BIOEDUSCIENCE
ISSN: 2614-1558
http://journal.uhamka.ac.id/index.php/bioeduscience

Effect of Dosage and Type Liquid Organic Fertilizer on Availability N and Cu in Soil and Growth Chilli Plant (*Capsicum annuum L.*)

Maratus Siram Solecha [1] , Purnomo Edi Sasongko [1*] and Wanti Mindari [1]

[1] Department of Agrotechnology, Faculty of Agriculture, National Development University "Veteran" East Java, Surabaya, Indonesia, 60294
* Correspondence: purnomoedis@upnjatim.ac.id

Abstract

Background: Liquid Organic Fertilizer (LOF) uses livestock manure such as chickens, goats, and cows to support the growth of Red Chillies (Capsicum annuum L.) in the form of N and Cu nutrients. This research aims to determine the type of LOF that provides the best chili production results. **Method:** This research was designed using the Completely Randomized Design (CRD) technique, which consists of two factors. The first factor is the types of animal manure fertilizer with three levels, namely chicken (K1), goat (K2), and cow (K3). The second factor is concentrations of animal manure fertilizer with three levels, namely 5 ml/L (A1), 10 ml/L (A2), and 15 ml/L (A3). Each treatment was repeated 3 times so that there were 3x3x3=27. A control was added as a comparison, which was repeated 3 times, so the total treatment was 30 experimental units. **Results:** The results showed that LOF K2A3 treatment provided the highest value for total soil Cu and Cu uptake in the roots and stems of chili plants. The LOF K1A3 treatment showed the highest value in soil N-total, and LOF K1A2 gave the highest results in N uptake in the roots of chili plants. The control treatment gave the highest results in plant height, the weight of chili fruit, and the number of chili. **Conclusion:** Chicken manure LOF treatment with a concentration of 15 ml/L provided the highest results in soil N-total, and at a concentration of 10 ml/L provided the highest results in N absorption in the roots of chili plants.

Keywords: Dossage; Nitrogen; LOF; Copper

Article history
Received: 13 Jan 2024
Accepted: 19 Apr 2025
Published: 31 Dec 2024

Publisher's Note:
BIOEDUSCIENCE stays neutral with regad to jurisdictional claims in published maps and institutional affiliations.

Citation: Solecha, M.S., Sasongko, P.E., and Mindari, W. (2024). Effect of Dosage and Type Liquid Organic Fertilizer on Availability N and Cu in Soil and Growth Chilli Plant (Capsicum annuum L.) *BIOEDUSCIENCE, 8*(3), 374-384. doi: 10.22236/jbes/14160

Introduction

Red chili (*Capsicum annuum* L.) is a commodity that can significantly contribute to economic development in Indonesia. The need for chilies continues to increase every year, along with the increase in the population of Indonesia. Increasing the yield of chili plants can be done by maintaining plants by fertilizing them using liquid organic fertilizer (LOF). Liquid organic fertilizer (LOF) comes from decomposing plant residues, animal manure, and human manure. Making LOF from chicken, goat, and cow manure requires paying attention to the quality standards set by the Minister of Agriculture Regulations so that fertilizer nutrient levels that comply with fertilizer quality standards are obtained and can have a real impact when applied to plants. These three types of livestock manure contain the nutrient Nitrogen (N), which supports plant growth. Lussy et al. (2017) stated that chicken, goat, and cow manure contain 2.79 % N, 0.5%, and 0.25%. LOF can be given by watering or spraying it on plants (Sumenda et al., 2011).

Red chili plants need the macronutrient N (Nitrogen) and the micronutrient Cu (Copper). The N element plays a role in the growth and development of cell tissue in plants (Yuniarti et al., 2019), while the Cu element plays a role in protein and carbohydrate metabolism, generative development (flowering process) (Fauzi & Sari Thesiwati, 2022). The average value of Cu nutrient content in plant tissue is six ppm (Lestari, 2009). The flowering and fruiting of red chili plants will be disrupted if they lack Cu. The Cu element is also an essential microelement for plant growth, chlorophyll formation, and disease

resistance. Therefore, organic fertilizer is believed to overcome this problem because it can improve soil's physical, chemical, and biological properties (Tammu, 2018).

Method

This experiment research was carried out from September 2020 to October 2021 at the Agroclimatology Field and Land Resources Laboratory, Faculty of Agriculture, National Development University "Veteran" East Java.

Experimental Design

This research was designed using a completely randomized design consisting of two factors. The first factor is the type of fertilizer with three levels, namely LOF of chicken manure (K1), goat (K2), and cow (KS). The second factor is concentration which is given at three levels, namely concentrations of 5 ml/L (A1), 10 ml/L (A2), and 15 ml/L (A3) were repeated 3 times. The treatments obtained were 27 trials in polybags with a diameter of 35 cm consisting of 1 seed per polybag with a soil weight of 8 kg per polybag. A total of 27 trials were then added to the comparison plants, which were treated without applying liquid organic fertilizer from livestock manure and repeated 3 times.

