Effect of Sawdust and Goat Manure Rate on Sweet Potato Growth and Yield in Sandy Soils

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Abstract

Sweet potato is an important carbohydrate source in Indonesia, alongside rice, maize, and cassava. It can contribute to meeting basic food needs, reducing dependence on rice, and supporting food diversification. This study aimed to evaluate the effects of sawdust and goat manure rates, as well as their interaction, on the growth and yield of sweet potato grown in sandy soil. The experiment was conducted using a Randomized Complete Block Design (RCBD) with two factors. The first factor was sawdust application at three rates: 12, 15, and 18 t ha^{-1}. The second factor was goat manure application at three rates: 15, 20, and 25 t ha^{-1}. The results showed that sawdust and goat manure treatments affected several observed parameters, including stem length and number of leaves at 112 days after planting (DAP), number of sweet potato tubers per plant, tuber diameter, fresh tuber weight per plant, and harvest index. The highest effective rates were 18 t ha^{-1} for sawdust and 25 t ha^{-1} for goat manure, resulting in fresh tuber weights of 734.21 g and 543.98 g, respectively.

Keywords: *Goat manure, sandy land, sawdust, sweet potato.*

INTRODUCTION

Sweet potatoes (*Ipomoea batatas* L. Lam.) are dicot vegetables pertaining to the family Convolvulaceae. It ranks as the seventh most cultivated crop globally, following wheat, rice, corn, potatoes, barley, and cassava, and is the fifth in developing nations. The sweet potato plant is a source of carbohydrates in Indonesia in addition to rice, corn and cassava. Apart from being food and feed, it can also be used as raw materials for both upstream and downstream industries. In addition to playing a role in meeting basic carbohydrate needs, sweet potato commodities can also be used as the main source of rice substitution or as a food diversification crop. Sweet potatoes also have advantages compared to various other tubers, in addition to containing beta-carotene and anthocyanins that can prevent cancer are also rich in vitamins A and C which are excellent for health (Jakarta Food Crops Agriculture Office, 2016).

Sweet potato or cassava vine has another name Sele bun, sweet potato or sweet potatoes are a variety of tuber that prossesses numerous benefits compared to other tubers, comprising containing high strength and freshness that are able to replenish energy rapidly, along with various essential compounds for the body, including vitamins, minerals, fiber, and anthocyanins, particularly in the purple kind of sweet potato which functions as an antioxidant. Purple sweet potatoes can be anti-cancer because they contain active substances called selenium and Iodine which are 20 times higher than other types of sweet potatoes (Sarwono, 2005).

Sweet potatoes are a perishable commodity because they contain a lot of water (ranging from 75-80%), as well as fruits and vegetables. Common damages that occur are bruises, cuts, the presence of broken parts, and abrasions and damage produced by respiration and transpiration. Damage can also be due to metabolic stress (such as sap), or the occurrence of brown discoloration from damaged tissue or the induction of ethylene gas which can spur the process of deterioration of product quality. Physical damage can also occur at all stages of pre-harvest activities, during harvesting, handling, grading, packaging, transportation, storage, and finally reaching consumers (Imade, 2001).

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The use of wood powder has the advantages of having light weight, uniformity, compactness, being able to store water and rich in nutrients needed for plant growth, which are in the form of 0.24% N, 0.20% P, and 0.45% K. In addition, wood powder contains the same chemical components as wood, namely cellulose, lignin, hemicellulose and extractive substances Damayanti, *et al*., (2019). Goat manure is available macro (N, P, K) and micro manure (Ca, Mg, S, Na, Fe, Cu, Zn). The content of macro and micro nutrients contained in goat manure is as follows (N=2.43%, P=0.73%, K=1.35%, Ca=1.95%, Mg=0.56%, Mn=4.68%, Fe=2.89%, Cu=4.2%, Zn=2.91%) (Susilowati, 2013). Based on research (Nurani *et al*. 2017), sandy soil has a low composition of organic subtances anda nutrients. This is because in sandy soils the level of sand fractions is high so that nutrients are not easily binded, water easily escapes, and the total number of microorganisms is relatively low. The objective of the research was to examine the impact of the interplay of sawdust treatment and caprine excrement on the development and productivity of sweet potatoes in sandy soils.

