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RESEARCH

Role of *Mycorrhizal* Fungi in Enhancing Growth Performance and Phytochemical Profile of Garlic (*Allium sativum* L.)

I Salmi[1*], S Messgo-Moumene[1], Y Kobae[2], ML Rabhi[1], HM El Shora[3],

and MS Shahid[4]

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ABSTRACT

Purpose: *Soil microorganisms significantly influence crop growth and quality, yet their effects on garlic's nutritional and functional components remain underexplored. This study investigates the impact of arbuscular mycorrhizal fungi (AMF) inoculation on garlic growth and Phytochemical Properties.*

Research Method: *Garlic plants were inoculated with 1g of mycorrhized root powder obtained from two isolates of endemic arbuscular mycorrhizal fungi (AMF), designated as MO (isolated from Allium triquetrum plants) and MA (isolated from Mentha plants) isolated from different host plants and regions. The effects of these inoculants were assessed by measuring growth parameters, including plant height, root biomass, bulb weight, and mycorrhization levels. Additionally, biochemical parameters including the contents of leaf pigments, sugars, total phenols, and antioxidant activity were analyzed.*

Findings and Values: *The isolation of arbuscular mycorrhizal fungi (MO) inoculation significantly enhanced plant height, root biomass, bulb weight, root colonization, leaf pigment content, phenolic compounds, and antioxidant activity compared to the control. In contrast, inoculation with the arbuscular mycorrhizal fungi (MA) isolate increased plant height, root fresh weight, total sugar content, and antioxidant activity but had no significant effect on bulb weight, leaf pigment content, or total phenol content. The isolate MO exhibited the highest root colonization frequency and greater hyphal length, confirming its role in enhancing nutrient uptake and plant development. This study highlights arbuscular mycorrhizal fungi inoculation as a sustainable strategy to improve garlic growth and quality, emphasizing the importance of soil microbiota management in optimizing cultivation.*

Keywords: *Allium sativum, Antioxidant activity, Arbuscular mycorrhizal inoculants, External hyphal length, Growth parameters, Root colonisation*

INTRODUCTION

Garlic (*Allium sativum L.*) is an ancient crop that originated in Central Asia. It has been grown for culinary, medicinal, and religious purposes for several millennia (Yimer 2020). Garlic contains several components, such as polysaccharides, saponins, phenolic and organosulfur compounds. The organosulfur

[1]Department of Biotechnology, Blida1 University, BP 270 Blida, Algeria.
[2]Department of Sustainable Agriculture, Rakuno Gakuen University, Ebetsu, Hokkaido, Japan.
[3]Department of Botany, Faculty of Science, Mansoura University, Mansoura, Egypt.
[4]Department of Plant Sciences, College of Agricultural and Marine Sciences, Sultan Qaboos University, Al-Khoud 123, Muscat, Oman.
*imanesalmi303@gmail.com
*salami_imen@unive-blida.dz

compounds are extracted and isolated for therapeutic purposes, and are responsible for its most important biological and pharmacological properties (Melguizo-Rodríguez *et al.* 2022). These compounds have been demonstrated to possess anti-inflammatory, antioxidant, and antimicrobial properties, conferring beneficial effects against cardiovascular diseases, cancers, and immune system disorders (El-Saber Batiha *et al.* 2020, Melguizo-Rodríguez *et al.* 2022).

However, the production and quality of garlic are significantly influenced by soil fertility and environmental stresses. Moreover, intensive use of chemical fertilizers and pesticides poses a threat to sustainability, increases costs, and may reduce the accumulation of beneficial secondary metabolites. Ensuring the availability and nutritional quality of garlic is therefore a priority for sustainable agriculture and food security. Arbuscular mycorrhizal fungi (AMF) are soil microorganisms that form symbiotic relationships with the majority of terrestrial plant species, enhancing plant growth and quality. AMF facilitate plant growth by enhancing nutrient uptake, particularly phosphorus, and increasing resistance to biotic and abiotic stresses (Golubkina *et al.* 2020).

AMF has been reported to exert direct or indirect effects on host plant roots, resulting in the production and accumulation of secondary metabolites, including phenolic and antioxidant compounds (Duc *et al.* 2021). In garlic and onion, AMF inoculation has been reported to enhance plant height, root development, chlorophyll and carotenoid contents, bulb yield, and the accumulation of sugars, phenolic compounds, and antioxidants. However, these benefits are not uniform; plant responses vary depending on the fungal isolate, soil type, and host genotype.

