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Biofertilizer Application of Rabbit Urine and Eggshell Powder Improves Purple Eggplant (*Solanum melongena* L.) Productivity Under Tropical Field Conditions

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Abstract

Background: *Eggplant (Solanum melongena L.) production in Indonesia is still low compared to the national demand of about 782,600 tons, with current production only 102,540.3 tons. To improve yields, organic fertilizers such as rabbit urine and chicken eggshells can be used, as they provide beneficial nutrients for the plants. The purpose is to determine the effects of liquid organic fertilizer (LOF) made from rabbit urine and varying doses of chicken eggshells on the growth and yield of purple eggplant (S. melongena L.).* **Methodology:** *The research was conducted in Menganti Subdistrict, Gresik Regency. The study used a Factorial Complete Randomized block Design (CRBD) with two factors: rabbit urine concentration (10, 20, 40, 80 ml/L) and chicken eggshell doses (5, 10, 15 grams/plant), observation parameter included plant morphology, fruit yield, and the quality of the fruit. ANOVA was used to analys the data.* **Findings:** *The results showed that there was no significant interaction between the two treatments on any observed parameters. The single-factor treatment of chicken eggshell dose had a highly significant effect on both vegetative and generative growth, with an optimal dose of 10 grams per plant. Meanwhile, the single-factor treatment of rabbit urine concentration had no significant effect; however, concentrations of 10–20 ml/L showed a tendency to increase plant yield. The highest fruit set percentage, 69.61%, was obtained from the combination treatment of 10 ml/L rabbit urine and 10 grams/plant chicken eggshell.* **Contribution:** *The combination of Rabbit urine and eggshell effective as a an promising biofertilizer for the optimum growth and yield of eggplant.*

Keyword: *Eggplant; Eggshell; Liquid Organic Fertilizer; Rabbit Urine*

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INTRODUCTION

Eggplant (*Solanum melongena* L.) is a type of vegetable plant that is very popular and favored by many people due to its delicious taste and rich nutritional content, which is beneficial for the human body. According to Martiningsih et al., (2014), eggplant fruit has a pleasant taste and contains various vitamins, including vitamins A, B1, B2, C, and D, as well as phosphorus, carotenoids, anthocyanins, and fiber. The average eggplant consumption of the Indonesian population remains low, at around 2.795 kg per capita per year (Ministry of Agriculture of the Republic of Indonesia, 2023). Therefore, the national demand for eggplant reaches 782,600 tons per year, while eggplant production in Indonesia in 2023 was only 102,540.3 tons (BPS, 2023). The gap between eggplant demand and production indicates the need for the expansion of planting areas and the intensification of eggplant cultivation through the implementation of proper and effective farming practices.

One of the efforts to intensively increase eggplant production is by applying proper cultivation practices through balanced fertilization (organic and inorganic), optimizing the absorption of nutrients by the plant through both roots and leaves (Farrasati et al., 2021). Continuous use of inorganic fertilizers without the addition of organic fertilizers can deplete soil organic matter and lead to the degradation of soil biological fertility. Therefore, to improve soil fertility, the use of inorganic fertilizers can be substituted by adding organic matter to the soil (Septian et al., 2015).

Rabbit urine and eggshells are organic wastes that have beneficial properties for plants. Rabbit urine can be processed into liquid organic fertilizer (LOF) because it has several advantages, such as containing relatively high levels of essential nutrients like nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O), improving and restoring soil fertility lost due to the use of inorganic or chemical fertilizers, and reducing farming costs (Rasyid, 2017). Dried chicken eggshells contain 95% calcium carbonate. This compound, with its high calcium content, can be used as a raw material for making LOF and to increase the pH of the soil and water media (Nursani & Amaliah, 2022).

The study by Fitriasari (2017) showed that the application of rabbit urine at a concentration of 25 ml/L of water had a significant effect on the plant height and leaf area of sweet corn. Similarly, Imran (2016) reported that applying rabbit urine at a concentration of 12 ml/L had a significant effect on the number of flowers, number of fruits, fruit length, and fruit weight of red chili plants.

