JPPIPA 11(3) (2025)

Jurnal Penelitian Pendidikan IPA
Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Growth and Yield of Corn with Different Animals Compost and Doses

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Received: January 15, 2025
Revised: February 21, 2025
Accepted: March 25, 2025
Published: March 31, 2025

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DOI: 10.29303/jppipa.v11i3.10405

Abstract: The purpose of this study was to determine of solid organic fertilizer (POP) from three animals' feces namely cow, goat, and chicken were applied with various dosages in maize to increase growth and yield. The study was used RCBD factorial with three reps and POP type (K1 = chicken K2 = cow and K3 = goat) was the first factor and the POP doses (D0 = 0.00; D1 = 0.75; D2 = 0.150; D3 = 2.25 and D4 = 3.00/ plot) was the second factor. Parameters measured were plant height, number of leaves, stem diameter, leaf area, cob length, cob diameter, number of rows, and cob weight. The results were showed significantly different for the type of POP, where the chicken POP was significantly with cow and goat POP, but t between goat and cow POP was no significant differently. The dosage was found, significantly difference among doses, but interaction between the dosage with the POP was no significant difference, respectively. The results indicated that, various compost from feces cow, goat and chicken were increased growth and yield of corn, but the better compost feces chicken as compare those ones. Especially in dosage, whereas all dosage were providing positive impact in growth and yield, but dose 2.25kg/plot was given high in growth and yield of corn.

Keywords: Chicken; Corn; Cow, Dose; Goat; POP

Introduction

Corn is a popular alternative crop, and it is the world's second most important cereal crop after wheat, rice and other food sources, accounting for 94% of all cereal consumption (Awata et al., 2019). In Indonesia this crop third ranked behind rice and cassava. This crop has several used, including as culinary ingredients, animal feed, and industrial products. Generally, sweet corn used to diet in place of rice due to 5-6% sugar content as compared to typical corn's 2-3% (F. A. Harahap, 2019; Mardiana et al., 2023). According to Ortiz et al. (2010), the demand for maize for consumption in emerging nations is predicted to rise by 1.3% annually until 2020. Furthermore, the demand for maize is predicted to reach 3.3 billion tons by 2050, and by 2025, it will overtake all other crops as the most produced crop in emerging nations worldwide (FAO, 2016). Between 2020 and 2023, Indonesia's corn crop production varied, ranging from 5.5 to 5.8 tons/ha to 6.0 to 5.8 tons/ha (BPS, 2023). In the meantime, Indonesia's maize crop production varied from 2020 to 2023, ranging from 12.9 to 13.4 to 16.5 to 14.5 million tons (BPS, 2024). There is a need to greatly boost maize yield in order to meet the growing demand for corn harvests.

Encouraged by sweet flavor, the popularity is growing, market value is rising and resulting high demand. The leaves and stems of sweet corn can be used as green fertilizer or animal feed due to early in harvest (Bapaimu et al., 2024; Dewanti et al., 2023). The productivity of sweet corn must be increased during this time, especially in quality, which includes raising in

How to Cite:
Syahputra, B. S. A., Sembiring, M., Riyanti, & Nurhayati. (2025). Growth and Yield of Corn with Different Animals Compost and Doses. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 1115-1122. https://doi.org/10.29303/jppipa.v11i3.10405

yields and ensuring in sugar content. Therefore, to increase of yield this crop needed suitable of land with optimize in fertilizer and high-quality seeds with superior varieties is to boost harvest yields. Otherwise, it is crucial to employ both natural and artificial fertilizers in both liquid and solid form, particularly those made from organic resources like animal feces or plant wastes like leaves and stems that have been processed to be compost. Organic fertilizers such as compost can be improving agricultural yields and soil fertility while reducing water and soil pollution. By enhancing soil structure, moisture retention, cation exchange, nutrient retention, and the encouragement of beneficial microbial activity, compost enhances soil quality (Aksarah et al., 2024; Phares et al., 2022).

Compost is a process decomposed by microbe of organic materials, such as plant stems and leaves and manure (feces) usually from animals. The end product of this process is always used to make organic fertilizers, which are used in place of synthetic fertilizers. Reducing the C/N of organic materials to the same level as the C/N of soil (≤20) is the process of decomposition while creating compost. Chemical elements such as: a) carbohydrates, cellulose, hemicellulose, fat, and lignin are converted into CO_2 and H_2O_2 during the composting process; and b) organic molecules break down into compounds that plants may absorb (Nugroho et al., 2022; Syahputra, 2022). A good compost has weathered sufficient and has color different as compared to basic material, has lower water content, and room temperature condition. Compost production and utilization must be improved, so that it may be used successfully, raise livestock producers' income, and combat environmental pollution. For example, cow manure made up of feces, urine, and leftover feed has more nitrogen than feces alone. Cattle can produce 23.6 kg of solid and 9.1 kilogram of liquid waste per day (Asmawati et al., 2021; Khan et al., 2021).

