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Evaluation of the Growth and Yield of Organic Corn Fodder under Various Watering Times and Concentrations of Rabbit Urine Fertilizers

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ABSTRACT

Organic Fodder System is a planting system without using soil as its main medium. The use of fertilizers can be regulated in quantities and concentrations that correspond to the needs of plants during the plant growth season to obtain optimal results with good quality. The study was conducted to determine corn fodder's growth productivity and nutrient content under the treatment of differences in watering time and rabbit urine fertilizer concentration. The treatment was carried out on the difference in the soaking solution of corn kernels and the difference in the watering time of corn seedlings. Soaking was carried out by 5 solutions namely L0: water, L1: AB mix (commercial fertilizer) 1%, L2: rabbit urine fertilizer 1%, L3: rabbit urine fertilizer 2.5%, L4: rabbit urine fertilizer 5%, as treatment, and 5 (five) replication groups. Watering was carried out at three different time intervals (W1: 6 hours/day, W2: 9 hours/day, W3: 12 hours/day) with five replication groups. The variables observed were germination percentage, normal sprout percentage, corn fodder height, fresh fodder production, fodder dry matter production, fodder protein content, fodder crude fiber content, fodder crude fat content, Non-Nitrogen Free Extract (NNFE), and corn fodder ash content. The experimental design used in this study was a Completely Randomized Design of factorial patterns. Differences in rabbit urine fertilizer concentration and watering time impact germination percentage, normal germination percentage, plant height, fresh matter production, dry matter production, protein content, and crude fiber.

Keywords: Corn fodder, Fertilizer, Organic, Rabbit urine, Watering time

Introduction

In recent years some regions in Indonesia have experienced a change in land function from agriculture to residential land, so farmers have had difficulty finding feed for their livestock. Periodic fluctuations in the availability of forage feed occur every year (Handayanta *et al*., 2015). In addition, to feeding problems, farmers are also faced with the problem of waste produced as a by-product of the livestock business, both liquid, solid, and gas. Based on Food and Agriculture Organization (FAO) data in 2006, 18% of environmental pollution comes from livestock. Therefore, farmers must pay attention to the processing of waste generated from their farms, so that their business continuity is maintained and avoid environmental damage in the long term. Based on this, a term has emerged that has become a topic of discussion in the world of animal husbandry called sustainable livestock.

Sustainable livestock according to the FAO is the managed conservation of natural resources. The orientation of technological change is carried out in such a way as to guarantee human needs sustainably. One of the strategies carried out to build sustainable farms includes optimizing the integration of zero-waste farms. The implementation of sustainable animal husbandry that farmers can do is with organic fodder system technology (Sunandar *et al*., 2020). Organic fodder system technology can help farmers in providing quality forage feed for livestock.

Organic Fodder System is a planting system without using soil as its main medium. The system uses an organic system that is completely independent of chemicals. Organic Fodder Systems can produce forage feed that has quality nutrients at a low cost and in a short time and does not depend on the season, so it can be applied throughout the year (Sunandar *et al*., 2020). The material can be grains from plants, one of which is corn. The advantage of corn plants grown utilizing an organic fodder system is the rapid growth of plants so that they can be harvested in a short time. In the Organic Fodder System, nutritional needs are given along with irrigation, known as fertigation.

At fertigation, the use of fertilizers can be regulated in quantities and concentrations that correspond to the needs of plants during the plant growth season to obtain optimal results with good quality (Hermanto, 2003).

Rabbit urine is one of the livestock wastes that can be used as fertilizer. The relatively higher nutrient content than the urine of other livestock, namely N, P, and K, respectively, 2.72%, 1.1%, and 0.5%, makes rabbit urine have the potential to replace chemical nutrients for fodder (Sholikhah *et al*., 2018). Rabbit urine fertilizer contains organic matter C 0.62%, N-total 2.11%, and pH 9.14 (Rosniawaty *et al*., 2015). Rabbit urine contains microorganisms that can accelerate the decomposition process and increase the availability of nutrients, especially nitrogen, potassium, and phosphorus, so as to reduce the use of inorganic fertilizers and increase plant yields to the maximum. Thus, pure rabbit urine has the potential to be used as organic fertilizer (Imas and Basuni, 2023). In general, the concentration of fertilizer application and the duration of watering play an important role in the growth of corn fodder. Therefore, research to investigate the influence of fertilization concentration and watering duration was conducted.

