

# Effectiveness of Chicken Manure and Foliar Fertilizer in Decreasing Inorganic Fertilizer Use for Cayenne Pepper (*Capsicum frutescens* L.) Cultivation in Dryland

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**Abstract:** The use of inorganic fertilizers in high doses for chili pepper (*Capsicum frutescens* L.) cultivation can negatively impact plant productivity over time. This study aimed to evaluate the effectiveness of chicken manure (CM) and foliar fertilizer (FF) in reducing the reliance on inorganic fertilizers for chili pepper plants grown in dryland conditions. The experiment was conducted in Gumantar Village, North Lombok Regency, from March to August 2023. As the control, an inorganic fertilizer treatment with NPK (16-16-16) at a dose of 1,200 kg/ha was used. The tested treatments included 85% NPK + CM, 70% NPK + CM, 55% NPK + CM, 85% NPK + CM + FF, 70% NPK + CM + FF, and 55% NPK + CM + FF. The dose of chicken manure applied was 20 tons/ha. These treatments were arranged using a randomized block design with three replications. The results indicated that CM, with or without FF, could increase the percentage of flowers that developed into fruits. There were no significant differences in the growth and yield of chili plants among the various treatments, suggesting that CM, with or without FF, could effectively replace up to 45% of the inorganic fertilizers used. This finding indicates that the dependence on inorganic fertilizers in chili pepper cultivation in drylands can be gradually reduced by incorporating organic and foliar fertilizers.

**Keywords:** Cayenne pepper; Flowers; Fruit; Organic matter; Soil health

## Introduction

Dry land has several problems such as limited water resources and low soil fertility (Moreno-Jiménez et al., 2019). The characteristic of dry land is that the water requirement is completely dependent on rainwater (Kipkemoi et al., 2021) which is generally very little, even less than 500 mm per year (Currier & Sala, 2022). The level of soil fertility in dry land, especially sandy dry land in North Lombok, is very low with an average organic matter content of less than 0.1%. (Jaya, 2021) which causes the cation exchange capacity (CEC) to be low (Solly et al., 2020). Soil with low organic matter content and CEC value makes it difficult for plants to absorb nutrients (Mautuka et al., 2022). As a result, fertilization efficiency is also very low if not done properly. With such dry land conditions, the plants that are cultivated should be plants that are needed in large

quantities and have high economic value so that they can improve the welfare of farmers.

One of the plants that has high economic value and is prospective to be cultivated in dry land is cayenne pepper (*Capsicum frutescens* L.), - (Prabowo et al., 2018). This prospect cannot be separated from the fact that cayenne pepper is one of the horticultural commodities consumed by almost all Indonesian people (Jaya et al., 2021). Consumption of cayenne pepper in 2022 reached 569.65 thousand tons/year, this number increased by 7.86% or 41.51 thousand tons from consumption in 2021, which was 528.14 thousand tons/year (Santika, 2023). This increase in consumption indicates that cayenne pepper production needs to be continuously increased. To increase production or at least achieve the potential production of cayenne pepper, cultivation needs to be carried out intensively in addition to improving soil fertility levels, especially in dry land in North Lombok which has such low fertility levels. One way to increase soil fertility is by fertilizing, either using inorganic or

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organic fertilizers. In general, chili plants require a high dose of inorganic fertilizer, especially nitrogen (N). In the dry land of North Lombok, NPK compound fertilizer (15-15-15) is used with a dose of 1,200 kg/ha, or around 180 kg N/ha. However, this N dose is still lower than the optimum dose of chili plants grown in China, which is 258.75 kg N/ha or equivalent to 562.5 kg Urea/ha (Zhang et al., 2024).

Fertilization can be done through the soil or through the leaves of the target plant (Niu et al., 2021). On land with low fertility levels, the provision of inorganic fertilizers in large quantities is continuously carried out to obtain high yields. Huang et al. (2019) stated that the use of inorganic fertilizers in large quantities and given continuously will have a negative impact on the physical properties of the soil, namely causing the soil structure to become hard so that it is difficult to cultivate the soil, damage the chemical properties of the soil which can cause low soil fertility and low CEC and have an impact on the biological properties of the soil which will later cause a reduction, or even the loss of soil microorganisms that are useful for plants (Geisseler & Scow, 2014).

