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Optimizing the Growth of Tasikmalaya Honje (*Etlingera elatior*) Accession Seeds by Implementing Fermentation of Rabbit Urine and Coconut Water

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Abstract

Organic matter has an important role besides providing macro and micronutrientsto plants, it can also improve environmental quality. The fermentation of rabbit urine and coconut water is expected to optimise the growth of honje seedlings. This study aimto determine the concentration of fermented rabbit urine and coconut water that can optimize the growth of honje seedlings of Tasikmalaya accession. The study used a completely randomized design with seven treatments, namely A = control, B = 25% rabbit urine fermentation, C = 50% rabbit urine fermentation, D = 25% coconut water, E = 25% rabbit urine fermentation + 25% coconut water, F = 50% rabbit urine fermentation + 25% coconut water, G = 50% rabbit urine fermentation + 50% coconut water. The results showed that the treatments gave significantly different results on shoot emergence, seedling height, seedling diameter, and root shoot ratio. Treatment G produced the fastest shoot emergence (8.5 days), and plant height (10.4 cm), not significantly different from treatment C (9 cm). Meanwhile, the widest seedling diameter was produced by treatment B (4.4 cm), C (3.9 cm), and treatment G (3.9cm). Treatment C produced the highestroot shoot ratio of 0.5.We concluded that treatment C was the best treatment for optimum growth of honje seedlings.

Keywords: coconut water, growth, honje, kecombrang, rabbit urine

1. Introduction

Since ancient times, honje has been grown and used by Indonesians as a traditional medicine, food ingredient, natural dye, paper raw material, cut flower, ornamental flower and fragrance material. Almost all parts of the honje plant including flower buds, leaves, stems, and rhizomes have been utilised for the above purposes. Honje has a lifespan of 155 days from the appearance of the first shoots of the rhizome to the withering of the flowers and Honje is usually propagated by rhizomes and seeds (Choon and Ding 2015).

Alkaloids, flavonoids, tannins, steroids, saponins, essential oils, carbohydrates, and glycosides are active compounds found in honje plants (Askal and Anton 2015; Lachumy et al 2010; Tan *et al* 2011). Antibacterial and antioxidant functions of these compounds are found in honje rhizomes (Rezki et al 2015). Honje stem extract can eradicate termites because it has biothermic properties (Fitri *et al* 2015). Administration of honje flower extract can prevent free radicals (Tan *et al* 2011).

The use of inorganic fertilizers in crop cultivation can increase production costs. In addition, if used continuously and excessively, it can reduce the quality of the environment and health. Indonesian people today are starting to be aware of healthy living and returning to nature, one of which is by consuming organically cultivated agricultural products, one of which is by using organic fertilizer technology. According to Anand *et al.* (2019) organic products are chosen by consumers because of their superior quality, taste, and nutrition when compared toconventional products. Organic matter has an important role in providing nutrients, providing macro and micro elements (Abustam *et al* 2018; Benchari and Simla 2017).Organic fertilizer requires time to composting and you have to make sure it's well composted, if its not the nutrients available to plants will be few (Nurjanah et al. 2022). Organic fertilizer whose nutrients are easily absorbed by plants is in liquid form. Liquid organic fertilizer makes it easier for plants to absorb nutrients compared to other fertilizers in solid form. Liquid fertilizer also contains elements that are easily decomposed so that its use can be more easily seen (Rabbani, 2021).One organic fertilizer that has the benefit of increasing soil fertility is fermented rabbit urine which is also able to increase plant productivity (Sembiring et al., 2011).Coconut water has complete nutritional content consisting of vitamins, amino acids, minerals, Ca, Na, Mg, S, Cu, Fe, and sugar. The nutrient content has a significant effect on plant growth (Mangesa et al., 2021).

Compared to the faeces and urine of other livestock such as chickens, horses, pigs, buffaloes, cows, and sheep, rabbit has higher N, P, K, elements (2.72%, 1.1%, and 0.5%) (Setyanto *et al.* 2014). Manure from cows and chickens is used by the community as fertiliser and circulated in solid form, not so with rabbit manure. This makes rabbit urine has a great opportunity as a source of liquid organic fertiliser.

