56	46.67

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% DMRT test.

to Siregar *et al.* (2016) that the parameter of seed growth speed was not all seeds in chemical treatment that had the highest water content compared to physical treatment were able to grow faster than expected according to the water content of each seed that had been chemically soaked. In this study, there was no interaction between the scarification treatment and the concentration level of the KNO_3 solution on the growth rate. So, it can be interpreted that the treatment effect of each factor stands alone.

3.5 Normal Sprouts (%)

Table 6 shows that the scarification treatment with sanding gives better results than other scarification treatments, which has an average value of 62.22%. According to Rahayu (2015) which stated that the number of normal sprouts in seeds without scarification was 71.25%, while the number of normal sprouts in seeds that received scarification treatment was 96.5%. Thus it can be stated that germination by scarification technique.

able to produce a larger number of normal sprouts.

In this research, treatment without scarification by soaking various concentration KNO_3 results lower normal seedling. This can be due to the length of soaking the seeds in a solution of potassium nitrate (KNO_3) were just soaked for 24 h. Ilyas (2007) *in* Nurussintani *et al.* (2013) states that the dampening seed for 48 h in KNO_3 0.2% can improve seed germination elephant peanut varieties from 60.00% at *the after-ripenning* 3 weeks to 80.00% after 6 weeks. In the treatment without scarification, seed rigors Kuranji acid causes the seeds take a long time to germinate the seeds even if soaked in a solution of potassium nitrate (KNO_3). The concentration of potassium nitrate used causes the curanji acid seeds to still have a hard texture. So that the seeds do not penetrate water and oxygen. In this study, there is no interaction between treatment scarification and concentration KNO_3 against the normal germination. So, it can be interpreted that the treatment effect of each factor stands alone.

3.6 Abnormal Sprouts (%)

The percentage of abnormal sprouts is a viability parameter that is strongly influenced by the percentage of normal sprouts. The higher the percentage of normal sprouts, the lower

Table 7. Effect of scarification and Concentration Solution Potassium nitrate (KNO_3) on the average percentage of Sprouts Abnormal (%).

Scarification	Potassium Nitrate (KNO_3)			Average
	B_1 0.3%	B_2 0.4%	B_3 0,5%	
	--------------------------------%	----------------	-------------	
A_0 No Scarification	0.00	0.00	0.00	0.00a
A_1 Seed Shearing	26.67	26.67	26.67	26.67c
A_2 Sanding Seeds	13.33	10.00	20.00	14.44b
Average	13.33	12.22	15.56	13.70

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% DMRT test.

the percentage of abnormal sprouts. The number of abnormal germination percentages was caused by some damaged/dead sprouted seeds, the presence of fungi that attacked the seeds, the seeds used were not good, and the planting media was not sterile. In this study, there was no interaction between scarification treatment and the concentration level of the KNO_3 solution on abnormal sprouts. So, it can be interpreted that the treatment effect of each factor stands alone (Table 7).

4 Conclusions and Suggestions

Based on the results and discussion, can be concluded as follows:

1. Physical scarification treatment gave the best results with to parameters: average germination age parameter (12.22 days), maximum growth potential (76.67%), germination power (86.67%), growth speed (0.10%/day), normal sprout percentage (62.22%), and the percentage of abnormal sprouts (14.44%).
2. The treatment of potassium nitrate (KNO 3) concentration was no significant effect on the germination of kuranji acid (Dialium indum L.) to all observed parameters.
3. There was no interaction between scarification treatment and the concentration level of potassium nitrate (KNO 3) solution to all observed parameters.

Based on the conclusion, can be suggested as follows:

1. Treatment can be done using scarification by sanding the seeds to break the dormancy of the kuranji acid seeds.
2. For further research, it can be used by treating various chemical solutions and with various concentrations to accelerate the germination of curanji acid seeds.

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