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Effect of Organic and Plastic Mulches on Growth and Yield of Peanut (*Arachis hypogaea* L.) under Organic Farming Conditions

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ABSTRACT

The decline in peanut production occurs due to the lack of effective cultivation techniques. This study aims to improve cultivation techniques by utilizing mulch. The study was conducted from April to June 2025, peanut using the Gajah variety. Parameters measured included plant height, number of leaves, total weight of peanut plants, total number of pods, number of filled pods, number of empty pods, total pod weight, filled pod weight, empty pod weight, and seed weight. A randomized block design with four mulch treatments and three replications was applied. Data were analyzed using analysis of variance (ANOVA) and if there were differences, then tested with the Least Significant Difference (LSD) at a significance level of 5%. The results showed that not all parameters showed significant differences. Banana stem mulch(M1) significantly M1 significantly increased plant height of 29.61 cm, the number of filled pods of 26.50 plant, the weight of filled pods of 65.22 g, the weight of seeds of 36.05 g, and the weight of empty pods of 3.33 g compared with the control. Meanwhile, the use of mulch from *Gynura procumbens* leaves and black silver plastic mulch resulted in lower growth and yield parameters in peanut plants. This study shows that banana stem mulch has the potential to support the increase in organic peanut production sustainably, because it improves soil conditions and contains nutrients such as nitrogen (N), phosphorus (P), and potassium (K) which are good for growth.

Keywords: Peanut (*Arachis hypogaea* L.), Harvest components, Organic mulch, Cultivation techniques, Gajah variety

INTRODUCTION

Peanuts (*Arachis hyogaea* L.), a non-cereal commodity with significant economic value, are one of the most important agricultural products after rice and corn due to their high vegetable oil and protein content. Furthermore, peanuts are widely used as food, both for direct consumption and as an ingredient in various products. Peanut demand continues to increase with population growth (Wahyudi *et al*., 2019). In addition to their nutritional value, peanuts also have the ability to form a symbiotic relationship with Rhizobium sp., a nitrogen-fixing bacteria that can naturally improve soil fertility.

Peanut agricultural yields in Indonesia remain relatively low. Despite increasing productivity, peanut production in Indonesia has not increased. Data from the Ministry of (Agriculture of the Republic of Indonesia, 2024) shows that peanut yields in the country have declined over the past three years. Production reached 399 thousand tons in 2021, then declined to 380 thousand tons in

2022, and then again to 350 thousand tons in 2023. Therefore, strategies to increase yields by using superior varieties and implementing sustainable cultivation systems are needed to support efficient peanut production in the future.

The use of superior varieties affects the potential for crop production and provides advantages in terms of production, optimal harvest time, and resistance to biotic and abiotic stresses. Currently, various superior peanut seed varieties have been developed, such as Jerapah, Kancil, and Gajah, which offer advantages in productivity, environmental resilience, and harvest time. This study used seeds from the Gajah variety, known for its large pods and high yields (Triyono *et al*., 2021). In addition to the use of superior seeds, efficient cultivation methods such as mulching and effective pest and disease control also play a role in increasing production and reducing the incidence of plant pests.

Mulch is a material that covers the surface of the soil and reduces evaporation, thus maintaining moisture in the root area of the plant and reducing the water needs of the plant ((Kader *et al.*, 2017) and is able to suppress weed growth so that it can increase plant growth.. There are two categories of mulch organic and inorganic. Organic mulch undergoes a decomposition process by soil microorganisms such as bacteria and fungi, which causes organic matter to gradually decompose, and provides nutrients, thereby increasing soil fertility (Angelia *et al.*, 2025). Meanwhile, inorganic mulch, made from synthetic materials such as plastic, is difficult to biodegrade but remains effective in retaining soil moisture. Different types of mulch provide varying levels of protection and affect peanut yields.

Plastic mulch has the advantage of reflecting light from a distance, which can increase chlorophyll formation, reduce pests on the underside of leaves, and maintain soil moisture (Pamuji *et al*., 2018). Banana stem mulch, according to (nurbati amir, 2018), has a relatively high cellulose content, with the main components being water and fiber. This content makes banana leaf easily biodegradable and able to absorb and retain moisture, making it potentially useful as an organic mulch. Meanwhile, mulch from the leaves of the sambung nyawa (*Gynura procumbens*) is known to contain various bioactive compounds such as flavonoids, saponins, alkaloids, and tannins that have the potential to increase organic matter. In contrast to plastic mulch for maintaining soil moisture, organic mulch is able to add nutrients to the soil through the decomposition process (Hang *et al*., 2024).

