Available online at http://bajas.edu.iq
https://doi.org/10.37077/25200860.2023.36.1.21
College of Agriculture, University of Basrah

Basrah Journal of Agricultural Sciences

ISSN 1814 – 5868

Basrah J. Agric. Sci., 36(1), 271-275, 2023

E-ISSN: 2520-0860

Short Notes: Application of Vesicular Arbuscular Mycorrhiza: Increasing the Yield of Okra

Maricar O. Dahilig* **& Raymund J. G. Rosales**

Department of Agricultural Sciences, Mariano Marcos State University,City of Batac, 2906, Ilocos Norte, Philippines

***Corresponding author email**: dahiligmicah0930@gmail.com; **R.J.G.R.**: rjrosales2019@gmail.com

Received 9th December 2022; Accepted 31st March 2023; Available online 30th June 2023

Abstract: A commercially available arbuscular mycorrhizal fungi was applied to investigate the response of okra plants, particularly the yield components. Okra plants were separately treated with inorganic fertilizer, organic fertilizer, and mycorrhiza. Untreated plants were used as a control (without fertilizers and mycorrhiza). Based on the results, the fruit number per plant, fruit length, and yield were significantly affected by treatments. The high fruit number and yield were observed in plants with mycorrhiza than those plants with fertilizers. The fruit length in plants applied with mycorrhiza was higher than the organic fertilizer, but mycorrhiza and organic fertilizer showed a similarity with inorganic fertilizer and control. The increase yield of okra by application of mycorrhiza was due to the positive association of number of fruits per plant. The fruit length and yield also showed a positive correlation.

Keywords: Fruit count, Fruit length, Mycorrhiza, Yield.

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is a flowering plant in the Malvaceae family and it is valued for its edible green pods due to nutritional value. Okra is widespread and commonly seen in the market (Coulibaly *et al*., 2021). It is widely grown worldwide, and the cultivation and the local name of okra is dependent on the country where they belong (Durazzo *et al*., 2018). It is also an indispensable component of Filipino dishes in "pinakbet', particularly in the northern part of the Philippines. However, good productivity is dependent on complex factors and some of them is cultural management, especially the nutrient management or the application of fertilizers. Inorganic and organic fertilizers are the materials which applied to plants to improve the performance of crops and to supplement the needed nutrients by the plants that the soil could not provide (Afe & Oluleye, 2017; Coulibaly *et al*., 2021).

On the other hand, plants are applied with mycorrhizae to enhance their nutrient and water uptake (Dighton, 2009). Arbuscular mycorrhizal fungi (AMF) are natural root symbionts to host plants to provide essential nutrients, to improve plant growth and yield (Begum *et al*., 2019). Moreover, the formation of the hyphal network by AMF will provide larger access for the plants to absorb water and nutrients. It was also reported it improves soil quality, texture, and plant health (Zou *et al*., 2016; Thirkell *et al*., 2017). Thus, this study was conducted to investigate the response of okra, particularly the yield components from the application of mycorrhiza

Materials & Methods

The range of the temperature and relative humidity throughout the growing period of the plants was 24 to 35 °C and 50-89%, respectively (MMSU-PAGASA-PCARRD 2016). The study was conducted in Pinili, Ilocos Norte. The area was prepared by plowing and harrowing twice to pulverize the soil and make it leveled before planting. Furrows were prepared at a distance of 50 cm in between each other. Small bunds were constructed between blocks and plots with 50 cm of width and 50 cm high.

A smooth green variety of okra was used. Fifty-five grams of okra seed was soaked in water overnight prior of planting. The okra was sown directly at 1-2 seeds per hole at a distance of 50 cm x 50 cm between rows and hills. Replanting was done seven days after planting (DAP). Before sowing, a commercial source of mycorrhizal fungi (mykovam) was applied at a rate of 5 grams per hole.

The application of inorganic and organic fertilizers depended on the treatments. For treatment 1, it had no mycorrhiza and fertilizers; treatment 2 was inorganic fertilizer (92-56-56 kg of $NP_2O_5K_2O$; treatment 3 was organic fertilizer using vermicompost; treatment 4 was the use of a commercially available source of VAM. Each treatment or plot had an area of $5m^2$ (1m x 5m).

Ten grams of complete fertilizer (14-14-14) was applied during planting time. Side dressing was done 30 days after emergence at a rate of 10 grams using 46-0-0. In addition, two kilograms (in every plot) of organic fertilizer (vermicompost) was applied basally before planting.

The pods of the plants were harvested based on the treatment, and a total of 10 harvesting was done. The plant samples from each treatment were harvested and placed in a plastic bag separately with proper labeling.

Number of fruits per plant was recorded from the first, middle, and last harvesting. The total number of fruits per plant was recorded from the first to the 10th harvesting. The number of fruits per kilogram was counted per plot. This was recorded every harvesting.

