IOP Conference Series:
Earth and
Environmental Science

PURPOSE-LED PUBLISHING™

PAPER • OPEN ACCESS

Integration of Arbuscular Mycorrhizae Types and Selective Pruning on Nutrient Uptake and Growth of bird's eye chili (Capsicum frutescens L.) on Andisols

To cite this article: Syatriana Canega *et al* 2026 *IOP Conf. Ser.: Earth Environ. Sci.* **1614** 012008

View the article online for updates and enhancements.

You may also like

- Improvement of soybean yields using amendments on dryland soils of Aceh Besar, Indonesia
S Sufardi, S Syakur, M Mislia et al.
- Examination of mycorrhizal inoculum for improving maize tolerance to water stress in pot culture using zeolite and Andisol
V R Cahyani, Suryanti, D F Setiawan et al.
- Response of Andisols to intensive agricultural land use: Implication on changes in P accumulation and colloidal surface charge
M Anda, A Kasno, C B Ginting et al.

This content was downloaded from IP address 87.49.42.83 on 30/09/2026 at 13:12

Integration of Arbuscular Mycorrhizae Types and Selective Pruning on Nutrient Uptake and Growth of bird's eye chili (Capsicum frutescens L.) on Andisols

Syatriana Canega[1*], Syafruddin [2], and Syakur [3]

[1] Master of Agroecotechnology study program, Syiah Kuala University, Banda Aceh, Indonesia
[2] Agrotechnology department, Syiah Kuala University, Banda Aceh, Indonesia
[3] Soil science department, Syiah Kuala University Banda Aceh, Indonesia

* E-mail: canega5@mhs.usk.ac.id

Abstrak: bird's eye chili (*Capsicum frutescens* L.) is one of the horticultural plants that has commercial value, thus significantly impacting the improvement of community economic well- being. Plant growth and productitivity can be enhanced throught the application of arbuscular mycorrhizae types. In addition to using Arbuscular Mycorrhizae, selectively pruning plant shoots at certain phases can also increase the number of fruits on the plant. This research aimed to evaluate the combined effect of arbuscular mycorrhizae and selective pruning in improving the growth and productivity of bird's eye chili plants on andisol soil media. The research was conducted at Kopelma Darussalam, Syiah Kuala District, Banda Aceh City, from August to October 2025 using a factorial randomized block design with three replications, resulting in 36 units. The observed morphological parameters include plant height, stem diameter, and leaf area. The results show a significant effect on height and stem diameter, and an interaction on leaf area parameters. The results indicated a strong correlation among vegetative growth parameters. These findings suggest that vegetative growth in that the bird's eye chili plants growth system is integrative manner. The combination of these two treatments makes the relationship between vegetative parameters more stable and consistent. The application of mixed arbuscula to combined with selective pruning showed a positive potential influence on bird's eye chili growth.

Keywords: Pruning, mycorrhizae, Chili, Andisol, Interaction, Leaf area

1. Introduction

bird's eye chili (Capsicum frutescens L.) is a high-value horticultural commodity widely cultivated by farmers, both in the highlands and lowlands. Chili peppers contain the compound capsaicin, which controls the spiciness of the fruit [1]. Andisol soils have a dusty soil structure, loose consistency, and high organic matter content. The cation exchange capacity of volcanic soils is high. Their physical, chemical, and morphological properties can support plant growth, but the problem lies in the difficult retention of P, which affects plant growth [2]. The application of AM fungi can significantly aid plant growth in managing P nutrient to andisol on low P soils increased

Content from this work may be used under the terms of the Creative Commons Attribution 4.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

soil P availability, degree of root infection, vegetative growth, and plants production [3].