In organic farming, the use of mulch in peanut cultivation is still limited. This is because organic land supports the presence of soil microorganisms, natural enemies, and biodiversity. However, the application of mulch is necessary to maintain soil moisture, suppress weeds, reduce erosion, and stabilize soil temperature. In this regard, research conducted by (Lahay *et al*., 2022) shows that most research on mulch is mostly conducted on non-organic land, so understanding the effectiveness of mulch in organic farming is still lacking. Therefore, This study evaluates the effectiveness of organic and inorganic mulches in improving peanut productivity under organic farming conditions.

MATERIALS AND METHODS

The study was conducted at PT. KAPOL ANTAR NUSA, Bogor Regency, West Java, Indonesia (-6.72217, 106.773443), from April to July 2025. The research location is approximately 700-900 meters above sea level facing the protected forest of Mount Salak, which has several water sources, such as rivers and springs, which are used for agricultural irrigation. This research used tools in the form of hoes, soil forks, buckets,

kored, watering cans, machetes, rulers,and digital scales. The materials used include Gajah variety peanut seeds, chicken compost, agricultural lime (kaptan), organic mulch in the form of banana stems and sambung nyawa leaves which were chopped before being applied to the land, and inorganic mulch using black and silver plastic mulch. A randomized block design─ with four treatments: M0 (control without mulch), M1 (banana stem mulch), M2 (*Gynura procumbens* leaf mulch), and M3 (black silver plastic mulch). Each treatment was replicated three times. The area of each experimental plot was 10 m x 1 m, with a planting distance of 30 cm x 20 cm. For effective and efficient plant growth, determining the correct planting distance is crucial (Makmur *et al*., 2020).

The study began with land preparation, which included clearing weeds and crop residue. Next, the soil was tilled using a fork and hoe to improve the compacted soil structure so that plant roots could grow well. According to (Wijayanti *et al*., 2024), tillage is carried out to create a soil structure that supports optimal plant growth.

Next, mounds measuring 1 m x 10 m were created, followed by the application of 40 kg of cow manure per mound. This aligns with research (Ashar & Sabahannur, 2024), which explains that a dose of 40 tons/ha of manure provides optimal results in increasing plant height and seed pod weight. This is also accompanied by the application of 250 g of agricultural lime (captan) per bed.

The next step is mulching according to the treatment. Black-silver plastic mulch (M3) is installed before planting, evenly covering the bed surface and making holes 30 cm x 20 cm apart. Meanwhile, organic mulch made from banana stem (M1) and *Gynura procumbens* leaves (M2) is applied after the peanut plants germinate, with two applications, 7 and 35 days after planting. The primary mulch requirement per bed in M1 is 35 kg of banana stem, while in M2, 15 kg of *Gynura procumbens* is used. The thickness of the organic mulch used in both treatments is approximately 3 cm.

Planting is done by inserting two Gajah peanut seeds into the planting hole 3 cm deep. Then, the seeds were lightly covered with loose soil and watered until moist. Thinning and replanting were carried out when the plants were 7 days old to ensure even growth. Plant care included watering, weeding, and pest and disease control. Watering was done twice daily, in the morning and evening, depending on weather conditions. Weeding was done manually to prevent competition for nutrients with weeds. In agricultural activities, the presence of weeds negatively impacts plant development, both directly and indirectly (H. Makaruku *et al*., 2022).

Furthermore, observation parameters during the vegetative phase were measured weekly, calculated from 7 to 35 days after planting, including plant height (cm) and number of leaves (leaflets). During the generative phase, when the plants were 81 days old after planting, these parameters included: total weight of peanut plants (g), total number of pods (plant) , number of filled pods (plant), number of empty pods (plant) , total pod weight (g), weight of filled pods (g), weight of empty pods (g), and seed weight (g). To determine the impact of treatments on peanut plant growth and yield, the collected data were analyzed using analysis of variance (ANOVA) at a 5% confidence level. If the results showed significant differences, the analysis was continued with the Least Significant Difference (LSD) test at the 5% level to determine the most optimal treatment for the observed parameters.

