Middle East Journal of Applied Sciences
Volume: 16 | Issue: 01| Jan. – Mar. | 2026

EISSN: 2706 -7947 ISSN: 2077- 4613
DOI: 10.36632/mejas/2026.16.1.4
Journal homepage: www.curresweb.com
Pages: 47-53

Enhancement of Growth, Productivity and Nutrient Uptake of Vegetable Plants Under Saline Conditions by Arbuscular mycorrhizal Inoculation

W.A. El-Tohamy[1], S.D. Abou-Hussein[1], M.A. Badr[2] and Salwa A. Orabi[3]

[1]Vegetable Res., Dept., Agricultural and Biological Institute, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.
[2]Plant Nutrition Department, Agricultural and Biological Institute, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.
[3]Botany Dept., Agricultural and Biological Institute, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.

Received: 25 Jan. 2026 **Accepted:** 10 Mar. 2026 **Published:** 30 Mar. 2026

ABSTRACT
The problem of salinity is considered as one of the most serious problems affecting vegetable plants as most vegetable plants are relatively sensitive to salinity. Growth and yield of vegetable plants are seriously affected by increasing salinity levels either in the soil or in irrigations water. There is evidence that inoculation with arbuscular mycorrhiza (A mycorrhiza) can improve salinity tolerance of vegetable plants. This improvement of salinity tolerance of vegetable plants in response to mycorrhizal inoculation is related to improvement of several aspects including: chlorophyll content, antioxidant levels, water status and nutrient uptake accumulation of several substances involved in salinity tolerance. Subsequently, vegetable plants inoculated with mycorrhiza have better growth and productivity under salinity stress conditions. This review explores the various effects of mycorrhizal inoculation on vegetable plants grown under saline conditions.

Keywords: mycorrhiza, vegetable plants, salinity, productivity, water status, nutrient uptake

Introduction

Salinity problem is one of most problems that seriously injure vegetable production in salt affected soils in many countries in the world. Growth and yield of vegetable plants is reduced by salinity as most of vegetable plants are relatively sensitive to salt stress.

Generally, salinity reduces several metabolic processes including photosynthetic and respiration rates of plants. It also negatively affects some substances such as total carbohydrate, protein content and fatty acids but helps increasing amino acid and proline as plants grown under salt stress have some higher secondary plant products than the crops grown under normal conditions and subsequently salinity can seriously affects the plant production especially in the arid and semi-arid regions (Devarshi *et al*., 2020).

Most of vegetable crops are affected by salinity more or less severely as salinity negatively affects the development of vegetable crops including their morphology, physiological function and productivity (Deepa Devi and Arumugam, 2019).

Moreover, salinity of soil and water is caused by the presence of high amounts of salts especially high Na^+ and Cl^-. In addition, salt stress affects several processes of plants, reduces water potential and causes ion imbalance or disturbances in ion homeostasis and toxicity. The negative changes in water status of plants under salt stress can cause initial growth reduction and limitation of plant productivity (Parida and Das, 2005).

However, finding a useful and sustainable tools to overcome the harmful effects of salinity could be of great value for vegetable growers under salt-affected soils or when using saline water for

Corresponding Author: W.A. El-Tohamy, Vegetable Res., Dept., Agricultural and Biological Institute, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.
E-mail: waeleltohamy27@gmail.com

irrigation. One of the solution of this problem is using mycorrhiza as the beneficial effects of mycorrhiza on improving salinity tolerance of vegetable production are evident in most vegetable plants.

AM fungi can improve nutrition in plants by improving absorption and translocation of nutrients and minerals in deeper depths and changes the metabolic activities and it is also indicated that under salinity conditions, AM inoculated plant has similar biomass as non-AM plants in non-saline conditions (Malhi *et al*. 2021). They also indicated that AM fungal symbiosis has positive effects on growth and osmolytes of several crops.

In addition, AM acts as bio-regulators and bio-protectors in several plants by interfering with the phytohormones of plants (Rouphael *et al*., 2015).

This review will focus on the various effects of mycorrhiza on vegetable plants grown under salinity stress conditions with special emphasis on nutrient uptake, growth and productivity of different vegetable plants. The possible roles of mycorrhiza on such effects are explained.

