JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 8 No. 2 May 2026

DOI :https://doi.org/10.36378/juatika.v8i2.5032
eissn 2656-1727
pissn 2684-785X
pages : 706 – 711

REVIEW ARTICLE Open Access

Optimization of Mycorrhizal Fertilizer Dosage and Goat Manure on Bean (*Phaseolus vulgaris* L.) Plant Yield

Dwi Rosa Ilma Silfia[1], Widi Wurdjani[1,*], Ramdan Hidayat[1]

Abstract

Green beans (*Phaseolus vulgaris* L.) are legume plants widely cultivated in tropical regions, particularly in Indonesia. However, their productivity remains low due to a lack of organic matter and limited availability of essential nutrients, especially phosphorus (P). This study aimed to determine the optimal dosage of mycorrhizal fertilizer and goat manure for the best growth and yield of green bean plants. The experiment was arranged in a factorial design with two factors using a Completely Randomized Design (CRD). The first factor was the dosage of mycorrhizal fertilizer, consisting of four levels: 0, 10, 20, and 30 g per plant. The second factor was the dosage of goat manure, also consisting of four levels: 60, 120, 240, and 480 g per plant. The application of mycorrhizal fertilizer and goat manure to bean plants, using 30 g/plant of mycorrhiza and 480 g/plant of goat manure, produced the best results for pod weight per plant, with an increase of 112.21% compared to the control treatment. The results showed that the combination of 30 g of mycorrhizal fertilizer and 480 g of goat manure per plant significantly affected the number of leaves at 14 and 28 days after planting (DAP), as well as the total pod weight per plant. A dosage of 30 g of mycorrhizal fertilizer per plant produced the highest total number of pods per plant, the best harvest index, the tallest plant height at 28 DAP, and the earliest flowering time. Meanwhile, a dosage of 480 g of goat manure per plant gave the best results for all observed parameters.

Keywords: Legume Plants, Organic Fertilizer, Organic Material, Phosphorus

1. Introduction

Green beans (*Phaseolus vulgaris* L.) are a type of legume widely cultivated in tropical regions. Green beans have high economic and nutritional potential. In Indonesia, the leaves and pods of green beans are widely used as a healthy and nutritious food source containing various essential minerals to meet nutritional needs (Celmeli et al., 2018).

As the food and beverage industry grows, so does the demand for high-quality green beans, which processed food companies use as ingredients in products like nutrient-rich *food bars*. However, domestic green bean production has not been able to meet this demand due to low yields from inadequate cultivation practices (Kartiwa & Endah Djuwendah, 2016).

Plants grown in soils lacking organic matter will struggle to utilize technological inputs such as fertilizers. Therefore, adding organic matter in the form of goat manure is crucial before planting. The organic material in manure can be a source of humus, macro- and micro-nutrients, and a carrier of beneficial microorganisms that can stimulate plant growth (Novitasari et al., 2021).

Field observations indicate several problems with green bean plants, including delayed flowering, prolonged pod development, high flower drop, low flower count, and small pod size at harvest. These problems are partly due to a lack of phosphorus (P).

Phosphate nutrients that are not available for plant absorption when needed are partly due to the low absorption efficiency of phosphate fertilizers. The efficiency of P fertilizers is generally less than 10% because other compounds bind P in the soil. Therefore, the use of P nutrients through the role of mycorrhizae is an alternative to increase P availability for plants (Sari et al., 2016). Plants whose roots are infected by mycorrhizal fungi will find it easier to absorb water and nutrients in the growing medium because the root absorption area is wider, there is a phosphatase enzyme to dissolve phosphorus

*Correspondence: widiwurjani@upnjatim.ac.id
1) Universitas Pembangunan Nasional "Veteran" Jawa Timur - Jl Rungkut Madya, Gunung Anyar, Kota Surabaya, Jawa Timur 60294, Indonesia

nutrients, and it can produce glomalin, which can help the soil structure become more crumbly and can be penetrated by roots (Susanti et al., 2021).