One of the activities to improve the physical, chemical and biological properties of the soil that can be done is through good soil processing practices and the addition of organic materials (Lal, 2015; Maticic et al., 2024). Improving the physical properties of the soil will increase the soil's ability to store water in the pores and adsorb nutrients, providing aeration to facilitate respiration and penetration of plant roots (Shahane & Shivay, 2021). The addition of organic matter can increase soil fertility (Solly et al., 2020), which at the appropriate pH increases the availability of cations which will then increase the efficiency of fertilization (Mautuka et al., 2022; Moru, 2021). Soil biology improvement using organic matter can encourage soil microbial life (Amor et al., 2017) and increase the activity of microorganisms in the soil (Antonius et al., 2018).

Among the organic materials that can be used to improve land quality is manure. Chicken manure is one of the manures used by farmers and has the highest content of N, P, and K elements compared to other manures (Sari et al., 2016), namely N, P, K in chicken manure respectively 1%, 0.8%, and 0.4% while the content of N, P, and K in cow manure is 0.4% N, 0.02% P, 0.10% K and goat manure is 0.6% N, 0.3% P, and 0.17% K (Amir et al., 2017).

To increase the efficiency of fertilization, fertilizer is not only applied through the soil but also through the leaves. Fertilization through the leaves is more effective because the fertilizer is applied in the form of a solution that can be absorbed directly by the plant (Ducatti & Tironi, 2024; Sulitio et al., 2018) and can be used immediately because the photosynthesis process takes

place in the leaves (Fageria et al., 2009). Nutrients provided through leaves are basically almost entirely acceptable and used by plants, thus increasing the efficiency of providing nutrients to plants and reducing negative impacts on the environment (Otalora et al., 2018). The results of this study indicate that the provision of inorganic fertilizers through leaves has the potential to reduce the provision of inorganic fertilizers through the soil which is then expected to reduce the negative impacts of inorganic fertilizers on the physical, chemical, and biological properties of the soil.

One of the foliar fertilizers that contains high nutrients is Growmore foliar fertilizer with a composition of 10% N, 55% P, 10% K. High P content is very important for vegetable and fruit plants because it plays an important role in metabolic processes, especially photosynthesis, respiration, energy transfer, biosynthesis, macromolecules, and signal transduction, and has the potential to increase plant growth and productivity (Bouras et al., 2024). Fulfillment of P nutrients can increase the development of a strong root system, plant growth, and earlier flowering (Sobczak et al., 2020). Conversely, P deficiency in plants can inhibit shoot and root growth, reduce leaf blade area, and reduce plant weight. This study aims to study the effectiveness of using manure and foliar fertilizer in reducing the use of inorganic fertilizers in chili cultivation in dry land.

## Method

### *Location and Experimental Design*

The research was conducted by conducting experiments in Amor-Amor Hamlet, Gumantar Village, Kayangan District, North Lombok Regency - from March to August 2023. The experiment was conducted using a Randomized Block Design (RBD) with seven treatments: 100% NPK (A), 85% NPK + chicken manure (B), 70% NPK + chicken manure (C), 55% NPK + chicken manure (D), 85% NPK + chicken manure + leaf fertilizer (E), 70% NPK + chicken manure + leaf fertilizer (F), and 55% NPK + chicken manure + leaf fertilizer (G). Each treatment was repeated three times to obtain 21 experimental units. The 100% NPK treatment was the application of Pak Tani 16-16-16 NPK fertilizer with a dose of 1,200 kg/ha, chicken manure equivalent to 20 tons/ha, and Growmore leaf fertilizer with a concentration of 2 g/liter.

### *Implementation of Experiments and Plant Management*

Chili seeds of Dewata 43 F1 variety are sown first before the transplanting process is carried out. The planting medium used for the nursery is a mixture of soil and manure with a ratio of 3:1 which is placed in a seedling tray and planted with seeds to a depth of 1 cm,

and covered with dark plastic. Furthermore, the seedling tray is placed in a place shaded with paranet (simple greenhouse). Then care is taken until the cayenne pepper seedlings have four leaves and are ready to be transplanted to the land. The land is cleared of weeds and remnants of previous crops and is plowed well and leveled. Beds measuring 7 m×1 m and 20 cm high, made into 21 plots with a distance between beds of 50 cm.