In the development of bird's eye chilli plant productivity, it is certainly influenced by many factors, especially the availability of plant nutrients in the soil and treatments that facilitate

photosynthesis. Efforts to increase plant growth and production are often done using inorganic fertilizers [4]. Growth can be increased by applying AM fungi, which are fungi found in plant roots and play a role in nutrient absorption, especially P, water, and as a protector of plant roots from soil pathogensa and the fungal function can be used as a biofertilizer [5]. Arbuscular Mycorrhizal have several types, with Glomus being the dominant genus in both regions, indicating its wider distribution compared to other genera, and it is dominated by silty clay soil texture [6]. This clay fraction is a criterion for the development of Glomus mosseae spores [7]. The Gigaspora type shows its abundance in soil characteristics that support its presence, namely sandy soil [8]. The combination of AM fungil types (Glomus mosseae and Gigaspora sp.) can be supported by the application of clay and sandy soil, which can survive in different textures and work actively on marginal land [9].

In addition treatment biogical approaches, selective pruning is a cultivation practice that can influence the distribution of photosynthates and the balance in plant growth. Pruning is a practice aimed at controlling growth, stimulating the development of new branches, and thus improving the efficiency of nutrient absorption by the plant. Pruning the shoot can affect the yield of the crop [10]. Pruning branches below the dichotomy influences plant growth and the quality of cayenne pepper plants, affecting growth during the vegetative phase by directing productive organs upwards and focusing nutrient flow more effectively [11].

2. Materials and methods

2.1 Research Design

The research will be conducted from August to October 2025 at the I Experimental Garden, Faculty of Agriculture, Syiah Kuala University. Observation of crop data at the Horticulture Laboratory, Department of Agrotechnology, Banda Aceh (5°33′18.7″ N; 95°20′16.7″ E; 4 masl). This research used chili seeds of the Pelita 8 F1 variety, arbuscular mycorrhizae of the Glomus mosseae type (M1) and Gigaspora sp (M2), as well as mixed AM fungi types [Glomus mosseae + Gigaspora sp] (M3) and Control (M0), and andisol soil from Suka Damai village, Lembah Seulawah sub-district, Aceh Besar district, which was used as the growing medium.

2.2 Sowing and Arbuscular mycorrhizae

Inoculation Chili seeds were sown in 10 x 5 cm polybags with a 1:2 ratio of manure to andisol soil. Each hole contained 2 chili seeds, and 5 g of AMF product per plant were applied directly to the seeds to accelerate interaction with the plant roots. from the seedling stage until 25 days after sowing (DAS) or until the plant has 5-7 true leaves. Land preparation was carried out by weeding the land and transferring pots containing soil into pots at a rate of 10 kg per plant, followed by a second dose of AM fungi product at a rate of 5 g per plant. At 7 days after planting, NPK fertilizer was applied at a rate of 0.983 g per plant. Maintenance begins with watering, weeding, pruning, fertilizing, and pest and disease control. Watering is done twice every morning and evening using a watering can until the field is fully saturated. Weeding is done twice a week in the research area because it can be a vector for pests and diseases. Fertilization using NPK fertilizer, the fertilizer is applied at a rate of 250 ml per plant. Pest and disease control is done mechanically and using tobacco extract when there are symptoms of ant infestation on the plants.Pruning Treatment Shoot pruning treatment is carried out at the age of 26 DAT by cutting the shoots of the plant with a 1.5 cm sweep. and pruning of dichotonomes is carried out

periodically.

2.3 Experiment design and observation parameters

This study used a randomized complete block design (RCBD) design with a factorial pattern with 4 AM fungi types treatments and 3 trimming using 4 treatments for 3 replications each so that 36 experimental units were obtained. Each unit consists of two plants, so there are a total of 12 plants in each location. Observation parameters include morphological parameters, such as plant height, stem diameter, and leaf area.

3. Results and discussion

3.1 Recapitulation of variance analysis

The recapitulation of variance analysis on a parameter due to the height of bird's eye chilli plants against the application of AM fungi types, as shown in table 1.