The growth and yield of purple eggplant can also be improved by utilizing chicken eggshell waste. Chicken eggshells are known to contain approximately 95% calcium carbonate ($CaCO_3$), which functions to increase soil pH and provide calcium for plants (Putri et al., 2015). Calcium plays an important role in root formation and growth, strengthening plant structure, resistance to environmental stress, and physiological processes such as cell division and elongation, protein synthesis, and nutrient transport. Tindaon et al., (2024) stated that the application of 10 grams of eggshells per plant produced the best results in terms of the number of eggplant fruits. The purpose of this study was to determine the effect of rabbit urine liquid organic fertilizer concentration and eggshell dosage on the growth and yield of eggplant plants,

if proven succesful it can provide the farmers on how beneficial the fertilizer is and also reduce organic waste.

METHOD

The research was conducted in Menganti Subdistrict, Menganti District, Gresik Regency, at an altitude of 5 – 12.5 meters above sea level, with an average temperature of 26.9 – 27.5 ºC and humidity of 68 %. The study was carried out over three months, from December 2024 to February 2025. A Factorial Completely Randomized Block Design (CRBD) was used, consisting of two factors: rabbit urine (with concentrations of 10 ml/L, 20 ml/L, 40 ml/L, and 80 ml/L) and eggshell (with doses of 5 grams/plant, 10 grams/plant, and 15 grams/plant), 12 types of treatment was used with a replicant of 3 thus creating 36 observation unit.

Preparing the eggplant seedling

Eggplant seedlings Mustang F1 variety, aged 3 weeks, were obtained from a nursery in the Pungging area, Mojokerto. The seedlings were first acclimatized for 3 days to allow them to adapt to the new environment. The seedlings used were those that still showed a bright green color, upright growth, and a height of approximately 10–15 cm, indicating they were ready to be transplanted into polybags. Growth medium that had soil:manure:compost (1:1:1) was used to plant the plants.

Preparation of rabbit urine and eggshells

Rabbit urine was purchased online and then diluted according to the treatment concentrations: 10 ml/L, 20 ml/L, 40 ml/L, and 80 ml/L. Chicken eggshells were collected over a period of 7 days. The eggshells used in this study were obtained from food vendors who use chicken eggs as raw ingredients. The collected eggshells were sun-dried for 2 days. After drying, the eggshells were crushed until fine and then blended using a blender to obtain a very fine eggshell powder, followed by sieving. The resulting eggshell powder was then weighed according to the treatment doses: 5 g/plant, 10 g/plant, and 15 g/plant.

Application of Rabbit Urine and Eggshell Treatments

The application was carried out by first preparing the liquid organic fertilizer (LOF) solution according to the required concentrations. The treatments were applied starting at 7 days after planting (DAP) and continued four times, at 7 DAP, 14 DAP, 21 DAP, and 28 DAP, with dosages according to the treatments. The application was done in the afternoon to reduce the evaporation of the LOF.

Observation parameter

Plant Height

Plant height (cm) was measured using a measuring tape. The measurement was taken from the base of the stem to the plant's growing point. Plant height measurements were conducted starting at 7 days after transplanting (DAT) and continued until the final observation at harvest. Measurements were taken at one-week intervals.

Number of Leaves

Leaf count was recorded starting at 7 days after transplanting and continued until the final observation at harvest. Observations were made at one-week intervals by counting the total number of leaves on each eggplant plant.

Stem Diameter

Stem diameter of the eggplant was measured starting at 7 DAT and conducted 7 times at weekly intervals. The measurement was taken on the main stem of the plant using a vernier caliper.

Time of First Flowering

Observation of the time of first flowering was conducted by recording and monitoring the first appearance of flowers on eggplant plants, counted from the day after transplanting.