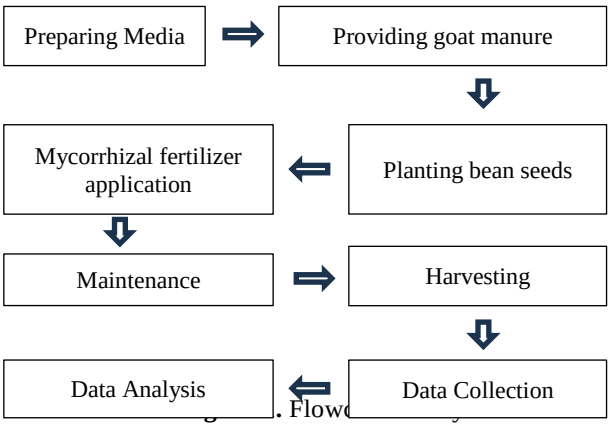
The combination of goat manure and mycorrhizal fertilizer can provide nutrients to long bean plants and increase yields. This was demonstrated by research showing that the use of mycorrhizal fertilizer at 5 grams per plant and goat manure at 5 tons per hectare had the best effect on pod weight and growth in long bean plants (Nainggolan et al., 2020).

This study will further examine the combination of mycorrhizal fertilizer and goat manure to determine whether the combination also provides positive results for bean plant growth. This study aimed to determine the best combination of fertilizer doses and the best dose of mycorrhizal fertilizer and goat manure for bean yield.

2. Material and Methods

The research was conducted in October-December 2024 at Agrifarm, Karangploso, Malang. Located at an altitude of 747 m above sea level with coordinates 7.8728107° South Latitude and 112.5762720° East Longitude. The materials used include: Myco Grow fertilizer, goat manure, upright bean seeds of the gypsy variety, planting media, and polybags. The tools used include shovels, hoes, watering cans, gloves, scales, and meters. The land used is a dry field with inceptisol soil. The research site has an average temperature of 23.91 ℃ and an average rainfall of 2,249 mm/year.

The study was a factorial experiment consisting of two factors and arranged using a Completely Randomized Design (CRD). The first factor was the dose of mycorrhizal fertilizer, consisting of four levels: 0 g/plant, 10 g/plant, 20 g/plant, and 30 g/plant. The second factor was the dose of goat manure, consisting of four levels: 60 g/plant, 120 g/plant, 240 g/plant, and 480 g/plant. The implementation of the research included:



. Flowc

The observation parameters in this study were plant length from 14 to 28 days after planting (DAP), number of leaves from 14 to 28 days after planting (DAP), initial flowering age, number of flowers, number of pods, and total pod weight per plant. The data obtained were then analyzed using Microsoft Excel 2019 software using ANOVA or the F test at the 5% and 1% levels. If the F test had a significant effect, it was continued with the Honestly Significant Difference (HSD) test at the 5% level.

3. Results and Discussion

3.1. Plant Length

The results of the analysis of variance of the effect of the combination of mycorrhizal fertilizer and goat manure doses on the length of green bean plants showed that there was no significant interaction at any observation ages. The single factor of mycorrhizal fertilizer dose treatment had a very significant effect on the length of green bean plants at the age of 28 HST. In contrast, the goat manure dose treatment had a very significant effect on the length of green bean plants at all observation ages. The average value of the length of green bean plants from 14 HST to 28 HST due to the treatment of mycorrhizal fertilizer doses and goat manure is presented in Table 1.

Table 1. Average Plant Length Beans Consequence Influence Dose Fertilizer Mycorrhiza and Fertilizer Pen Goat

Treatment	Plant Length (cm)		
	14 HST	21 HST	28 HST
Mycorrhizal Fertilizer Dosage			
0 (Control) g/plant	16.67 ± 1.68	24.57 ± 1.65	37.24 ± 2.06 a
10 g/plant	16.83 ± 1.30	24.88 ± 1.27	38.76 ± 2.08 ab
20 g/plant	16.35 ± 1.12	25.06 ± 1.59	38.69 ± 2.41 ab
30 g/plant	17.13 ± 1.94	25.43 ± 1.99	40.15 ± 2.21 b
BNJ 5%	**Mr.**	**Mr.**	**1.83**
Goat Manure Dosage			
60 g/plant	15.72 ± 0.55 a	23.63 ± 0.81 a	37.57 ± 1.37 ab
120 g/plant	15.57 ± 0.64 a	24.11 ± 0.19 a	37.11 ± 2.15 a
240 g/plant	16.93 ± 0.83 b	25.38 ± 1.01 b	38.96 ± 1.94 b
480 g/plant	18.75 ± 1.18 c	26.82 ± 1.21 c	41.21 ± 1.64 c
BNJ 5%	**0.90**	**1.17**	**1.83**

Information: The average number followed by the same letter in the same treatment shows no significant difference in the 5% BNJ test.