Research Procedures

Liquid organic fertilizer is made from 3 basic livestock manure ingredients: chicken, goat, and cow manure from chicken, goat, and chicken farms in Sawahan Hamlet, Sambirejo Village, Jogoroto District, Jombang Regency. The feed given to goats and cows comes from grass in the village field, while the chicken feed is given pellets (chicken feed). This fertilizer adds supporting ingredients: coconut water, rice washing water, EM4, and sugar cane molasses. Making LOF in this research follows the research method (Pancapalaga, 2011), starting by preparing 5 kg of livestock manure each, putting it into a large plastic barrel, then adding 5 liters of coconut water and rice washing water each, 1 liter of EM4 and 1-liter sugar cane molasses. All the ingredients entered are stirred until thoroughly mixed using wood, then closed in a plastic vat for 14 days to carry out the fermentation process. LOF livestock manure is applied twice a week after planting. Fertilizer application time is in the afternoon. Fertilizer is applied using a plant waterer (Taofik et al., 2020). Application of LOF with concentrations of 5 ml/L, 10 ml/L, and 15 ml/L is adjusted to each treatment.

Data Analysis

Data processing uses CRD (Completely Randomized Design) with analysis using the Treatment Diversity table or Analysis of Variance (ANOVA). If the analysis results show a real difference, continue with the Least Significant Difference (LSD) test at the 5% level. The LSD testing procedure uses more than three treatments, intending to test all treatment averages without a plan.

Result and Discussion

The results of the analysis of initial soil characteristics for research are presented in Table 1 as follows:

Table 1. Results of Preliminary Soil Analysis Before Treatment

Parameter	Results	Unit	Criteria (*)
pH	7.64	-	Slightly alkaline
C- organic	0.57	%	Very low
N-total	0.08	%	Very low
P- available	15.69	ppm	Currently
K- got it exchanged	0.92	cmol/kg	Tall
Cu -Total	13.36	Ppm	Normal Limits

Description: (*) Criteria sourced from (Balai Penelitian & Pertanian, 2005)

Analysis results in the land beginning show that the soil in the Mojokerto area has a soil pH classified as slightly alkaline, at 7.64. C-organic and N- total contents in the land are classified as low, respectively, 0.57% and 0.08%. The availability of P nutrients is currently at 15.69 ppm, nutrient K is also classified tall at 0.92 cmol /kg, and micronutrient Cu is classified as usual at 13.36 ppm. N-Total in soil classified as low at 0.08%. Management intensive on the soil is the reason for low C-organic levels. Loss of C- organic inside land is caused by increased decomposition processes. Organic material in layers processing (topsoil) is the ground consequence of the high-intensity utilization of land and change management (Neneng & Jubaedah, 2014). The results of this analysis show that the soil to be used for research contains nutrients that can support plant growth.

Characteristics of Animal Manure Liquid Organic Fertilizer

Organic fertilizer liquid (LOF) is essential in repairing characteristic land and providing good nutrients for plants. Organic materials will be given inland for research, preferably conducting a nutrient content test formerly for known characteristics of organic material. The LOF characteristics analyzed consist of pH, C-organic, Nitrogen (N)-total, Phosphorus (P)-total, Potassium (K)-total, and (Cu)-total.

Table 2. Results of Analysis of Chemical Characteristics of Animal Manure Liquid Organic Fertilizer

Parameter	Quality Standards (*)	LOF Chicken Manure	LOF Goat Manure	LOF Cow Manure
pH	4 – 9	4.02	4.73	4.40
C- organic (%)	Min 6	1.52	1.93	1.89
N-total (%)	3 – 6	0.08	0.10	0.12
P-total (%)	3 – 6	0.10	0.04	0.06
K-total (%)	3 – 6	0.21	0.21	0.20
Cu -total (ppm)	250 – 5000	174.40	27.19	23.95

Description: (*) Quality Standards are sourced from(Permentan No.70, 2011)

The nutrient content of the three types of LOF livestock manure has varying values; apart from the kind of animal, the influence of the food source, physical form, and age of the animal can cause changes in the nutrient content. The P-total, K-total, and Zn-total levels in LOF made from chicken manure have the highest values compared to other LOF. This is because the decomposition process is easy because chickens simultaneously excrete manure in solid and liquid form. Also, chickens' food sources come from grains, which can increase the nutrient content in their droppings (Lussy et al., 2017). The results of the LOF chemical analysis show that the use of chicken manure is thought to improve the quality of LOF, especially in fertilizer nutrients, namely P, K, and Cu levels.

Application LOF to Soil Chemical Properties

One method for overcoming the lack of organic land is using fertilizer organic liquid (LOF), which can repair physical, chemical, and biological land characteristics. LOF can also reduce the use of fertilizer inorganic and enhance results in quantity and quality. Raw material fertilizer liquid can originate from various materials customized organically to the local environment, one of them originating from animal manure. Liquid fertilizer can be applied to plants when watered or sprayed. Organic fertilizer can supply the nutrient needs of plants in a readily available form. It is hoped that the use of organic fertilizer today will help reduce the use of chemical fertilizers so that they can maintain the condition of the surrounding environment and not pollute the soil. Organic fertilizer results from the decomposition of plant or animal remains, which are transformed into organic material with the help of soil microorganisms (Syafri et al., 2017).

Yuliana et al. (2019) explained that the nutrient content in LOF could not be higher than that contained in chemical fertilizers; however, Rizqiani et al. (2007) say that the provision of LOF can increase production plants. One of the available materials used for creating a LOF

originates from animal manure: chicken manure, goat manure, and cow manure. The nutrient content of chicken manure is nitrogen (N) 1%, phosphorus (P) 0.8%, and potassium (K) 0.4%. Goat manure has N 0.7%, P 0.3%, and K 1.2%. Cow manure has N 0.4%, P 0.2%, and K 0.17% (Hartatik & Setyorini, 2011).