Materials and Methods

The research was conducted at Campus II Anday West Papua and the Pangkep State Polytechnic Laboratory in West Sulawesi from February to June 2022. Tools and materials in this study include rabbit urine from a rabbit farm on Campus II of Polbangtan Manokwari, commercial fertilizer with brand AB mix (as positive control), corn seeds Bisi 228, fodder installations and equipment, digital scales, and stationery. This research used Completely Randomized Design (CRD) 5 x 3 factorial design. Data were analyzed using analysis of variance, subsequently if there was a significant effect was continued with Duncan's Multiple Range Test (DMRT). The treatment was carried out on the difference in the soaking solution of corn kernels (5 treatments) and the difference in the watering time of corn seedlings (3 treatments). The variables observed were germination percentage, normal sprout percentage, corn fodder height, fresh fodder production, fodder dry matter production, fodder protein content, fodder crude fiber content, fodder ether extract content, Non-Nitrogen Free Extract (NNFE), and corn fodder ash content.

Corn kernel preparation

Planting corn fodder begins with the preparation of a planting medium in the form of trays (size 26 x 9 x 5 cm) that are given holes for water drainage. Preparation of corn kernels by washing and sorting floating and rotten seeds for disposal. Then the selected seeds are soaked for 12 hand then drained and placed in the prepared substrate. Each tray was filled with 100 g of corn seeds. Soaking was carried out with 5 solutions (L0: water, L1: AB mix 1%, L2: rabbit urine fertilizer 1%, L3: rabbit urine fertilizer 2.5%, L4: rabbit urine fertilizer 5%) as treatment, and 5 (five) replication groups.

Corn fodder maintenance

Already placed seeds in trays are subsequently carried out watering at different time intervals. Hydroponic corn fodder was covered with a cloth for 2 days in dark conditions or until root growth. Corn kernels that have already grown roots can be transferred to a bright place, then watered using nutrient solutions. After 9 days the hydroponic corn fodder is ready to be harvested by rolling the root part. Watering was carried out at three different time intervals (W1: 6 hours/day, W2: 9 hours/day, W3: 12 hours/day) with a total of 100 ml per day for each solution with five replication groups.

Parameters observed

Germination percentage. The percentage of germination is calculated using units of percent based on the following formula.

% germination $= \frac{n}{N} \times 100\%$

In which :
n: Number of germinated seeds
N: Number of seeds tested

Normal sprout percentage

Normal germination or germination is determined by calculating the number of seeds that germinate normally over a period of 9 days using the following formula:

JK= $\frac{DK}{JC} X\ 100\%$

In which :
JK: Number of normal sprouts produced
DK: Germination capacity
JC: Number of seeds tested

Corn fodder height. Plant height is measured using a ruler, by measuring from the base of the plant to the highest leaves.

Fresh fodder production. The production of fresh fodder is obtained by weighing the fresh weight of corn fodder after it has been harvested with digital scales.

Nutrient content (dry matter, crude protein, crude fiber, crude fat, NNFE, and ash content). Corn fodder is dried at a temperature of 55ºC for 2 weeks using a drying oven, then ground for nutrient content testing using proximate analysis (dry matter, crude protein, crude fiber, ether extract, NNFE, and ash content).

