



The Effect of Rabbit Urine Fertilizer Application on the Growth of Water Spinach (*Ipomoea Aquatica*)

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Abstract. Water spinach (*Ipomoea aquatica*) is a highly nutritious vegetable. The demand for these vegetables, as well as consumer awareness of the importance of eating vegetables, is increasing. The application of fertilizers has an impact on the growth of water spinach. The study aimed to determine the effect of rabbit urine fertilizer on the growth of water spinach plants. The study used a randomized block design, with rabbit urine fertilizer being sprayed once, twice, and three times on solid organic fertilizer-based growth. Water spinach cultivation without rabbit urine fertilizer or solid organic fertilizer was used as the control for the research treatment. The observations included plant height and plant wet weight. The results showed that there was a significant difference in the wet weight and height of the plants treated with rabbit urine and solid organic fertilizer ($p < 0.05$). The best-wet weight and height of water spinach plants were 0.1375 kg and 26 cm, respectively, after three applications of rabbit urine fertilizer in the cultivation on solid organic fertilizer-based growth.

Keywords: Water spinach · Rabbit urine · Organic fertilizer

1 Introduction

In addition to the beautiful appearance and delicious meat, it turns out that rabbits have other advantages that can be used for agricultural activities, namely as fertilizers and biological pesticides. Rabbit urine is a liquid that is able to provide a high enough nitrogen supply for plants, this is due to the high levels of nitrogen contained in it. When compared to other grass-eating animals, rabbit urine has high levels of Nitrogen due to its habit of never drinking water and only consuming forage.

Plants in their growth and development require two types of nutrients, namely macro and micro nutrients. Nevertheless, only the elements N, P, and K are needed in larger quantities. The manufacture of liquid organic fertilizers can be made using a simple composting method. Compost is used in the form of 25 L gallons with an outer connecting hose whose ends are immersed in a bottle of water to ensure the continuity of the composting process in an anaerobic atmosphere. The resulting liquid organic fertilizer

products have a diverse macro nutrient content that is highly dependent on the mixture of fertilizer organic materials used [1].

Rabbits are a type of animal that is still rarely cultivated, even hearing its urine as liquid organic fertilizer feels very strange. This is because looking at the posture of a small rabbit, so the consideration of collecting rabbit urine is relatively long when compared to the urine of cows, goats and sheep.

But beyond that, rabbit urine has advantages in the nutrient content of either micro or macro exceeding the content of goat and sheep urine. It is for this reason that many people trade liquid waste from rabbit livestock as super liquid organic fertilizer.

In comparison using organic liquid fertilizer made from cow pee it takes 2 livestock for a breadth of 1 hectare, 20 goats and sheep/hectares. If using rabbit urine it takes as much as 200 tails to get 1 ha. The amount of adult rabbit urine production, the average of 10 rabbits can be obtained as much as 2 L of liquid waste per day.

The macro and micro urine content of rabbits element N P K averages (N) 2.72%, (P) 1.1%, and (K) 0.5% and this content is higher when compared to the urine of other animals such as cows, goats, sheep, horses and pigs. Still based on the results of research, the benefits of rabbit urine are getting super, if rabbit urine that has been processed into liquid organic fertilizer can be from livestock that reaches an adult age of 6 to 8 months. This is because adult rabbit urine has been shown to be the highest and rich in elements N, P, and K.

The efficacy of rabbit urine as an organic agricultural fertilizer will be super, if the liquid waste from the livestock is fermented and used in conjunction with rabbit solid feces that have been processed into Bokashi will increase the various content of more complex nutrients among others: *Nitrogen (N) 2.20%, Phosphorus (P) 87%, Potassium/Potassium (K) 2.30%, Sulfur (S) 36%, Calcium (Ca) 1.26%, Magnesium (Mg) 40%*. It is a very super liquid organic fertilizer to be used for your cultivated crops, as well as processed into pesticides or plant pest controllers (see Table 1).

Table 1. Nutrient content of livestock manure

Types of livestock	Nutrients			
	N (%)	P (%)	K (%)	H2O (%)
Horse (solid)	0,55	0,30	0,40	75
Buffalo (solid)	0,60	0,30	0,34	85
Cow (solid)	0,40	0,20	0,10	85
Sheep (solid)	0,75	0,50	0,45	60
Pigs (solid)	0,90	0,35	0,40	80
Chicken	0,40	0,10	0,45	97
Young rabbit*	1,6–2,0	0,43–1,3	0,4–1,0	44,7–32,5
Adult rabbit**	2,72	1,1	0,5	55,3

Source: [2].