Total Number of Flowers

Observation of the total number of flowers was carried out by counting all fully bloomed flowers from the initial appearance of flowers until harvest. Observations were conducted at 7-day intervals or whenever new flowers appeared.

Number of Fruits Formed

Observation of the number of fruits formed was done by counting the total number of fruits formed per plant.

Number of harvested fruits

The total number of fruits harvested per plant was observed by counting the fruits harvested each week. Fruits that showed characteristics of 30 cm in size, glossy purple color, and firm texture are considered ready for harvest.

Fruit Diameter

Observation of fruit diameter was carried out after the fruits were harvested by measuring their cross-sectional diameter using a caliper. Observations were conducted at 7-day intervals, starting from the first week of harvest until the fourth week.

Fruit Length

Observation of fruit length was performed after the fruits were harvested by measuring the length from the fruit's stem to its tip using a measuring tape. Observations were conducted at 7-day intervals, starting from the first week of harvest until the fourth week.

Fruit Weight

Observation of fruit weight per plant was conducted by weighing ripe or harvested fruits. Observations were carried out at 7-day intervals, from the first to the fourth week of harvest. The weighing was performed using an analytical balance.

Fruit Set (%)

Fruit set was calculated at the end of the observation period by counting the total number of successfully formed eggplants, from the first to the last harvest. The fruits counted were characterized by large size, firmness, and shiny purple color. The fruit set percentage was obtained by dividing the number of formed fruits by the total number of bloomed flowers, then multiplying by 100 %. In other words, this measurement reflects the percentage of flowers that successfully developed into fruits, using the following formula (Susanto et al., 2013):

$$fruitset\ (\%) = \frac{\sum number\ of\ formed\ fruits}{\sum total\ flowers}\ x\ 100\ \%\ \ldots\ldots\ldots\ldots\ldots\ (1)$$

RESULT AND DISCUSSION

Plant Height

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dose on the height of eggplant plants showed no significant interaction at all observation ages. Likewise, the single factor of rabbit urine concentration had no significant effect at all observation ages, while the single factor of chicken eggshell dose had a highly significant effect on the height of the eggplant plants at all observation ages. The average height of eggplant plants from 2 to 12 weeks after planting (WAP) under the influence of rabbit urine concentration and chicken eggshell dose is presented in Table 1.

Table 1. Average Plant Height of Eggplant at 2–12 Weeks After Planting (WAP) Under Rabbit Urine Concentration and Chicken Eggshell Dose Treatments

Treatment	Plant Height (cm) --WAP--					
	2	**4**	**6**	**8**	**10**	**12**
Rabbit urine concentraion (ml/L)						
10	10,09	20.39	51.56	83.19	101.67	118.67
20	9.78	19.83	49.85	82.98	103.15	122.31
40	10.20	20.61	50.83	80.96	99.09	114.61
80	9.44	19.98	50.39	82.09	102.17	120.39
BNT 5 %	ns	ns	ns	ns	ns	ns
Eggshell dosage (g/plant)						
5	9.96 b	20.26 b	50.42 a	82.17 a	100.50 a	117.40 a
10	9.89 b	20.28 b	51.08 b	82.04 a	102.39 b	121.14 b
15	9.79 a	20.07 a	50.47 a	82.71 b	101.67 b	118.44 a
BNT 5%	0.08	0.12	0.37	0.35	0.95	1.93

Note: Numbers followed by the same letters within the same treatment and observation period indicate no significant difference based on the 5% LSD test. **ns:** not significantly different.

Table 1 shows a tendency for increased plant height of eggplant at 12 weeks after planting (WAP) under the influence of rabbit urine concentration up to 20 ml/L (K2), resulting in a plant height increase of 6.53%, reaching 122.31 cm. Meanwhile, a

chicken eggshell dose of 10 g/plant (C2) produced the highest plant height at 4, 6, 10, and 12 WAP and showed a significant difference compared to other eggshell doses. There was a 3.15% increase in eggplant height at 12 WAP with the application of 10 g/plant chicken eggshell dose compared to the 5 g/plant eggshell dose.