MATERIALS AND METHODS

Time and Place

The research was carried out for 4 months from October 2024 - February 2025 in Kereng Bengkirai Village, Sebangau District, Palangkaraya City, Central Kalimantan.

Materials and Tools

Materials used in the study include: sweet potato cuttings, dolomite lime, sawdust, goat manure. The tools used are hoes, digital scales, soil scales, pH meters of solutions, and hand sprayers.

Research Methods

The experiment employed a factorial randomized complete block design with two factors, each consisting of three levels. The first factor was sawdust application, with three application rates: S1 = 12 t ha^{-1}, S2 = 15 t ha^{-1}; S3 = 18 t ha^{-1}. The second factor was goat manure application, with three application rates: G1 = 15 t ha^{-1}, G2 = 20 t ha^{-1}; G3 = 25 t ha^{-1}. The two factors were combined to produce nine treatment combinations, and each combination was replicated three times, resulting in 27 experimental units. The treatment combinations are presented in Table 1.

Table 1. Combination of Sawdust and Goat Manure Rates Applied to Sweet Potato Grown in Sandy Soil

Sawdust (S)	Goat Manure (G)		
	G_1	G_2	G_3
S_1	S_1G_1	S_1G_2	S_1G_3
S_2	S_2G_1	S_2G_2	S_2G_3
S_3	S_3G_1	S_3G_2	S_3G_3

Preparation of Research Land

The research location used was measured in area and then cleaned of grass and litter. Cleaning aims to reduce the danger of pest and disease attacks. After that, it was continued with the making of a bed measuring 1.5 m x 1.5 m using a hoe. The beds were made with a thickness of 30 cm so as not to be waterlogged during the study. Preparation of Planting Materials. The criteria for sweet potato cuttings used, with healthy and normal growth of the mother plant and not affected by disease, the length of the sweet potato cuttings is 30 cm. Label Installation. The installation of labels on the beds is carried out before the treatment, namely by attaching the label to the wood and then inserting it on the ground in front of each bed. The labeling aims to distinguish the treatment that will be given to each bed. Planting hole making. Planting must be done so that the development of sweet potatoes is perfect, making planting holes by drilling holes in the soil with a maximum depth of 10 cm, planting seedlings with roots facing down, then cover the soil and compact it around the seedlings so that they do not shake.

Planting

The sweet potato planted is a healthy, sturdy seedling, uniform in age, and growth. Planting is carried out in the afternoon when the weather is not too hot and hot, to reduce evaporation in excessive

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seedlings, plants are prepared on each bed with a planting distance of 30 cm x 40 cm. Planting sweet potatoes that are planted are healthy, sturdy, uniform in age, and growth. Planting is carried out in the afternoon when the weather is not too hot and hot, to reduce evaporation in excessive seedlings, plants are prepared on each bed with a planting distance of 30 cm x 40 cm.

Maintenance and care for sweet potatoes must be carried out carefully, so that growth can be maximized. Weed cleaning on the bed is carried out once every 1 week so as not to inhibit the growth of sweet potatoes and facilitate observation. This is done to reduce the occurrence of pests and diseases, which can affect the growth of other plants. Containment variables included plant stem length, number of leaves, number of sweet potatoes per sample, fresh weight of sweet potatoes per sample, dry weight of sweet potatoes per sample, harvest index, and harvest potential.

Data Analysis

The observation data was examined by a variety analysis (F-Test) at the degree of α = 5% and 1%. Should the outcomes of the F-Test show an effect following the treatment, it is succeeded by an average difference evaluaste utilizing the Honestly Difference Test (HSD) of 5%.

RESULTS AND DISCUSSION

Stem Length (cm)

The outcome of the test of the average length of the stem demonstrated that the combination of sawdust treatment and goat fertilizer exerted a tangible influence on both treatments and there was an interaction. The results of the examination of the mean disparity in plant stem length is illustrated in Table 2.

Table 2. Stem Length of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates

Sawdust (S)	Goat Manure (G)		
	G_1 (15 t ha^{-1})	G_2 (20 t ha^{-1})	G_3 (25 t ha^{-1})
S_1 (12 t ha^{-1})	18.53a	18.71b	18.53a
S_2 (15 t ha^{-1})	19.04c	19.54d	19.85f
S_3 (18 t ha^{-1})	20.11g	20.82h	21.56i
HSD 5% = 0.24			

Note: The figure paired with the same letter within the same column reveals no meaningful difference as per the HSD test of 5%.