The kind of compost that farmers request is made from manure, which is the term for animal waste, including that of cows, goats, chickens, and others. Harahap et al. (2020) claim that every manure treatment can indirectly boost root growth at all typical root depths and continually promote an increase in all plant growth. Additionally, it can be used as an additional plant nutrient element in place of chemicals, which can improve the biology and structures of the soil. Manure, a fertilizer derived from animal manure, can help plants develop more vegetatively and generatively by supporting planting media (Koryati et al., 2024; Nugroho et al., 2022). While the nutrients in manure vary depending on the type of raw fecal source, this is not always the case (Melsasail et al., 2019; Surya et al., 2020).

Cow manure contains a lot of cellulose or fiber, meanwhile, a carbon chemical chain molecule, cellulose will go through additional breakdown. The N element in cow manure is still used first by degrading microbes or not yet accessible to plants during the breakdown of the buried carbon chemical chain molecule (cellulose). This is the rationale behind the recommendation against using fresh cow manure. Because when employed in fresh form, it may cause the primary plants and decaying microorganisms to compete for nitrogen elements throughout the composting process. The Cow feces content can contribute to strengthening soil structure, boosting soil humus content, and promoting the survival of soil microorganisms, despite its generally low nutrient content (Naibaho, 2019; Wardani et al., 2024).

Table 1. Nutrient Content of Cow, Goat and Chicken Feces (Yusdian et al., 2021)

	Fresh material (%)						
	N	P_2O	K_2O	CaO	C/N Ratio	Organic material	Water content
Cow	0.30	0.30	0.15	0.20	20-25	16	80
Goat	0.70	0.40	0.25	0.40	20-25	31	64
Chicken	1.50	1.30	1.80	4.00	9-11	29	57

The chicken feces have the highest nutrient content as compared of three livestock feces utilized as compost, followed by goat and cow feces (table 1). All livestock excrement composts are excellent for plants, notwithstanding their differences. Soil fertility will be improved by the sustainable use of goat manure (Nugroho et al., 2022; Sembiring et al., 2023). Because it takes time for the materials in chicken dung to transform and become available in the soil, it is categorized as a cold fertilizer. This occurs because, in comparison to other manures, chicken manure decomposes more quickly and has a relatively high nutrient content (Hasibuan et al., 2024; Yusdian et al., 2021).

Method

Study Area and Design

This study was carried out from July to September 2023 at an elevation of around 25 meters above sea level in Pasar IX Sei Rokan, Batang Kuis, Percut Sei Tuan District, Deli Serdang Regency, North Sumatra. Two factors were examined with Randomized Complete Block Design (RCBD) design: the first factor consist of compost (K1 = chicken, K2 = cow, and K3 = goat) and the second factor consist of dosses (D0 = 0.00, D1 = 0.75, D2 = 1.50, D3 = 0.2,25, and D4 = 3.00 kg / plot). Three reps of the treatment were done with fifteen combinations.

Making Composts

The Bokashi method, which involves added bioactivator namely "Stardec" to speed up the composting process, is used to make mature. By layering, with chopped rice straw at the bottom and cow, goat, or chicken fesses (which must not be combined; each is created separately using the same technique) on top and then covered with husk bran. The proportion of animal waste to husk, straw, and feces is 10%:10%:80%. Once the layers are in place, uniformly distribute the bioactivator (stardec) on top and water with a solution containing 5% urea. The feces are layered until there is enough of them to make compost. The compost layer is watered every morning and evening, and the humidity level needs to be kept between 70 and 85%. To ensure that everything is uniformly distributed, it is flipped over after three days and then once a week after that. After four weeks of fermentation, the compost is fully mature.