Leaf Total

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dose on the number of leaves in eggplant plants showed no significant interaction at all observation periods. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation periods, whereas the single factor of chicken eggshell dose had a highly significant effect on the number of leaves at all observation periods. The average number of leaves of eggplant plants from 2 to 12 weeks after planting (WAP) under the influence of rabbit urine concentration and chicken eggshell dose is presented in Table 2.

Table 2. Average Number of Leaves of Eggplant at 2–12 Weeks After Planting (WAP) Under Rabbit Urine Concentration and Chicken Eggshell Dose Treatments

Treatment	Leaf Total (cm) --WAP--					
	2	**4**	**6**	**8**	**10**	**12**
Rabbit urine concentraion (ml/L)						
10	5.26	10.30	21.76	36.91	51.85	56.98
20	4.98	9.78	20.91	36.28	50.41	55.26
40	5.24	10.31	21.41	35.81	49.48	54.50
80	4.78	9.91	21.17	35.20	48.72	53.56
BNT 5 %	ns	ns	ns	ns	ns	ns
Eggshell dosage (g/plant)						
5	5.33 b	10.57 b	21.85 b	36.65 b	51.07 b	56.06 b
10	5.10 b	9.90 a	21.21 a	36.13b	50.22 b	55.07 b
15	4.76 a	9.75 a	20.88 a	35.38 a	49.06 a	54.10 a
BNT 5%	0.29	0.44	0.49	0.64	1.01	0.98

Note: Numbers followed by the same letters within the same treatment and observation period indicate no significant difference based on the 5% LSD test. **ns:** not significantly different.

Table 2 shows that the treatment of rabbit urine at 10 ml/L resulted in the highest number of leaves from 2 to 12 weeks after planting (WAP), with an increase in leaf growth of 6.39 %, producing up to 56.98 leaves. Meanwhile, the treatment with 5 grams/plant of eggshell produced the highest number of leaves, totaling 56.06 leaves over the 12-week observation period, with the greatest increase occurring at 4, 6, 8, 10, and 12 WAP, and showing a significant difference compared to the other treatments. The eggshell dose of 5 g/plant resulted in a 3.62 % increase in the number of leaves compared to the other treatments.

Stem Diameter

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dose on the stem diameter of eggplant plants showed no significant interaction at all observation periods. Likewise, the single factor of rabbit urine concentration had no significant effect at all observation periods, whereas the single factor of chicken eggshell dose had a highly significant effect on the stem diameter of eggplant plants at all observation periods. The average stem diameter of eggplant plants from 2 to 12 weeks after planting (WAP), influenced by rabbit urine concentration and chicken eggshell dose, is presented in Table 3.

Table 3. Average Stem Diameter of Eggplant at 2–12 Weeks After Planting (WAP) Under Rabbit Urine Concentration and Chicken Eggshell Dose Treatments

Treatment	Stem Diameter (mm) --WAP--					
	2	**4**	**6**	**8**	**10**	**12**
Rabbit urine concentraion (ml/L)						
10	11.04	20.81	27.06	32.20	36.06	39.75
20	10.97	19.56	26.94	32.59	37.08	41.28
40	11.06	19.96	27.23	32.64	36.56	40.33
80	10.72	19.72	27.61	34.19	38.63	42.99
BNT 5 %	ns	ns	ns	ns	ns	ns
Eggshell dosage (g/plant)						
5	10.90 a	19.93 a	26.79 a	32.11 a	36.26 a	40.10 a
10	11.05 b	20.13 b	27.31 b	33.12 b	37.54 b	41.93 b
15	10.88 a	19.98 a	27.53 b	33.50 b	37.43 b	41.23 b
BNT 5%	0.09	0.11	0.38	0.72	0.71	0.93

Note: Numbers followed by the same letters within the same treatment and observation period indicate no significant difference based on the 5% LSD test. **ns:** not significantly different.