Based on research, it is stated that the vegetative growth of potato plants can be increased by the application of rabbit urine watered (Marpaung *et al.* 2014). Application of 300cc L-1 rabbit urine can produce the largest melon weight (Sunandra *et al.* 2019).According to research by Setiawati *et al.* (2010) stated that tiger orchid seeds given coconut water had the fastest germination time. This is because coconut water contains auxin 198.55 mgL-1, cytokinin 273.62 mgL-1, and zeatin 290.47 mgL-1 (Seswita 2010). Kusnadi and Tivani (2017) explained that rabbit urine and coconut water contain natural growth regulators. Giving a combination of rabbit urine and coconut water gives a higher rhizome dry weight and essential oil content of red ginger when compared to the control.The 25% rabbit urine fermentation treatment in the study gave the highest number of combrang roots, not significantly different from the 25% rabbit urine + 25% coconut water fermentation treatment (Rabbani et al., 2021). Research by Sihabudin et al., (2022) explains that adding 25% coconut water increases the vegetative growth of red spinach plants.

Based on the description above, it is necessary to study the concentration of fermented rabbit urine and coconut water on the growth of honje seedlings. The aim is to know the appropriate concentration of fermented rabbit urine and coconut water to get optimal honje seedling growth, so as to increase the opportunity to get organic honje raw materials that can be used for the development of herbal medicines in Indonesia.

2. Materials and Methods

The research was conducted at the Experimental Garden of UniversitasPerjuangan Tasikmalaya, Tasikmalaya City. Materials and tools used were Tasikmalaya honje rhizome accession, fermented rabbit urine and coconut water, planting media (soil, manure, and husk charcoal) in the ratio of 2:1:1, EM4, red sugar. The tools used were 35 cm x 40 cm polybags, meter, hand sprayer, hoe, shovel, stationery, label, camera, digital scale, hose, bucket and measuring cup.

The experiment used a completely randomised design (CRD), with 7 treatments (A = control; B = 25% fermented rabbit urine; C = 50% fermented rabbit urine; D = 25% coconut water; E = 25% fermented rabbit urine + 25% coconut water; F = 50% fermented rabbit urine + 25% coconut water; G = 50% fermented rabbit urine + 50% coconut water). Each treatment was repeated six times.

Observations

Observations were made on honje growth characters, namely: shoot emergence, seedling height, seedling diameter, number of leaves, number of tillers, biomass, shoot dry weight, root dry weight, root shoot ratio.

Data Analysis Growth data were tested with the F test at a real level of 5%. If the results of the F test have a significant effect, it will be tested further with the LSD test using the Minitab 17 programme.

Preparation of planting material

The planting material was Tasikmalaya honje accession rhizomes, cut into pieces of approximately 100g in size, and soaked in 80% mankozeb fungicide solution, at a concentration of 1 g L-1 water for 6 hours. The rhizomes were then planted in 35 x 25 cm polybags with a composition of husk charcoal: manure: soil (1:1:2). Honje seedlings were watered every 5-7 days.

Preparation of treatment.

Rabbit urine was first fermented with EM4 + molasses in a 100L drum where there was no sunlight. The fermentation of rabbit urine is stirred once every week, and stops at the 4th week, where the fermentation of rabbit urine is no longer hot and smelly, which indicates that the fermentation of rabbit urine has matured. After that, prepare as many small black buckets as the number of treatments, to start making fertilizer according to the treatments. The preparation of fertilizer according to the treatment is as follows: B = 250ml rabbit urine + 750ml water; C = 500ml rabbit urine + 500ml water; D = 250mlcoconut water + 750ml water; E = 25% rabbit urine by 500ml + 25% coconut water by 500ml; F = 50% rabbit urine by 500ml + 25% coconut water by 500ml; G = 50% rabbit urine by 500ml + 50% coconut water by 500ml. The coconut water used comes from young coconutsThe fermentation of urine and coconut water was carried out based on the method of Kusnadi and Tivani (2017), carried out every two weeks. The details of the doses given are as follows: 2 MST = 25ml, 4 MST = 35 ml, 6 MST = 50 ml, 8 MST = 60 ml, 10 and 12 MST = 75 ml, 14 and 16 MST = 90ml.Treatment is given by pouring it onto the plants.

Nutrient Content Analysis of Treatments

The nutrient content analysis of C-organic, N-organic, Total N, P O25 Total, K2 O Total, and pH of the treatments given are presented in Table 1. Treatment analysiswas conducted at the Laboratory of Soil Chemistry and Plant Nutrition, Department of Soil Science and Land Resources, UNPAD

3. Results and Discussion

Shoot Emergence, Seedling Height, Seedling Diameter, Number of Leaves, Number of Saplings

Based on the research results described in Table 2, it can be seen that treatment G (50% rabbit urine fermentation + 50% coconut water) produced the fastest shoot emergence when compared to other treatments, which was 8.5 days. Meanwhile, treatment F (50% rabbit urine fermentation + 25% coconut water) produced the slowest shoot emergence when compared to the other treatments, which was 15.2 days.Treatment G also produced the highest seedling height (10.4 cm), not significantly different from treatment C (9 cm). In addition, treatment G also produced the widest seedling diameter (3.9 cm), not significantly different from treatments B and C (4.0 cm and 3.9 cm). Meanwhile, the control produced the smallest seedling height and diameter, which were 4.0 cm and 2.5 cm, respectively.