Making LOF requires paying attention to the fertilizer quality standards of Permentan No.70 (2011). The qualities that need to be paid attention to are several characteristics of LOF, which include scent, color, temperature, pH, macro, and micronutrient content contained in the LOF (Lussy et al., 2017). The provision of LOF made from livestock manure (chicken, goat, and cow) and the application of several fertilizer concentrations in this study aimed to examine the effectiveness of livestock manure LOF, which provides the best effect and highest yields on chili plants.

Soil pH

Soil acidity (pH) from results analysis after given treatment shows that the pH value is within the criteria neutral until slightly alkaline, which is shown in Table 3 as follows:

Table 3. Average Value Effect of LOF Type and Concentration on N-total, Cu-total, and pH in soil

Treatment	N-total soil (%)		Soil Cu-total (ppm)		Soil pH	
	1 Week	9 Week	1 Week	9 Week	1 Week	9 Week
K1A1	0.24f	0.03cd	8.24e	10.53d	7.40a	8.36e
K1A2	0.20d	0.02bc	7.59c	9.67c	7.55b	8.29cd
K1A3	0.17c	0.04d	8.94f	10.87e	7.65d	8.28c
K2A1	0.20e	0.03c	9.01fg	11.48g	7.62cd	8.21a
K2A2	0.17c	0.02b	7.95d	11.29f	7.66e	8.31d
K2A3	0.10a	0.02bc	9.88h	12.13h	7.61c	8.25b
K3A1	0.10a	0.01a	7.37b	9.08b	7.65de	8.39f
K3A2	0.12b	0.02b	7.84d	9.69c	7.65de	8.40f
K3A3	0.10a	0.02b	7.04a	8.07a	7.68e	8.30cd
Control					7.69	8.40
BNT 5%	**0.0022**	**0.0023**	**0.15**	**0.17**	**0.023**	**0.023**

Description: Different letters in the same column show different real treatment in the 5% BNT test;

Soil acidity (pH) is the chemical property of the soil that determines the soil's ability to absorb nutrients from plants. In this case, LOF application of livestock manure greatly influences soil pH. The LOF pH value of livestock manure ranges between 4.02 - 4.73, indicating the LOF nature sour (Table 2). However, soil pH in this research ranges from 7.61 – 8.31, including land neutral until slightly alkaline (Table 3). Treatment results show that the type of LOF livestock manure and concentration of fertilizer have a very real influence on soil pH at 1 week and 9 weeks. The highest soil pH at 1 week was in the K3A3 (cow manure, concentration 15 ml/L) and pH control at 7.68, while the lowest pH soil was in the K1A1 (chicken manure, concentration 5 ml/L) at 7.40.

The highest soil pH at 9 weeks was in the K3A2 (cow manure, concentration 10 ml/L), and the control was the same at 8.40. The pH of the soil given treatment with land without treatment is not far different. The lowest soil pH at 9 weeks at 8.21 was in the K2A1 (goat manure, concentration 5 ml/L). This shows that the application of LOF cow manure influenced the soil pH in this research. Compared with the initial soil pH, the overall soil pH increased after treatment, including the control that was not given any nutrients. From start to finish, soil pH is classified as alkaline: the lowest pH is 7.68, and the highest is 8.40 (Balai Penelitian Tanah, 2009).

Soil pH increases due to the application of organic materials, especially those made from livestock manure, because organic materials will decompose further and release soil

minerals in the form of basic cations (Ca, Mg, Na, K), which will cause the concentration of OH- ions to increase and make the pH will increase (Yuniarti et al., 2020). Humic acid contained in livestock manure POC is thought to influence soil pH. Humic acid has carboxyl (COOH-) and phenolic (OH-) functional groups, which can neutralize the activity of H+ (Hydrogen). Siregar & Fauzi (2017) say that the level of soil acidity is a function of H+ and OH- (Hydrogen) ions; if the concentration of H+ ions in the soil is high, the pH will decrease, whereas if the concentration of hydrogen ions in the soil is high, the pH will rise.

These results show that LOF, which was originally acidic because it contained a high concentration of H+ ions, could influence soil pH, making the soil pH slightly alkaline. This is because organic acid compounds from the decomposition of LOF can bind H+ ions so that the pH will increase. The LOF provided will carry out a further decomposition process in the soil, which requires quite a long time for the organic material mineralization process to make the organic material nutrients available to the soil and plants.

The results of soil pH analysis in this study showed that the soil pH condition after LOF application with several treatments, the soil pH ranged from 7.40 - 7.69 in 1 WAP soil conditions, while in 9week soil conditions, the soil pH value ranged from 8.21 - 8.40. According to the Soil Research Institute (2009), the soil pH value from this research is slightly alkaline. The highest soil pH value in 1-week soil was obtained from the K3A3 treatment (cow manure, concentration 15 ml/L), which was 7.68, and the lowest pH was obtained from the K1A1 treatment (chicken manure, concentration 5 ml/L), which was 7.40. At 9 weeks of soil conditions, the highest soil pH value was obtained from the K3A2 treatment (cow manure, concentration 10 ml/L), namely 8.40, while the lowest soil pH value was obtained from the K2A1 treatment (goat manure, concentration 5 ml/L) namely 8.21. This shows that administering LOF made from cow manure can provide the best results compared to chicken or goat manure. The results of this research align with the results of research conducted by Maharani et al. (2021) which states that adding cow manure can increase the pH of the soil from acid to neutral. The addition of cow manure can raise soil pH and release hydroxyl ions. This is caused by the decomposition process of organic material contained in cow manure, which produces humus, which improves the physical properties of the soil, thereby increasing the affinity of OH- ions. During the planting process, further decomposition of cow manure releases OH- ions from the adsorption complex so that the pH can increase.