The findings of the examination of the average stem length difference test demonstrated that the engagement of sawdust treatment and goat manure had a very real effect on the growth of stem length, this is suspected because the effect of both treatment doses was able to increase plant growth and soil productivity. The combination of treatment doses of 18 t ha^{-1} sawdust and 25 t ha^{-1} goat manure gave the highest result, namely a bantang length of 21.56 cm. Fahmi *et al*., 2010 researched that goat manure can provide additional nutrients nitrogen and phosphorus where these elements are elements that are needed by plants in large quantities, if plants lack nitrogen growth slow and stunted plants, so that plant growth is inhibited. In addition, the increase in stem length is due to the influence of sawdust treatment, this shows that the higher the nutrients contained in sawdust, the faster it grows.

Winarti (2017) reported that the nutrients contained in sawdust are sodium, phosphorus, potassium and magnesium. With the support of these nutrients, growth increases and as a result of the nutrient content provided by the soil becomes productive/fertile. Other research states that the elements contained in goat manure are able to accelerate the growth of plant stem length. This is because goat manure has a content of N = 2.10%, P_2O_5 = 0.66%, K_2O = 1.97%, Ca= 1.64%, Mg = 0.60%, Mn = 2.33 ppm, and Zn = 90.8 ppm so it is the right alternative to be applied to the soil in increasing fertility (Samekto, 2006).

Number of Leaves (leaves)

The results of the variety analysis showed that the treatment of sawdust and goat manure had a very real effect and there was an interaction regarding the uantity of plant leaves. The results of the test of the average number of leaves are presented in Table 3.

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Table 3. Number of Leaves of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates.

Sawdust (S)	Goat Manure (G)		
	G_1 (15 t ha^{-1})	G_2(20 t ha^{-1})	G_1 (15 t ha^{-1})
S_1 (12 t ha^{-1})	34.16a	36.19b	37.23c
S_2(15 t ha^{-1})	38.25d	40.29e	43.58e
S_3(18 t ha^{-1})	46.27e	50.70f	52.40f
HSD 5%		SK = 1.18	

Note: The number followed by the same letter in the same column shows no significant difference based on the HSD test of 5%.

An interaction between sawdust and goat manure rates significantly affected the number of sweet potato leaves at 112 days after planting (DAP) (Table 3). At 12 t ha^{-1} sawdust, increasing the goat manure rate from 15 to 20 t ha^{-1} significantly increased the number of leaves from 34.16 to 36.19 leaves, and a further increase to 25 t ha^{-1} resulted in a significant increase to 37.23 leaves. At 15 t ha^{-1} sawdust, increasing the goat manure rate from 15 to 20 t ha^{-1} significantly increaseed the number of leaves from 38.25 to 40.29 leaves; however, a further increase to 25 t ha^{-1} (43.58 leaves) was not significant. Similarly, at 18 t ha^{-1} sawdust, increasing the goat manure rate from 15 to 20 t ha^{-1} significantly increased the number of leaves from 46.27 to 50.70 leaves, whereas a further increase to 25 t ha^{-1} (52.40 leaves) was not significant. The highest number of leaves was recorded with the combination of 18 t ha^{-1} sawdust and 25 t ha^{-1} goat manure (52.40 leaves), although it was not significantly different from the combination of 18 t ha^{-1} sawdust and 20 t ha^{-1} goat manure (50.70 leaves).

The combination of sawdust treatment as an organic material that can improve soil structure and goat manure as a source of nutrients has a significant effect on leaf growth. The results of this study are strengthened (Winarti *et al*., 2017), which states that in addition to containing macro and micro nutrients, goat manure can also improve the physical, chemical, and biological properties of the soil. Meanwhile, sawdust can increase the permeability and content of organic matter in the soil, reduce the erodibility value of the soil and improve soil stability. Goat manure provides nutrients that are able to meet plant growth because the nutrients in this fertilizer are higher than other manure (Magagula, 2010).