The results of this study are in line with research conducted by Kusnadi and Tivani (2017), that the treatment with high concentrations of rabbit urine and coconut water(rabbit urine 50% + coconut water 25%), produced red ginger plants with rapid plant height growth parameters. The high content of rabbit urine provides nutrients that are able to fulfil all nutrient needs for plants. While the research of Karo *et al.* (2014) mentioned that giving rabbit urine can increase the growth of granola potato plants. According to Viza and Ratih (2018), coconut water contains cytokinin and auxin hormones, which are hormones that affect cell division, thus helping stem lengthening.

Based on Table 1, treatment G contains the highest total K compared to the other treatments at 0.21%. In addition, it also contained organic N, P, and C elements of 0.05%, 0.06%, and 3.19%, respectively. Potassium is a macronutrient involved in many important processes in plants, such as osmoregulation, cell division, stomatal regulation, enzyme activation, proten synthesis, photosynthesis, and nutrient ion transport in the phloem (Pettigrew 2008). In addition, it plays a role in crop quality, disease resistance, and product quality (Oosterhuis *et el* 2013). According to White and Brown (2010), N, P, and K are the main elements required for plant growth, and are easily transported through the phloem network.

The highest K content and the highest C, N, P content in treatment G caused this treatment to produce the highest shoot emergence, seedling height, and seedling diameter compared to other treatments. Nutrients K and P play a role in metabolic processes such as photosynthesis and respiration. The element P is an ATP-forming material that plays a role in the process of photosynthesis, if ATP is sufficient, it will lead to increased absorption of N. While N and P themselves will form proteins, carbohydrates, nucleic acids, and will be translocated by the element K (Arista et al. 2015).

The treatments in this study produced the number of leaves and the number of tillers that did not differ between treatments. The highest number of leaves was produced by treatment C (50% rabbit urine fermentation), which was 1.7 leaves. In the number of tillers parameter, treatments C (50% rabbit urine fermentation) and E (25% rabbit urine fermentation + 25% coconut water) produced 0.3 tillers.

Treatments C and E based on the results of laboratory analysis presented in Table 1, contain N-total, and K-total with amounts that are not too high or not too low. Research by Djafar *et al* (2013) explained that the nitrogen content in rabbit urine responded to the number of tillers of red ginger plants.

Table 1. Nutrient Content of Rabbit Urine and Coconut Water Treatments

Treatment	Nutrients					
	C-organic (%)	N-organic (%)	N Total (%)	P_2O_5 Total (%)	K_2O Total (%)	pH
B	5.71	0.00	0.09	0.07	0.03	7.17
C	5.95	0.00	0.05	0.00	0.06	7.32
D	5.50	0.00	0.07	0.00	0.08	3.43
E	4.88	0.00	0.02	0.00	0.04	4.58
F	7.48	0.00	0.04	0.00	0.09	3.89
G	3.19	0.00	0.05	0.06	0.21	3.90

Table 2. Shoot emergence, seedling height, seedling diameter, number of leaves, number of tillers at 8 weeks after planting.

Treatment	Shoot Emergence (days)	Seedling Height (cm)	Seedling Diameter (cm)	Number of Leaves (blade)	Number of saplings
A	10.8 ± 2.8 ab	4.0 ± 1.3 b	2.5 ± 0.4 b	1.6 ± 1.5	0.0 ± 0.0
B	10.5 ± 4.5 ab	8.3 ± 2.8 ab	4.0 ± 0.8 a	1.1 ± 0.4	0.0 ± 0.0
C	11.8 ± 4.1 ab	9.0 ± 2.9 a	3.9 ± 0.4 a	1.7 ± 1.5	0.3 ± 0.5
D	12.2 ± 3.8 ab	7.6 ± 2.4 ab	3.6 ± 0.9 ab	1.0 ± 0.0	0.0 ± 0.0
E	14.5 ± 3.3 ab	6.5 ± 1.7 ab	3.4 ± 0.4 ab	1.0 ± 0.0	0.3 ± 0.5
F	15.2 ± 3.6 a	8.0 ± 1.1 ab	3.1 ± 0.4 ab	1.0 ± 0.0	0.0 ± 0.0
G	8.5 ± 0.6 b	10.4 ± 2.7 a	3.9 ± 0.8 a	1.1 ± 0.0	0.0 ± 0.0

Notes: Numbers followed by different letters in the same column indicate significantly different based on the LSD test at the 5% level. The ± value presented is the standard deviation

Biomass, Shoot Dry Weight, Root Dry Weight, Root-Shoot Ratio

Treatment C produced the highest shoot-root ratio compared to the other treatments (Table 3). This treatment also produced the highest shoot dry weight compared to other treatments. The root-shoot ratio (R:S ratio) is influenced by the dry weight of the shoot and roots. R:S ratio shows the ratio between the area of photosynthesis and transpiration processes with the ability of seedlings to absorb water and minerals from the soil (Santosa *et al.* 2013).