N-total

The total nitrogen (N) in the soil from the analysis results obtained using the Kjeldahl method can be seen in Table 3. The results show that the average value of N-total Soil is classified as low, according to Balai Penelitian & Pertanian (2005). The effect of LOF type and fertilizer concentration on soil N-total was very significant in all treatments. In 1MST soil conditions, the highest N-total was 0.237%, which was obtained from the K1A1 (chicken manure, concentration 5 ml/L), while the lowest soil N-total was obtained from the K3A3 treatment (cow manure, concentration 15 ml/L) is 0.099%. Soil conditions without LOF (control) had an N-total of 0.087%. This shows that providing organic material in POC can supply N elements to the soil, causing N elements to become available.

The highest soil N-total in the 9week soil was 0.040% from the K1A3 treatment (chicken manure, concentration 15 ml/L), while the lowest N-total in the 9week soil was 0.012% from the K3A1 treatment (cow manure, concentration 5 ml/L). The total N-value of Soil without LOF (control) was 0.005% in 9-week soil. In soil N-total from 1 week to 9 weeks, without LOF, there was a decrease of 94%; in the K1A1 treatment, there was a decrease of 85%; in the K1A3 treatment, there was a decrease of 75%.

Chicken manure has the highest nutrient content because liquid manure (urine) is mixed with solid manure (Roidah, 2013). According to Yuniarti et al. (2019), chicken manure fertilizer has a higher N content value of 1.82% compared to other animal manure fertilizers. Apart from that, chicken manure has a high content of N, P, and K. This organic fertilizer can

improve soil drainage and aerase and activate the life of soil microorganisms, which helps increase plant growth and development. This is in line with research results showing that giving chicken manure LOF can provide the highest results compared to cow manure LOF or goat manure LOF. The total N value of the soil at the 1-week condition is classified as low; at the 9-week condition, it is classified as very low. This occurs because there is a decrease in total N levels in the soil from 1-week to 9-week soil conditions, which is because plants absorb nitrogen well. Plants usually absorb nitrogen (N) from the soil in the form of nitrate (NO3-) or ammonium (NH4+). In most agricultural soils, nitrate is the nitrogen (N) compound that plants mostly absorb. Nitrogen (N), when given in sufficient quantities, will cause lush vegetative growth and dark green leaf color. Nitrogen (N) is an inseparable part of the chlorophyll molecule (Tando, 2018).

Table 3 shows a decrease in soil N-total in the treatment types and LOF concentrations from soil conditions at 1 week to 9 weeks. LOF treatment reduces total N because the N element in the soil can be absorbed by plants quite well, and what was originally in large quantities is diminished. So, in this study, the type and concentration of LOF treatment significantly affected total N, and the provision of LOF provided N nutrients in the soil for chili plants.

Cu-total

The analysis showed that the type of LOF treatment of livestock manure and fertilizer concentration significantly influenced soil Cu-total. The average value of soil total Cu on LOF type and concentration is presented in Table 3. The effect of LOF type and fertilizer concentration on Soil total Cu significantly affected all treatments. In 1week soil conditions, the highest Cu-total value was 9.88 ppm which was obtained from the K2A3 treatment (goat manure, concentration 15 ml/L), while the lowest Soil Cu-total was obtained from the K3A3 treatment (cow manure, concentration 15 ml/L). L), which is 7.04 ppm. Soil conditions without LOF (control) had a Cu-total of 6.35 ppm. This shows that applying organic material in LOF can increase the soil's Cu-total.

The highest soil Cu-total in the 9week soil was 12.13 ppm from the K2A3 treatment (goat manure, concentration 15 ml/L), while the lowest Cu-total in the 9week soil was 8.07 ppm from the K3A3 treatment (cow manure, concentration 15 ml/L). The total Cu value of the Soil without LOF (control) was 7.67 ppm in 9-week soil. Cu is an essential element; excessive concentrations of the Cu component can cause phytotoxicity problems and limit the activity of soil organisms, thereby reducing soil function. Cu is also more strongly bound to colloids and soil organic matter than other heavy metals, reducing its mobility as free Cu (Paradelo et al., 2013). According to research, applying liquid organic fertilizer (LOF) to livestock manure can affect plant growth and the availability of nutrients in the soil. Research has found that copper (Cu), one of the nutrients that can be affected by applying LOF to livestock manure, can increase the availability of Cu in the Soil. However, you must remember that administering LOF to livestock manure must be done at the correct dose so as not to disturb the balance of nutrients.

Effect of POC Application on Plant Height, Absorb N, Absorb Cu, Number of Fruit, Fruit Weight, and Fruit Sugar Content in Chilli Plants

LOF livestock manure containing humic acid can increase nutrients and release nutrients absorbed in the soil according to plant needs so that the efficiency of LOF use can be optimal. Humic acid can increase optimal nutrient availability and extract nutrients for plants through its ability to absorb, bind, and exchange nutrients in the soil with water so that plants can form.