Data analysis

This study was done following a Complete Randomized Design (CRD) with a factorial pattern of 5 x 3 (5 treatments of soaking solution and 3 treatments of watering time). Data were analysed using analysis of variance for the SPSS data analysis program's, if there was a significant effect was continued with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Plant growth is a process of plant life that results in irreversible additions and changes in size, shape, and volume. Two important factors influence the growth of a plant, namely genetic factors and environmental factors. Genetic factors are related to the inheritance of plant traits, while environmental factors are related to the environmental conditions in which the plants grow (Sembiring *et al*., 2017). One of these environmental factors is the influence of the nutrient content contained in liquid organic fertilizer. The nutrient content of the liquid organic fertilizer (AB mix and rabbit urine fertilizer) used in this study is shown in Table 1. Differences in rabbit urine fertilizer concentration and watering time impact germination percentage, normal germination percentage, plant height, fresh matter production, dry matter production, protein content, and crude fiber.

Table 1. Nutrient content of the liquid organic fertilizer (AB mix and rabbit urine fertilizer)

Nutrient content (%)	AB mix	Rabbit urine
Nitrogen (N)	0.0486	2.2
Phosphor (P)	0.0425	1.1
Potassium (K)	0.0469	2.3
Sulfur (S)	0.0320	3.6
Calcium (Ca)	0.0372	1.2
Magnesium (Mg)	0.0030	0.0040

Source: Petro 3 l (PT. Petrokimia Gresik, 2019) and Primary data (2022).

Germination percentage

The germination percentage of corn fodder seeds in this study is shown in Table 2. Based on the results of the 1% Duncan test, the lowest germination percentage was found in the AB mix fertilizer treatment at 1% with a length of watering time every 12 hours per day (49.01%), very significantly different from rabbit urine fertilizer treatment at 1% and watering time in every 6 hours per day (90.38%). The highest average germination percentage was achieved at L2 (rabbit urine fertilizer 1%) and the lowest was at L1 (water). This is because the differences in the solution and watering treatment greatly affect the germination process. Therefore, the effect of a rabbit urine fertilizer solution 1% using an interval of 6 h is very good in the germination percentage process. In line with Sarah *et al*. (2016) stated that the success of the percentage of germination to reach 80% of the yield can be a reference for planting corn fodder. According to Puspitaningtyas and Handini (2021), the addition of organic material helps to increase the germination rate and gives a better response to the growth of the seed. Research conducted by Kustyorini *et al*. (2019) obtained the results that organic fertilizers have a very significant effect on the percentage of germination of corn fodder (*Zea mays*).

Normal sprout percentage

The normal sprout percentage of the corn fodder seeds in this study is shown in Table 3. Based on the results of the 1% Duncan test, it shows that the lowest percentage of normal germination for 9 days was found in the water treatment at a length of watering time every 12 hours per day (0.48%), very significantly different from rabbit urine fertilizer treatment with level 1% and watering time in every 6 hours per day (79.69%). The average percentage of normal germination with the highest value was achieved at rabbit urine fertilizer treatment with level 2.5% and the lowest at water treatment. This is because the differences in the solution and watering treatment greatly affect the process of normal germination percentages. Therefore, the effect of rabbit urine fertilizer with a content of 2.5% using an interval of 6 hours is a suitable condition for the normal germination percentage process. According to Saputra *et al.* (2019), one of the purposes of germination testing in addition to knowing the quality of seeds is to determine the quality of fertilizer given. The quality of the seeds was good as indicated by the initial high percentage of germination (Puspitaningtyas and Handini, 2021).

Corn fodder height

The data of corn fodder height is shown in Table 4. Based on the results of Duncan's 1% test showed the lowest corn fodder height was found in the water treatment with the length of watering time every 12 hours per day (2.96 cm), very significantly different from rabbit urine fertilizer treatment with a

Table 2. Germination percentage (%)

Time (h)	Rabbit urine fertilizer dosage (%)					
	L0 (0%)	L1 (AB mix)	L2 (1%)	L3 (2.5%)	L4 (5%)	Average (W)
W1(6)	80.51	85.59	90.38	89.37	74.62	84.09^{a}
W2(9)	82.99	70.59	87.68	88.33	76.25	81.17^{a}
W3(12)	61.68	49.01	75.72	71.30	72.83	66.11^{b}
Average (L)	75.06^{z}	68.39^{x}	84.59^{z}	83.00^{z}	74.56^{y}	

^{a,b} Different superscripts in the same column show significant differences (p<0.05).
^{x,y,z} Different superscripts on the same line show significant differences (p<0.05).