As is well known, the role of nitrogen (N) which is usually obtained from kimi fertilizers such as UREA, etc. is very important to help the process of photosynthesis. In addition, nitrogen elements are needed by various types of plants as a means of vegetative formation of plants such as: roots, stems, leaves and also for the process of forming leaf chlorophyll (green substances that all leaves have). For this reason, rabbit urine is a blessing from God that farmers need to know as a natural fertilizer from the best farm animals.

Liquid organic fertilizer made from livestock urine after fermenting there is an increase in the content of element P, decreased element K and pH. The measured pH ranges from 6.85–8.45 and is in accordance with the requirements of liquid organic fertilizer on the basis of Permentan No. 70/Permentan/SR.140/10/2011. Organic fertilizer liquid form made from livestock urine is able to increase the number of leaves and the height of pakcoy plants that are significantly different from chemical fertilizers. The application of liquid organic fertilizer goat urine produces the same wet weight and dry weight of pakcoy crop harvest as chemical fertilizers [3].

Support of Rabbit Urine POC can increase all parameters of mustard growth spoon, (2) Giving NPK fertilizer can increase all parameters of mustard growth spoon, (3) Giving a combination of POC rabbit urine and NPK fertilizer has a real interaction with all parameters of mustard growth spoon, (4) The best treatment of plant height, wet weight and dry weight is a dose of 6 ml POC/100 ml of water and 0.4 g of NPK/100 ml of water, The best treatment of the number of leaves and leaf area is a dose of 4 ml POC/100 ml of water and 0.6 g of NPK/100 ml of water, and the best treatment of total chlorophyll content is a dose of 4 ml POC/100 ml of water and 0.4 g of NPK/100 ml of water [4].

This study tried to examine the application of rabbit urine to spinach plants. The need for spinach is relatively increasing as consumer awareness of the importance of vegetable consumption increases. Everyone must know *Ipomoea reptans* aka kale. But it may be that not everyone knows spinach consists of two types, namely land spinach and water kale. It's similar, but physically different. Spinach water flowers a reddish white color, while land spinach flowers clean white.

Plant growth is a process of plant life that results in accretion and changes in size, shape, and volume that are irreversible (cannot be reversed). There are two important factors that affect the growth of a plant, namely genetic factors and environmental factors. Genetic factors are related to inheritance of plant traits, while environmental factors are related to the environmental conditions in which the plant grows [5].

From the size of the stem and the shape of the leaves are also different. The water spinach is stretched and leafy larger. The stems of water spinach are green, while the land spinach is greenish white. It's another flavor, too. Land spinach is relatively tastier and crunchier than water kale.

Water Spinach (*Ipomoea* sp.) can be grown in low lands and high lands. Spinach is a type of leaf vegetable plant, including the family *Convolvulaceae*. Long spinach leaves, whiteish green is a source of vitamin pro vitamin.

This plant can grow quickly within 4–6 weeks from the beginning of seed form. This plant originated in India which then spread to Malaysia, Burma, Indonesia, South China, Australia, and Africa.

In China, this vegetable is known as *weng cai*. In European countries, spinach is commonly called *swamp cabbage*, *water convolvulus*, or *water spinach*. Spinach consists of two varieties, namely land spinach called Chinese spinach and water spinach that grow naturally in rice fields, swamps, or trenches. The difference between land spinach and water spinach lies in the color of the flower. Spinach water flowers reddish white, while the land spinach white flowers are clean.

Another difference is that the water spinach is larger than the land kale. The color of the stem is also different. Spinach water is green, while the land spinach is greenish-white. Another, the habit of breeding. Land spinach has more seeds than water spinach that's why land spinach is propagated through seeds, while water spinach by cuttings stem shoots.

Spinach has a sweet, fresh, cold taste. The nature of this plant goes into the meridians of the intestines and stomach. The pharmacological effects of this plant as antiracy (antitoxic), anti-inflammatory, urinary straighteners (diuretics), stop bleeding (hemostatic), sedative (sleeping pills). Spinach is also soothing and soothing.