Basic fertilization was carried out before transplanting by burying NPK fertilizer into the soil with a standard dose of NPK 700 kg/ha adjusted to the treatment, namely, A (490 g/plot), B and E (416.5 g/plot), C and F (343 g/plot), D and G (269.5 g/plot and chicken manure with a dose of 20 tons/ha or equivalent to 14 kg/plot with the following treatments, B, C, D, E, F and G. The chicken manure used was chicken manure with the Gotama trademark with a pH-H<sub>2</sub>O of 7.6, water content of 31.35%, organic C 29.00%, total N 1.74%, C/N ratio 16.72, P<sub>2</sub>O<sub>5</sub> 4.44%, K<sub>2</sub>O 2.58%, Mg 1169.40 ppm, B 182.38 ppm, and Ca 3.87%.

After applying the base fertilizer and chicken manure, the beds are covered with plastic mulch in which holes are made as planting places with a diameter of 10 cm and a distance between holes of 60 cm in rows and 50 cm between rows, so that there are 22 holes per plot. After three days of mulch installation, one chili seedling was planted in each planting hole. Then, the sample plants were determined using the systematic random sampling method in a zigzag manner, namely - Sample plants were selected five times apart from the first determined plants, so that there were three sample plants in each treatment plot.

Irrigation was carried out once every five days during the experiment using well water by flowing water on the experimental land until it was inundated, namely up to a height of 10-15 cm or covering half of the height of the experimental plot. The first watering was carried out when transplanting and subsequent watering was carried out every five days. Weeding was also carried out in the plant holes and on the edges of the beds where there were weeds.

Follow-up fertilization is carried out since the cayenne pepper plants are two weeks after planting (MST) until before the first harvest and is carried out every two weeks. The fertilizer used is Pak Tani's NPK (16-16-16) fertilizer solution with a concentration of 20 g/liter of water. Each plant is watered according to the treatment, namely, A: 160 ml/plant, B: 136 ml/plant, C: 114 ml/plant, D: 91 ml/plant, E: 136 ml/plant, F: 114 ml/plant, and G: 91 ml/plant.

The foliar fertilizer used was Growmore foliar fertilizer (10-55-10) which was applied at a concentration of 2 g/liter until the plants were 21 days after planting (DAP). After the plants were more than 21 DAP, foliar

fertilizer was applied at a concentration of 3 g/liter with an interval of once every two weeks until before the fifth harvest. Each application of foliar fertilizer was calibrated so that the plants received sufficient fertilizer. After calibration, the application of foliar fertilizer at 7 DAP was 2 ml/plant, 21 DAP 6 ml/plant, 35 DAP 13 ml/plant, 49 DAP 27 ml/plant, 63 DAP 30 ml/plant, 77 DAP 32 ml/plant, 81 DAP 34 ml/plant.

Thrips pests that attack plants are overcome with pesticides with the active ingredient abamectin, which is applied at intervals of five days with a concentration of 1 ml / l during seeding and 2 ml / l after transplanting. Fungicides with the active ingredients copper sulfate pentahydrate, sulfuric acid and copper hydroxide pentahydrate are used to control diseases caused by fungi and bacteria. Chili peppers are harvested five times with a one-week interval. The first harvest is carried out at 82 days after planting (DAP). Chili plants are harvested with the criteria of chili fruit that is already red or 90% red. Harvesting is done in the morning by picking the fruit including the stalk.

#### *Observation parameters and data analysis*

When the plants were 60 HST old, C-organic, N-total, P-available, K-exchangeable, *Trichoderma* sp fungi and N-total in the leaves were analyzed. At this time, plant height, main stem diameter, and number of productive branches were also observed. The parameters of the percentage of flowers becoming fruit were observed from the beginning of the plant bearing fruit until the third harvest, as well as the number of fruits per plant, the weight of fruit per plant, and the weight of fruit per plot, which were each carried out during the first harvest to the fifth harvest. The observation data were analyzed using analysis of variance (ANOVA) at a significance level of 5% and where further testing was necessary using Duncan's Multiple Range Test (DMRT) at a level of 5%.

## **Results and Discussion**

#### *Chemical Properties of Soil Before Experiment*

The factor that plays an important role in the growth and yield of chili plants is soil. The characteristics of the initial soil chemical properties at the experimental location are presented in Table 1.