Effects of VA mycorrhiza on salinity tolerance of vegetable plants

Mycorrhizal inoculation (AMF) can improve morphological and biochemical traits of vegetables even under salinity conditions (Yadav *et al*. 2021) as they investigated the effect of mycorrhiza on carrot plants under salinity stress and indicated that soil salinity significantly reduced the yield and quality of carrots and found promising results for AMF application on carrot plants under salinity conditions as it improved several morphological parameters, including root weight, indicating the efficiency of using mycorrhizal fungi to improve carrot production under salinity stress. They related the efficiency of microbial inoculum and mycorrhizal fungi in attaining a profitable carrot yield to improving water uptake, maintaining osmotic balance, enhancing photosynthetic efficiency, and modulating phytohormones profiling. Their results also indicated that AMF application enhanced the quality of carrots. These results are in line with Damaiyanti *et al*. (2015) who found that salinity stress at the level of 7500 ppm reduced the height, leaf area, and proline content and reduced the yield of fruit for about 30.84% and fresh weight of fruit per ha for about 51.72%. of tomato plant and found that the separate application of 20 g mycorrhiza had positive effects on high plant height, fruit yield, leaf area, numbers of leaf, index of chlorophyll, and proline content of tomato plant under saline conditions.

In a study conducted by Garcia *et al*. (2019) on the effects of mycorrhiza and rhizobium on snap bean plants under salinity conditions, they found that the dual inoculation of mycorrhiza and rhizobium showed beneficial effects on all physiological parameters and biomass production compared to the single inoculation treatment under all three salinity levels used in this study. They suggested that a reduction of salinity can be obtained by independent and dual microbial inoculations in salt-affected soils, and can be promising for better crop productions under such conditions. They also found that under all salinity levels, dual inoculation (AMF + Rhizobium) activated AMF root colonization compared to the single treatment of mycorrhiza.

Moreover, in a study on the effects of arbuscular mycorrhizal fungi (*Glomus intraradices*), soil salinity and P availability on pepper plants, Beltrano *et al*. (2013) found that mycorrhizal plants had higher root and shoot biomass at all salinity levels compared to non-mycorrhizal plants, regardless the P level. They found that cell membrane integrity was greater in mycorrhizal plants and that mycorrhizal inoculation can reduce the damage caused by salt stress conditions on pepper plants. They concluded that the application of AMF provides a sustainable and environmentally safe treatment to improve salinity tolerance of pepper plants.

In another investigation on pepper plants under saline conditions, Al-Karaki. (2017) indicated that pre–inoculation of green pepper transplants with AM fungi had positive effects on nutrient uptake and fruit yield especially under moderate rather than severe salinity levels. He found that AM inoculated pepper plants had higher shoot and root dry matter and plant height than non AM plants under all salinity levels and fruit fresh yield, fruit weight, and fruit number per plant were higher in AM than non-AM plants under salinity conditions and concluded that pepper transplants inoculated with AM fungi showed higher tolerance to salt stress through enhancing plant growth, fruit yield and nutrient uptake under relatively medium salinity levels.

However, Sané *et al*. (2022) found that tomato plants inoculated with AMF had significant enhancement in growth under salt stress conditions, as they indicated that AMF stimulated the development of the aerial part and that of the roots of the tomato and the mycorrhizal plants had higher phosphorus, potassium and proline contents while reducing the sodium content.

In addition, Basak *et al*. (2011) studied the effects of different doses of mycorrhiza treatment on morphological characteristics and chlorophyll content of tomato seedlings (*Lycopersicon esculentum* L.) grown under saline conditions and found that mycorrhiza prevented the negative effects of salt on tomato seedlings as they have better growth and high chlorophyll content.

Similar results were found previously by Poss (1985) who indicated that vesicular-arbuscular mycorrhiza fungi (VAM) increased tomato and onion growth in saline soils as he indicated that the higher tomato water potentials, along with improved K nutrition by VAM in onion is important for VAM plants growing under saline stress.

Moreover, Santander *et al*. (2019) indicated that AMF inoculation can act as a symbiotic rhizosphere barrier, by reducing the negative effects of salinity stress on lettuce plants. They indicated that the mechanisms of action for the AMF could be due to maintaining cellular homeostasis, via AMF-induced alterations in cation balances and suggested that improved ionic balance is related to a filtering effect of AMF structures both in the soil and in the root and subsequently prevents the entry of toxic Na+ ions, this is important for improving lettuce production under saline conditions in response to mycorrhizal inoculation.