In the overall growth of land kale plants that include plant height, leaf length, number of leaves, rooting using humic acid is better than without humic acid, as well as the productivity of plants increased by 300 kw/ha [6].

2 Research Methods

The object of this study is the method of using rabbit urine in spinach plants. As a control variable, organic fertilizers are used. The organic fertilizer used is Petroganik. The main study was conducted at the Soropadan location, Tawang Sari, Pengasih, Kulon Progo Regency in November 2020 on expanse of rice fields in the Marsudi Tani Farmer Group. The sample is selected using *the purposive sampling method*. Purposive because the research object is easy to observe, so the purpose of observation can be done every day.

In general, the necessary data includes data on physiological aspects of spinach plants that undergo treatment including plant height and plant weight. This data is obtained by observing directly in the field.

There are 4 treatments that are without urine, spraying rabbit urine once (as a basic fertilizer), 2 times (basic fertilizer and a week post planting) and 3 times (basic fertilizer, a week after planting and 3 days after the second spray).

Rabbit urine used is rabbit urine that has been fermented. Every 1 L of rabbit urine is mixed with 10 cc Em4 and 10 cc drops of sugarcane and left for 2 weeks before use. Next diluted 10 times. As a control variable is a petrogenic organic fertilizer. The treatment used is to use organic fertilizers and without organic fertilizers.

Observations were made covering plant weight and plant height. There are 4 repeats for plant weight, and 12 repeats for plant height. Map of the attached location.

Analysis and processing of data using the Anova *method*. This method continued (*posthoc*) Tukey to see the difference. This study does not use heteroscedasticity, autocorrelation, multicollinearity and normality tests because this study does not use multiple linear regression analysis based on ordinary least squares (OLS) but only 2-way ANOVA test. Data processing uses the help of IBM statistics software.

3 Discussion

Observational data in the study included the weight and height of the plants. Observations about plant weight are seen in Table 2.

Table 2 shows that the weight of plants is greatly affected by organic fertilizers. The average crop without organic fertilizer is 0.050625 medium that uses organic fertilizer of 0.1059375. From different tests there is a real difference in treatment that uses organic fertilizers and those that do not. As for the treatment of kelinncci urine showed no noticeable difference, although the trend of frequency of rabbit urine use that causes a lot of plant weight to be higher. Starting from 0.059375, 0.068125, 0.085625 and 0.1, but showed no significant difference. From Table 2 it can be concluded that organic fertilizers play an important role in increasing plant weight.

Organic fertilizer is a fertilizer composed of matter of living things, such as weathering the remains of plants, animals and humans. Organic fertilizers can be solid or liquid in shape used to improve the physical, chemical and biological properties of the soil. Organic fertilizers contain a lot more organic matter than their nutrient content. Sources of organic matter can be compost, green fertilizer, manure, harvest waste (hay, brangkas, corncobs, sugarcane bagas, and coconut coir), livestock waste, industrial waste that uses agricultural materials, and municipal waste.

Artificial organic fertilizer is an organic fertilizer produced in a factory using modern equipment. Some of the benefits of artificial organic fertilizers, namely:

- 1) Increases the nutrient content needed by plants.
- 2) Increases crop productivity.
- 3) Stimulates the growth of roots stems, and leaves.
- 4) It grows and fertilizes the soil.

In general, artificial organic fertilizers are used by spreading it around the plant, so that there is an increase in nutrient content effectively and efficiently for plants that are given organic fertilizer.

Various research results indicate that most intensive agricultural land is declining in productivity and has experienced land degradation, mainly related to the very low organic carbon content in the soil, which is 2%. Whereas to obtain optimal productivity

Table 2. Weight of Spinach Plants (kg)

Heavy	Without organic		Organic			
No urine	0,03750	a	0,08125	abc	0,05938	x
1 time	0,04000	a	0,09625	abc	0,06813	x
2 times	0,06250	Off	0,10875	bc	0,08563	x
3 times	0,06250	Off	0,13750	c	0,10000	x
	0,05063	p	0,10593	q		

Description: The number followed by the same letter indicates no real difference to a significance level of 5%.

it takes organic carbon about 2.5%. Organic fertilizers are very beneficial for increasing agricultural production both in quality and quantity, reducing environmental pollution, and improving land quality in a sustainable manner. Long-term use of organic fertilizers can increase land productivity and can prevent land degradation. The source of materials for organic fertilizers is very diverse, with physical characteristics and chemical contents that are so diverse that the influence of the use of organic fertilizers on land and plants can vary. In addition, its role is considerable to improve the physical properties, soil biological chemistry and environment. Organic fertilizers added to the soil will undergo several phases of remodeling by soil microorganisms to become humus. Organic matter also acts as an energy source and food of soil microbes so as to increase the activity of these microbes in the provision of plant nutrients.