**Table 1.** Characteristics of Initial Soil Chemical Properties at the Experimental Location of Gumantar Village, Kayangan District, North Lombok Regency

Parameter	Unit	Mark	Dignity
pH		6.9	Neutral
C-organic	%	1.19	Low
N-total	%	0.63	Low
P-available	ppm	37.73	Currently

K-total	Meq %	0.77	Tall
KTK	Meq %	9.99	Low

Source: Soil Chemistry Laboratory, University of Mataram

The soil characteristic data in Table 1 shows that the soil conditions in the experimental field have a low level of fertility. This is indicated by, among others, the low C-organic content, the low N-total content, and the CEC which also has a low level. The low C-organic content indirectly indicates the low content of organic matter in the soil because soil organic matter is one of the parameters that determines the level of soil fertility (Gerke, 2022). Soil organic C status can be influenced by various factors such as microbial types, rainfall, temperature, organic matter input from aboveground biomass, and soil processing activities (Angst et al., 2021). Low N (nitrogen) in the soil can be caused by leaching and evaporation, so the possibility of absorption by plants is very small. The soil texture at the experimental location is sandy loam so that the potential for leaching and evaporation of nutrients is quite high, so that the N content in the soil is relatively low. Lack of N in plants can cause plants to be pale green or yellow (chlorosis) due to low chlorophyll in the leaves (de Bang et al., 2021).

The high or low KTK greatly affects the soil's ability to absorb soil nutrients and minerals (Solly et al., 2020). Low levels of soil CEC can be influenced by the proportion of clay content, the amount of organic matter, and the C-organic content in the soil (Mishra et al., 2019). The CEC value is in line with the C-organic content in the soil as seen in Table 1. The acidity level (pH) of the

soil at the experimental location has a neutral value. For tropical areas such as Indonesia, the pH of the soil suitable for cultivating cayenne pepper plants is between 6.0 and 7.0 (Ziaulhaq & Amalia, 2022), and there are also those who report that the ideal pH is at 5.5 to 6.0 (Akinbile & Yusoff, 2011). Then, the available P is classified as moderate, and the total K content is classified as high. The high content of P and K compared to the N content in the soil is likely due to the presence of mineral rocks containing high P and K or because the experimental location is very intensively used for planting chili and tomato plants. There is a possibility of quite high residues of P and K as a result of the use of high doses of NPK fertilizer for the two plants mentioned earlier.

The results of the analysis of variance on all parameters showed that the treatment did not affect almost all observation parameters except the percentage of flowers becoming fruit. Meanwhile, the block factor affected almost all observed parameters except the percentage of flowers becoming fruit and soil P-available. The existence of several parameters that were significantly affected by the block indicated that there was variation in the plant growth environment in the experimental environment.

*Effect of Treatment on Soil Chemical Properties, Total N in Leaves and Trichoderma sp. Fungus*

The results of the analysis of variance showed that the treatment had no effect on total N, organic C, available P, exchangeable K, total N in leaves and the number of Trichoderma sp. fungi (Table 2).

**Table 2.** Mean of total N (%), organic C (%), available P (%), and exchangeable K (Meq%) after 60 DAP at the Experimental Site.

Treatment	N-total (%)	C-organic (%)	P-available (ppm)	K-exchange (Meq.%)
A (100% NPK)	0.08	1.29	322.09	2.69
B (85% NPK + PKA)	0.08	1.47	348.71	2.37
C (70% NPK + PKA)	0.06	1.39	322.34	1.87
D (55% NPK + PKA)	0.08	1.28	346.29	1.91
E (85% NPK + PKA + PD)	0.07	1.38	315.53	2.02
F (70% NPK + PKA + PD)	0.07	1.21	317.53	1.88
G (55% NPK + PKA + PD)	0.10	1.44	380.74	2.60

Description: PKA = Chicken Manure, PD = Leaf Fertilizer

From Table 2, it can be seen that the total N value of the soil ranged between 0.06% and 0.10%, with the highest value in treatment G (55% NPK + chicken manure + leaf fertilizer) which was not significantly different from the value in the control treatment A (100% NPK). The application of chicken manure which is claimed to have an N content of 1.74% was unable to increase the N content in the soil after 60 HST. This is thought to be because the N content in the soil can

decrease due to the absorption of N by plants in the metabolic process (Patti, 2018; Rahmayanti et al., 2021). The decrease in N content in the soil can also be caused by evaporation and leaching (Budi et al., 2023). Bako et al. (2023), stated that soil with low rainfall or hot temperatures can cause evaporation (volatilization) of nitrogen in the form of ammonia (NH<sub>3</sub>). This leaching is thought to occur because the process of watering the plants is carried out by flooding the experimental

location. Table 2 also shows the N value given by chicken manure with a reduction in NPK fertilizer up to 45%, the same value was obtained and even in treatment G (55% NPK + chicken manure + leaf fertilizer) a higher value was obtained. This is because chicken manure can improve soil structure so that it can withstand the loss of nutrients in the soil (Cayci et al., 2017).