Permatasari and Kusmana (2011) explained that seedlings are said to be good if the root shoot ratio interval is between 1-3. The values of shoot-root ratio in this study are all less than 1, this is because the dry weight of honje rhizome roots is greater than the dry weight of honje seedling shoots. This is reasonable because the honje seedlings in this study were only 4 months old, so their vegetative growth had only reached the initial stage, so the shoot had not yet reached maximum growth. Honje itself is an annual plant. The small R:S ratio indicates that the rhizome-shaped roots of honje are able to fulfil the nutrient needs for shoot development.

Based on thefertilizertest analysis results of treatment C (50% rabbit urine fermentation) in Table 1, it can be seen that treatment C contains 5.95% organic C, 0.05% total N, 0.06% total K2 O, and a pH of 7.32. According to Neumann and Römheld (2012), nutrient absorption is closely related to the absorption or release of protons, and is closely related to pH. Although the content of C, N, K in fertilizer C is not large when compared to other treatments, the neutral pH value of fertilizer C causes the nutrients contained in it to be absorbed by honje seedlings optimally to support their growth.

Table 3. Biomass, shoot dry weight, root dry weight, C/N ratio, leaf area at8 weeks after planting.

Treatment	Biomassa (g)	Shoot Dry Weight (g)	Root Dry Weight (g)	Root-Shoot Ratio
A	60.0 ± 76.0	10.3 ± 4.3	51.1 ± 73.4	0.4 ± 0.2 ab
B	43.7± 22.9	14.4 ± 9.7	36.4± 29.3	0.5 ± 0.2 ab
C	81.4 ± 92.4	16.1 ± 8.4	65.3 ± 86.5	0.5 ± 0.4 a
D	63.7 ± 65.0	13.0 ± 8.7	54.1 ± 63.0	0.4 ± 0.2 ab
E	94.6 ± 101.2	10.0 ± 4.6	84.6 ± 99.7	0.2 ± 0.2 b
F	78.9 ± 59.0	11.1 ± 6.0	67.7 ± 55.5	0.3 ± 0.3 ab
G	92.9 ± 90.5	14.1 ± 7.2	78.8 ± 84.5	0.3 ± 0.2 b

Notes: Numbers followed by different letters in the same column indicate significantly different based on the LSD test at the 5% level. The ± value presented is the standard deviation.

Correlation

Based on Table 4, there is a very strong positive relationship between root dry weight and biomass (0.995). The correlation between growth characters indicates that these characters influence each other. Root dry weight had a very strong positive relationship with biomass. This means that an increase in root dry weight significantly increases biomass (Chandrasekaran, 2022)

Table 4. Correlation matrix between honje variables affected by rabbit urine and coconut water fermentation treatments

Perlakuan	PH	D	NL	NO	B	SDW	RDW
D	0,556*						
NL	-0.019^{tn}	-0.174^{tn}					
NO	0.118*	0.074^{tn}	0.006^{tn}				
B	0.384^{tn}	0.207^{tn}	-0.145^{tn}	-0.127^{tn}			
SDW	0.245^{tn}	0.427*	0.188^{tn}	-0.004^{tn}	0.595*		
RDW	0.374^{tn}	0.164^{tn}	-0.179^{tn}	-0.136^{tn}	0.995*	0.513*	
R:S Ratio	-0.046^{tn}	0.135^{tn}	0.528*	0.161^{tn}	-0.522*	0.227^{tn}	-0.586*

4. Conclusions

The results showed that the treatments gave significantly different results on shoot emergence, seedling height, seedling diameter, and root shoot ratio.Treatment G (50% fermented rabbit urine + 50% coconut water)produced the fastest shoot emergence (8.5 days), and plant height (10.4 cm), not significantly different from treatment C (9 cm). Meanwhile, the widest seedling diameter was produced by treatment B (25% fermented rabbit urine) =4.4cm, C (50% fermented rabbit urine) = 3.9 cm, and treatment G (50% fermented rabbit urine + 50% coconut water) = 3.9cm. Treatment C (50% fermented rabbit urine) = produced the highestroot shoot ratio of 0.5.

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