The addition of organic matter in addition to being a source of nutrients for plants, as well as a source of energy and nutrients for microbes. The basic ingredients of organic fertilizers derived from the rest of the plant contain little harmful material. The use of manure, industrial waste and municipal waste as compost base material is dangerous because it contains many heavy metals and organic acids that can pollute the environment. During the composting process, some of these harmful ingredients will be concentrated in the final product of the fertilizer. For that, it requires the selection of compost base ingredients that contain harmful and toxic ingredients (B3). Organic fertilizer can act as a binder of primary granules into secondary grains of soil in the formation of fertilizers. This condition affects storage, water supply, soil aeration, and soil temperature. Organic matter with a lot of carbon and nitrogen, such as straw or chaff, has more effect on improving the physical properties of the soil than decomposed organic matter such as compost.

Organic fertilizers have important chemical functions such as the provision of macro nutrients (nitrogen, phosphorus, potassium, calcium, magnesium and sulfur) and micros such as zinc, copper, cobalt, barium, manganese, and iron. although the number is relatively small. Macro and micro nutrients are needed for plant growth, especially for lovers of ornamental plants. Many hobbyists and lovers of ornamental plants ask about the composition of fertilizer content and the percentage of nitrogen, phosphorus and potassium content that is right for plants that are seedlings, teenagers, or adults / parentage.

Nitrogen (N) serves to stimulate the growth of the plant as a whole, part of the plant's own cells (organs), function for synthesis of amino acids and proteins in plants stimulate vegetative growth (green color of leaves, leaf length, width of leaves) and vegetative growth stems (high and stemsize), plant lack of nitrogen element symptoms: slow growth/dwarf, yellowish green leaves, narrow leaves, short and upright, old leaves quickly yellowing and dying.

Phosphorus (P) function for the transportation of energy resulting from metabolism in plants stimulating flowering and fruit, stimulating root growth, stimulating seed formation, arousing plant cell division and enlarging celltissues, anaman deficiency of phosphorus elements symptoms: fruit formation/and seeds reduced, dwarf, purplish-colored leaves or redness.

Potassium (K), function in the process of photosynthesis, transport of assimilation results, enzymes, and minerals including water, increase the durability/immunity of plants against disease, who lack potassium elements symptoms: stems and leaves become

Table 3. Height of spinach plant (cm)

Tall	Without organic		Organic			
No urine	4,92	a	19,83	bc	17,38	x
1 time	16,42	ab	22,17	cd	19,29	xy
2 times	17,38	ab	24,25	of	20,81	yz
3 times	19,29	bc	26,00	e	22,65	e
	17,00	p	23,06	q		

Description: the number followed by the same letter shows no real difference to a significance level of 5%

limp/fall, leaves dark bluish green is not fresh and healthy green, the tip of the leaves yellow and dry, brown patches arise on the leaf shoots.

Organic fertilizers also serve to increase the cation exchange capacity of soil and form complex compounds with metal ions that poison plants such as aluminum, iron, and manganese.

As for the height of the plant observations can be seen in Table 3. From Table 3. The best results are for the combination of organic fertilizers and the use of rabbit urine. The combination of the two produces the best plant height of 24.25 cm and 26 cm. This result is the best result among other combinations. This means that the use of organic fertilizers and the use of rabbit urine as much as 2 and 3 times produces the best combination.

From the test of the difference between the height of plants using organic fertilizers and without organic there is a noticeable difference (plant height of 17 and 23.0625 cm). Likewise, the use of rabbit urine also showed a noticeable difference. There is a noticeable difference between without urine and 2 and 3 times. While the use of 1 time there is a real difference with 3 times. As for those without urine and 1 time use does not show a significant difference. While the use 1 time and 2 times also did not show a significant difference. Likewise, for 2 times and 3 times also did not show a significant difference.