Plant height

The application of LOF livestock manure influences the height of chili plants. Plant height measurements were carried out once a week. Total plant height observations were carried

out for 10 weeks, from 14 to 70 days after planting. The average value of plant height can be seen in Table 4 as follows:

Table 4. Average Plant Height Chilli at 14 days – 70 days.

Treatment	14 Days	21 Days	28 Days	35 Days	42 Days	49 Days	56 Days	63 Days	70 Days
K 1A1	12.83d	19.00cd	30.50d	35.67a	43.67c	45.33c	48.83b	50.00b	51.00cd
K1A2	15.50e	21.50f	34.00g	40.00e	44.67de	47.33d	50.83c	52.67d	54.00f
K1A3	13.00d	19.50d	30.00cd	37.00b	42.50b	46.00c	49.50b	50.67b	50.67bc
K2A1	11.50c	18.67c	30.50d	38.00c	44.50d	48.00de	51.17c	51.67c	52.00e
K2A2	9.00a	16,17a	28.17a	36.67b	42.17b	45.67c	49.33b	50.17b	50.67bc
K2A3	13.00d	20.17e	31.33e	39.17de	45.33e	48.17de	51.17c	51.67c	51.83de
K3A1	10.17b	17.33b	29.17b	35.50a	41.17a	44.17a	47.67a	48.33a	48.33a
K3A2	10.00b	17.50b	29.33bc	35.50a	41.33a	45.00bc	48.83b	50.00b	50.00b
K3A3	12.83d	20.17e	32.67f	39.00d	44.17cd	49.00e	49.67b	50.33b	50.83bc
Control	9 .00	16.67	28.83	40.16	45.83	52.5	55.66	56.16	56.33
BNT 5%	0.60	0.59	0.82	0.89	0.82	1.09	0.95	0.85	0.83

Description: Numbers followed by the same letter in the column show No difference real in the 5% BNT test; tn = no real

Table 4 shows that chicken manure LOF treatment with a concentration of 10 ml/g (K1A2) provided the highest results on chilli plant height and significantly differed from the control at the age of 14-28 days after planting. Research by Sahetapy et al. (2017) stated that chicken manure has the advantage of high nitrogen and phosphorus nutrient content, where the nitrogen element functions to stimulate and increase plant growth, while the phosphorus element functions to promote root growth and accelerate flowering and ripening of seeds and fruit. Waluyo (2014) explained that the N element greatly influences leaf growth in plants in the soil. Plants like leaves, stems, and roots need the N element to stimulate vegetative growth.

Furthermore, the highest plant height was found in the control and significantly differed from all treatments at 49-70 days. Chili plants aged 14 to 28 days had an increase in plant height after LOF treatment with livestock manure; however, at the age of 49-70 days, the height of chili plants did not increase optimally. This is caused by the high soil pH (Table 3), so plants cannot absorb nutrients properly. The degree of soil acidity (pH) is essential in soil analysis because it is related to the availability of nutrients in the Soil (Siswanto, 2018). Apart from that, applying several types of LOF livestock manure and concentrated fertilizer to chili plants has been able to meet nutrient needs, especially in supporting the vegetative growth of chili plants. These results align with Pramitasari et al.'s (2016) opinion that applying fertilizer will have no effect if all the nutrients needed by plants are available as required.

Absorption N in plants

The nutrient element nitrogen (N) is one of the macronutrients needed for the growth and development of chili plants. In contrast, the nutrient P plays a role in stimulating root growth and is a constituent of plant metabolic enzymes.

Table 5. Average of the Effect of LOF Type and Concentration on Absorption N, Absorption Cu, Fruit Sugar Content, Fruit Weight and Number of Fruits in Chilli Plants

Treatment	Absorption N		Absorption Cu		Fruit Sugar Content	Weight Fruit	Amount Fruit
	mg/ plant						
	Root	Stem	Root	Stem	%	grams	
K1A1	357.56e	610.13a	4.64cd	0.07a	4.7d	27.57a	5.3b
K1A2	407.00f	974.55c	4.81cd	0.96c	4.3c	49.65bc	8.7c
K1A3	302.85c	661.30a	4.72cd	1.68de	3.7b	49.14bc	8.3c
K2A1	233.96b	1126.87d	4.53c	2.11f	3.7b	43.66b	7.7c
K2A2	316.88cd	884.69b	5.82e	1.73e	5.0d	58.82c	9.0c

K2A3	328.79d	1033.32c	7.16f	2.09f	2.7a	55.59c	8.7c
K3A1	226.85b	613.04a	2.18a	0.81b	4.7d	18.13a	3.0a
K3A2	200.18a	1520.81e	3.86b	2.09f	3.7b	61.97d	11.3d
K3A3	362.83e	810.17b	4.79cd	1.58d	2.7a	71.93d	12.7d
Control	336.37	1108.17	1.67	0.08	3.3	80.12	15.33
BNT 5%	**23.72**	**80.08**	**0.34**	**0.14**	**0.34**	**10.18**	**1.82**

Description: Numbers followed by the same letter in the same column show No difference real in the 5% BNT test; tn = no real

The results showed that applying LOF livestock manure and several concentrations significantly affected N absorption in the roots of chili plants. The highest mean value of N absorption in the origins of chili plants was in the K1A2 treatment (chicken manure, concentration 10 ml/L), 407.00 g/plant, while the lowest value was obtained from the K3A2 treatment (cow manure, concentration 10 ml /L) which is worth 200.18 g/plant. Chilli N absorption in the roots of chili plants without LOF (control) was 336.37 g/plant. There was an increase in N uptake in the roots of chili plants by 20.99% compared to the control. Application of chicken manure LOF influences N absorption in the origins of chili plants. This is related to the results of the previous analysis, where the highest soil N-total content was found in the K1A3 treatment combination (chicken manure, concentration 15 ml/L) at 9 weeks of 0.04% (Table 5).