A substantial body of research has demonstrated the positive effects of AMF on garlic under fertilizer regimes or in combination with selenium supplementation (Golubkina *et al.* 2025). Although significant progress has been made in this field, most studies have focused on commercial inoculants or characterized species under controlled conditions. Consequently, the potential influence of endemic AMF isolates—locally adapted fungi originating from native ecosystems—on garlic growth and biochemical quality remains insufficiently understood.

Moreover, while numerous studies have assessed root colonization percentage, few have examined colonization frequency in conjunction with hyphal length. This methodological approach provides a more comprehensive understanding of mycorrhizal functioning and nutrient foraging capacity. Addressing these gaps is imperative for the development of low-input, sustainable strategies that enhance both garlic yield and functional value.

The aim of the present research was to investigate the effect of two different isolates of endemic AMF isolated from two different host plants and regions on crop yield and phytochemical properties of garlic. This research focuses on understanding the interaction between indigenous AMF isolates and garlic as a crop to provide an alternative to the excessive and unselective use of chemical fertilizers and pesticides in agriculture, which cause environmental pollution.

MATERIALS AND METHODS

Plant material and fungal inoculants

The study required the use of plant material and fungal inoculants. The plant material consisted of garlic cloves (*Allium sativum L.*) of the pink variety, obtained from a local market in Algeria. The fungal material comprised two inoculants of endemic arbuscular mycorrhizal fungi, designated MO and MA.

The isolate MO was obtained from *Allium triquetrum* plants, whereas the isolate MA was isolated from *Mentha* plants. Both host plants were cultivated in the field in different regions.

Installation of garlic cultivation

The experiment was conducted from November 2021 to June 2022 in an uncontrolled greenhouse. Garlic cloves were germinated in sterilized peat and then transferred to plastic pots with a capacity of approximately 1.2–1.3 L, each filled with 1 kg of a sterilized peat–soil mixture. The inoculants were prepared by rinsing with distilled water, air-drying, and pulverizing dried mycorrhizal roots into a fine powder using a laboratory blender. The powder was then inoculated into garlic plants.

One gram of each endemic AMF inoculant was added separately to the pots. Additional pots without inoculation were used as negative controls. After harvest, the various parameters were measured.

Growth parameters

Six plants from each treatment, as well as the non-treated control, were examined for growth parameters. Plant height was measured from the soil surface to the tip of the longest leaf using a ruler. The fresh weight of roots and bulbs was determined immediately after harvest using an analytical balance.

Leaf pigment content

Chlorophyll a, chlorophyll b, and carotenoid contents were determined using the method described by Lichtenthaler (1987). Fresh leaf samples were ground in a porcelain mortar with 10 mL of 80% acetone. The homogenized mixture was transferred to a 25 mL volumetric flask and filtered through Whatman No. 1 filter paper (11 µm pore size).

The resulting solution was analyzed using a spectrophotometer (GENESYS 180 UV–Vis Spectrophotometer, China) at wavelengths of 470, 646, and 663 nm. The concentrations were calculated using the following equations:

$$Chl\ a = 12.25A_{663} - 2.79A_{646}$$

$$Chl\ b = 21.5A_{646} - 5.1A_{663}$$

$$Cc = \frac{1000A_{470} - 1.82Chl\ a - 85.02Chl\ b}{198}$$

Sugar content

The sugar content of each garlic sample was determined using the method of Dubois *et al.* (1956). In the test tube, 1 mL of 5% phenol was added to 1 mL of garlic extract, followed by the addition of 5 mL of 98% sulfuric acid. The mixture was allowed to cool for three minutes in the dark.

The tubes were then placed in a water bath at 30 °C for 20 minutes, during which a yellow–red coloration developed. The reaction was terminated by introducing a stream of cold water. Absorbance was measured at 490 nm using a UV–visible spectrophotometer (GENESYS 180 UV–Vis Spectrophotometer, China). The concentration of total sugars was determined using a calibration curve constructed with glucose.

Arbuscular mycorrhiza colonization

Root colonization was assessed according to Phillips & Hayman (1970). Root fragments were washed, cleared in 10% potassium hydroxide, stained with trypan blue, decolorized in lactoglycerol, and examined microscopically at $\times 125$ and $\times 500$ magnifications.