In a study on eggplant (*Solanum melongena* L.), Erve *et al*. (2022) found that the use of (P + AMF) alleviated the toxicity of NaCl, improved growth, physiological and biochemical parameters, indicating that the application of mycorrhiza is important for better plant production in saline soils. They indicated that Eggplants could be cultivated in soils with moderate salinity and the use of AMF and P can be considered as an alternative way of decreasing NaCl stress in plants and to maintain soil fertility.

Moreover, in a study conducted on pepper plants, Beltrano *et al*. (2013) found that the mycorrhizal inoculation can reduce the damage caused by salt stress on pepper plants and help maintaining the membranes stability and subsequently pepper plants inoculated with mycorrhiza had better plant growth due to P nutrition. They found that inoculation improved pepper root growth and improved shoot biomass at all salinity levels compared to non-mycorrhizal plants. The improved nutrition of mycorrhizal plants is also evident as indicated by higher K and P and lower Na concentrations in leaf tissue. They concluded that the application of AMF provides a sustainable and environmentally safe treatment to improve salinity tolerance of pepper plants.

Similarly, Yilma (2019) indicated that in pepper production, inoculation with arbuscular mycorrhiza had pronounced effects on improving economic yield, and maturity due to activating nutrient uptake, reducing salinity effects and improve tolerance to diseases as mycorrhiza helps plant roots to better uptake of water and mineral nutrients, especially phosphorus.

On the other hand, Basak *et al*. (2024) investigated the effects of mycorrhizal inoculation and salt stress on root and stem development, mineral nutrition, enzyme activity and lipid peroxidation levels in pepper (*Capsicum annuum* L.) plants and found that mycorrhiza ameliorated the negative effects of salt stress on root and stem dry weights of pepper plants compared to non-inoculated plants. They also found that mycorrhizal inoculation improved pepper plants nutrition as indicated by higher nutrient contents of stem and root tissues of mycorrhizal inoculated plants. AMF inoculation decreased SOD, CAT, POD and AxPOD enzymes of plant and the MDA and H2O2 contents, indicating lower oxidative damage when pepper plants inoculated by mycorrhiza. They concluded that AMF can protect pepper plants against salinity by different means such as alleviating the salt induced oxidative stress and improving nutrient uptake in saline condition.

Also, Suhail and Mahdi (2013) found that the inoculation with the mycorrhizal fungi resulted in an increase in vegetative growth of onion plants under saline conditions as indicated by improvement of plant height, fresh weight and dry weight of all levels of salinity compared to non-inoculated plants and also led to a significant reduction in electrical conductivity under salinity conditions.

Moreover, the findings of Altuntas *et al*. (2024) suggested that AMFs had an important role in improving plant growth, water status, and photosynthesis characteristics of salt-sensitive pepper genotypes, under moderate-to-high salt stress levels. They indicated the role of mycorrhizal symbiosis on the alteration of some physiological aspects including water relations in leaves, consequently enhancing photosynthetic activities in pepper plants subjected to salt stress and they related these effects to the facts that the association (symbiosis) of both plants with mycorrhizal fungi can improve pepper growth by increasing water uptake through external hyphae and enhancing the osmotic potential under salt stress conditions.

On the other hand, Cantrell and Linderman (2001) investigated the effect of mycorrhizal association on lettuce and onion plants under saline conditions and found that the leaves of VAM lettuce at the highest salt level had significantly higher chlorophyll content compared to non-inoculated plants and Non-VAM onions were stunted as they had P deficiency while the inoculation with VAM fungi alleviated P deficiency and salinity effects. They also indicated that VAM onions had significantly higher growth at all salt levels than non-VAM onions. They concluded that inoculation of onion and lettuce transplants with VAM as a pretreatment is effective in reducing the negative effects of saline soils on their growth and yield. Similar results were obtained by Zuccarini (2007) on lettuce plants as indicated that the dry mass production of inoculated lettuce plants was significantly enhanced under salinity conditions and the effect was even more evident at the highest salinity level. Other characters such as total chlorophyll content and total foliar area were also enhanced by mycorrhizal colonization. He found that mycorrhizal association also stimulated the absorption of K and P while reduced Na and Cl plant uptake and concluded that mycorrhiza is effective in inducing salt-stress resistance in horticultural crops especially at medium-high salinity levels of the irrigation water.