The analysis results of giving LOF livestock manure and several concentrations significantly affected N absorption in the stems of chili plants. The highest mean value of N absorption in stem parts of chili plants was in the K3A2 treatment (cow manure, concentration 10 ml/L), namely 1520.81g/plant, while the lowest value was obtained from the K3A1 treatment (cow manure, concentration 5 ml/ L) which is worth 613.04 g/plant. N absorption in the roots of chili plants without LOF (control) was 1108.17 g/plant. There was an increase in N absorption in chili plant stems by 037.23% compared to the control. The application of cow manure will increase the pH, Ca, and Mg content, significantly increase the availability of nitrogen and phosphorus in the soil, and increase the diversity of microorganisms in the Soil (Ramadhani et al., 2020).

Factors influencing nitrogen absorption are respiration, soil compaction, nutrient concentration, root density and distribution, soil pH, and plant absorption capacity. Nitrogen fertilizer can stimulate root growth and increase the ability of roots to absorb nutrients, especially nitrogen, which plants need for vegetative growth, including leaf growth (Fajarditta et al., 2012). Nitrogen is absorbed by roots, apart from nitrate and ammonium ions, but can also occur in the form of low-weight organic compounds such as amino acids. Absorption of nitrogen in the nitrate form usually requires a K cation pair. Therefore, the nitrate form can increase K absorption compared to nitrogen in the ammonium form. Nitrogen is not only absorbed through mass flow but also through diffusion. If the water content around plant roots is significant in mass flow and the diffusion absorption mechanism, the concentration of nutrients in groundwater plays an important role. This differs from the nutrients phosphorus and potassium plants generally absorb through diffusion. Another way of absorbing nutrients from plant roots is by interception, namely through direct contact with the roots. This method is effective in conditions of dense root development, thereby helping nutrient absorption (Masturi, 2015).

Absorption Cu in plants

The Cu nutrient is one of the micronutrients that chili plants need in plant growth and development, whereas zinc plays a role in plants as a regulator of many types of enzymes (Suci, 2000). The results of the analysis are presented in Table 5. It is known that the application of LOF livestock manure and fertilizer concentration has a significant effect on Cu absorption in plants. Cu absorption in plant roots, which showed the highest value, was obtained from the K2A3 treatment (goat manure, concentration 15 ml/L), namely 6.93

mg/plant, while the lowest value was obtained from the K3A1 treatment (cow manure, concentration 5 ml/L) which is worth 2.15 mg/plant. Cu absorption in the roots of chili plants without LOF (control) was 1.67 mg/plant. There was an increase in N absorption in chili plant stems by 314.97% compared to the control.

Cu absorption in plant stems, which showed the highest value, was obtained from treatment, namely K2A1 (goat manure, concentration 5 ml/L) 2.11 mg/plant. In contrast, the lowest value was obtained from K1A1 treatment (chicken manure, concentration 5 ml/L), which is worth 0.07 mg/plant. Cu absorption in chili plant stems without LOF (control) was 0.08 mg/plant. Application of goat manure LOF influences Cu absorption in the roots and stems of chili plants. This is related to the results of the previous analysis where the highest Cu-total soil content was found in the K2A3 treatment combination (goat manure, concentration 15 ml/L) at 1 week and 9 weeks, respectively, at 9.88 ppm and 12.13 ppm (Table 5).

Cu is a metal element that is important for plant growth and development. The Cu content in liquid organic fertilizer can support the flowering process. The flowering and fruiting of red chili plants will be disrupted if the plants lack Cu (Tammu, 2018). The Cu nutrient was absorbed by plants more in the roots of the plants than in the stems of the plants in this study. Cu has a vital role in plants in photosynthesis and respiration, fruit ripening processes by the hormone ethylene, and reactive oxygen metabolism. Cu deficiency causes symptoms of chlorosis, necrosis, stunting, discoloration of leaves, and inhibition of root growth (Safitri et al., 2017). The concentration did not show symptoms of excess or deficiency of Cu in plants. This means that the concentration is sufficient for the plant's needs. Cu concentrations that exceed the limit can be toxic to plants. Plant tissue's average Cu nutrient content is six ppm (Neoriky et al., 2017). High Cu concentrations can reduce N absorption and plant accumulation (Hippler et al., 2018).

Cu absorption in plants occurs because plant biomass can adsorb metal ions due to the protein and cellulose content. The groups that play a role in proteins are amino acids, sulfhydryl, and hydroxyl in cellulose. These two groups can act as ion exchangers and as adsorbents for metals. Proteins are composed of several amino acids, which, when dissolved in water, carboxylate groups (COOH) will release H+ ions, and amine groups (NH2) will accept H+ ions to form NH3+. This ion is very reactive when binding with metal ions, while the carbohydrate, namely cellulose, has a functional group, namely the hydroxyl group (-OH). This group can interact with other groups, namely -O, -N, and -S, to form hydrogen or coordination bonds. The bond between metal ions and cellulose can occur through hydrogen bonds (Elawati et al., 2018).