The treatment of mycorrhizal fertilizer dose of 30 g/plant produced the highest length of bean plants at 28 days after planting. It was significantly different from the control, but not significantly different from other mycorrhizal fertilizer dose treatments. There was an increase in the length of bean plants at 28 days after planting due to the treatment of mycorrhizal fertilizer dose of 30 g/plant by 7.81% compared to the mycorrhizal fertilizer dose of 0 g/plant. The application of mycorrhizal fertilizer to plants affects plant growth through nutrient absorption of the extraradical hyphae of mycorrhizal fungi (Suherman et al., 2012).

The treatment of goat manure at a dose of 480 g/plant produced the highest bean plant length at all observation ages and was significantly different from other goat manure dose treatments. There was an increase in the length of bean plants at 28 days after planting due to the treatment of goat manure dose of 480 g/plant or equivalent to 40 tons/ha by 9.68% compared to the use of goat manure dose of 60 g/plant. This result was also proven by research (Styaningrum & Dawam Maghfoer, 2013), which showed that the use of goat manure with a dose of 30 to 40 tons/ha showed a good effect on the growth of bean plants.

Goat manure plays a significant role in plant growth. The organic matter in manure can be a source of humus, macro- and micronutrients, and a carrier of beneficial microorganisms that can stimulate plant growth. Fertilization using goat manure can increase plant productivity because it contains various macronutrients (N, P, K) and micronutrients (Mg, Ca, S, Na, Mo, Cu, Fe) that plants need(Rihana et al., 2013).

3.2. Number of Leaves

The results of the analysis of variance of the effect of the combination of mycorrhizal fertilizer and goat manure doses on the number of leaves of green bean plants showed that there was a significant interaction at the age of 14 days after planting and a very significant interaction at the age of 28 days after planting. The single factor of mycorrhizal fertilizer dose treatment had a very significant effect on the number of leaves of green bean plants at the age of 28 days after planting.

The single treatment dose of goat manure had a very significant effect on the number of leaves of green bean plants aged 14 HST-28 HST. The average value of the number of leaves of green bean plants due to the combined effect of the treatment dose of mycorrhizal fertilizer and goat manure is presented in Table 3.2.

Table 2. The average value of the number of leaves of green bean plants due to the combined effect of the treatment dose of mycorrhizal fertilizer and goat manure

Age (HST)	Treatment	Number of leaves (stalks)			
		Goat Manure Dosage (g/tan)			
Mycorrhizal Fertilizer Dosage (g/plant)		60	120	240	480
14	0 (Control) g/plant	3.00 ± 0.00 a	2.89 ± 0.19 a	3.00 ± 0.00 a	3.11 ± 0.19 ab
	10 g/plant	2.89 ±0.19 a	2.89 ± 0.19 a	3.22 ± 0.19 ab	3.22 ± 0.19 ab
	20 g/plant	2.78 ± 0.19 a	3.00 ± 0.00 a	3.11 ± 0.19 ab	3.67 ± 0.33 b
	30 g/plant	2.78 ± 0.38 a	3.00 ± 0.33 a	3.11 ± 0.19 ab	3.78 ± 0.19 b
BNJ 5%			**0.65**		
28	0 (Control) g/plant	9.67 ± 0.00 a	9.78 ± 0.38 a	10.44 ± 1.07 ab	13.00 ± 0.58 bc
	10 g/plant	10.33± 0.33 ab	10.11 ± 0.38 ab	11.56 ± 0.51 b	14.33 ± 0.88 c
	20 g/plant	10.56 ±0.38 ab	10.33 ± 0.33 ab	12.22 ± 0.84 b	15.33 ± 0.00 c
	30 g/plant	11.00 ±0.00 ab	11.67 ± 0.33 b	14.40 ± 1.02 c	15.78 ± 0.51 c
BNJ 5%			**1.72**		

Information: The average number followed by the same letter in the same treatment shows no significant difference in the 5% BNJ test.

The combination of 30 g/plant mycorrhizal fertilizer and 480 g/plant goat manure at 14 days after planting produced the highest average number of leaves. There was a 26% increase in the number of leaves in bean plants 14 days after planting compared to the combination of 0 g/plant mycorrhizal fertilizer and 480 g/plant goat manure.