Table 1. Average application of AM fungi types to the height of bird's eye chilli plants in andisol soil

Sample Code	Plant Height (cm)	
	15 DAT	30 DAT
Glomus Mosseae	11,52	24,17c
Gigaspora SP	12,66	24,11b
Glomus mosseae + Gigaspora sp	12,72	27.38d
Control (without AMF)	13,28	22,08a
GDP 0.05	-	1,01

Based on Table 1, it shows that the AM fungi types treatment had a significant effect. The table indicates that mixed mycorrhizal types had the best growth results at 30 days after planting. Differences were observed among treatments. Each type of AMF has varying effectiveness in helping to improve plant growth and yield. Mixed AM fungi types have a higher association rate with plant roots compared to other AM fungi types. Basically, this is supported by the influence of AM fungi, which are able to increase plant resistance to drought, and are therefore considered capable of promoting growth, especially in areas with low rainfall. Currently, AM fungi are receiving a lot of attention due to their ability to associate with 80% of plant species [12].

Table 2. Average stem diameter bird's eye chilli plants result of treatment with AM fungi types

Sample Code	Stem Diameter (mm)	
	15 DAT	30 DAT
Glomus Mosseae	2.20b	3.23c
Gigaspora SP	2.18b	3.04b
Glomus mosseae + Gigaspora sp	2.38c	3.35d
Control (without Mycorhyza)	2.02a	2.86a
GDP 0.05	0,07	0,10

Based on Table 2, it shows that the type of AM fungi treatment has not yet provided a significant difference, but it can be seen that the ratio of AM fungi application on bird's eye chilli plants affects the stem diameter of the chilli plants. From the table, it can be seen that the most likely factor is because mixed AM fungi (Glomus mosseae + Gigaspora sp.) are able to maximize the absorption of phosphorus nutrients, which can stimulate the growth of productive branches in plants. Mycorrhizal hyphae also produce certain compounds that can bind soil aggregate stability, thereby increasing soil water holding capacity. They form a crucial symbiotic relationship with most terrestrial plants, which significantly enhances their resistance to stress. AM fungi enhance nutrient absorption, particularly nitrogen and phosphorus, thru their extensive mycelial network. Additionally, this fungus improves soil structure, increases water use efficiency, and strengthens antioxidant defense mechanisms, particularly in environments stressed by drought, salinity, extreme temperatures, heavy metal contamination, and flooding.

Table 3. Interaction of Leaf Area Impact of AM fungi Types with Pruning of Chili Plants 30 DAT plants

Jenis Mikoriza g plant-1 -	**Prunning**		
	Without	**Shoots**	**Branch**
Glomus Mosseae	20.17Aa	18.27Aa	24.07BCbc
Gigaspora SP	20.17Aab	18.77ABb	21.17ABab
Glomus mosseae + Gigaspora sp	20.77Cd	33.77Bb	29.47ABab
Control (without AMF)	20.37Bc	18.57Bb	17.41ACc
GDP 0.05		2.55	

Note: The numbers followed by the equivalent letters show an intangible difference in the HSD test ($p \leq 0.05$) The capita letters are read horizontally and the lowercase letters are read vertically

Based on Table 3, the application of AM fungi has not yet yielded significant data on the number of bird's eye chilli leaves. However, the results obtained from using AM fungi in the soil show more leaf growth compared to chilli plants without AM fungi application. The interaction between factors shows interesting and physiologically consistent patterns. The combination of Glomus mosseae + Gigaspora sp. with shoot pruning produced a synergistic effect on leaf area (33.77 g plant^{-1}), which was statistically significantly different from the other treatments. This result suggest that the combined effect of AM fungi and shoot pruning is synergistic, not merely additive. AM fungi increase nutrient and water availability, while tip pruning stimulates the formation of new photosynthetic organs. The combination of the two results in a wider and more efficient plant canopy for light capture. Conversely, in the treatment without AM fungi, pruning branches or shoots did not show a significant increase in leaf area.

This indicates that the effect of pruning on increasing leaf area is highly dependent on the AM fungi colonization status in the root zone. AM fungi play a major supporting role in restoring post-pruning vegetative growth. This indicates that mixed AM fungi can enhance leaf expansion in chilli by improving nutrient uptake (particularly P), water status, and photosynthesis [13]. There by increasing leaf area and vegetative biomass. This is also supported by [14], who stated that AMF can alter cytokinin hormone concentrations and improve photosynthetic efficiency, thus promoting the rate of assimilate formation for leaf expansion.