Mycorrhization frequency (F) was calculated according to Trouvelot *et al.* (1986):

$$F(\%) = \left(\frac{\text{No. of colonized root fragments}}{\text{Total observed root fragments}}\right) \times 100 \quad (1)$$

Mycelial staining

Mycelia were extracted and stained with trypan blue solution following Jakobsen *et al.* (1992) and observed under a microscope. The length of the mycelium spread over the filter paper was determined by measuring the image area and the effective filtration area of the membrane filter. The average value was calculated based on eight filters per sample. The result was expressed as mycelium length per gram of dry soil.

Extract preparation

Garlic bulb samples were peeled, cleaned, and ground to extract phytochemicals. Extraction was performed according to Akullo *et al.* (2022). Twenty-five grams of fresh garlic were mixed with 100 mL of distilled water. The mixture was shaken at 300 rpm using a mechanical shaker (New Brunswick Innova 42R refrigerated incubator shaker, Eppendorf, United States) in the dark for 24 hours.

The solution was filtered using Whatman filter paper No. 1. The filtrate was diluted tenfold and stored at 4 °C until further analysis.

Determination of total phenol content

Total phenol content was determined using the Folin–Ciocalteu method described by Jang *et al.* (2018). A mixture of 0.5 mL of extract and 2.5 mL of Folin–Ciocalteu reagent was prepared and allowed to react at room temperature for five minutes. Subsequently, 2 mL of 75% Na_2CO_3 was added, and the mixture was incubated for two hours.

Absorbance was measured at 760 nm using a spectrophotometer. Methanol was used as the blank. A standard curve was constructed using gallic acid equivalents.

Determination of flavonoid content

Total flavonoid content was determined according to Djeridane *et al.* (2007). A solution containing 0.5 mL of extract was mixed with 1 mL of $AlCl_3$. The mixture was incubated at room temperature for 10 minutes.

Absorbance was measured at 510 nm, with a control sample used as reference. Flavonoid levels were calculated using quercetin standards ranging from 37.5 to 2.3 µg/mL. Results were expressed as micrograms of quercetin equivalent per gram of fresh matter (µg EQ/g MF).

DPPH free radical scavenging activity

Free radical scavenging activity was determined using the method of Blois (1958) with slight modifications. Briefly, 5 mL of 0.1 mM DPPH solution in 95% ethanol was added to 1 mL of each sample. The mixture was vigorously shaken and incubated at room temperature for 30 minutes in the dark.

Absorbance was measured at 517 nm. Ascorbic acid was used as the standard antioxidant.

Statistical analysis

The results were analyzed using Minitab version 19 software. One-way analysis of variance (ANOVA) was performed, followed by Tukey's test to determine significant differences at $p \leq 0.05$. Results are expressed as the mean ± standard deviation of four replicates.

RESULTS AND DISCUSSION

Growth parameters of garlic

AMF inoculants were found to have a significant effect on garlic plant height, root weight, and bulb weight (Fig. 1). The statistical analysis clearly demonstrates a significant difference between the arbuscular mycorrhizal inoculant and the control, providing strong evidence that the treatments have a distinct effect on the measured parameters related to garlic growth promotion (Fig. 1). The isolates of AMF MO and MA dramatically increased plant height (46.46±0.2 and 43.74±0.2 cm), and root weight (13.2±0.1 g and 10.08±0.05 g), respectively, compared to the control (43.12±0.3 cm and 6±0.03 g) (Figure 1a, 1c). The isolate of AMF MO demonstrated a notable increase in bulb weight (18.42 ± 0.3), while the isolate MA exhibited a distinct decline, with a weight (8.66 ±0.6 g) that was lower than that of the control (10.18g±0.1) (Fig. 1c). The isolate of arbuscular mycorrhizal fungi MO demonstrated a notable increase in growth parameters of garlic, this finding is in harmony with those of Nacoon *et al.* (2023), who demonstrated the beneficial impact of Arbuscular mycorrhizal colonization on the growth performance of two black-rice cultivars. Furthermore, Golubkina *et al.* (2019) demonstrated that the application of Mycorrhizal formulations has been demonstrated to exert a considerable influence on the growth and development of shallot plants, this finding is also supported by Hayman Mosse (1971) who reported that the application of arbuscular mycorrhizal fungi to *Allium cepa* also resulted in a significant increase in bulb yield, with a 2–18-fold increase observed, contingent on the initial phosphorus content of the soil.