Fruit length and diameter were measured using a vernier caliper from the first, middle, and last harvesting.

Yield parameters were analyzed using Analysis of Variance in Randomized Complete Block Design (RCBD) with three replications using the SPSS-22 software (SPSS In., Chicago, IL., USA), Mean standard errors (SE) were used to present the data. Treatment means differences that show significant result was further tested using Tukey's Honestly Significant Difference (HSD).

Results & Discussion

There were no significant differences among okra plants were which applied with either mycorrhiza and fertilizers regarding to the plant height and root length from 20 to 60 DAP (data not shown), but the root length was longer in okra plants that were applied with mycorrhiza alone than with no application; however, mycorrhiza and no fertilizer were comparable with the other treatments. The plant height ranged from 9.67 to 10.96 cm, 26.70 to 30.74 cm, and 68.46 to 83.07 cm at 20, 40, and 60 DAP, respectively. However, the root length at 20 and 60 DAP were 10.05 to 13.05 cm and 21.30 to 26.97 cm, respectively.

The fruit number per plant, fruit length, and yield per hectare affected significantly by the different treatments (Table 1). In the number of fruits per plant, wherein the fruits were counted from first to the last priming, the sole

application of mycorrhiza showed the highest fruit number as compared to other treatments. A previous study reported that the arbuscular mycorrhizal fungi significantly increased the fruit number compared to those without application (Olawuyi *et al*., 2012). Previous studies also noted the increase by application of mycorrhiza (Adavi & Tadayoun, 2014).

Whereas those plants without application of mycorrhiza and fertilizers exhibited the lowest fruit count per plant. The fruit length of okra was higher in plants that were treated with mycorrhiza than organic fertilizer, but these treatments were comparable with the other treatments.

The application of arbuscular mycorrhiza effectively increased the nutrient uptake of the plants and increased plant yield (Ortas, 2010; Begum *et al.*, 2019). This conformed with the study that the application of mycorrhiza produced the highest yield than no application, fertilizers, and mycorrhiza + fertilizers. The fruit yield was almost double higher than plants without mycorrhiza and fertilizers. The high yield may be due to the high fruit count per plant, wherein the variation was the same as the yield. This claim was observed in their positive correlation (Table 2). Moreover, it was observed there was a positive association between root lengths at 40 DAP and fruit length with yield. It indicates that the length of roots and fruit length plays a role in the high yield of okra. The mycorrhiza may absorb the native soil nutrients that were used by the okra plants, which provided a high fruit count per plant and yield. The importance of other attributes of okra should be considered in future study, and a larger area should be used.

Table 1. The number of fruits per plant, fruit length, fruit diameter, and yield per hectare of okra applied with mycorrhiza and fertilizers.

Treatment	Number of fruits per plant	Fruit length (cm)	Fruit diameter (cm)	Yield per hectare (ton)
No Fertilizer	558.67d	8.73ab	1.27a	10.25d
Inorganic Fertilizer	1360.67b	9.13ab	1.26a	27.17b
Organic Fertilizer	1012.67c	8.42b	1.29a	18.83c
Mycorrhiza	1557.33a	9.20a	1.28a	31.60a

Values are means ± standard error (SE); Means followed by different lowercase letters$^{(a-b)}$ in a column are significantly different at $p \leq 0.05$ by using Tukey's Honestly Significant Difference (HSD) test.

Table 2. Pearson correlation of some attributes of okra.

	Number of fruits per plant	Yield per hectare
Root length at 40 DAP*	0.533	0.517
Fruit length	0.460	0.475
Number of fruits per plant	-	0.996

* DAP: days after planting

Conclusion

The application of mycorrhiza proved that it would improve crop performance, especially the fruit characteristics of okra. The role of fruit count per plant, fruit length, and root length plays an importance to the yield, as shown by their positive relationship. The commercially available of mycorrhizal fungi can be used in the same agro-climatic conditions as the study. In order to have conclusive results, additional parameters to gather, larger area, and variation of the amount of the commercially available mycorrhizal fungi used are recommended.

Acknowledgments

The authors express their gratitude to the editor and reviewers for dedicating their time and offering feedback that contributed to enhancing the manuscript.

Author Contributions

MODahilig – Conceptualization, Methodology, Data gathering, Data analysis, Writing-Draft and Editing; RJGRosales – Conceptualization, Methodology, Supervision, Data analysis, Writing and editing final.