Table 3 shows a tendency that the application of rabbit urine concentration up to 80 ml/L increased the stem diameter of eggplant plants to 42.99 mm, resulting in an 8.15 % increase in diameter. Meanwhile, the application of 10 g/plant chicken eggshell dose produced the largest stem diameter at all observation periods and showed a significant difference compared to the 5 g/plant dose, but no significant difference compared to the 15 g/plant dose. There was a 4.56 % increase in stem diameter of eggplant plants at 12 weeks after planting (WAP) with the application of 10 g/plant chicken eggshell dose compared to the 5 g/plant dose.

First Flowering Time

The analysis of variance results on the effect of the combination of rabbit urine concentration and chicken eggshell dose on the time to first flowering of eggplant showed no significant interaction at any observation period. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation periods,

whereas the single factor of chicken eggshell dose had a highly significant effect on the time to first flowering of eggplant at all observation period. The average time to first flowering of eggplant over 12 weeks after transplanting (WAT) under the influence of rabbit urine concentration and chicken eggshell dose is presented in Table 4.

Table 4. Average Time to First Flowering of Eggplant Under the Treatments of Rabbit Urine Concentration and Chicken Eggshell Dosage

Treatment	First Flowering Time (DAP)
Rabbit urine concentraion (ml/L)	
10	27.37
20	27.81
40	26.70
80	27.81
BNT 5%	ns
Eggshell dosage (g/plant)	
5	26.94 a
10	27.50 b
15	27.83 b
BNT 5%	0.37

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Table 4. shows a tendency for earlier first flowering in the treatment with 40 ml/L rabbit urine. Meanwhile, the 5 g/plant eggshell dosage resulted in the earliest flowering time, which was 26.94 days, with a reduction of 3.20% in days to flowering and a significant difference compared to other treatments.

Total Flower

The analysis of variance results on the effect of the combination treatment of rabbit urine concentration and chicken eggshell dosage on the total number of flowers of eggplant showed that there was no significant interaction at all observation periods. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation times. However, the single treatment of chicken eggshell dosage had a highly significant effect on the total number of eggplant flowers at all observation period. The average total number of eggplant flowers over 12 weeks after transplanting (WAT) under the influence of rabbit urine concentration and chicken eggshell dosage is presented in Table 5.

Table 5. shows a tendency of increased flower production with the application of 80 ml/L rabbit urine, resulting in the highest number of flowers at 22.37 flowers per plant—an increase of 16.14 %. Meanwhile, the 5 g/plant eggshell dosage produced the highest flower count among the dosage treatments at 21.56 flowers, with an increase of 11.83 % and a significant difference compared to other treatments.

Table 5. Average Total Number of Flowers of Eggplant Under the Treatment of Rabbit Urine Concentration and Chicken Eggshell Dosage

Treatment	Total Flower (pieces)
Rabbit urine concentraion (ml/L)	
10	19.26
20	20.44
40	21.48
80	22.37
BNT 5%	ns
Eggshell dosage (g/plant)	
5	21.56 b
10	19.33 a
15	19.28 a
BNT 5%	1.30

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Number of Fruits Formed

The results of the analysis of variance (ANOVA) on the effect of the combination treatment of rabbit urine concentration and chicken eggshell dosage on the number of fruits formed in purple eggplant plants showed that there was no significant interaction at all observation ages. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation ages, whereas the single factor treatment of chicken eggshell dosage had a highly significant effect on the total number of fruits formed in eggplant plants at all observation times. The average number of fruits formed in purple eggplant plants over 12 weeks after transplanting (WAT) under the influence of rabbit urine concentration and chicken eggshell dosage is presented in Table 6.

Table 6 shows a tendency for an increase in the number of fruits formed in the treatment with 10 ml/L rabbit urine by 10.77 %, resulting in the highest number of fruits formed, which was 13.78 fruits. Meanwhile, the 5 g/plant chicken eggshell dosage produced the highest number of fruits formed at 13.25 fruits, with an increase of 4.58 % and a significant difference compared to the 15 g/plant eggshell dosage treatment.