Also, Kaya *et al*. (2009) investigated the effects of arbuscular mycorrhizal on growth and fruit yield of pepper plants grown under high salinity levels and found that NaCl treatments reduced pepper shoot and root dry matter, and yield compared with the non-saline treatments and N, P and K contents of leaves were significantly reduced by salinity stress. They found that mycorrhizal colonization of the salt-stressed pepper plants restored leaf nutrient concentrations to the levels in non-stressed plants and that AM inoculation resulted in enhancement of pepper growth under both saline and non-saline conditions and reduced cell membrane leakage.

In addition, Yilma (2019) found that pepper plants inoculated with arbuscular mycorrhiza had higher yield, improved maturity, higher nutrient uptake, reduced salinity effects and improved diseases tolerance as mycorrhiza can help pepper plants to tolerate different stresses including salt stress and diseases occurrence.

In another investigation on taro plants, Bernal *et al*. (2022) studied the the effects of mycorrhiza on salinity tolerance of taro plantlets during acclimation and found that mycorrhizal symbiotic association had positive effects on the development of taro plantlets both in saline and non-saline conditions. They also concluded that mycorrhizal symbiotic interaction contributes to salinity stress tolerance in taro (*C. esculenta*) plantlets and suggested that the early application of AMF in in vitro-obtained taro plantlets is important to increase or maintain better yield under saline soil conditions. Moreover, the findings of Haghighi *et al*. (2016) are in line with the previous studies as they found that mycorrhizal inoculation resulted in enhanced fruit weight, photosynthesis, root and shoot dry weights, stomatal conductance and proline content of the cucumber leaves at all salinity levels.

Effects of VA mycorrhiza on nutrient uptake of vegetable plants under salinity conditions

Regarding the mitigation of mycorrhizal effects on plant stress, Badr *et al*. (2020) demonstrated that the inoculation of mycorrhizal colonization enhanced the yield and regulated the physiological status of eggplant. This enhancement was associated with increased nutrient uptake and improved soil fertility under varying levels of water stress, potentially contributing to better drought tolerance. The mycorrhizal response exhibited superior performance under severe water stress compared to conditions of full irrigation.

The improvement of productivity of pepper plants under salinity conditions in response to mycorrhizal inoculation is related to the fact that VA mycorrhiza activates the nutrient uptake (especially P) and water by roots of pepper plants under saline conditions (Yilma ,2019). Similar results were achieved by Abdel Latef and Chaoxingb (2011) on tomato plants as they found higher content of P and K in AM compared with non-AM plants grown under both saline and non-saline conditions. They found lower concentration of Na in AM than non-AM plants grown under non-saline and saline conditions and indicated that AMF also could protect plants under salinity by alleviating the salt induced oxidative stress as AMF colonization was accompanied by an activation of superoxide dismutase (SOD), catalase (CAT), peroxidase (POD) and ascorbate peroxidase (APX) in leaves of salt stressed and non-stressed tomato plants. As mentioned by Dere (2024), salt stress significantly reduced nutrient absorption, plant growth and chlorophyll content of pepper plants. He tested the application of AMF and PGPR (plant growth-promoting rhizobacteria) under saline conditions and found increased nutrient uptake and plant growth and indicated that the co-inoculation had the highest efficacy in improving nutrient uptake and increasing relative water content. The combined application of AMF and PGPR treatments resulted in an enhancement of potassium retention and reduced sodium and chloride accumulation and mitigating ionic imbalance. Moreover, Al-Karaki (2000) studied the nutrient uptake of tomato plants under saline conditions and found that mycorrhizal plants had higher total accumulation of P, Zn, Cu, and Fe than nonmycorrhizal plants under both control and medium salt stress conditions with lower shoot Na concentrations in mycorrhizal plants compared to nonmycorrhizal plants grown under salinity conditions. He concluded that the positive effects of mycorrhiza on growth and nutrient uptake of tomato plants demonstrate its efficiency for protecting plants against salt stress in arid and semiarid areas. Abdelhameid and El-Shazly (2020) investigated the effect of arbuscular mycorrhizal fungi on tomato tolerance and nutrients uptake under salinity conditions and found that mycorrhizal inoculation significantly increases the plant N by 6.34 and 5.31%; P by 23.66 and 22.03% ad K by 3.64 and 3.15% for both seasons respectively. They also found that mycorrhizal inoculation resulted in a significant improvement of microbial activities in the soil rhizosphere area of tomato plants. Moreover, Altome *et al*. (2015) found an enhancement in Mn, Zn, Cu, and Fe acquisition in addition to increasing of shoot, dry weight of tomato plants due to AMF inoculation and the effect was more pronounced with *Glomus macrocarpium* than *Glomus intraradiaces* under saline conditions. Their results confirmed that mycorrhizal inoculation and compost application are beneficial for tomato plant under adverse conditions such as salinity. On the other hand, Shalaby and Ramadan (2024) indicated that the combined treatment by mycorrhizal inoculation and calcium spray on pepper plants facilitated nutrient uptake, modulated physiological responses, and activated the antioxidant system and enhanced salinity tolerance of salt-stressed pepper. The effect on nutrient uptake includes improving nutrient balance (increasing N, P, K and reducing Na content) of pepper plants under salinity conditions which resulted in improved pepper growth and yield parameters. They concluded that the enhancement of pepper tolerance to salt stress in response to mycorrhizal inoculation and calcium spray is due to improving nutritional status and other physiological processes. Moreover, Tavasolee and Aliasgharzad (2009) studied the effect of mycorrhiza on nutrient uptake and yield of onion under salinity and found a significant difference between the treatment on onion yield and P, Na, Cl, Zn, Cu content and total uptake of N, P, K, Zn and Cu in the bulbs and total uptake of Na, Cl and Mn and concluded that inoculation with mycorrhiza resulted in higher yield and lower Na and Cl content in the onion bulbs.