Research Action

A total of forty-five plots were created, each plot measuring 120 × 120 cm, with a 50 cm distance between plots and a 100 cm distance between replications. While making the plot, compost (POP) was applicated. Once the plot was make, the compost was distributed uniformly throughout the existing plot and adjusted according to the type and dosage. Allowing the compost to mix with the soil, planting was done two weeks after the compost was applied. Bisi 2 Hibrid-F1 corn seeds, which have the benefit of uniform plants, were employed in this investigation. Prior to planting, the seeds were allowed to germinate. Once the growth point had emerged, they were placed in the plot with one sprout per planting hole, using a 40 cm × 40 cm planting distance. Plant height, stem diameter, total leaf and leaf area were measured at 2, 4 and 6 WAP and ear length, ear diameter, number of ws, ear weight/sample, and ear weight/plot were measured at harvesting.

Data Analyze

The R-Studio 4.3.2 software was used to perform an Analysis of Variance (ANOVA) on all plant parameter data. The DMRT test was used at the 5% level to the analysis of variance data that showed a significant difference.

Result and Discussion

Plant Height (cm)

The vegetative growth of corn plants on plant height, the results on analysis of variance in the treatment of chicken, goat, and cow feces compost (Table 2) revealed a statistically different on observations of 4 WAP and 6 WAP, but not significantly different on observations of 2 MST, respectiply. Similarly, the results for different compost dosages were not substantially different during the second week (2 WAP), but they were considerably different during the fourth and sixth MST observations. There was no differently effect of the interaction between the type of compost with the different dosages. Compost made from chicken compost was observed to have positive outcomes, as was a dosage of 2.25 kg per plot.

Table 2. Average Plant Height (cm) of Corn after Application Three Composts with Several doses at 2, 4 and 6 Weeks after Planting (WAP)

Treatments	Plant height (cm)					
	2 WAP		4 WAP		6 WAP	
Fesses compost						
K3 = Goat	35.91	a	72.54	a	143.15	B
K2 = Cow	33.55	a	71.67	a	140.98	B
K1 = Chicken	38.54	a	78.92	b	161.83	A
Compost doses						
D0 =0.00 kg/plot	30.99	a	63.79	b	129.39	B
D1 =0.75 kg/plot	33.56	a	67.25	b	133.18	B
D2 =1.50 kg/plot	35.81	a	74.48	a	151.33	A
D3 =2.25 kg/plot	37.78	a	75.93	a	155.69	A
D4 =3.00 kg/plot	39.69	a	78.83	a	159.93	A

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

Growth and development of plants, some nutrients are needed, but the most important is N nutrient. Therefore, for the growth of increase in height of corn plants, the N element is needed. It can be seen that the higher of dose given, the increase of height sweet corn, especially in chicken feces compost. The N element is the main element in the vegetative growth of plants, especially in increase size like number of stems and leaves (Khan et al., 2021; Maulintar, 2019). The addition of organic matter can accelerate the weathering of volcanic ash (Narka et al., 2022; Yusuf et al., 2024), so that at 4 MST and 6 MST, the applied of higher doses had a significant effect on the height of corn plants.

Table 3. Average of Total Leaves Corn after Application Three Composts and Several Doses at 2, 4 and 6 Weeks after Planting (WAP)

Treatments	Total leaves (unit)					
	2 WAP		4 WAP		6 WAP	
fesses compost						
K3 = Goat	4.02	a	6.32	b	9.13	b
K2 = Cow	4.06	a	6.19	b	9.06	b
K1 = Chicken	4.40	a	6.68	a	9.98	a
compost dosage						
D0 =0.00 kg/plot	3.83	a	5.89	b	8.53	b
D1 =0.75 kg/plot	4.04	a	6.06	b	8.74	b
D2 =1.50 kg/plot	4.12	a	6.25	b	9.05	b
D3 =2.25 kg/plot	4.42	a	6.75	a	9.81	a
D4 =3.00 kg/plot	4.39	a	6.85	a	10.04	a

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

The number of leaves showed, did not significantly different from the plant height results, indicating that the three types of manure treated with chicken compost fertilizer performed well as compared ones (Table 3). While there were no differently variations between the three composts in the second week, observations in the sixth and fourth weeks yielded quite diverse outcomes. Similarly, fertilizer dosage observations indicated significantly different results in weeks four and six, but were not significantly different in the first two weeks, respectively. It is evident that the average number of leaves grows with increasing manure dosage; nonetheless, the optimal dosage is 2.25 kg/plot; a dose of 3.00 kg/plot yields a higher number, but statistical analysis no significantly difference. Applied compost has a positive impact on the rate of photosynthesis because compost is able to provide nitrogen (N) in the soil and increase nitrogen absorption by plants The increasing nitrogen absorption by plants contributes to increased chlorophyll and increases the number of leaves in plants (Nasution et al., 2023).