Total Harvested Fruits

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dose on the total number of harvested fruits per eggplant plant showed no significant interaction at all observation periods. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation periods, whereas the single factor of chicken eggshell dose had a highly

significant effect on the total number of harvested fruits per eggplant plant at all observation periods. The average total number of harvested fruits per eggplant plant over the 12-week observation period, influenced by rabbit urine concentration and chicken eggshell dose, is presented in Table 7.

Table 7. shows a tendency for an increase in the number of harvested fruits in the treatment with 10 ml/L rabbit urine, resulting in a 7.29% increase and producing the highest number of harvested fruits, totaling 11.33 fruits. Meanwhile, the 5 g/plant chicken eggshell dose produced the highest number of harvested fruits at 10.83 fruits, showing a 1.50% increase and a significant difference compared to the other treatments.

Table 6. Average Total Number of Fruits Formed in Purple Eggplant Plants under Rabbit Urine Concentration and Chicken Eggshell Dosage Treatments

Treatment	Total Formed Fruits (Pieces)
Rabbit urine concentration (ml/L)	
10	13.78
20	13.22
40	12.56
80	12.44
BNT 5%	ns
Eggshell dosage (g/plant)	
5	13.25 b
10	13.08 b
15	12.67 a
BNT 5%	0.30

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Treatment	Total Harvest Fruit (pieces)
Rabbit urine concentraion (ml/L)	
10	11.33
20	11.00
40	10.11
80	10.56
BNT 5%	ns
Eggshell dosage (g/plant)	
5	10.83 c
10	10.75 b
15	10.67 a
BNT 5%	0.068

Note: Numbers followed by the same letters within the same treatment indicate no significant difference based on the 5% LSD test. **ns:** not significantly different.

Table 7. Average Number of Harvested Fruits of Eggplant at 2–12 Weeks After Planting (WAP) Under Rabbit Urine Concentration and Chicken Eggshell Dose Treatments

Fruit Diameter (mm)

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dosage on the fruit diameter of eggplant showed that there was no significant interaction at all observation times. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation periods. However, the single treatment of chicken eggshell dosage had a highly significant effect on the fruit diameter of eggplant at all observation periods. The average fruit diameter of eggplant during harvest periods 1 to 4 under the influence of rabbit urine concentration and chicken eggshell dosage is presented in Table 8.

Table 8. Average Fruit Diameter of Eggplant under the Treatment of Rabbit Urine Concentration and Chicken Eggshell Dosage

Treatment	Fruit Diameter (mm)
Rabbit urine concentraion (ml/L)	
10	48.48
20	48.26
40	50.47
80	49.19
BNT 5%	ns
Eggshell dosage (g/plant)	
5	48.66 a
10	48.93 a
15	49.70 b
BNT 5%	0.44

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Table 8 shows an increase in fruit diameter of eggplant in the 40 ml/L rabbit urine treatment by 4.58 %, resulting in the largest fruit diameter of 50.47 mm. Meanwhile, the 15 g/plant eggshell dose produced the largest fruit diameter of 49.70 mm, with a diameter increase of 2.14 %, and was significantly different from the other treatments.

Fruit Length (cm)

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and eggshell dosage treatments on the fruit length of eggplant showed no significant interaction at all observation periods. Similarly, the single factor of rabbit urine concentration had no significant effect at any observation period. However, the single treatment of eggshell dosage had a significant effect on the fruit

length of eggplant at all observation periods. The average fruit length of purple eggplant during harvest periods 1 to 4 under the influence of rabbit urine concentration and eggshell dosage treatments is presented in Table 9.

Table 9. Average Fruit Length of Eggplant Under Treatments of Rabbit Urine Concentration and Chicken Eggshell Dosage.