The combination of 30 g of mycorrhizal fertilizer/plant and 480 g of goat manure/plant at 28 days after planting resulted in the highest average number of leaves. There was a 21.38% increase in the number of leaves in green bean plants at 28 days after planting compared to the combination of 0 g of mycorrhizal fertilizer/plant and 480 g of goat manure/plant.

Providing mycorrhizal fertilizer that forms a symbiosis with plant roots, combined with the addition of manure, can make it easier for plants to absorb nutrients available in the soil so that nutrients can be absorbed optimally (Mawardiana et al., 2024).

3.3. Age of First Flower Appearance

The results of the analysis of variance of the combined effects of mycorrhizal fertilizer and goat manure on the age of first flowering in green bean plants showed no significant interaction. The single factors of mycorrhizal fertilizer and goat manure doses each had a very significant and significant effect on the age of first flowering in green

bean plants. The average age of first flowering due to mycorrhizal fertilizer and goat manure treatments is presented in Table 3.

Table 2. Average Age of Initial Flowering in Green Bean Plants: Consequence of Fertilizer and Goat Manure Treatments

Treatment	Early Flowering Age (DAP)
Mycorrhizal Fertilizer Dosage	
0 (Control) g/plant	32.50 ± 1.2 b
10 g/plant	30.92 ± 1.1 a
20 g/plant	30.67 ± 1.1 a
30 gr/plant	30.17 ± 0.4 a
BNJ 5%	**1.08**
Goat Manure Dosage	
60 g/plant	31.67 ± 1.6 b
120 g/plant	31.42 ± 1.6 a
240 g/plant	30.67 ± 0.9 a
480 g/plant	30.58 ± 0.8 a
BNJ 5%	**1.08**

Information: The average number followed by the same letter in the same treatment shows no significant difference in the 5% BNJ test.

The 30 g/plant mycorrhizal fertilizer treatment resulted in the lowest average flowering age, meaning the initial flowering age of the bean plants was faster, but not significantly different from the 10 and 20 g/plant doses. The in g/plant mycorrhizal fertilizer treatment increased the speed of first flower emergence of the bean plants to the 30 g/plant mycorrhizal fertilizer treatment of 55.92 hours, compared to the control treatment.

The goat manure dose of 480 g/plant produced the lowest average, meaning that this treatment resulted in the earliest flowering time for the bean plants, but was not significantly different from the goat manure doses of 60 and 120 g/plant. There was an increase in the flowering speed of the bean plants due to the goat manure dose of 480 g/plant by 24 hours compared to the dose of 60 g/plant.

3.4. Amount of Interest

The results of the analysis of variance of the combined effects of mycorrhizal fertilizer and goat manure on the total number of flowers in green bean plants showed no significant interaction. However, the single factors of mycorrhizal fertilizer and goat manure doses each had an insignificant and a very significant effect on the total number of flowers in green bean plants. The average value of the total number of flowers in green bean plants due to the influence of mycorrhizal fertilizer and goat manure is presented in Table 4.

Table 43 Average Number of Flowers per Total Plant Beans Consequence Influence Dose Fertilizer Mycorrhiza and Fertilizer Pen Goat

Treatment	Total Number of Flowers (flowers)
Mycorrhizal Fertilizer Dosage	
0 (Control) g/plant	28.69 ± 6.4
10 g/plant	30.97 ± 8.5
20 g/plant	31.94 ± 7.9
30 g/plant	31.25 ± 6.5
BNJ 5%	**Mr.**
Goat Manure Dosage	
60 g/plant	23.69 ± 1.7 a
120 g/plant	26.50 ± 2.4 a
240 g/plant	32.31 ± 4.8 b
480 g/plant	40.36 ± 3.8 c
BNJ 5%	**3.04**

Information: The average number followed by the same letter for the same treatment shows no significant difference in the 5% BNJ test. tn = no significant effect.

The highest average total flower number for green bean plants was obtained with a mycorrhizal fertilizer dose of 20 grams/plant. The 20 g/plant mycorrhizal fertilizer treatment resulted in an 11.3% increase in the total flower number of green bean plants compared to the control treatment.

The highest average total flower number was obtained with the 480 g/plant goat manure treatment. The total flower number of green bean plants increased by 70.37% due to the 480 g/plant goat manure treatment compared to

the 60 g/plant treatment.