The pruning alters assimilate distribution, although plant height is temporarily reduced. Leaf diameter and area can increase in the later stages (30 DAT), but the relationship between variables remains positive with pruning. This aligns with the opinion of 17) that pruning at 30 DAA can also stimulate the formation of productive branches and often increases total leaf area per plant in the medium term (after the regeneration period). However, with overly aggressive or premature pruning, plants can experience a temporary decrease in leaf biomass. AM fungi

accelerate post-pruning vegetative recovery and increase nutrient availability for newly developing leaves; however, the specific interaction depends on the AMF species, Capsicum variety, and environmental conditions [15]. AMF enhances phosphorus (P) and micro-water absorption, increasing nutrient availability to the leaves. P is essential for leaf development and chlorophyll formation, thus supporting leaf lamina growth and area per leaf. Studies on Capsicum and other solanaceae report increased leaf area/LAI after AMF inoculation [16].

3.2. Correlation of AM fungi types with pruning

Table 4. Correlation between the integration parameters of AM fungi Type with the Pruning of bird's eye chilli plants

Correlations Parameters						
	TT 15 DAT	TT 30 DAT	DB 15 DAT	DB 30 DAT	LD 15 DAT	LD 30 DAT
T 15 DAT	1	0,293	.862**	.855**	0,515	0,494
TT 30 DAT		1	0,456	.643*	0,365	0,450
DB 15 DAT			1	.911**	0,534	.694*
DB 30 DAT				1	.607*	.751**
LD 15 DAT					1	.846**
LD 30 DAT					.	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results of the correlation analysis based on the data above show that there is a significant positive relationship between the vegetative growth parameters of bird's eye chilli plants, both in the early phase (15 DAT) and in the later phase (30 DAT). The correlation coefficient (r) values range from 0.643 to 1.000, all of which indicate a strong to very strong level of relationship based on the correlation table data. This relationship illustrates that an increase in one component of vegetative growth is always followed by an increase in other components, indicating that plant growth is integrated and synergistic due to the combined effects of AM fungi type and pruning treatment. the AM fungi help restore and balance vegetative growth after pruning, maintaining a positive correlation between leaf area and plant height. Tip/branch pruning at 30 DAT manipulates plant architecture because it can stimulate and increase the number of leaves and total leaf area per plant due to the reorganization of source-sink (Zn) resources and the stimulation of lateral shoots [17]. In the observation of plant height (PH) between 15DAT and 30 DAT, a correlation value of $r = 0.293$ ($p < 0.01$) was obtained. This strong correlation indicates that plants that grow faster in the early stages tend to maintain good height growth in subsequent phases. This indicates that early AM fungi colonization can accelerate the absorption of nutrients, especially phosphorus (P) and water, which play an important role in stem cell division and elongation. Additionally, moderate tip pruning does not hinder height growth, but rather strengthens plant vigor by increasing the number of lateral shoots that support vertical growth and physiological balance.

The relationship between plant height and stem diameter at 15 days after planting (DAT) showed a very strong correlation ($r = 0.862$; $p < 0.01$). This indicates that height growth is followed by a proportional increase in stem diameter. Physiologically, plants with high photosynthetic activity have a larger supply of assimilates that are allocated not only for stem elongation but also for stem tissue thickening. The AM Fungi play an important role in this process because they improve the nutritional status of plants, especially for the elements P and Zn, which are related to enzymatic activity and the formation of stem vascular tissue. Meanwhile, the pruning effect can increase the flow of assimilates to the main stem due to reduced competition from the apical bud, thereby thickening the plant stem.

The correlation between plant height and leaf area also showed a strong relationship, with $r = 0.515$ at 15 DAE and $r = 0.494$ at 30 DAE ($p < 0.01$). This relationship confirms that the larger

the leaf area, the higher the plant growth. Leaves are the primary photosynthetic organs that produce energy (ATP and NADPH) and assimilated carbon (carbohydrates), which are necessary for the formation of stem tissues and other organs. AM fungi are known to increase leaf area by improving phosphorus availability, which stimulates chlorophyll formation, thereby increasing the rate of photosynthesis [18]. After pruning, some energy is diverted to new leaf regeneration; although there was a slight decrease in correlation at 30 DAT, the relationship between variables remained strong because pruning stimulated the formation of lateral leaves, which rebalanced the plant's canopy area.