Treatment	Fruit length (cm)
Rabbit urine concentraion (ml/L)	
10	27.10
20	26.85
40	27.94
80	27.70
BNT 5%	ns
Eggshell dosage (g/plant)	
5	27.22 a
10	27.62 b
15	27.37 a
BNT 5%	0.17

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Table 9. shows a tendency for increased fruit length in the treatment with 40 ml/L rabbit urine, resulting in the longest average fruit length of 27.94 cm, an increase of 4.06 %. Meanwhile, the 10 g/plant eggshell dose produced the longest fruit at 27.62 cm, indicating a 1.47 % increase and a statistically significant difference compared to other treatments.

Table 10. Total Fruit Weight per Purple Eggplant Plant under the Treatment of Rabbit Urine Concentration and Chicken Eggshell Dosage

Treatment	Fruit Weight (g)
Rabbit urine concentration (ml/L)	
10	2161.58
20	2119.25
40	2399.08
80	2224.42
BNT 5%	ns
Eggshell dosage (g/plant)	
5	2889.83 a
10	2994.25 b
15	3020.25 b
BNT 5%	56.36

Note: Numbers followed by the same letter within the same treatment indicate no significant difference based on the 5% LSD test. ns: not significantly different

Fruit Weight (gram)

The results of the analysis of variance (ANOVA) on the effect of the combination of rabbit urine concentration and eggshell dosage treatments on the fruit weight per harvest per plant of eggplant showed no significant interaction at all observation periods. Similarly, the single factor of rabbit urine concentration had no significant effect at all observation times, whereas the single factor of eggshell dosage had a significant effect on the fruit weight per plant at all observation periods. The average fruit weight per plant of eggplant from harvest periods 1 to 4 influenced by the concentration of rabbit urine and eggshell dosage is presented in Table 10.

Table 10. shows a tendency for increased fruit weight of eggplant under the 40 ml/L rabbit urine treatment by 13.20%, resulting in the highest fruit weight of 2,399.08 grams. Meanwhile, the 15 g/plant eggshell dosage produced the heaviest fruit weight of 3,020.25 grams, representing a 4.51% increase and showing a significant difference compared to the 5 g/plant eggshell dosage treatment.

Fruit Set (%)

The results of the analysis of variance on the effect of the combination of rabbit urine concentration and chicken eggshell dose on fruit set showed no significant interaction at all observation periods. Similarly, the single factors of rabbit urine concentration and chicken eggshell dose had no significant effect at all observation periods. The average fruit set influenced by rabbit urine concentration and chicken eggshell dose is presented in Table 11.

Table 11. Fruit Set Results of Eggplant Under the Combination Treatments of Rabbit Urine and Chicken Eggshell Dose

	***Fruit Set* (%)**
Rabbit urine concentraion (ml/L)	
10	71.54
20	64.69
40	58.45
80	55.63
BNT 5 %	ns
Eggshell dosage (g/plant)	
5	61.46
10	67.68
15	65.70
BNT 5%	ns

Table 11. shows the fruit set results of eggplant plants. The best treatment was 10 ml/L rabbit urine combined with 10 grams/plant eggshell, which produced the highest fruit set of 69.61%. Meanwhile, the treatment with 80 ml/L rabbit urine and 5 grams/plant eggshell resulted in the lowest fruit set, at 58.54%, indicating an increase of 18.91%.

The effect of Rabbit urine and eggshell againts eggplant growth

Rabbit urine containt a hight amount of Nitrogen around 1.34 % per liter (Rosniawaty et al., 2015). Nitrogen is used for plant growth especially in its cell division and as a major element in vegetative vigor mainly in its photosintesis process (Rasyid, 2017) but giving a higher dose of nitrogen to it can also cause poisoning, Ferrón et al., (2021) stated that nitrogen poisoning can cause week stems, delayed flowering, and excessively dark green leaves, each plants can stand different dose of nitrogen also require a different minimal dose of nitrogen (Duan et al., 2023). Afiati et al., (2021) research showed that eggplant needs around 1.0 – 2.5 grams of nitrogen/plant and around 100 – 150 kg / ha to help with it growth, Setiawan et al., (2021) also stated that the duration of applying the nitrogen need at least once every two week. Based on the data above we can see that 10 and 80 ml/l of Rabbit urine can improve eggplant growth this was cause by the nitrogen content in it that can support eggplant growth (Cholisoh et al., 2018). According to Lakitan (2019) eggplant have a rather moderate nitrogen tolerancy level around 5 g/plant or 200 kg/ha.