Table 4. Average of Stem Diameter Corn after Application Three Composts and Several Doses at 2, 4 and 6 Weeks after Planting (WAP)

Treatments	Stem Diameter (cm)					
	2 WAP		4 WAP		6 WAP	
Fesses compost						
K3 = Goat	1.02	a	1.21	b	1.51	B
K2 = Cow	1.05	a	1.29	b	1.55	B
K1 = Chicken	1.07	a	1.47	a	1.74	A
Compost doses						
D0 =0.00 kg/plot	0.92	b	1.16	c	1.44	c
D1 =0.75 kg/plot	0.97	b	1.21	c	1.49	c
D2 =1.50 kg/plot	1.04	ab	1.30	bc	1.58	bc
D3 =2,25 kg/plot	1.08	a	1.37	b	1.66	b
D4 =3.00 kg/plot	1.12	a	1.50	a	1.78	a

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

The basic concept of rapid growth usually requires Nitrogen as a vegetative growth stimulant. Likewise with corn plants, to increase growth in both height and number of leaves and also green leaves, Nitrogen is needed as the main source of the nutrient (Asmawati et al., 2021; Nugroho et al., 2022). In comparison to goat and cow manure compost, Table 4 showed that the diameter of sweet corn plants following the application of chicken compost produced was the best results. There was no statistically significant difference between goat and cow manure compost and chicken manure compost, however there was a significant difference between goat and cow manure compost. Regarding dosage, the highest dose (3.00 kg/plot) produced results that were significantly different from those of the other doses (control; 0.75; 1.50 kg/plot), but they were not significantly different from the dose of 2.25 kg/plot. In addition, they were not significantly different from the dose of 3.00 kg/plot, nor were they different from the dose of 1.50 kg/plot, but they were significantly different from the control and the dose of 0.75 kg/plot. It is evident that observations made at the second, fourth, and sixth weeks produced findings that were nearly identical to the treatment of a dose of 2.25 kg/plot, which was good in comparison to other dosage.

Stem diameter one of parameter that used to be considered in determining fertilizer application, because the higher of plant, the larger of stem diameter is needed for the plant survive growing. It can be seen that the application of compost fertilizer for the three types provides a high contribution to the stem diameter. Although the good was showed in the provision of chicken feces compost, but other composts also provide good results. Resulting research of Syamsiyah et al. (2017), the provision of compost can increase the total Ca content of the soil because compost also contains Ca elements. Calcium (Ca) is an important element for plants, especially in photosynthesis and absorption of plant nutrients so that it affects plant growth (Weng et al., 2022). In the observation of 6 MST, the chicken feces compost treatment had the largest stem diameter of 1.74 cm. Based on the research of Nengsih et al. (2024) and Yusuf et al. (2024), the provision of 900 g of compost can increase the stem diameter of sweet corn plants at 6 MST.

Following the application of various feces compost types and dosages, the leaf area of sweet corn plants showed that chicken feces compost produced relatively good performance as compared to goat and cow feces compost (Table.5). The D3 compost dose produced the best resulted out of all the compost doses. Statistically, the results were showed no significantly difference at a dose one level lower (D3 = 2.25 kg/plot), even if the largest leaf area value was seen at the highest dose (3.0 kg/plot). Similar findings were obtained with the first dose (0.75 kg/plot), which was significantly different from the higher treatment but did not from the control. The D2 dose had different results than the D0, D1, and D4 dose levels, but it was not statistically different from the D3 dose. The compost dose was stable throughout its process in maize plants during the vegetative growth stage, as evidenced by the trend of nearly identical results for leaf area in observations of weeks 2, 4, and 6.

Table 5. Average Leaf Area Corn after Application Three Composts and Several Doses at 2, 4 and 6 (WAP)

Treatments	Leaf area (cm^2)					
	2 WAP		4 WAP		6 WAP	
Feses compost						
K3 = Goat	307.86	b	332.18	b	385.44	b
K2 = Cow	305.69	b	328.19	b	388.76	b
K1 = Chicken	353.42	a	398.46	a	473.18	a
Compost doses						
D0 =0.00 kg/plot	258.67	c	287.43	c	323.85	c
D1 =0.75 kg/plot	267.25	c	305.12	c	345.12	c
D2 =1.50 kg/plot	316.31	b	337.72	b	404.54	b
D3 =2.25 kg/plot	353.32	ab	368.14	ab	443.31	ab
D4 =3.00 kg/plot	386.75	a	426.17	a	475.61	a