Conflict of Interest

Authors declare no conflict of interest

ORCID

R.J.G. Rosales : https://orcid.org/0000-0003-0230-2507

References

Adavi, Z., & Tadayoun, R. (2014). Effect of mycorrhiza application on plant growth and yield in potato production under field conditions. *Iranian Journal of Plant Physiology*, *4*(3), 1087-1093. https://ijpp.saveh.iau.ir/article_540653.html

Afe, A., & Oluleye, F. (2017). Response of okra (*Abelmuschus esculentus* L. Moench) to combined organic and inorganic fertilizers. *International Journal of Recycling of Organic Waste in Agriculture*, *6*, 189-193. https://doi.org/10.1007/s40093-017-0166-6

Begum, N., Qin, C., Ahanger, M., Raza, S., Khan, M., Ashraf, M., Ahmed, N., & Zhang, L. (2019). Role of asbuscular mycorrhizal fungi in plant growth regulation: implications in abiotic stress tolerance. *Frontiers in Plant Science*, *10*, 1-15. https://doi.org/10.3389/fpls.2019.01068

Coulibaly, S., Toure, M., Koumae, A., Kambou, I., Soro, S., Yeo, K., Kone, S., & Zoro, B. (2021). Vermicompost as an alternative to inorganic fertilizer to improve okra productivity in Cote d'Ivoire. *Open Journal of Soil Science*, *11*, 1-12. https://doi.org/10.4236/ojss.2021.111001

Dighton, J. (2009). *Mycorrhizae*. Pp. 153-162. In Schaechter, M. (Ed.). *Encyclopedia of microbiology*. 3rd edition. Academic Press. https://doi.org/10.1016/B978-012373944-5.00327-8

Durazzo, A., Lucarini, M., NNovellino, E., Souto, E., Daliu, P., & Santini, A. (2018). *Abelmoschus esculentus* (L.): Bioactive compoents' beneficial properties-focused on antidiabetic role-for sustainable health applications. *Molecules, 24*, 38. https://doi.org/10.3390/molecules24010038

MMSU-PAGASA-PCARRD (2016). Agro-meteorological l Station, City of Batac, Ilocos Norte, Philippines. Temperature and relative humidity data from December 2015 to February 20, 2016.

Olawuyi, J., Ezekiel-Adewoyin, D., Odebode, A., Aina, D., & Esenbamen, G. (2012). Effect of arbuscular mycorrhizal (*Glomus clarum*) and organomineral fertilizer on growth and yield performance of okra (*Abelmoschus esculentus*). *African Journal of Plant Science*. *6*(2), 84-88. https://doi.org/10.5897/AJPS11.295

Ortas, I. (2010). Effect of mycorrhiza application on plant growth and nutrient uptake in cucumber production under field conditions. *Spanish Journal of Agricultural Research*. *8*(1), 116-122. https://doi.org/10.5424/sjar/201008S1-1230

Thirkell, T., Charters, M., Elliot, A., Sait, S., & Field, K. (2017). Are mycorrhizal fungi our sustainable saviours considerations for achieving food security. *Journal of Ecology*, *105*(4), 921-929. https://doi.org/10.1111/1365-2745.12788

Zou, Y., Srivastava, A., & Wu, Q. (2016). Glomalin: A potential soil conditioner for perennial fruits. *International Journal of Agriculture and Biology*. *18*(2), 93-297. https://doi.org/10.17957/IJAB/15.0085

تطبيقات لفطريات الميكوريزا الحويصليّة: زيادة إنتاجية نبات البامية

ريموند جوليوس روزاليس وماريكار داهليليج

قسم العلوم الزراعية، جامعة ولاية ماريانو ماركوس، الفلبين

المستخلص: تم تطبيق الفطريات الميكوريزا الحويصلية المتوافرة تجارياً لبحث استجابة نباتات البامية، بالأخص مؤشرات الانتاجية. تمت معاملة نباتات البامية بشكل مستقل بالأسمدة غير العضوية والأسمدة العضوية والفطريات. تم استخدام النباتات غير المعاملة للمقارنة (بدون الأسمدة والفطريات). بناءً على النتائج ، تأثر عدد الثمار بالنبات وطول الثمرة والحاصل معنوياً بالمعاملات. لوحظ ارتفاع عدد الثمار واحاصل في النباتات المعاملة بفطريات بالميكوريزا مقارنة بالنباتات التي عوملت بالأسمدة. كان طول الثمار في النباتات المعاملة بفطريات الميكوريزا أعلى من السماد العضوي ، لكن الفطريات والأسمدة العضوية أظهرت تشابهًا مع السماد غير العضوي والمقارنة. يعود سبب زيادة محصول البامية عن طريق المعالمة بفطريات الميكوريزا إلى الارتباط الإيجابي لعدد الثمار لكل نبات. كما أظهر طول الثمرة والمحصول علاقة ارتباط موجبة.

الكلمات المفتاحية: عدد الثمار، طول الثمار، الميكوريزا، الحاصل.