The findings of our study indicate that

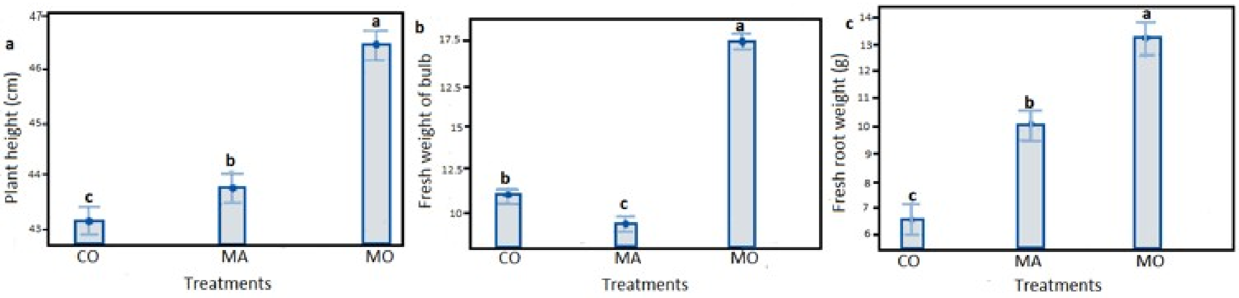

Figure 1. Effects of AMF inoculants of on growth parameters of garlic. Plant height (1a), fresh weight of bulb (1b), fresh weight of root (1c). (CO: Control, MO, MA different inoculant of AMF).

mycorrhizal fungi may facilitate enhanced plant growth by enabling the absorption of water and mineral nutrients. This hypothesis is corroborated by the findings of Karandashov Bucher (2005), who reported that one of the most significant effects of AMF inoculation on the host plant is the increase in phosphorus in the plant, which is primarily due to mycorrhiza absorbing phosphate from the soil and transferring it to host roots. Additionally, García Mendoza (2008) observed that the highest arbuscular colonization was associated with the greatest concentrations of nitrogen and phosphorus in plant tissue, indicating a correlation between an increase in the rate of nutrient transfer between the two organisms. As well as, the findings of Clark Zeto (2000) demonstrated that AMF plays a crucial role in the enhancement of uptake of nutrients, including phosphorus (P), nitrogen (N) and potassium (K), The isolate MA increased plant height and root weight, but reduced plant bulb weight.

This result is consistent with the findings of Sari *et al.* (2002) who have shown mycorrhizal inoculation did not show any significant effect on the fresh weight of bulbs or the number of cloves per bulb. The observed reduction in growth of colonized plants is attributed to an unbalanced trade between the host plant and Arbuscular mycorrhizal fungi. This interaction is parasitic-due to the carbon drainage caused on the host by the fungi (Duc *et al.* 2021).

Leaf pigment content

To evaluate the potential influence of arbuscular mycorhizal fungi on garlic leaf pigmentation, the concentrations of chlorophyll a and b and carotenoids were determined. The analysis of variance in leaf pigment content demonstrated significant variability in chlorophyll a, chlorophyll b and carotenoids (Table 1). The inoculation of garlic with the Arbuscular mycorrhizal inoculants MO resulted in an increase in chlorophyll a and chlorophyll b contents and a decrease in carotenoid content in comparison to the control. In contrast, the MA did not show any increase in leaf pigment content compared to the control. The increase in leaf pigmentation resulting from the application of arbuscular mycorrhizal fungi MO showed in the present study has been observed also in numerous studies. One such study, conducted by Jabborova *et al.* (2021), indicated that the use of arbuscular mycorrhizal fungi alone led to a notable increase in the contents of chlorophyll a, chlorophyll b, total chlorophyll, and carotenoids. Similarly, Ghani *et al.* (2022) observed that the application of AMF enhanced the contents of chlorophyll a, chlorophyll b, and carotenoids at all growth stages.

Additionally, Sulistiono *et al.* (2023) have suggested that arbuscular mycorrhizal fungi inoculation may result in a notable increase in chlorophyll content in *Myristica fragrans* cultivars, Moreover, the studies conducted by Sulistiono *et al.* (2017) and Mathur *et al.* (2018) have demonstrated that elevated levels of leaf chlorophyll facilitate photosynthesis and enhance plant growth. A similar result was observed in the present study, wherein the stimulation of chlorophyll corresponded to the stimulation of growth parameters, indicating that isolate MO may stimulate photosynthesis, which in turn may lead to growth stimulation in garlic.