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

Since the yield component is one of measure in commodity production, variations in its appearance will affect the commodity's output. Three characteristics of the yield component—length, diameter, and number of rows on the corn ear—are measured for corn plants in this study. Goat feces compost does not significantly different from cow feces compost, but chicken feces compost performs the best when compared to cow and goat feces compost, according to Table 6's observations of the three parameters for the application of the type of feces compost, respectively. In the D2 treatment, the resulted were different significantly from D0 and D1, but not significantly from D3 and D4, the dosage was deemed to be appropriate. It is evident from this yield component that the best outcomes occur at a middle-level dose rather than at a high one. This indicates that 1.5 kg of feces compost suitable for production should be applied per plot; while the numbers show that the larger the dose, the higher the component of the result, the differences are not statistically significant. The similar pattern can be observed in the vegetative growth, harvest, and production components per sample and per plot, with chicken feces compost continuing to be the best type of animal feces compost. Chicken feces compost offers a substantial difference when compared to goat and cow feces compost, but there is no significantly difference between the two types of compost. compost is able to increase the leaf area of melon plants so that compost is able to increase the growth of melon plants with a compost application dose of 25 tons/ha and also the growth of kale plants, including the leaf area of kale plants at 28 days after planting (DAP) (Ichwan et al., 2022; Sembiring et al., 2023).

Table 6. Average of Long, Stem and Number of Ear after Application Three Composts and Several Doses at Harvesting

Treatment	Ear length (cm)		Ear Diameter (cm)		number of ear	
fesses compost						
K3 = Goat	14.09	b	4.27	b	13.58	b
K2 = Cow	14.38	b	4.28	b	13.96	b
K1 = Chicken	15.46	a	4.47	a	14.63	a
compost doses						
D0 =0.00 kg/plot	13.32	b	4.06	b	13.52	b
D1 =0.75 kg/plot	13.87	b	4.14	b	13.75	b
D2 =1.50 kg/plot	14.73	a	4.40	a	14.11	a
D3 =2.25 kg/plot	14.65	a	4.42	a	14.11	a
D4 =3.00 kg/plot	15.87	a	4.49	a	14.28	a

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

In comparison to goat and cow manure compost, there was a growing trend in the high application treatment of chicken manure, as indicated by the nearly same harvest results for each sample and plot (Table 7). The results were nearly identical across all criteria, indicating that the compost made from chicken was superior to the other two composts. Although chicken compost better than others in vegetative and yield growth of corn plant, but cow and goat compost are still potential for used to corn plant. On other words, three composts were made from fesses animals had better used on plants, besides maintenance environmental balance and also used of organic materials in farming system.

Table 7. Average Ear Weight after Application Three Composts and Several Doses at Harvesting

Treatment	Ear Weight (g)			
	Sample		plot	
Fesses compost				
K3 = Goat	161.41	b	1379.08	b
K2 = Cow	162.96	b	1390.51	b
K1 = Chicken	187.21	a	1695.75	a
Compost doses				
D0 =0.00 kg/plot	141.83	b	1215.67	b
D1 =0.75 kg/plot	158.13	b	1296.41	b
D2 =1.50 kg/plot	174.89	a	1589.89	a
D3 =2.25 kg/plot	181.47	a	1675.92	a
D4 =3.00 kg/plot	183.89	a	1752.33	a

Note: the different letters in the same colomb are showed significantly difference at DMRT 5%

Conclusion

Numerous studies have been conducted on the use of organic fertilizer made from animal feces, with very positive outcomes. The study's findings also demonstrate the significant contribution that organic fertilizer made from cow, goat, and chicken dung makes to the development and yield of maize plants. Generally speaking, compost made from chicken dung is superior to compost made from goat and cow manure out of the three types. When compared to other dosages and no treatment, it is evident that several of the ones that were tried produced positive outcomes, specifically a dose of 2.25 kg/plot. Compared to using c compost from cow and goat feces at different dosages, it is undeniable that using 2.25 kg of chicken fesses per plot can increase corn plant development and yield.

Acknowledgments

Authors thanks to all research team including students who help in the field and laboratory.

Author Contributions

Concept and design of the research (BSAS and Nur); field/laboratory experiment and also data collection (BSAS, MS and Riy); data analysis and interpretation (BSAS and Nur); manuscript preparation (MS, Riy and Nur); finishing article (BSAS and Nur).

Funding

This study was funded independently.

Conflicts of Interest
Authors declare that, we have no competing interest with the reviewers.

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