3.5. Number of Pods

The results of the analysis of variance for the combined effect of mycorrhizal fertilizer and goat manure on the total number of pods per bean plant showed no significant interaction. However, the single factors of mycorrhizal fertilizer and goat manure each had significant and highly significant effects on the total number of pods per bean plant. The average number of pods per bean plant is presented in Table 5.

Table 4. Average Number of Total Plant Pods Beans Consequence Influence Dose Fertilizer Mycorrhiza and Fertilizer Pen Goat

Treatment	Total Number of Pods of Plant
Mycorrhizal Fertilizer Dosage	
0 g/plant	25.25 ± 5.80 a
10 g/plant	28.14 ± 8.37 a
20 g/plant	28.83 ± 7.55 b
30 g/plant	27.36 ± 6.08 a
BNJ 5%	**3.58**
Goat Manure Dosage	
60 g/plant	20.78 ± 1.64 a
120 g/plant	23.11 ± 2.21 a
240 g/plant	29.55 ± 5.41 b
480 g/plant	36.14 ± 5.25 c
BNJ 5%	**3.58**

Information: The average number followed by the same letter in the same treatment shows no significant difference in the 5% BNJ test.

The 20 g/plant mycorrhizal fertilizer treatment resulted in the highest total number of pods per bean plant and was significantly different from the other treatments. The in g/plant mycorrhizal fertilizer treatment increased the total number of pods per bean plant by 14.2% compared to the control treatment. The use of 25 g/plant mycorrhizal fertilizer influenced plant biomass, seed fresh weight, and the percentage of mycorrhizal infection in mung beans (Putri et al., 2019).

The 480 g/plant goat manure treatment resulted in the highest total number of pods per bean plant, significantly different from the other treatments. The 480 g/plant goat manure treatment increased the total number of pods per bean plant by 74% compared to the 60 g/plant treatment.

3.6. Total Pod Weight per Plant

The results of the analysis of variance of the effect of the combination of mycorrhizal fertilizer and goat manure doses on the total pod weight per bean plant showed a significant interaction. The single factors of mycorrhizal fertilizer and goat manure doses also each had a very significant effect. The average value of the total pod weight per bean plant due to the combination of fertilizer doses Mycorrhiza and goat manure are presented in Table 6.

The combination of 30 g/plant Mycorrhizal Fertilizer and 480 g/plant goat manure treatment produced the highest total pod weight per bean plant, with an increase in total pod weight per bean plant of 112.21% when compared to the combination of 0 g/plant mycorrhizal fertilizer and 480 g/plant goat manure treatment. The provision of mycorrhizal fertilizer that forms a symbiosis with plant roots, combined with the addition of goat manure, can make it easier for plants to absorb nutrients available in the soil so that nutrients can be absorbed optimally (Awardiana et al., 2024). The effectiveness of the use of mycorrhizal and manure was proven by Nainggolan et al. (2020), who found that the combination of 5 g/plant mycorrhizal fertilizer and 5 tons/ha manure had a significant effect on pod weight results.

Table 5. Average Total Pod Weight per Plant Beans Consequence Influence Combination Dose Fertilizer Mycorrhiza and Fertilizer Pen Goat

Treatment	Total Pod Weight per Plant (grams)			
	Goat Manure Dosage (g/tan)			
Mycorrhizal Fertilizer Dosage (g/plant)	60 g/plant	120 g/plant	240 g/plant	480 g/plant
0 (Control) g/plant	164.33 ±13.03 ab	167.07 ± 40.89 ab	189.20 ± 6.32 ab	303.10 ± 20.14 c
10 g/plant	167.10 ± 8.07 ab	195.23 ± 17.68 ab	266.00 ± 17.91 bc	340.83 ±10.88 c
20 g/plant	145.23 ± 31.28 a	213.87 ± 27.51 ab	273.77 ± 46.61 bc	341.83 ± 10.23 c
30 g/plant	175.80 ± 12.50 ab	216.77 ± 27.24 ab	318.83 ± 19.94 c	**348.73 ± 8.54 c**
BNJ 5%		**81.09**		

Description: The average number followed by the same letter shows no significant difference in the 5% BNJ test.