Table 3. Normal sprout percentage (%)

Time (h)	Rabbit urine fertilizer dosage (%)					
	L0 (0%)	L1 (AB mix)	L2 (1%)	L3 (2.5%)	L4 (5%)	Average (W)
W1(6)	24.11	22.01	79.69	77.94	66.59	54.07^{c}
W2(9)	14.86	5.02	6.28	18.17	29.85	14.84^{b}
W3(12)	0.48	3.62	1.69	2.70	1.13	1.93^{a}
Average (L)	13.15^{xy}	10.22^{x}	29.22^{xy}	32.94^{z}	32.52^{z}	

^{a,b,c} Different superscripts in the same column show significant differences (p<0.05).
^{x,y,z} Different superscripts on the same line show significant differences (p<0.05).

Table 4. Corn fodder height (cm)

Time (h)	Rabbit urine fertilizer dosage (%)					
	L0 (0%)	L1 (AB mix)	L2 (1%)	L3 (2.5%)	L4 (5%)	Average (W)
W1(6)	7.31	11.12	15.78	17.11	14.67	13.19[b]
W2(9)	4.45	6.56	7.96	7.18	8.02	6.83[a]
W3(12)	2.96	7.24	7.06	7.37	6.24	6.17[a]
Average (L)	4.91[x]	8.31[y]	10.27[z]	10.55[y]	9.64[y]	

[a,b] Different superscripts in the same column show significant differences (p<0.05).
[x,y,z] Different superscripts on the same line show significant differences (p<0.05).

level 2.5% and the length of watering time every 6 hours per day (17.11 cm). The highest average corn fodder height was achieved at rabbit urine fertilizer treatment with level 2.5% and the lowest was at water treatment. This is because the differences in the solution and watering treatment greatly affect the height of the corn fodder process. Therefore, the effect of rabbit urine level solution with level 2.5% using a time interval of 6 hours is very good on corn fodder height. Plant height is influenced by the number of active cells in the plant. Other aspects that affect the height of corn plants are fertilization levels and different light intensities so the yields have a significant effect on plant height (Malik, 2014). According to Satriawan *et al*. (2022), plant height was affected by a combination of shading and varieties. In addition, Hairrudin and Mawardi (2017) stated that the application of liquid organic fertilizer has an influence on plant height and the number of leaves.

Corn fodder production

The result of corn fodder production is showed in Table 5. Based on the results of 1% Duncan's test showed the lowest yield of fresh corn fodder was found in treatment with the length of watering time every 6 hours per day (54.63 g), very significantly different from rabbit urine fertilizer treatment with a level 1% and the length or watering time in every 6 hours per day (208.09 g). The highest average is achieved at rabbit urine fertilizer treatment with level 1% and the lowest is at water treatment. This is because the differences in the solution and watering treatment greatly affect the production process of fresh corn fodder. So that the effect of a rabbit urine fertilizer with level 1% using an interval of 6 hours is very good on the production of fresh corn fodder. The use of fertilizer dose levels up to a dose of 1 gram/liter of water has the highest influence on the production of fresh weight. The nitrogen content contained in rabbit urine fertilizer used for soaking corn kernels can help plant growth. Tando (2019) added that nitrogen is an important element for plant growth. If plants lack nitrogen elements, plant growth will slow down and cause plant growth and production to be less than optimal.