The relationship between stem diameter at 30 days after transplanting (DAT) and leaf area at 15 DAT showed very strong correlation ($r = 1.000$; $p < 0.01$). This value indicates a very close physiological link between photosynthetic capacity in the early phase and the structural development of the plant in the subsequent phase. Plants with large leaf areas at the beginning of growth are able to produce more assimilates to be allocated to stem formation and supporting tissues. AM fungi play a direct role in this process by expanding the root absorption area and increasing the efficiency of nutrient transfer from the soil to plant tissues [19]. Integration with selective pruning strengthens this function, as the photosynthetic energy produced in the early stages can be allocated more effectively to the structural organs remaining after pruning. The correlation between stem diameter and leaf area at both 15 and 30 DAT ($r = 0.534$ and $r = 0.751$) shows a significant positive relationship, indicating that stem and leaf development are interconnected. In the AM fungi treatment, larger stems tend to support a more stable supply of water and nutrients to the leaves, while broad leaves increase the supply of photosynthetic carbon to the stems, forming a mutually reinforcing two-way physiological relationship. The balance between leaf area and stem thickness is an indication of the efficiency of nutrient transport and photosynthetic yield during the vegetative phase [20]. In general, a strong correlation pattern between all growth parameters gives positive results in the chilli poultry growth system. plants is integrative. AM fungi acts as a foundation growth enhancer by accelerating the formation of photosynthetic tissues and nutrient absorption, while pruning acts as a growth rebalancer that ensures a balance between vertical, lateral, and stem thickening. The combination of these two treatments causes the relationship between vegetative parameters to be more stable and consistent from the initial to the advanced phase (15–30) DAT.

4. Conclusions

The effect of bird's eye chilli growth on plant height has a significant effect on plant height and diameter in the application of mixed arbuscular mycorrhizae with the interaction contained in the parameter of leaf area, the application of mixed AM fungi (*Glomus mosseae* + *Gigaspora sp*.) combined with selective pruning pruning improved vegetative growth parameters of bird's eye chilli plants gives good results. evident in a very strong correlation pattern between all growth parameters. It is important that the growth system of chilli plants is integrative. The combination of these two treatments causes the relationship between vegetative parameters to be more stable and consistent The application of mixed AM fungi type to pruning branches shows a potential influence on the growth of bird's eye chilli.

References

[1] Yang N, Yang Q, Chen J, and Fisk I 2020 Impact of capsaicin on aroma release and perception from flavoured solutions. LWT 138 -110613.

[2] Sukarman S, Dariah A, and Suratman S 2020 Volcanic soils in sloped drylands and their potential for agriculture in Indonesia. *Journal of Agricultural Research and Development.* **39** 21-34

[3] Rosliani R, Prathama M, Sulastrini I, Sugiartini E, and Santosa AD 2023 the effect of arbuscular mycorrhizae inoculation on growth and yield of red chili on the highland andisol soil. In *IOP Conference Series: Earth and Environmental Science*. IOP Publishing. 1287 012005

[4] Kamal M I, Syamsuddin S, and Syafruddin S 2020 The Effect of Mycorrhizal Types on the Growth and Yield of Several Varieties of Red Chili (Capsicum annum L.) on Andisol Soil in the Seulawah Valley, Aceh Besar. *Jurnal Ilmiah Mahasiswa Pertanian*. **5** 61-70.