RESULTS AND DISCUSSION

Plant Height

Observations on the height of peanut plants showed that the treatment with banana stem mulch (M1) at 35 days after planting

produced an average of 29.61 cm, which means that plant height growth shows significant variation when compared to other treatments (Table 1). This indicates that ground cover using organic banana stem material is able to create more balanced conditions around the roots, so that the process of water and nutrient absorption takes place more efficiently. (Juniati *et al*., 2023) explains how the use of organic mulch causes plants to grow taller because it maintains moisture and improves soil temperature.

Treatments without mulch (M0) and with *Gynura procumbens* leaf mulch (M2) tended to produce lower plant heights, likely due to drier soil conditions and higher surface temperatures, which can inhibit enzyme activity and stem cell growth. Black and silver plastic mulch (M3) showed moderate growth; this treatment was effective in maintaining temperature but did not provide additional nutrient input like organic mulch.

Number of leaves

Observations of the number of leaves on peanut plants at 14, 21, 28, and 35 days after planting showed that the control treatment without mulch (M0) had the highest number of leaves at 21 days after planting (DAP), with 29.33 leaves, and at 28 days after planting (DAP), as many as 45.22 leaves (Figure 1). Differences in leaf number were observed numerically; statistical analysis revealed that this difference was not statistically significant ($p > 0.05$), indicating that mulching did not significantly impact leaf number in peanut plants. Variations in watering intensity also affected leaf growth, with more frequent watering tending to accelerate leaf growth.

Table 1. Average Plant Height

Treatment	Average Plant Height (cm)			
	14 DAP	21 DAP	28 DAP	35 DAP
Control without mulch (M0)	6.78 b	11.61 b	18.22 b	23.50 bc
Banana stem mulch (M1)	9.17a	14.89a	22.44 a	29.61a
Gynura procumbens leaf mulch(M2)	7.50 b	11.61 b	19.39 b	21.50 c
Black silver plastic mulch (M3)	9.22a	14.05a	20.28 ab	25.61 b

Description: The numbers in the treatment column are marked with letters that indicate significant differences based on the 5% LSD test; DAP = Days After Planting

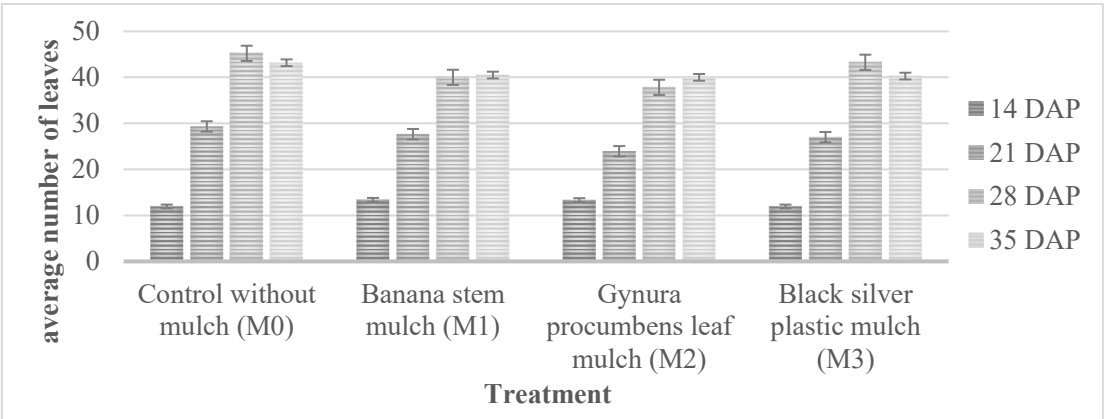

Figure 1. Average Number of Leaves

Meanwhile, treatments with banana stem mulch, *Gynura procumbens* leaf mulch, and black and silver plastic mulch showed no significant changes compared to the control without mulch. This is likely due to the relatively uniform environmental conditions and nutrient availability during the vegetative phase, resulting in an insignificant effect of mulching on leaf growth. Research (Zairani *et al.*, 2023) shows that mulch is able to maintain soil moisture better than without mulch, but this does not always have a significant impact on every observed plant growth parameter.