In addition, Hashim *et al*. (2018) indicated that mycorrhizal inoculation resulted in an enhancement of uptake of cucumber plants of several important mineral elements including K, Ca, Mg, Zn, Fe, Mn and Cu with significant reductions in the uptake of other deleterious ions such as Na^+ under salinity conditions, suggesting that AMF is effective in protecting cucumber plants from salt stress. Also, Abdelhameid and El-Shazly (2020) found that mycorrhizal inoculation significantly increased tomato nutrient uptake of N, P and K under salinity conditions compared to non-inoculated plants as mycorrhiza can reduce the negative effects of salinity on growth, nutrient contents and yield of tomato.

Conclusion

Salinity is one of the major problems affecting growth and productivity of plants including vegetables, considering that most of vegetable plants are seriously injured by salinity. However, it is suggested that using mycorrhiza is an environmentally safe and simple method to overcome this problem and will be of great value for vegetable producers. Moreover, mycorrhiza provides a useful solution for vegetable plants grown in salt-affected soils. It is indicated that mycorrhiza improves salinity tolerance by several means including enhancement of nutrient uptake accumulation of several substances involved in salinity tolerance. Other effects are also evident for vegetable plants inoculated by mycorrhiza under salinity conditions which related to increase salinity tolerance such as improvement of chlorophyll content, proline, antioxidant levels as well as improving water status under salt conditions. It is also indicated that mycorrhiza enhances salinity tolerance through different aspects including improvements of cell membrane integrity, ionic balance to prevent the entry of toxic Na ions in roots, nutrient uptake of macro- and microelements by the external hyphae and water uptake and osmotic potential. It is also evident that A-mycorrhiza acts as bio-regulators and bio-protectors by interfering with the phytohormones of plants. According to the reviewed information, it is possible to minimize the harmful effects of salinity on vegetable plants by using mycorrhiza in salt-affected soils or when using saline water for irrigation.

References

Abdel Latef, A.A. and H. Chaoxingb, 2011. Effect of arbuscular mycorrhizal fungi on growth, mineral nutrition, antioxidant enzymes activity and fruit yield of tomato grown under salinity stress. Scientia Horticulturae 127:228–233.

Abdelhameid, N.M. and M.M. El-Shazly, 2020. The Impact of Inoculation with Arbuscular mycorrhizal Fungi on Tomato Tolerance to Salt Stress and Nutrients Uptake in Sandy Soil. Journal of agricultural chemistry and biotechnology, 11(3):63-70.

Al-Karaki, G.N., 2000. Growth of mycorrhizal tomato and mineral acquisition under salt stress. Mycorrhiza, 10 :51–54.