These results support the research conducted by Enny Mutryarny, Endriani and Sri Utami Lestari [7] which showed that giving rabbit urine liquid organic fertilizer with increasing concentration increased plant growth and production, it was seen that the increasing concentration showed the best results for all observation parameters. Provision of liquid organic fertilizer rabbit urine is able to provide nutrients to support plant vegetative growth and plant production and the higher the concentration, the higher the nutrient content contained in the fertilizer, the more plant growth and production will increase.

According to Gardner et al. [8], the availability of nutrients is one of the environmental factors that greatly determines the rate of plant growth. So that more available essential nutrients are needed which can be obtained through increasing the concentration of liquid organic fertilizer in rabbit urine. The availability of nutrients in sufficient and balanced quantities for plant growth, can cause the process of cell enlargement and cell elongation to take place rapidly which results in several organs.

plants grow quickly [7]. The existence of a good growth and production response to the administration of liquid organic fertilizer of rabbit urine is caused by the presence

of nutrients in the form of nutrients contained in liquid organic fertilizer of rabbit urine. Liquid organic fertilizer of rabbit urine which contains macro elements N, P, K which is quite high compared to other liquid organic fertilizers of livestock urine. Nitrogen is needed by plants in the formation of vegetative parts of plants such as stems, leaves and roots. Phosphorus is a very important part in cell division for the development of meristem tissue, as well as a building block for fats and proteins. The element potassium helps in the formation of proteins and carbohydrates.

Fertilization through leaves has the advantage of faster absorption of nutrients compared to root fertilization, because nutrient absorption runs faster through the stomata so that it provides a fast response to plant growth and development. Liquid organic fertilizer of rabbit urine can increase the proliferation of microorganisms in the soil that actively remodel and release nutrients in the weathering process, so that the decomposition process will combine loose soil grains which cause better water absorption. Dense soil will become loose as a result the roots will be able to absorb nutrients properly, thus the better the physical and biological properties of the soil as a medium for plant growth, the more growth and development of plants will be. One of the properties of organic fertilizers can bind water four times of its body weight. The wet weight of the plant is caused by the water content so that it allows an increase in the optimal water content of the plant [7].

Rabbit urine has advantages in the nutrient content of either micro or macro exceeding the content of goat and sheep urine. It is for this reason that many people trade liquid waste from rabbit livestock as super liquid organic fertilizer.

Content of macro nutrients and micro urine rabbits element N P K averaged (N) 2.72%, (P) 1.1%, and (K) 0.5% and this content is higher when compared to the urine of other animals such as Cows, Kambing, Sheep, Horses and Pigs. Still based on the results of the study, the benefits of rabbit urine are getting super, if rabbit urine that has been processed into liquid organic fertilizer in can from livestock that reaches an adult age of 6 to 8 months. This is because adult rabbit urine has been shown to be the highest and rich in elements N, P, and K.

The role of nitrogen (N) which is usually obtained from kimi fertilizers such as UREA, etc. is very important to help the process of photosynthesis. In addition, nitrogen elements are needed by various types of plants as a means of vegetative formation of plants such as: roots, stems, leaves and also for the process of forming chlorophyll leaves (green substances that all leaves have).

The results of this study support the research conducted by Cholisoh KN, S. Budiayanto, and E. Fuskhah, [9], Fitriiningtyas AN, Sutarno and E. Fuskhah, [10], Ummi Sholikhah, Illia Seldon Magfiro and Wahyu Indra Duwi Fanata [11], Rosniawaty, Sudirja, Afrianto [12], Dhedy Kristanto and Sandra Arifin Aziz [13], Melda Yuartaria Sembiring, Lilik Setyobudi and Yogi Sugito [14].

Melda et al. [14] stated that in the experiment rabbit urine fertilizer also gave the best number of fruits and tomato fruit weight compared to the control treatment, cow urine and goat urine because rabbit urine contains high N, P, K. Lestari [15] added that the high content of N, P and K in rabbit urine can provide sufficient nutrients for plants, so that they will produce larger fruit. This research can be applied to the agricultural scale in a broad sense, not only at the household scale. Therefore, rabbit urine is a blessing

from god that needs to be known by farmers as a natural fertilizer from the best farm animals.

4 Conclusion

From the above discussion can be concluded that the combination of rabbit urine and the use of organic fertilizer produces the best results. For future studies it is expected that there will be analysis for adult rabbit urine and young rabbit urine. In addition, organic fertilizers for future research are analyzed for manure, green manure and compost.

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