Eggshell have a rather high amount of calcium mainly calcium carbonate around 5 – 6 grams (Aditya et al., 2021). Calcium carbonate ($CaCO_3$) for plant growth can promote cell wall development, root strength, and preventing blossom end rot in fruiting crops (Anugrah et al., 2021). Ahmed et al., (2021) stated that too much $CaCO_3$ can cause poor fruit quality, leaf tip burn, and can increase soil pH level, applying CaCO3 needs to be properly watch if not then its not just the plant that have a problem but the soil itself too (Saldanha et al., 2021). Each plant have a different tolerant level of $CaCO_3$ eggplant need around 2.5 – 4 grams / plant this was given only when the plant reach its generative phase (Sinaga et al., 2024), beside promoting its growth it can also protect the eggplant from pest and disease, especially for its fruit Wong et al., (2023) therefore it is crucial to give it only when it reach its generative phase. Based on the data above all of the dosage that were used in this experiment showed a almost same result but the 10 grams of eggshell treatment showed the best one yet.

Combining Rabbit urine and eggshell as a biofertilizer is one of the way to cut cost and promote its effectiveness. Raw Rabbit urine have microbe such as *E. coli. Salmonella* sp. and many more that can help to kick start a fermentation process (Said et al., 2024). Fermenting can help by breaking it down to its basic form so that it can be adsorb by the plant more easily, usually the fermentation proses need a catalyst and a microbe to help it digest (Bunny et al., 2023). The microbe can break down eggshell's CaCO3 into a more suitable nutrients as Ca, the fermentation usually take around 1 – 2 weeks depending on the temperature (Tarafdar et al., 2021) for it to be completely useable. Producing a biofertilizer by fermentation needs to be done

correctly otherwise the final product can contain high level of ammonia that can act as a phytotoxic for the plants (Buulolo et al., 2022). Vassileva et al., (2021) stated that a successful fermentation for biofertilizer is based on its smell, appearance, gas production, pH change, odor, and microbial activity, biofertilizer that was based on Rabbit urine and eggshell can resulting in a product that have 4 different type of macro nutrient (N,P,K,Ca) and a few micronutrients not only it can promote plant growth but also soil health and also making it both economically viable and environmentally friendly.

CONCLUSION

The combination of rabbit urine and eggshell treatments showed no significant interaction, but the best overall result was observed in treatment K3C1 (40 ml/L + 5 g/plant), producing good vegetative and generative growth with a plant height of 61.07 cm, 27.33 leaves, flowering at 26.70 days after planting, 13.67 flowers, and fruits measuring 29.3 cm in length. Rabbit urine concentration alone had no significant effect, though treatment K3 (40 ml/L) gave the best generative results with flowering at 26.70 days, 21.48 flowers, and fruits measuring 27.9 cm in length and 50 mm in diameter. Eggshell dosage had a significant effect, with treatment C1 (5 g/plant) performing best, producing flowering at 26.76 days, 21.56 flowers, 1.7 formed fruits, and 8.1 harvested fruits. This study contributes to sustainable crop nutrition by integrating rabbit urine and eggshell powder as complementary organic fertilizers. The optimal combination (40 ml/L + 5 g/plant) improved vegetative and generative growth, offering an eco-friendly and low-cost alternative for smallholder farmers. Although the interaction was not significant, the results indicate potential nitrogen–calcium synergy that warrants further study on its physiological and agronomic implications.

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