Table 1. Effects of AMF inoculants on the levels of garlic leaf pigment.

Treatments	AMF (MO)	AMF (MA)	Control
Chlorophyll (a) mg g^{-1} FW	3.74±0.008 a	2.89±0.005 c	3.53±0.009 b
Chlorophyll (b) mg g^{-1} FW	1.11±0.006 a	0.76±0.03 c	1.05±0.04 b
Carotenoid mg g^{-1} FW	1.08±0.002 b	0.95±0.002 c	1.22±0.002 a
Total sugar content mg $100g^{-1}$ FW	1.82±0.01 a	1.282±0.02 b	1.274±0.01 b

By contrast, Shuab *et al.* (2014) noted that the chlorophyll content remained relatively stable or showed only a slight increase after 20 days of plant growth. However, at the subsequent 20-day interval, there appears to be a slight increase in the chlorophyll a and chlorophyll b contents in arbuscular mycorrhizal fungi inoculated plants compared to non-inoculated ones, which persists until 80 days.

Sugar content

The application of mycorrhizal isolates showed a highly significant difference in the total sugar content of cultivated garlic bulbs (Table 1). The MA showed the highest sugar content (3.73±0.2 mg g^{-1} FW), followed by the MO (3.61±0.1 mg g^{-1} FW), compared to the control (3.44±0.1 mg g^{-1} FW). Sugars are the energy source for plant metabolism and are also used in practical horticulture to assess the degree of ripeness and quality of fruit and vegetables Perner *et al.* (2008). In the present study the application of mycorrhizal showed a high increase in sugar content in garlic, these results are consistent with those of Mollavali *et al.* (2016), this result is in line with previous findings that reported higher reducing sugar content in AMF-inoculated plants. For example, Mollavali *et al.* (2016) showed that inoculation with *Rhizophagus intraradices* resulted in an increase in the sugar content of onion plants. However, Perner *et al.* (2008) reported that concentrations of sucrose and reducing sugars (glucose and fructose) in bulbs were not significantly affected by AM colonization. The plant nutrient supply and sugar concentrations demonstrate that the plants were cultivated under balanced conditions with regard to nutrient and energy supply. The higher monosaccharide content in AMF-inoculated plants compared to controls may be attributed to the physiological changes induced by AMF, particularly the increased enzyme activity, which converts complex sugars into simple ones (Golubkina *et al.* 2020).

Arbuscular mycorrhizal fungi colonization

The result indicated that there was a notable variation in garlic root colonization frequency and mycorhizal external hyphal length of the isolate MO and MA. The inoculation of mycorrhizal inoculants MO and MA had a significant effect on plant root colonization. MO isolate exhibited the highest frequency of colonization (63±0.1 %), while Arbuscular mycorhizal inoculant exhibited a lower frequency (30±0.5 %) compared to MO inoculants, which reveals that garlic responded well to Arbuscular mycorrhizal fungi inoculant MO than the inoculants MA.

Mycorrhizal external hyphal length measured to investigate the response of garlic to arbuscular mycorrhizal inoculants. The analysis of variance of external mycorhizal hyphal length revealed a statistically significant effect between the two inoculants (Table 2). The external hyphae of the isolate MO were observed to be significantly longer (536 mm) than those of the inoculants MA (165 mm).

Total phenolic and total flavonoid contents

The inoculation of garlic plants with arbuscular mycorrhizal inoculants was found to significantly affect the levels of total phenol and flavonoids contents (Fig. 2). Garlic inoculated with the arbuscular mycorrhizal inoculants MO exhibited the highest total phenol content (5.43±0.04 mg GAE g^{-1}). In contrast, the MA isolate did not show any significant effect (1.75±0.07 mg GAE g^{-1}) compared to the control (1.69±0.04 mg GAE g^{-1}).

The analysis of garlic flavonoids indicated a relatively low quantity of these compounds

Table 2. Root colonization frequency and external hyphal length of AMF inoculants.