The factor that influences Cu uptake in plants is pH. According to Suhud (2012), pH 4 is the most effective in absorbing Cu metal in water spinach. However, the kale plants showed tissue damage in the third week due to Cu poisoning. The soil pH in this study was classified as slightly alkaline, so Cu absorption did not cause plant poisoning. Chelating agents also influence Cu absorption in the form of organic substances. Phytochelatin in plants forms complexes with heavy metals and functions as heavy metal binders.

Number of fruit, fruit weight, and sugar content of chilies

The analysis showed that the combination treatment of livestock manure LOF and fertilizer concentration significantly affected fruit sugar content, weight, and number of fruit on chili plants. The chili fruit sugar content parameter with the highest value was obtained from the K2A2 treatment (goat manure, concentration 10 ml/L), which was 5%. In contrast, the lowest value was obtained from the K2A3 treatment (goat manure, concentration 15 ml/L), which was 2.67%. The sugar content of chili fruit in plants without LOF (control) was 3.3%. There was an increase in sugar content in chili fruit in the K2A2 treatment by 51.51% compared to the control.

Regarding fruit weight parameters, the highest value was obtained from the K3A3 treatment (cow manure, concentration 15 ml/L), namely 71.93 grams. In contrast, the lowest

value was obtained from the K3A1 treatment (cow manure, concentration 5 ml/L), namely 18.13 grams. The weight of chili fruit on plants without LOF (control) was 80.12 grams. This shows that the weight of chili fruit from plants without LOF is greater when compared to the weight of chili fruit from plants given LOF from livestock manure.

Conclusion

The results of this research are Chicken manure LOF treatment with a concentration of 15 ml/L was able to provide the highest results in soil N-total, and at a concentration of 10 ml/L provided the highest results in N absorption in the roots of chili plants. Goat manure LOF treatment with a concentration of 15 ml/L was able to provide the highest results in total soil Cu, Cu absorption in the roots and stems of chili plants, and at a concentration of 10 ml/L provided the highest results in increasing the sugar content of chili fruit. Without treatment (control), the highest results were obtained for chili plant heights aged 49-70 days after planting, the weight of chili fruit, and the number of chili fruit.

Declaration statement

The authors report no potential conflict of interest.

References

Balai Penelitian Tanah. (2009). *Petunjuk Teknis Edisi 2 Analisis Kimia Tanah, Tanaman, Air dan Pupuk*, 4(1).

Balai Penelitian, & Pertanian, B. P. dan P. P. D. (2005). *Petunjuk Teknis Analisis Kimia Tanah, Tanaman, Air, dan Pupuk.* 129–144. https://doi.org/10.30965/9783657766277_011

Hafizah, N., & Mukarramah, R. (2017). Aplikasi Pupuk Kandang Kotoran Sapi pada Pertumbuhan. *Ziraa'Ah*, *42*(1), 1–7. http://dx.doi.org/10.31602/zmip.v42i1.636

Hartatik, W., & Setyorini, D. (2011). *Pemanfaatan Pupuk Organik untuk Meningkatkan Kesuburan Tanah dan Kualitas Tanaman*. 571–582.

Hermanto, N.K.T. Dharmayani, R. Kurnianingsih, & S.R. Kamali. (2013). Pengaruh asam humat sebagai Pelengkap Pupuk terhadap Ketersediaan dan Pengambilan Nutrien pada Tanaman Jagung di Lahan Kering kec. Bayan-NTB. *Ilmu Pertanian*, *16*(2), 28–41. https://doi.org/10.1016/s0166-2481(08)70257-5

Jamilah, Fauzi, P., & Sari Thesiwati, A. (2022). Peranan Pupuk Cair Asal Inokulan Trichoderma sp. pada Budidaya Tanaman Kentang Merah Semi Organik. *Jurnal Solum, 19*(1). https://doi.org/10.25077/jsolum.19.1.34-42.2022

Lussy, N. D., Walunguru, L., & Hambamarak, H. K. (2017). Karakteristik Kimia Pupuk Organik Cair Cari Tiga Jenis Kotoran Hewan dan Kombinasinya. *Politeknik Pertanian Negeri Kupang*, *22*(1), 452–463. http://dx.doi.org/10.35726/jp.v22i1.239

Maharani, Iradhatullah Rahim, & Harsani. (2021). Kadar Cu dan Pb pada Tanah Masam yang Dibioremediasi Menggunakan Jamur Mikoriza dan Pupuk Kandang Sapi. In *Seminar Nasional dalam Rangka* .

Neneng, N. L., & Jubaedah. (2014). Teknologi peningkatan cadangan karbon lahan kering dan potensinya pada skala nasional. *Konservasi Tanah Menghadapu Perubahan Iklim*, *1989*, 53–81.

Pancapalaga, W. (2011). Pengaruh rasio penggunaan limbah ternak dan hijauan terhadap kualitas pupuk cair. *Gamma*, *7*(1), 61–68.