Al-Karaki, G.N., 2017. Effects of mycorrhizal fungi inoculation on green pepper yield and mineral uptake under irrigation with saline water. Adv. Plants Agric. Res., 6(5):164–169.

Altome, M. M. , M.G. Nessim, M.A. Hussein and I.I. AbouElSaoud, 2015. Response of tomato plant to compost application and inoculation with mycorrhizal fungi under salt stress conditions. Journal of the Advances in Agricultural Researches, 20:(1):46-65.

Altuntas, O., H.Y. Dasgan, Y. Akhoundnejad, and Y. Nas, 2024. Unlocking the potential of pepper plants under salt stress: Mycorrhizal effects on physiological parameters related to plant growth and gas exchange across tolerant and sensitive genotypes. Plants, 13:1380. https://doi.org/10.3390/plants13101380.

Basak, H., K.M. Cimrin and M. Turan, 2024. Effects of Mycorrhiza on Plant Nutrition, Enzyme Activities, and Lipid Peroxidation in Pepper Grown Under Salinity Stress. J. Agric. Sci. Technol., 26 (2): 359-369.

Basak, H., K. Demdr, R. Kasim, and F.Y. Okay, 2011. The effect of endo-mycorrhiza (VAM) treatment on growth of tomato seedling grown under saline conditions. African Journal of Agricultural Research, 6(11): 2532-2538.

Badr, M. A., W.A. El-Tohamy, S. D. Abou-Hussein and N. S. Gruda, 2020. Deficit Irrigation and Arbuscular Mycorrhiza as a Water-Saving Strategy for Eggplant Production. Horticulturae, 6(45):2-17. doi:10.3390/horticulturae6030045

Beltrano, J., Ruscitti, M., Arango, M.C. and M. Ronco, 2013. Effects of arbuscular mycorrhiza inoculation on plant growth, biological and physiological parameters and mineral nutrition in pepper grown under different salinity and p levels. Journal of Soil Science and Plant Nutrition, 13(1):123-141.

Bernal, O.B., J.L. Spinoso-Castillo, E.M. Álvarez, and J.J. Bello-Bello, 2022. Arbuscular mycorrhizal fungi induce tolerance to salinity stress in taro plantlets (*Colocasia esculenta* L. Schott) during acclimatization. Plants (Basel)., 11(13): 1780. doi: 10.3390/plants11131780.

Cantrell, I.C. and R.G. Linderman, 2001. Preinoculation of lettuce and onion with VA mycorrhizal fungi reduces deleterious effects of soil salinity. Plant and Soil, 233: 269–281. DOI: 10.1023/A:1010564013601.

Damaiyanti, D.R.R. , Aini, N. and R. Soelistyono (2015). Effects of arbuscular mycorrhiza inoculation on growth and yield of tomato (*Lycopersicum esculentum* Mill.) under salinity stress. Journal of Degraded and Mining Lands Management, 3(1):447 – 452. DOI:10.15243/jdmlm.

Deepa Devi, N. and T. Arumugam. (2019). Salinity tolerance in vegetable crops: A review. Journal of Pharmacognosy and Phytochemistry, 8(3): 2717-2721.

Dere, S., 2024. Mitigating the adverse effects of salt stress on pepper plants through arbuscular mycorrhizal fungi (AMF) and beneficial bacterial (PGPR) inoculation. Horticulturae,10,1150.

Devarshi, P., S. Jayswal, H. Solanki and B. Maitreya, 2020. Effect of salinity on different vegetable crops- a review. International Journal of Recent Scientific Research, 11(2):37418-37422.

Ervé, N. A., S.E. Wiraghan, M.R. Fosah, C. Fridolin, T.I. Alice, Fotso and T.V. Desiré, (2022). Influence of arbuscular mycorrhizal fungi and phosphorous on the growth, nutrient uptake, chlorophyll content and some metabolites of eggplant (*Solanum melongena* L. VAR. Yalo) under saline conditions. African Journal of Biotechnology, 21(7):342-352. DOI: 10.5897/AJB2022.17493

Garcia, C.L., S. Dattamudi, S. Chanda, and K. Jayachandran, 2019. Effect of salinity stress and microbial inoculations on glomalin production and plant growth parameters of snap bean (*Phaseolus vulgaris*). Agronomy, 9, 545; doi:10.3390/agronomy9090545.