Total weight of peanut plants

The overall weight of peanut plants showed that the banana stem mulch treatment (M1) produced the highest overall weight, namely 221 g, followed by black silver plastic mulch (M3) with an average of 202 g, *Gynura procumbens* leaf mulch (M2) with an average of 200 g, and the control without mulch (M0) with the lowest average of 191 g (Figure 2). The difference in overall weight is numerical, but statistical analysis showed that the difference was not statistically significant ($p > 0.05$). The highest average value in banana stem mulch is thought to be due to the nature of its organic material which is easily decomposed, thus increasing the presence of nutrients such as nitrogen (N), phosphorus (P), and potassium (K) in the soil. This result is in line with research (Yu *et al*., 2018) the use of organic mulch increases nutrients in the soil after the decomposition process, so that the availability can last longer.

Total number of pods

Total number of bean pods shows the banana stem mulch treatment (M1) produced the highest average yield of 37.94 plant (Figure 3). The difference in the total number of pods was numerically significant however, statistical analysis showed that the difference was not statistically significant ($p > 0.05$). This indicates that the use of various types of mulch did not have a significant impact on the total number of bean pods. These results are in line with research (Sukma *et al*., 2024) which explains that organic mulch plays a role in maintaining moisture and improving soil structure, but its effect on crop yields can vary depending on the type of mulch used and the physiological characteristics of the plants tested.

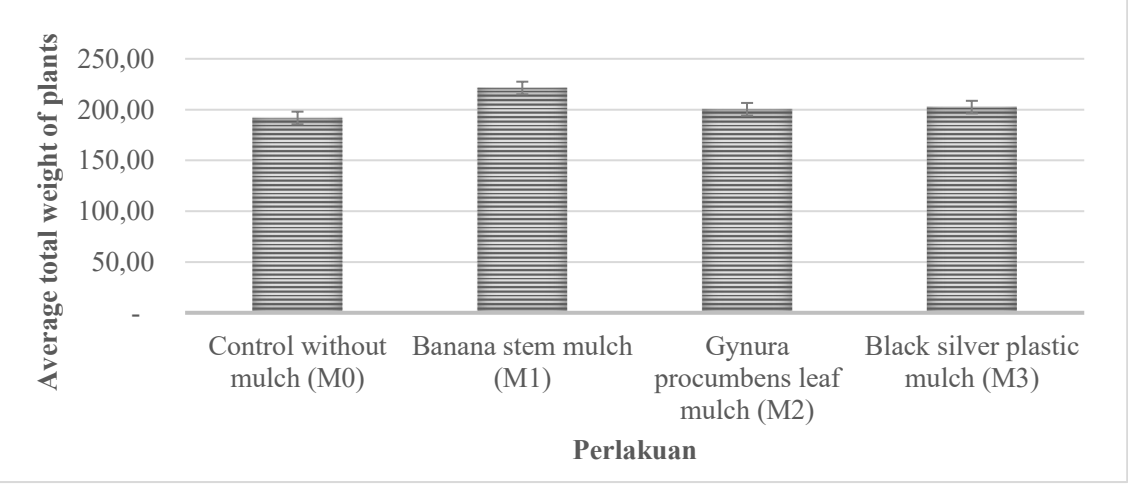

Figure 2. Average total weight of peanut plants

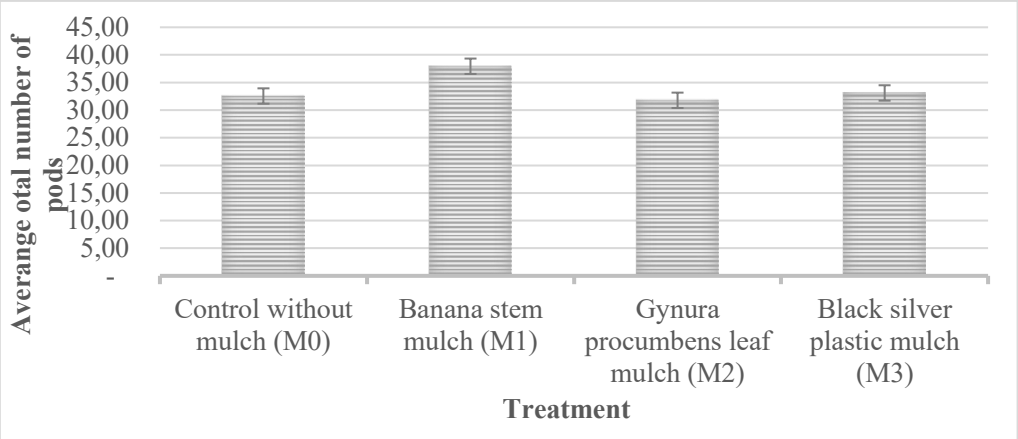

Figure 3. Average Total Number of Pods

Number of Filled Pods

Observations on the number of filled pods in peanut plants showed that the banana stem mulch treatment (M1) produced an average of 26.50 pods per plant, significantly higher than the other treatments (Table 2). The increased yield is due to the organic matter's ability to retain soil moisture and stabilize the temperature around the roots, thus creating optimal growing conditions for pod formation and filling. According to (Nusa *et al*., 2023), the use of banana stem mulch increases peanut plant growth and yield by improving soil physical conditions and nutrient uptake efficiency.