The content of C-organic in the soil is basically influenced by the activity of microorganisms in breaking down organic matter in the soil (Sianipar et al., 2020). Soil C-organic after 60 HST has a moderate value with an average value of all treatments of 1.35% or it can be said to have increased by 13.91% when compared to the results of the initial soil C-organic value, as shown in Table 1. In treatments B, C, E, and G, there was an increase in C-organic content that exceeded the content in treatment A, although it was not significantly different.

The value of soil available P after 60 HST increased several times compared to the initial available P analysis value. This is possible because available P is not widely used by plants (Sahu et al., 2018). Application of chicken manure with or without leaf fertilizer can increase the value of available P which was previously classified as moderate to very high. The values obtained in each treatment have insignificant results, but in Table 2, the highest available P value was produced in treatment G

(55% NPK + chicken manure + leaf fertilizer). The high available P in the soil is thought to be due to the provision of P through the leaves so that the nutrients available in the leaves are sufficient for plants so that P in the soil is not widely used. This is because leaf fertilizer is more easily and quickly absorbed by plants compared to fertilizer given through the soil (Vallepy et al., 2024). This high available P content can also be increased due to the addition of 16% P nutrients from NPK fertilizer, and 4.44% P content in chicken manure.

The function of K nutrients in plant growth is its influence on the efficiency of water use, one example of which is in the process of opening and closing leaf pores and stomata (Romadhon & Bambang, 2021). Exchangeable K (Table 2) has a value of 1.87% to 2.69% or an average of 2.19% which is classified as high. The highest K value was found in treatment A (100% NPK), because the amount of K content from the fertilizer was 16%. Although the 100% NPK treatment gave the highest value (Table 2), the values obtained from each treatment were not significantly different. This indicates that the reduction in NPK fertilizer by up to 45% can be covered by the addition of chicken manure, either with or without leaf fertilizer.

The results of the analysis of variance showed that the treatment had no significant effect on the total N in the leaves and the number of *Trichoderma* sp. fungi.

**Table 3.** Average N-total in Leaves (%) and *Trichoderma* sp. Fungus (CFU/g)

Treatment	N-total on Leaves (%)	Mold <i>Trichodermasp.</i> (CFU/g)
A (100% NPK)	1.43	5850
B (85% NPK + PKA)	1.31	7650
C (70% NPK + PKA)	1.35	7500
D (55% NPK + PKA)	1.46	11650
E (85% NPK + PKA + PD)	1.39	6350
F (70% NPK + PKA + PD)	1.24	6350
G (55% NPK + PKA + PD)	1.36	4000

Description: PKA = Chicken Manure, PD = Leaf Fertilizer

Table 3 shows that the total N in the leaves of each treatment was not significantly different (non-significant). The total N in the leaves of each treatment had a value ranging from 1.31% to 1.46%, which is relatively low. This is because the content of N nutrients is influenced by environmental conditions (Kusuma & Kastalani, 2020). According to Naibaho (2019), nutrients such as nitrogen are volatile compounds. In addition, Venezuela (2024) stated that the availability of N in leaves is influenced by the availability of N in the soil. Based on the data in Table 2, the soil N value is relatively low, ranging from 0.06% to 0.10%, but when viewed in Table 3, the highest N value in the leaves was obtained from the 55% NPK + chicken manure treatment. This means that although the N content in the NPK fertilizer

and leaf fertilizer used is quite high, namely 16% and 10%, the low N in the leaves is thought to be due to evaporation. These values (Table 3) show that reducing NPK fertilizer by up to 45% with the addition of chicken manure can bind N in the soil (Walida et al., 2022) so that it can be utilized by plants.