Haghighi, M., S. Mohammadnia, Z. Attai, and M. Pessarakli, 2016. Effects of mycorrhiza inoculation on cucumber growth irrigated with saline water. Journal of Plant Nutrition, 40(1):128-137.

Hashem, A., A.A. Abdulaziz, R. Ramalingam, F. A. Al-Bandari, A. A. Horiah, E. Dilfuza, and E. F. Abdallah, 2018. Arbuscular mycorrhizal fungi regulate the oxidative system, hormones and ionic equilibrium to trigger salt stress tolerance in *Cucumis sativus* L. Saudi Journal of Biological Sciences, 25(6): 1102-1114.

Kaya, C., M. Ashraf, O. Sonmez, S. Aydemir, A.L. Tuna, and M.A. Cullu, 2009. The influence of arbuscular mycorrhizal colonisation on key growth parameters and fruit yield of pepper plants grown at high salinity. Scientia Horticulturae, 121:1-6.

Malhi, G.S., M. Kaur, P. Kaushik, M.N. Alyemeni, A.A. Alsahli and P. Ahmad, 2021. Arbuscular mycorrhiza in combating abiotic stresses in vegetables: An eco-friendly approach. Saudi Journal of Biological Sciences, 28:1465–1476.

Parida, A.K. and A.B. Das, 2005. Salt tolerance and salinity effects on plants: a review. Ecotoxicol. Environ. Saf., 60(3):324-49. doi: 10.1016/j.ecoenv.2004.06.010.

Poss, J. A., 1985. Effect of salinity on mycorrhizal onion and tomato in soil with and without additional phosphate. Plant and Soil, 88:307-319.

Rouphael, Y., P. Franken, C. Schneider, D. Schwarz, M. Giovannetti, M. Agnolucci, S.D. Pascale, P. Bonini, and G. Colla, 2015. Arbuscular mycorrhizal fungi act as biostimulants in horticultural crops. Sci. Hortic. 196, 91–108. https://doi.org/10.1016/j.scienta.2015.09.002.

Sané, A., A. Kane, B. Diallo, M. Ngom, D. Sané, and M. Ourèye, 2022. Response to inoculation with arbuscular mycorrhizal fungi of two tomato (*Solanum lycopersicum* L.) varieties subjected to salt stress under semi-controlled conditions. Agricultural Sciences, 13:1334-1362. DOI: 10.4236/as.2022.1312082.

Santander, C., M. Sanhueza, J. Olave, F. Borie, A. Valentine and P. Cornejo, 2019. Arbuscular mycorrhizal colonization promotes the tolerance to salt stress in lettuce plants through an efficient modification of ionic balance. Journal of Soil Science and Plant Nutrition. https://doi.org/10.1007/s42729-019-00032-z.

Shalaby, O.A. and M.E. Ramadan, 2024. Mycorrhizal colonization and calcium spraying modulate physiological and antioxidant responses to improve pepper growth and yield under salinity stress. Rhizosphere, 29(3):100852.

Suhail, F.M. and I. A. Mahdi, 2013. Test the efficiency of mycorrhizal fungi (*Glomus fasciculatum*) and magnetic water to reduce the effect of salinity on plant onion (*Allium cepa* L.). Bulletin UASMV serie Agriculture, 70(2):325-333.

Tavasolee, A.R. and N. Aliasgharzad, 2009. Effect of arbuscular mycorrhizal fungi on nutrient uptake and onion yield in a saline soil at field conditions. Water and soil science,19(1):145-158.

Yadav, V.K., R.K. Jha, P. Kaushik, F.H. Altalayan, T. Al Balawi and P. Alam, 2021. Traversing arbuscular mycorrhizal fungi and Pseudomonas fluorescens for carrot production under salinity. Saudi Journal of Biological Sciences, 28:4217–4223.

Yilma, G., 2019. The role of mycorrhizal fungi in pepper (*Capsicum annuum*) production. Int. J. Adv. Res. Biol. Sci., 6(12):59-65. DOI: 10.22192/ijarbs.

Zuccarini, P. (2007). Mycorrhizal infection ameliorates chlorophyll content and nutrient uptake of lettuce exposed to saline irrigation. Plant Soil Environ., 53(7): 283–289.