The control treatment without mulch (M0), the *Gynura procumbens* leaf mulch (M2), and the black and silver plastic mulch (M3) each produced an average number of filled pods of 19.72 , 19.94 , and 19.28 , respectively. These three treatments differed significantly from the banana stem mulch treatment (M1). The low number of filled pods in the control treatment without mulch was caused by rapid soil moisture loss due to direct evaporation from the soil surface, resulting in water stress in the plants during the generative phase. While the *Gynura procumbens* leaf mulch treatment reduced evaporation, its effectiveness in maintaining soil moisture and temperature stability was not as good as that of banana stems due to its biodegradability. Meanwhile, the black and silver plastic mulch treatments resulted in fewer full pods than the control, possibly due to excessively high soil temperatures and lack of aeration, which resulted in suboptimal root activity and pod formation.

Number of Empty Pods

The number of empty pods in peanut plants showed that the treatment using black silver plastic mulch (M3) produced the highest number of empty pods, namely 13.95 per plant, compared to the other treatments (Figure 4). The difference was numerically significant, but statistical analysis showed that the difference was not statistically significant ($p > 0.05$).

The high average value in the M3 black silver plastic mulch treatment is thought to be caused by an imbalance between soil temperature, moisture, and aeration, which is influenced by the physical properties of the mulch material. According to (Harefa & Laia, 2024), the use of black silver plastic mulch can increase soil temperature compared to other types of mulch, but organic mulch is more effective in retaining moisture and absorbing nutrients.

Table 2. Average Number of Filled Pods

Treatment	Average Weight of Filled Pods
Control without mulch (M0)	19.72 b
Banana stem mulch (M1)	26.50 a
Gynura procumbens leaf mulch (M2)	19.94 b
Black silver plastic mulch (M3)	19.28 b

Description: The numbers in the treatment column are marked with letters that indicate significant differences based on the 5% LSD test