Treatments	AMF (MO)	AMF (MA)
Root colonization frequency (%)	63±0.1 a	33±0.5 b
Mycorrhizal external hyphal length (mm)	536±0.083 a	165±0.03 b

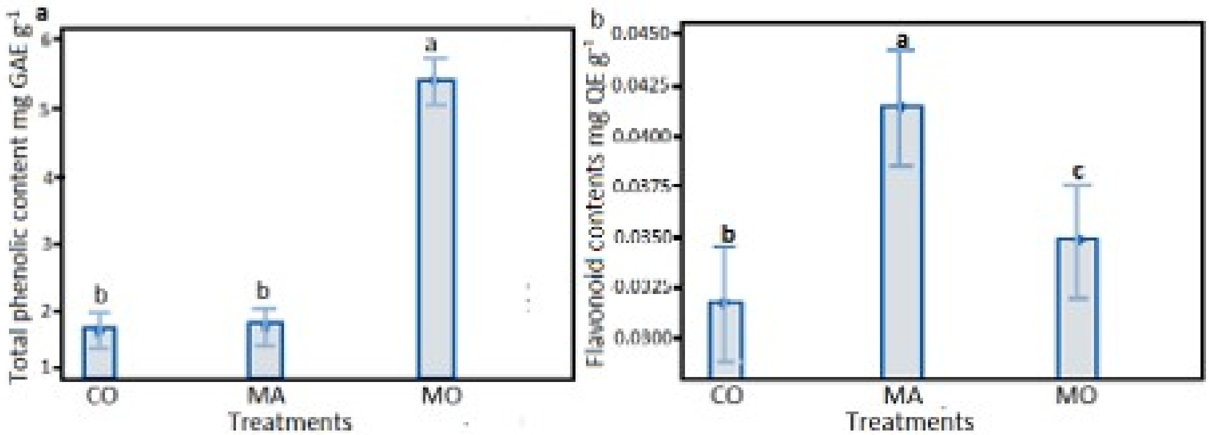

Figure 2. Impact of arbuscular mycorrhizal inoculants on the levels of phenolic (a) and flavonoids compounds (b). CO: control, MO, MA: different inoculants of arbuscular mycorrhizal fungi.

(Fig. 2). However, the MA demonstrated the ability to enhance the flavonoid content (0.004±0.01 mg QE g^{-1} FW), while the MO (0.0034±0.01 mg QE g^{-1} FW) exhibited no discernible impact compared to the control (0.0031±0.01 mg QE g^{-1} FW). The inoculants MO exert a beneficial influence on the production of phenolic compounds in plants. This finding is in accordance with the findings of Mollavali *et al.* (2015), who observed that the isolate of *Diversispora vermiformis* was effective in increasing the total polyphenol content in onions. Similarly, Lahbouki *et al.* (2022) demonstrated that the total phenolic content was significantly enhanced by the application of AMF on the prickly pear cactus. The observed increase can be attributed to the enhanced uptake of macro- and micronutrients by AMF due to their hyphal network within the root system Lohse *et al.* (2005), Boutasknit *et al.* (2020) have demonstrated the elevated concentration of total phenols can be attributed to the influence in the tricarboxylic acid cycle, which ultimately leads to the formation of sub-products that are employed in the integration of phenolic compounds. Additionally, Volpin *et al.* (1994) demonstrated that AMF can induce the production of defence-related compounds (including phenolic compounds) in plants. Conversely, Duc *et al.* (2021) reported that arbuscular mycorrhizal fungi treatments did not significantly alter the content of proline and total phenols during plant growth of *Eclipta prostrata* (L.).

In addition, Lee Scagel (2009) reported that inoculation of basil with AMF had no impact on the level of individual phenolic compounds or total polyphenolics, the results demonstrate that AMF does not consistently enhance the phenolic content. Instead, its impact is influenced by a multitude of variables, including cultivar, AMF isolate colonization, and mycorhizal hyphal length. The flavonoid content of the *Allium* extract exhibited considerable variation. In the present study, a low flavonoid concentration was identified, while the findings of Atif *et al.* (2021) indicated the absence of flavonoids in garlic. Conversely, the results of Miean & Mohamed (2001) indicated a high flavonoid concentration.

The results demonstrated that AMF MA increased flavonoids compared to the control, while the MO showed no effect. This finding is in line with the results reported by Perner *et al.* (2008), who indicated that AMF may enhance flavonoids in bulb and root of onion. Furthermore, Mollavali *et al.* (2016) demonstrated that plants inoculated with *Diversispora versiformis* exhibited an increase in QDG content (Quercetin-3,4'-O-diglucoside) compared to other AMF strains and the control treatment. However, further research is required to elucidate the relationship between AMF and the production of secondary metabolites in its host plant.