The number of *Trichoderma* sp. fungi in almost all treatments that had been given chicken manure, or chicken manure + leaf fertilizer was higher than the number of *Trichoderma* sp. fungi in treatment A (100% NPK). This shows that *Trichoderma* sp. grows better in land conditions that are given lower chemical fertilizers. According to Amalia et al. (2019), the administration of chicken manure added with *Trichoderma* sp. will increase the number of microbes in the soil. The increase in the number of *Trichoderma* sp. fungi also comes from

the chicken manure used because it already contains nine to 10 *Trichoderma* sp. individuals per gram (Jaya et al., 2022). Meanwhile, the low number of *Trichoderma* sp. in the control treatment is thought to be caused by soil microorganisms tending to have difficulty surviving in environments lacking water (Mickan et al., 2019). Ye et al. (2022) also stated that drought stress can disrupt the development and metabolic rate of fungi and microbes, resulting in the loss of soil microorganism populations. As is known, one of the benefits of chicken manure is increasing the soil's ability to retain water. So

it is natural that the population of *Trichoderma* sp. fungi in the treatments given chicken manure is higher than the population found in treatment A.

#### *The Effect of Chicken Manure and Leaf Fertilizer on the Growth of Chili Plants*

The results of the analysis of variance showed that the treatment did not have a significant effect on plant height, stem diameter, and number of productive branches, each of which was observed at 60 HST (Table 4).

**Table 4.** Effect of Chicken Manure and Leaf Fertilizer Treatment on Plant Height, Plant Stem Diameter, and Number of Productive Branches

Treatment	Plant Height (cm)	Stem Diameter (cm)	Number of Productive Branches (branches)
A (100% NPK)	35.9	0.6	8.3
B (85% NPK + PKA)	38.4	0.6	8.1
C (70% NPK + PKA)	37.5	0.7	8.4
D (55% NPK + PKA)	37.7	0.6	8.0
E (85% NPK + PKA + PD)	36.4	0.6	7.0
F (70% NPK + PKA + PD)	31.8	0.6	7.2
G (55% NPK + PKA + PD)	34.7	0.7	9.1

Description: PKA = Chicken Manure, PD = Leaf Fertilizer

The absence of any effect on each treatment on the parameters of plant height, stem diameter, and number of productive branches indicates that the amount of N, P, and K nutrients needed by cayenne pepper plants has been met with the N, P, and K elements contained in the 55% NPK and PKA treatments. This is understandable if we assume that the provision of PKA can prevent leaching or reduce the loss of nutrients. Because there is no significant difference between treatments, we assume that the amount of nutrients used by cayenne pepper plants in all treatments is relatively the same, which is equivalent to the NPK content in the 55% NPK and PKA treatments. The NPK content in the treatment with a dose reduction of up to 45% is equivalent to the general recommendation for NPK fertilizer for chili plants, namely, urea 300-350 kg/ha (equivalent to 120-150 kg N/ha), SP-36 fertilizer as much as 200-300 kg/ha (equivalent to 72-108 kg P/ha), and KCl fertilizer as much as 200-250 kg/ha (equivalent to 120-150 kg K/ha) (Nugroho et al., 2022). If this assumption is correct, then the results of this study indicate that the provision of organic matter can withstand the loss of water and nutrients in the soil (Rachmadtullah et al., 2024). As for the doses of 85% NPK and 70% NPK, NPK may be retained by the presence of PKA organic matter, but the NPK that can be used or utilized by cayenne pepper plants is the same, namely a maximum of 55% NPK. This value also shows that by adding organic materials, the provision of inorganic fertilizers to chili plants in dry

land can be equivalent to or even lower than the provision of chili plant fertilizers in optimum land. According to Dani et al. (2021) the provision of chicken manure can increase plant growth. In addition, the results of this study are reinforced by research conducted by Sumiati et al. (2021); Natsir (2018) namely the provision of chicken manure increases plant growth and development such as plant height and stem diameter.

The plant height in this study (Table 4) ranged from 31.8-38.4 cm, which is not in accordance with the height of the chili plant in the variety description, which is  $\pm 50$  cm. However, in terms of the size of the stem diameter, the chili plants in this study had a stem diameter (0.6-0.7 cm) which was larger than that written in the variety description, which was  $\pm 0.4$  cm. Thus, the inhibition of plant height growth is compensated for in the size of the stem so that the plant looks short but sturdy. However, there are also research results that show that increasing N, both in the soil and in the leaves, can affect the size of the stem diameter (Samadi, 2020).

#### *The Effect of Manure and Leaf Fertilizer on Chili Plant Yield*

The results of the analysis of variance showed that the treatment had no significant effect on all yield parameters, except for the percentage of flowers becoming fruit (Table 5).

**Table 5.** Effect of Treatment on Percentage of Flowers Becoming Fruit (%), Number of Fruit per Plant, Fruit Weight per Plant (kg), and Fruit Weight per Plot (kg).