The increase in the number of leaves due to the influence of sawdust plays a role in increasing the activity of soil microorganisms and helping the weathering of organic matter and the slow release of nutrients. Sustainably available nutrients support the process of photosynthesis and the formation of new leaf tissues, so that the number of leaves increases. According to Hamzah (2019) the use of wood powder has advantages, namely having light weight, uniformity, compactness, being able to store water and being rich in nutrients needed for plant growth, which are in the form of 0.24% N, 0.20% P, and 0.45% K. The increase in the number of leaves is caused by the effect of goat manure treatment which can enrich the nutrient content. Furthermore (Azizah *et al*., 2017) stated that goat manure contains nutrients N which can increase leaf growth so that the leaves become more numerous.

Number of Tubers (fruit)

The results of the test differed from the average in Table 4, showing that a single treatment of sawdust and goat manure had a very noticeable effect on the number of sampled sweet potatoes.

The results of the variety analysis showed that a single treatment of sawdust had a very noticeable effect on the number of yams. The number of sweet potatoes is obtained by counting the sweet potatoes calculated at harvest time, ranging from the largest to the smallest. The number of sweet potatoes with a treatment dose of 18 t $^{ha-1}$ was able to produce a total of 45.62 pieces of sweet potatoes, a dose of 15 t ha^{-1} produced a total of 35.06 pieces of sweet potatoes and a dose of 12 t ha^{-1} produced a total of 27.82 pieces of sweet potatoes. The large number of yams is caused by sawdust treatment and produces the largest yams, the number of yams is influenced by the composition of the fiber content arranged in sawdust which is then able to provide quite high nutrients. In addition, sawdust has a loose texture so that it makes it easier for the roots to develop and good aeration, (Riadi *et al*., 2020). Sawdust also has other advantages, namely being able to bind and store water effectively and contain essential nutrients (Tintondp, 2015).

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Table 4. Number of Tubers of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates.

Treatments	Number of Tubers (fruit)	HSD 5%
Sawdust (S)		
S1 (12 t ha^{-1})	27.82a	
S2 (15 t ha^{-1})	35.06b	0.77
S3 (18 t ha^{-1})	45.62c	
Goat Manure (G)		
G1 (15 t ha^{-1})	32.27a	
G2 (20 t ha^{-1})	36.20b	0.77
G3 (25 t ha^{-1})	40.03b	

Note: The number followed by the same letter in the same column shows no significant difference based on the HSD test of 5%.

The results of the variety analysis showed that a single treatment of goat manure had a very noticeable effect on the number of yams. The number of sweet potatoes is obtained by counting the number of sweet potatoes per sample that are counted at harvest time, ranging from the largest to the smallest. Observation of the number of sweet potatoes per sample calculated at harvest time, which produces the number of sweet potatoes with a treatment dose of 25 t ha^{-1} is able to produce the number of sweet potatoes as much as 40.03 pieces, the dose of 20 t ha^{-1} produces the number of sweet potatoes 36.20 pieces, and the dose of 15 t ha^{-1} produces the number of sweet potatoes as much as 32.27 pcs. The large number of sweet potatoes is caused by the treatment of goat manure which produces the largest to the smallest sweet potato, which is influenced by the treatment of goat manure. Goat manure can provide both macro (N, P, K) and micro (Ca, Mg, S, Na, Fe, Cu, Mo) nutrients. In addition to being able to provide nutrients, manure has a high ion binding power so that it can effectively use inorganic fertilizers by minimizing the loss of inorganic fertilizers due to evaporation or washing by flushing or rainwater (Musnamar, 2004).

Tuber Diameter (cm)

The results of the average difference test are presented in Table 5, showing that a single treatment of sawdust and goat manure has a very noticeable effect on the diameter of the sweet potato.

Table 5. Tuber Diameter of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates.

Treatments	Tuber Diameter (cm)	HSD 5%
Sawdust (S)		
S1 (12 t ha^{-1})	50.16a	
S2 (15 t ha^{-1})	62.66b	0.23
S3 (18 t ha^{-1})	83.33c	
Goat Manure (G)		
G1 (15 t ha^{-1})	60.22a	
G2 (20 t ha^{-1})	64.16ab	0.23
G3 (25 t ha^{-1})	71.77b	

Note: The number followed by the same letter in the same column shows no significant difference based on the HSD test of 5%.