Paradelo, M., Moldrup, P., Arthur, E., Naveed, M., Holmstrup, M., López-Periago, J. E., & de Jonge, L. W. (2013). Effects of Past Copper Contamination and Soil Structure on Copper Leaching From Soil. *Journal of Environmental Quality*, *42*(6), 1852–1862. https://doi.org/10.2134/jeq2013.05.0209

Permentan No.70. (2011). Peraturan Menteri Pertanian Nomor 70/Peraturan Menteri Pertanian Republik Indonesia/SR.140/10/2011 Tentang Pupuk Organik, Pupuk Hayati Dan Pembenah Tanah. *Permentan*, 16.

Pramitasari, H. E., Wardiyati, T., & Nawawi, M. (2016). Pengaruh Dosis Pupuk Nitrogen dan Tingkat Kepadatan Tanaman terhadap Pertumbuhan dan Hasil Tanaman Kailan (*Brassica oleraceae* L.). *Jurnal Produksi Tanaman*, *4*(1), 49–56. https://doi.org/10.21176/protan.v4i1.259

Ramadhani, W. S., Handayanto, E., Nuraini, Y., & Rahmat, A. (2020). Aplikasi Limbah Cair Nanas dan Kompos Kotoran Sapi Meningkatkan Populasi Mikroorganisme Pelarut Fosfat di Ultisol, Lampung Tengah. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering)*, *9*(2), 78. https://doi.org/10.23960/jtep-l.v9i2.78-84

Rizqiani, N. F., Ambarwati, E., & Nasih Widya Yuwono. (2007). Pengaruh Dosis dan Frekuensi Pemberian Pupuk Organik Cair terhadap Pertumbuhan dan Hasil Buncis (*Phaseolus vulgaris* L.) Dataran Rendah. *Jurnal Ilmu Tanah dan Lingkungan*, *7*(1), 43–53. https://doi.org/10.22146/ipas.59920

Roidah, I. S. (2013). Manfaat Penggunaan Pupuk Organik untuk Kesuburan Tanah. *Jurnal Universitas Tulungagung BONOROWO*, *1*(1), 31–42. https://doi.org/10.36563/bonorowo.v1i1.5

Sahetapy, M. M., Pongoh, J., & Tilaar, W. (2017). Analisis Pengaruh Beberapa Dosis Pupuk Bokashi Kotoran Ayam terhadap Pertumbuhan dan Produksi Tiga Varietas Tomat (*Lycopersicum esculentum* MIIL.) di Desa Airmadidi. *Agri-Sosioekonomi*, *13*(2A), 71. https://doi.org/10.35791/agrsosek.13.2a.2017.16607

Siregar, P., & Fauzi, S. (2017). Pengaruh Pemberian Beberapa Sumber Bahan Organik dan Masa Inkubasi terhadap Beberapa Aspek Kimia Kesuburan Tanah Ultisol. *Jurnal Agroekoteknologi Universitas Sumatera Utara*, *5*(2), 256–264. https://doi.org/10.32734/jaet.v5i2.15383

Suci Handayani. (2000). *Ketersediaan Seng (Zn) dalam Tanah Dan Faktor-Faktor yang Berperan*.

Syafri, R., Chairil, -, & Simamora, D. (1930). Analisa Unsur Hara Makro Pupuk Organik Cair (Poc) dari Limbah Industri Keripik Nenas dan Nangka Desa Kualu Nenas Dengan Penambahan Urin Sapi dan EM4. *Photon: Journal of Natural Sciences and Technology, 8*(01), 99-104. https://doi.org/10.37859/jp.v8i01.539

Tando, E. (2018). Upaya Efisiensi dan Peningkatan Ketersediaan Nitrogen dalam Tanah serta Serapan Nitrogen pada Tanaman Padi Sawah *(Oryza sativa L.)*, *Buana Sains, 18*(2), 171. http://dx.doi.org/10.33366/bs.v18i2.1190

Taofik, A., Sofiya, H., Cahyaningtyas, A., & Frasetya, B. (2020). Pemanfaatan Pupuk Organik Cair Paitan (*Tithonia diversifolia*) pada Berbagai Dosis dan Ragam Aplikasinya terhadap Pertumbuhan Kailan *(Brassica oleracea Var. Acephala)*. *Jurnal Agroteknologi, 11*(1), 25–32. http://dx.doi.org/10.24014/ja.v11i1.7802

Yuliana, A. I., Ami, M. S., Kh, U., & Hasbullah, A. W. (2019). Respon Tanaman Jagung Manis (*Zea mays saccharata Sturt* L .) terhadap Aplikasi Pupuk Organik Cair Limbah Kambing. *Agrosaintifika: Jurnal Ilmu-Ilmu Pertanian, 1*(2), 2003–2006. https://doi.org/10.32764/agrosaintifika.v1i2.354

Yuniarti, A., Damayani, M., & Nur, D. M. (2019). Efek pupuk organik dan pupuk n,p,k terhadap c-organik, n-total, c/n, serapan n, serta hasil padi hitam (Oryza sativa L. indica) pada inceptisols. *Jurnal Pertanian Presisi (Journal of Precision Agriculture)*, *3*(2), 90–105. https://doi.org/10.35760/jpp.2019.v3i2.2205

Yuniarti, A., Solihin, E., & Arief Putri, A. T. (2020). Aplikasi pupuk organik dan N, P, K terhadap pH tanah, P-tersedia, serapan P, dan hasil padi hitam (*Oryza sativa L.*) pada inceptisol. *Kultivasi*, *19*(1), 1040. https://doi.org/10.24198/kultivasi.v19i1.24563