Treatment	Percentage of Flowers to Fruit (%)	Number of Fruits per Plant (fruit)	Fruit Weight per Plant (kg)	Fruit Weight per Plot (kg)
A (100% NPK)	83.6c	175.3	0.27	5.90
B (85% NPK + PKA)	85bc	174.6	0.27	5.78
C (70% NPK + PKA)	85.8bc	189.9	0.27	6.44
D (55% NPK + PKA)	85.7bc	202.3	0.31	6.90
E (85% NPK + PKA + PD)	87.1ab	188.2	0.29	6.20
F (70% NPK + PKA + PD)	88.3a	183.9	0.28	6.09
G (55% NPK + PKA + PD)	87.0ab	174.1	0.27	5.85

Note: Numbers followed by the same letter indicate no significant difference based on the results of the 5% DMRT test.

PKA = Chicken Manure, PD = Leaf Fertilizer

The percentage of flowers becoming fruit in each treatment tended to increase in the treatment that was added with leaf fertilizer (E, F, G) and the highest value was in treatment F (75% NPK + PKA + PD) with a value of 88.3%. The high P content in Growmore leaf fertilizer is thought to be the cause of the high percentage of flowers becoming fruit. The content of N, P, and K nutrients in Growmore leaf fertilizer used respectively were 10%, 55%, and 10%. Marlina et al. (2018) stated that P nutrients can accelerate flower growth and increase the number of flowers. In addition, the provision of P and K nutrients is carried out to prevent flower and chili fruit loss (Herpiani et al., 2024). It can be seen in Table 2 that the P nutrient content in the soil is very high, but it cannot be absorbed properly by plants due to low soil fertility and the possibility of limited water in the soil (Novianto et al., 2024), so that the provision of P nutrients through these leaves can meet the P needs of plants.

All treatments tested did not significantly affect the number of fruits per plant, fruit weight per plant, and fruit weight per plot. However, in all three parameters there was a tendency to increase in the treatment given chicken manure, both with and without the addition of leaf fertilizer compared to the treatment given only 100% NPK fertilizer. Based on these values, it can be said that chicken manure can increase the efficiency of NPK fertilizer use in the soil because treatment A (100% NPK) produces the same results as the treatment of reducing NPK fertilizer by 45%. This can happen because the addition of chicken manure can increase nutrients and the presence of microorganisms in it (Luo et al., 2017). Relatively higher results were obtained from treatment D (55% NPK + chicken manure) with the number of fruits per plant, fruit weight per plant, and fruit weight per plot respectively being 202.3 fruits, 0.31 kg, and 6.90 kg. This value indicates a positive correlation between the number of fruits per plant and the weight of the fruit per plant and the weight of the fruit per plot. However,

the insignificant difference in the effect of all treatments on the components of cayenne pepper yields strengthens the previous assumption that the provision of PKA can prevent the loss of NPK nutrients and the amount of NPK required by cayenne pepper plants is equivalent to that provided in the 55% NPK + PKA treatment. This assumption is even stronger if the results of the 55% NPK + PKA treatment in this study (treatments D and G) which were around 10 tons/ha were compared to the potential yield of the variety according to the description which reached 12 tons/ha. Furthermore, when associated with the nutrient value (Table 2), and nutrients in the leaves and the number of *Trichoderma* sp. fungi (Table 3) between the control treatment and all other treatments were not significantly different, so that the amount of nutrients that can be used by plants is relatively the same. Based on these data, it can be said that chicken manure can cover the nutrient needs of plants after reducing fertilizer application. In addition, continuous provision of chicken manure can also improve the chemical, biological and physical properties of the soil (Xu et al., 2022). However, the weakness of this study is that observations on the biological properties of the soil were only carried out on the number of *Trichoderma* sp. fungi and no observations were made on the physical properties of the soil.

## Conclusion

Based on the results of the research that has been done, it can be concluded that the provision of chicken manure and leaf fertilizer can reduce the use of inorganic fertilizers by up to 45%. The tendency to use chicken manure with or without the addition of leaf fertilizer increases the harvest, and the provision of manure + leaf fertilizer can also increase the percentage of flowers to fruit. In addition, reducing the use of inorganic fertilizers in a sustainable manner can improve soil quality.

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All authors have made a real contribution in completing this manuscript

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**Conflicts of Interest**

The authors declare no conflict of interest

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