[5] Khaliq A, Perveen S, Alamer K H, Zia Ul Haq M, Rafique Z, Alsudays I M, Althobaiti A T, Saleh M A, Hussain S, and Attia H 2022 Arbuscular mycorrhizal fungi symbiosis to enhance plant–soil

interaction. *Sustainability*. **14** 7840
[6] Asad F, and Rokhminarsi E 2021 Inoculum propagation of mycorrhizal fungi glomus and gigaspores with various formulas.
Jurnal Agrowiralodra **1** 16-24
[7] Zhao H, Li X Zhang Z, Zhao Y, Yang J, and Zhu Y 2017 Species diversity and drivers of arbuscular mycorrhizal fungal communities in a semi-arid mountain in China Peer J. 2017 12
[8] Nie, W, He Q, Guo H, Zhang W, Ma L, Li J, and Wen D 2024 Arbuscular mycorrhizal fungi: boosting crop resilience to environmental stresses. *Microorganisms*, *12*(12), 2448
[9] Santi I V, Jumini J, and Syafruddin S, 2023 Effect of Guano Dosage and Mycorrhizal Types on the Growth and Yield of Red Chili (Capsicum Annuum L.) On Inceptisol Soil. *Jurnal Ilmiah Mahasiswa Pertanian.* **8** 63-71
[10] Kurniasari A D, Kasmiyati S, and Cahyaningrum D C 2021 Pengaruh Inokulasi Glomus mosseae terhaDAT Pertumbuhan dan Aktivitas Antioksidan pada Artemisia cina Berg ex Poljakov. *Jurnal Biologi Indonesia*, **17**153-163.
[11] Pratama N I, Jaya K D, and Jayaputra J 2023 The effect of branch Pruning and Foliar Fertilizer treatment on growth and yield of Cayenne pepper (*Capsicum frutescens* L.). *IOP Science*. *Sci.* **1253** 012010
[12] Oktovianus R N, Beatrix R U, and Eduardus, Y N 2022 Application of FMA (Mycorrhizal Arbuscula Fungi) and Compost Fertilizers with Different Levels on the Growth and Production of Setaria Sphacelata Grass Biomass. *Portal Jurnal Unimor*, **7** 1-4
[13] Eman G. Sayed,S. F. Desoukey ,Abeer F. Desouky, Mervat F. Farag,Ragab I. EL-kholy and Samah N. Azoz. 2024. Synergistic Influence of Arbuscular mycorrhizal Fungi Inoculation with Nanoparticle Foliar Application Enhances Chili (Capsicum annuum L.) Antioxidant Enzymes, Anatomical Characteristics, and Productivity under Cold-Stress Conditions. *Plant*. **13** 517
[14] Vincenzo C G, Campanelli T, D'Addabbo D, Castronuovo M, Renco I, and Camele 2025 Growth and yield promoting effect of artificial mycorrhization combined with different fertiliser rates on field-grown tomato. *Italian Journal of Agronomy*. **8** 22
[15] Mila Y P F, Dewanti D, and Hidayat R 2024 Response of Chili Pepper (Capsicum frutescens L.) Yield to Age of Shoot Pruning and Trichotomous Dosage. *BIOEDUSCIENCE*, **8** 334-342.
[16] Agnieszka J B S. Bednarz E, Patkowska H, Buczkowska A, Gałązka J, Grządzie and M Kopacki. 2020. Effect of Mycorrhizal Inoculation and Irrigation on Biological Properties of Sweet Pepper Rhizosphere in Organic Field Cultivation. *Agronomy*. **10** 11- 1693.
[17] Fery. I. , E. Hanizar, F. Sugianto 2025 The Effect Of Pruning On Chili Pepper Stems (Capsicum Frutescens L) On Productivity. *Jurnal Pengabdian Pada Masyarakat.* **9** 762-771.
[18] Sayed E G, Desoukey S F, Desouky A F, Farag M F, El-Kholy R I, and Azoz SN 2024 Synergistic influence of arbuscular mycorrhizal fungi inoculation with nanoparticle foliar application enhances chili (Capsicum annuum L.) antioxidant enzymes, anatomical characteristics, and productivity under cold-stress conditions. *Plants*, ***13*** 4-517
[19] Jamiołkowska A. Skwaryło-Bednarz B. and Patkowska E 2020 Effect of mycorrhizal inoculation and irrigation on biological properties of sweet pepper rhizosphere in organic field cultivation. *Agronomy,* **10** 974.
[20] Taiz L, Zeiger E. Møller, I M, and Murphy A. 2021 Plant physiology and development.