The results of the variety analysis showed that a single treatment of sawdust had a very noticeable effect on the diameter of the sweet potato. Diameter measurement is carried out after harvest, diameter measurement helps in the classification of quality or sweet potato grade for the determination of large and small tubers. In a single treatment, sawdust produced a sweet potato diameter with a dose of 18 t ha^{-1} of 83.33 cm, a dose of 15 t ha^{-1} of 62.66 cm, and a dose of 12 t ha^{-1} of 50.16 cm. This can be explained

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because the role of sawdust can improve soil structure, improve aeration and water retention, as well as accelerate the decomposition of organic matter, through improving soil conditions allowing roots to grow healthier and more efficiently in absorbing water and nutrients, so that plants can produce more photosyntheses. These photosynthes are then translocated to the sweet potato storage organs, which encourage the enlargement of the sweet potato in increasing its diameter. According to research conducted Setyorini *et al*., (2006), sawdust is one of the sources of compost materials that contain nitrogen. The nitrogen content in sawdust is around 0.1%.

The results of the variety analysis showed that a single treatment of goat manure had a very noticeable effect on the diameter of the bulbs. Diameter measurement is carried out after harvest, diameter measurement helps in the classification of quality or grade of sweet potatoes for the determination of large and small sweet potatoes. In a single treatment, goat manure produced a sweet potato diameter with a dose of 25 t ha-$^{-1}$ of 83.33, a dose of 20 t ha^{-1} of 64.16, and a dose of 15 t ha^{-1} of 60.22. In this treatment, it shows that the influence of goat manure has elements that are necessary in the growth and improvement of elements found in the soil. According to Sigit *et al*. (2019) goat manure contains 1.26% N, 16.36 Mg kg^{-1} P, 2.29 Mg.L^{-1}, Ca, Mg and 4.8% C-organic. When compared to compound inorganic fertilizers, the amount of nutrients contained in goat manure is less, but goat manure has a fairly complete nutrient content. According to Sigit *et al*. (2019), goat manure is able to supply nutrients N in the plant growth phase which will accumulate with a number of substances resulting from photosynthesis that can stimulate the formation of new shoots.

Fresh Tuber Weight (g)

The results of the difference in the average weight of fresh tubers are presented in Table 6, showing that a single treatment of sawdust and goat manure has a very noticeable effect on the fresh weight of sweet potatoes.

Table 6. Fresh Weight of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates.

Treatments	Fresh Weight of Tubers (g)	HSD 5%
Sawdust (S)		
S1 (12 t ha^{-1})	214.65a	
S2 (15 t ha^{-1})	416.77b	3.96
S3 (18 t ha^{-1})	734.21c	
Goat Manure (G)		
G1 (15 t ha^{-1})	374.28a	
G2 (20 t ha^{-1})	447.36ab	3.96
G3 (25 t ha^{-1})	543.98b	

Note: The number followed by the same letter in the same column shows no significant difference based on the HSD test of 5%.

The results presented in Table 6 show that sawdust and goat manure rates significantly affected fresh tuber weight. Increasing the sawdust rate from 12 to 18 t ha^{-1} significantly increased fresh tuber weight, with the highest value recorded at 18 t ha^{-1} (734.21 g). The fresh tuber weight at 18 t ha^{-1} was significantly higher than those obtained at 12 and 15 t ha^{-1}. This indicates that increasing the sawdust rate within the range tested increased fresh tuber weight. Goat manure rate also significantly affected fresh tuber weight. The highest fresh tuber weight was obtained with 25 t ha^{-1} goat manure (543.98 g), which was significantly higher than that obtained with 15 t ha^{-1} (374.28 g), but was not significantly different from the 20 t ha^{-1} treatment (447.36 g). Thus, increasing the goat manure rate from 20 to 25 t ha^{-1} did not result in a statistically significant increase in fresh tuber weight. This is in accordance with the statement Anjani *et al.,* (2022) which states that the wet weight of plants is influenced by the availability of nutrients, especially the nutrient N which is very important in increasing high growth and leaf formation. Suyitman, (2014) states that the wet weight of plants can show the metabolic activity of plants and the wet weight of plants is influenced by tissue water content, nutrients and metabolic results.