Figure 2. Harvest Results Beans

4. Conclusion

The results of the study showed that the combination of mycorrhizal fertilizer and goat manure treatments of 30 g/plant and goat manure of 480 g/plant affected the parameters of the number of leaves at 14 HST, the number of leaves at 28 HST, and the total pod weight per plant. The single factor of mycorrhizal fertilizer 30 g/plant affected the length of the plant 28 HST and the age of the first flower emergence. The single factor of goat manure 480 g/plant affected all observation parameters.

References

Celmeli, T., Sari, H., Canci, H., Sari, D., Adak, A., Eker, T., & Toker, C. (2018). The nutritional content of common bean (*Phaseolus vulgaris* L.) landraces in comparison to modern varieties. *Agronomy, 8*(9), 166. https://doi.org/10.3390/agronomy8090166

Kartiwa, N. A. R., & Djuwendah, E. (2016). Faktor penyebab ketidakmampuan petani memenuhi permintaan babybuncis untuk PT. Alamanda Sejati Utama serta strategi untuk mengatasinya (Studi kasus Kelompok Tani Tauhid, Kabupaten Bandung Barat). *Jurnal Social Economic of Agriculture, 5*(1), 28–38. https://doi.org/10.26418/j.sea.v5i1.15057

Mawardiana, Karnilawati, Al-Hadi, B., & Isnawati. (2024). Aplikasi mikoriza dan pupuk kandang untuk meningkatkan produksi tomat. *Jurnal Agroristek, 7*(2), 63–70. https://doi.org/10.47647/jar.v7i2.2641

Nainggolan, E. V., Bertham, Y. H., & Sudjatmiko, S. (2020). Pengaruh pemberian pupuk hayati mikoriza dan pupuk kandang ayam terhadap pertumbuhan dan hasil tanaman kacang panjang (*Vigna sinensis* L.) di Ultisol. *Jurnal Ilmu-Ilmu Pertanian Indonesia, 22*(1), 58–63. https://doi.org/10.31186/jipi.22.1.58-63

Novitasari, D., & Caroline, J. (2021). Kajian efektivitas pupuk dari berbagai kotoran sapi, kambing dan ayam. *Seminar Teknologi Perencanaan, Lingkungan, dan Infrastruktur*, 442–447. https://ejurnal.itats.ac.id/stepplan/article/view/1606

Putri, T. E., Yuliani, & Trimulyono, G. (2019). Penggunaan mikoriza vesikular arbuskular (MVA) genus *Glomus* untuk meningkatkan pertumbuhan dan produksi tanaman kacang hijau (*Vigna radiata*) pada cekaman air. *Lentera, 8*(2), 107–112. http://ejournal.unesa.ac.id/index.php/lenterabio

Rihana, S., Heddy, Y. B. S., & Dawam, M. (2013). Pertumbuhan dan hasil tanaman buncis (*Phaseolus vulgaris* L.) pada berbagai dosis pupuk kotoran kambing dan konsentrasi zat pengatur tumbuh Dekamon. *Jurnal Produksi Tanaman, 1*(4). https://doi.org/10.21176/protan.v1i4.46

Sari, D. N., Yusnaini, S., Niswati, A., & Sarno. (2016). Pengaruh dosis dan ukuran butir pupuk fosfat super yang diasidulasi limbah cair tahu terhadap serapan P dan pertumbuhan tanaman jagung (*Zea mays* L.). *Jurnal Agrotek Tropika, 4*(1), 81–85. https://doi.org/10.23960/jat.v4i1.1907

Styaningrum, L., & Maghfoer, M. D. (2013). Respons tanaman buncis (*Phaseolus vulgaris* L.) terhadap dosis pupuk kandang kambing dan pupuk daun yang berbeda. *Jurnal Produksi Tanaman, 1*(1), 54–60. https://doi.org/10.21176/protan.v1i1.7

Suherman, Rahim, I., & Akhsan, A. M. (2012). Aplikasi mikoriza vesikular arbuskular terhadap pertumbuhan dan produksi tanaman kedelai. *Jurnal Galung Tropika, 1*(1), 1–6. https://doi.org/10.31850/jgt.v1i1.29

Susanti, A., Aziz, A. A., & Muhibuddin, A. (2021). The effectiveness of adding mycorrhizae and fertilizer composition on the growth of spinach (*Amaranthus* sp.). *Jurnal Agronomi Tanaman Tropika, 3*(2), 135–147. https://doi.org/10.36378/juatika.v%vi%i.1396