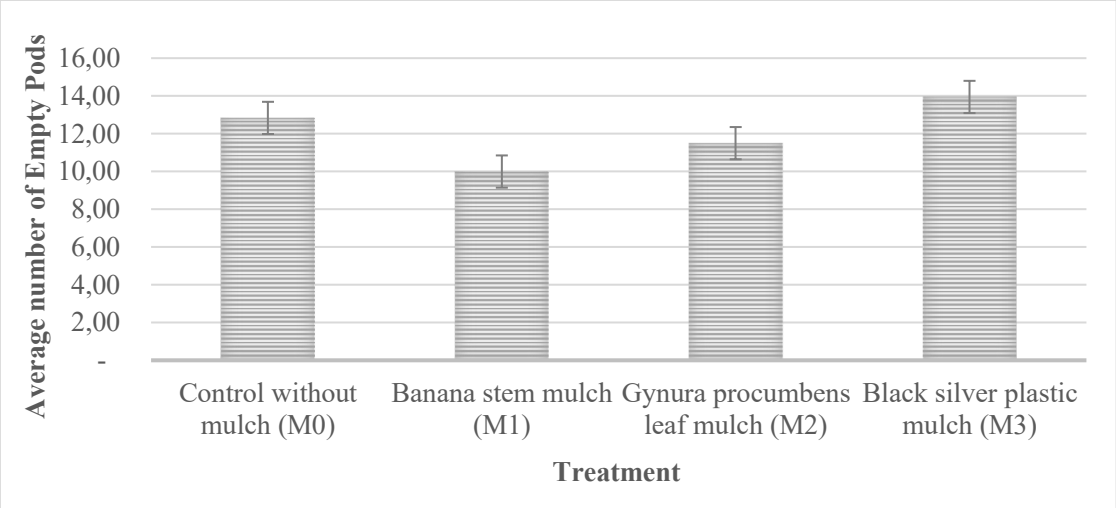

Figure 4. Average Number of Empty Pods

Total Pod Weight

Observations on the overall pod weight of peanut plants showed that the banana stem mulch treatment (M1) produced the highest average of 68.56 g, compared to other treatments (Figure 5). Although the difference in the average treatment values was numerically significant, statistical analysis showed that the difference was not statistically significant ($p > 0.05$), meaning that the mulch treatment did not have a significant impact on the overall pod weight of peanut plants. According to (Gultom *et al.*, 2021), banana stems contain 16% calcium, 23% potassium, and 32% phosphorus, as well as other materials such as lignocellulose consisting of 26.6% cellulose, 20.43% hemicellulose, and 9.92% lignin, which plays a role in maintaining soil fertility and long-term biological balance.

Filled Pod Weight

In contrast, the treatments without mulch, mulch with G*ynura procumbens* leaves, and black silver plastic mulch produced lower pod weights, at 52.00 g, 51.61 g, and 53.39 g, respectively, meaning that these three treatments were not significantly different from each other, but significantly different from banana stem mulch (Table 3). The low yield in the treatment without mulch was caused by the absence of a protective layer on the soil surface, so that moisture was quickly lost due to evaporation and the soil temperature experienced high fluctuations.

Meanwhile, *Gynura procumbens* leaf mulch is less effective because the leaves are thin and decompose quickly, making it unable to retain soil moisture for long periods. On the other hand, black and silver plastic mulch can maintain stable soil temperature and humidity, but because it doesn't decompose easily, it doesn't provide the additional nutrients needed for plant growth and pod formation.

Empty Pod Weight

The results showed that the use of banana stem mulch (M1) resulted in the lowest empty pod weight, at 3.33 g, significantly lower than the other treatments (Table 4). The use of banana stem mulch can suppress the formation of empty pods. This supports previous research (Mulyadi *et al*., 2019) that organic mulch application, which maintains soil moisture, can increase peanut yields. This condition improves soil physical properties, thereby stimulating better root growth and development, allowing for efficient water and nutrient uptake. The availability of water and nutrients during the pod formation and seed filling phases can increase peanut yields.

The control treatment without mulch, the mulch with *Gynura procumbens* leaves, and the black and silver plastic mulches resulted in higher empty pod weights. These three treatments showed no significant differences among themselves, but differed significantly from the banana stem mulch. In the control treatment without mulch, the soil surface directly exposed to sunlight experienced an increased rate of water evaporation, causing water stress in the plants, especially during the seed formation and filling phases. This condition resulted in some pods failing to fully fill. The average weight of empty pods in the *Gynura procumbens* leaf mulch treatment was higher. This is likely due to the thin, easily degraded structure of the mulch, which accelerates decomposition and triggers temporary nitrogen competition between microorganisms and plants. Microorganisms actively decomposing organic matter with a high C/N ratio require large amounts of nitrogen, thereby reducing nitrogen availability to plants and resulting in suboptimal seed filling. Meanwhile, the black silver plastic mulch (MPHP) treatment, although effective in maintaining soil moisture and temperature stability, its inorganic nature prevents the availability of additional organic matter and nutrients. Therefore, the yield increase obtained from this mulch was not as high as that produced by the organic banana stem mulch.