Evaluation of antioxidant activity

The application of arbuscular mycorrhizal fungi inoculants significantly impacted the DPPH scavenging activity and IC_{50} values. The antioxidant activity of garlic plants treated with the MO and MA inoculants was found to have increased by 56.74±0.03 % and 54.43±0.02 %, respectively, in comparison to the control (46.82±0.01%), with no significant difference between the two inoculants. The garlic extract treated with the MA exhibited the lowest and most significant IC_{50} value (0.56 µg±0.01 mL^{-1}), followed by the MO (0.63 µg±0.02 mL^{-1}) in comparison to the control (1.11±0.01 µg mL^{-1}). Nevertheless, these values did not reach the value of 0.01 µg mL^{-1} exhibited by ascorbic acid, as shown in Table 3. A number of researchers have reported comparable outcomes, indicating the impact of arbuscular mycorrhizal fungi on diverse plant species. This includes the study conducted by Rasouli *et al.* (2022), which demonstrated that mycorrhizal inoculation elevated the levels of total phenols, chlorogenic acid, and antioxidant activity in artichoke leaves. Similarly, Albrechtova *et al.* (2012) found that arbuscular mycorrhizal fungi significantly increased the total antioxidant capacity of onion bulbs. However, despite extensive research, no documented reports have been found which describe the beneficial effects of arbuscular mycorrhiza on the antioxidants found in garlic. Golubkina *et al.* (2020) reported that a field trial conducted in the Chechen Republic (Russia) demonstrated an increase in antioxidant activity in *Allium cepa* bulbs.

However, no significant impact on the antioxidant activity of garlic was observed. In a study conducted by Avio *et al.* (2017), it was observed that the inoculation of lettuce plants with arbuscular mycorrhizal fungi resulted in the accumulation of greater quantities of antioxidant compounds. This phenomenon may be attributed to the interaction of the mycorrhizal fungi with the host plant's metabolism, leading to the increased production of phytochemicals and antioxidant molecules. Consequently, this alters the composition of the plant's secondary metabolites and enhances its antioxidant potential.

While in a study published by Jiang *et al.* (2016) demonstrated that arbuscular mycorrhizal fungi influence the concentration of phytohormones, including jasmonic acid, gibberellic acid, and cytokinins. These changes enhance the absorption of essential nutrients and promote the production of antioxidant compounds.

Meriga *et al.* (2012) and Mamun *et al.* (2016) reported that the increase in phenol concentration is accompanied by an increase in antioxidant power. The primary contributors to observed antioxidant activity are the phenolic constituents found in plants, including flavonoids, phenolic acids, and phenolic diterpenes. However, in our study the MA was observed to enhance antioxidant activity concomitant with a reduction in polyphenol concentration this finding lends support to the results reported by Fredotović Puizina, (2019), and thus, it can be concluded that the observed antioxidant effects are primarily due to the presence of organosulfur compounds. Additionally, Albrechtova *et al.* (2012) have reported that arbuscular mycorrhizal fungi may facilitate the production of organosulfur compounds in field conditions. Nevertheless, in the present study, the total antioxidant capacity was measured, rather than specific compounds. Consequently, it was not possible to determine which chemical compound arbuscular mycorrhiza was responsible for the observed increase in antioxidant activity.

CONCLUSION

In conclusion the results of this study demonstrate that the utilization of endemic arbuscular mycorrhizal fungi represents a

Table 3. Impact of arbuscular mycorrhizal fungi inoculants (MO and MA) on the antioxidant activity and IC_{50} in garlic.

Treatments	AMF (MO)	AMF (MA)	Control	Ascorbic acid
Antioxidant activity %	56.74±0.03 a	54.43±0.02 a	46.82±0.01 b	99
IC_{50} mg/mL	0.63±0.02 b	0.56±0.01 c	1.11±0.01 a	0.011

viable strategy for the enhancement of garlic production, particularly MO inoculants which exhibited remarkable effect on the growth, biomass and production of secondary metabolites with increasing the antioxidant activity of garlic as crop plant. This may be regarded the MO as a growth promoter and an alternative to the excessive and unselective utilization of chemical fertilizers in agricultural contexts.

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