Corn fodder proximate analysis

Based on the results of proximate analysis on corn fodder, it can be described that the difference in the dose of rabbit urine organic fertilizer application affects the levels of dry matter, ash, crude fiber, ether extract, NNFE, and crude protein. The highest dry matter content is found in the rabbit urine fertilizer treatment with level of 1%, while the highest organic matter content is found in the rabbit urine fertilizer treatment with level of 2.5%. Based on the results obtained, shows that the greater the dose of rabbit urine fertilizer, the higher the organic matter contained in corn fodder. The results of a study conducted by Raharjo *et al*. (2016) showed that the difference in the fertilizer application dose affects the corn fodder's dry matter content. The higher the dose of fertilizer, the dry matter content of corn fodder also increases. Seseray *et al*. (2013) added that plants that have a larger cell wall content, have more dry matter content. High-content organic matter in corn fodder is affected by water and minerals that are successfully absorbed by young plants (Gurawal *et al*., 2022). After sprouting shoots or sprouts, the amount of organic matter and cell wall content (cellulose, hemicellulose, and lignin) as well as the dry matter content of the plant has increased. According to Prihartini (2014) that plants will experience an increase in organic matter as they age plant.

The highest ether extract content is found in the rabbit urine fertilizer treatment with level 5%, while the water treatment has the highest crude fiber and NNFE. The highest crude protein content is found in the AB mix fertilizer treatment with level 1%. Research conducted by Hanum (2013) explains that adequate absorption and availability of phosphorus will help the metabolic processes of plants. The accumulation of protein in seeds is determined by the adequacy of plant phosphorus. Therefore, phosphorus deficiency in plants will result in low growth rates, inhibition of nodule formation, and change the rate of N and C uptake per unit area which ultimately results in plant protein synthesis. Increasingly the large amount of N absorbed by plants causes crude plant proteins

Table 5. Corn fodder production (g)

Time (h)	Rabbit urine fertilizer dosage (%)					
	L0 (0%)	L1 (AB mix)	L2 (1%)	L3 (2.5%)	L4 (5%)	Average (W)
W1(6)	54.63	164.09	208.09	204.53	191.10	164.49[c]
W2(9)	120.06	101.19	133.12	126.62	81.84	187.61[b]
W3(12)	69.32	65.64	57.07	57.68	87.49	67.44[c]
Average (L)	81.34[x]	110.31[xy]	132.74[y]	129.61[y]	120.14[xy]	

[a,b,c] Different superscripts in the same column show significant differences (p<0.05).
[x,y,] Different superscripts on the same line show significant differences (p<0.05).

Table 6. Corn fodder proximate analysis

Proximate analysis (%)	Solution (%)				
	L0	L1	L2	L3	L4
Dry matter	88.91	86.63	89.71	86.15	85.05
Ash	4.46	4.70	4.41	2.39	2.96
Ether extract	17.85	22.06	20.86	22.04	26.57
Crude fiber	2.62	2.38	2.26	2.29	2.45
NNFE	45.60	37.45	43.03	41.30	35.57
Crude protein	18.38	20.04	19.15	18.13	17.50

L0: water, L1: AB mix 1%, L2: rabbit urine fertilizer 1%, L3: rabbit urine fertilizer 2.5%, L4: rabbit urine fertilizer 5% as treatment.

to increase (Prihartini, 2014). According to Gurawal *et al*. (2022), the proximate analysis results show that the crude fiber content of corn fodder is higher when compared to whole corn seeds, which is above 4%. According to Septian (2023), the crude fiber content of corn fodder given rice washing water as the main nutrient ranges from 5.94 ± 0.12% to 16.52 ± 0.44% in the harvest period of 7-21 days. The increase in crude fiber content in corn fodder is caused by an increase in organic matter contained in plants (Prihartini, 2014).

Conclusions

Based on the research conducted, it was concluded that the treatment of differences in watering time and rabbit urine fertilizer concentration against corn fodder hydroponics had an impact on the content of germination percentage, normal germination percentage, plant height, fresh matter production, dry matter production, protein content, and crude fiber.

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