The results of the variety analysis showed that a single treatment of goat manure had a very noticeable effect on the fresh weight of sweet potatoes. The results of the analysis showed the effect of

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goat manure treatment in the fresh weight of sweet potatoes, the fresh weight of sweet potatoes was measured after harvest, the measurement of fresh sweet potatoes was carried out to determine the fresh weight of sweet potatoes treated with goat manure treatment at a dose of 25 t ha^{-1}) with a weight of 543.98 g, a dose of 20 t ha^{-1} 447.46 g, and a dose of 15 t ha^{-1} with a weight of 374.28 g, we can see that the treatment of goat manure produces sweet potatoes with a weight of 543.98 g, this is because goat manure provides a positive response to the growth and production of sweet potatoes well, the willingness to provide nutrients that can affect the formation of sweet potatoes. According to Vidiatama and Elfis (2024) goat manure contains higher nitrogen, phosphorus and potassium compared to cow manure. Awalia *et al*. (2026) explained that manure has natural properties and does not damage the soil, provides macro and micro nutrients, in addition to that manure functions to increase water retention, soil microbiological activity, cation exchange capacity value and improve soil structure.

Harvest Index

The results of the average difference test are presented in Table 7, showing that a single treatment of sawdust and goat manure has a very pronounced effect on the yield index.

Table 7. Harvest Index of Sweet Potato as Affected by the Interaction Between Sawdust and Goat Manure Rates.

Treatments	Fresh Weight of Tubers (g)	HSD 5%
Sawdust (S)		
S1 (12 t ha^{-1})	1021.14a	
S2 (15 t ha^{-1})	1294.83ab	14.9
S3 (18 t ha^{-1})	2296.10c	
Goat Manure (G)		
G1 (15 t ha^{-1})	1241.88a	
G2 (20 t ha^{-1})	1454.39b	14.9
G3 (25 t ha^{-1})	1915.81c	

Note: The number followed by the same letter in the same column shows no significant difference based on the HSD test of 5%.

The results of the variety-analysis showed that a single treatment of sawdust had a very significant effect on the harvest index. The treatment of sawdust is able to increase the harvest index in a high amount, the purpose of calculating the harvest index is to determine the planting intensity with the maximum number of doses of 18 t ha^{-1} as much as 2296.10. Zuraida (2010) stating that the harvest index is determined between the ratio of sweet potato yield and the ratio of leaves and vines of plants. The harvest index can be used as an indicator to determine crop productivity (Putri *et al*., 2013). In addition to harvest time that affects plant productivity, environmental conditions also play an important role in increasing productivity, especially related to the content of available nutrients, including macroessential nutrients (Nitrogen, Phosphorus, and Potassium) and soil organic matter (Edyson, *et al.,* 2019). Sawdust contains chemical components such as cellulose, hemicellulose, lignin and extractive substances (Sari and Darmadi, 2016).

The results of the variety analysis showed that a single treatment of goat manure had a very real effect on the harvest index. The treatment of goat manure is able to increase the harvest index in high quantities which produces the largest amount with a dose of 25 t ha^{-1} with the highest amount of 1915.81. Goat manure can increase the yield index by improving soil fertility, strengthening plant growth, and increasing yields. However, optimal results are achieved with proper dosage and management. According to Suminarti and Susanto (2015) it is stated that the higher the harvest index value, the higher the weight of the planting sweet potato and the potential yield. In this case, goat manure has an important role in increasing an element in goat manure such as, the results of research Hikmah (2008) goat manure contains 1.19% N, 0.92% P_2O_5, and 1.58% K_2O, so the higher the dose given, the more it will increase the soil nutrient content. Of the various nutrients that exist, nitrogen is a very important element for plant growth.

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CONCLUSION

Sawdust significantly affected stem length, number of leaves, number of tubers, fresh tuber weight, and harvest index, with the highest values generally obtained at 18 t ha^{-1}. Goat manure also significantly affected these variables, with the highest values generally obtained at 25 t ha^{-1}. Significant interactions between sawdust and goat manure rates were observed for stem length and number of leaves. The combination of 18 t ha^{-1} sawdust and 25 t ha^{-1} goat manure produced the highest stem length and number of leaves. For fresh tuber weight, the highest mean values were 734.21 g at 18 t ha^{-1} sawdust and 543.98 g at 25 t ha^{-1} goat manure.

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