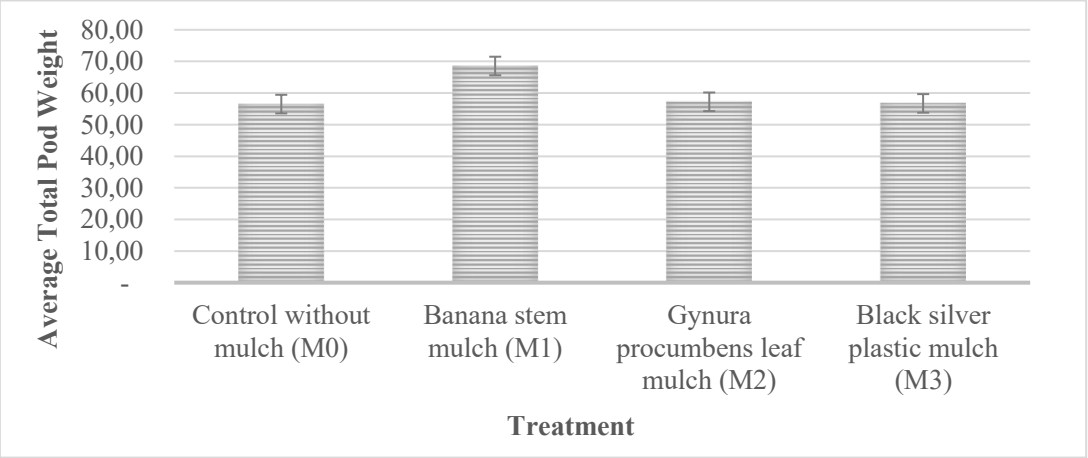

Figure 5. Average Total Pod Weight

Table 3. Average Weight of Filled Pods

Treatment	Average Weight of Filled Pods
Control without mulch (M0)	52.00 b
Banana stem mulch (M1)	65.22 a
Gynura procumbens leaf mulch (M2)	51.61 b
Black silver plastic mulch (M3)	53.39 b

Description: The numbers in the treatment column are marked with letters that indicate significant differences based on the 5% LSD test

Table 4. Average Weight of Empty Pods

Treatment	Average Weight of Empty Pods
Control without mulch (M0)	4.50 ab
Banana stem mulch (M1)	3.33 b
Gynura procumbens leaf mulch (M2)	5.61 a
Black silver plastic mulch (M3)	4.94 a

Description: The numbers in the treatment column are marked with letters that indicate significant differences based on the 5% LSD test

Seed Weight

The results showed that the banana stem mulch treatment (M1) produced a seed weight of 36.05 g, significantly higher than the other treatments (Table 5). This indicates that the use of banana stem mulch is effective in increasing peanut yields. According to (Situmorang *et al*., 2025), banana stems are rich in various nutrients, including nitrogen (N), phosphorus (P), and potassium (K), which support soil fertility and plant growth. Nitrogen supports vegetative growth. Phosphorus plays a role in stimulates root development, as well as accelerating flowering and seed maturation. Meanwhile, potassium regulates photosynthesis.

The control treatment without mulch (M0), *Gynura procumbens* leaf mulch (M2), and black and silver plastic mulch (M3) produced lower seed weights, at 25.56 g, 23.83 g, and 24.89 g, respectively. These three treatments did not show significant differences among themselves, but differed significantly from the banana stem mulch treatment.

The low yield in the control treatment without mulch was caused by the high rate of water evaporation from the soil surface, which caused stress on the plants during the seed formation phase, resulting in lower seed weight. *Gynura procumbens* leaf mulch produced the lowest seed weight because the material has a structure that is easily decomposed naturally and quickly loses its physical function. The rapid decomposition process can also cause nitrogen competition between microorganisms and plants due to the decomposition of organic matter. The black and silver plastic mulch (MPHP) treatment, although effective in suppressing evaporation and maintaining stable soil temperatures, is inorganic and therefore does not provide additional organic nutrients. As a result, the increase in harvest yields obtained was not as high as in the banana stem mulch treatment, because there was no contribution of organic nutrients that increased soil fertility biologically.

Table 5. Average Seed Weight

Treatment	Average Seed Weight
Control without mulch (M0)	25.56 b
Banana stem mulch (M1)	36.05 a
Gynura procumbens leaf mulch (M2)	23.83 b
Black silver plastic mulch (M3)	24.89 b

Description: The numbers in the treatment column are marked with letters that indicate significant differences based on the 5% LSD test

CONCLUSION

The results of the study indicate that in organic farming, the application of various types of mulch has different impacts on the growth and yield of peanuts (*Arachis hypogaea* L.) plants. The organic mulch treatment from banana stem mulch (M1) produced the best result compared to other treatments, with a plant height of 29.61 cm, a number of filled 26.50 pods plant, a filled pod weight of 65.22 g, and a seed weight of 36.05 g. This treatment also produced the lowest empty pod weight, at 3.33 g. This indicates that the use of abundant and readily biodegradable banana stem mulch helps retain soil moisture, improves soil physical properties, and increases nutrient availability through the decomposition of organic matter. This improved soil condition creates a more favorable environment for plant growth. The use of *Gynura procumbens* leaf mulch and black and silver plastic mulch resulted in lower results for peanut growth and yield parameters. Therefore, banana stem mulch has strong potential as an environmentally sustainable strategy to improve peanut productivity in organic farming systems.

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