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EFFECT OF MICRONUTRIENTS FOR GROWTH AND YIELD IN BHENDI (*Abelmoschus esculentus* L)

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ABSTRACT
The present investigation entitled "Effect of micronutrients for growth and yield in bhendi (*Abelmoschus esculentus* L) *cv*. CO^3"was carried out during 2017 at Vanavarayar Institute of Agriculture, Manakkadavu, Pollachi. The studies were carried out with 8 different treatments involving the micronutrients ($MnSO_4$, $MgSO_4$, $ZnSO_4$, $FeSO_4$, Borax, $CuSO_4$, Water spray and Control), at two different concentrations sprayed at 20 and 40 DAS. The experiment was laid out in a randomized block design (RBD) with three replications and data on effect of different micronutrients on growth, yield and yield attributes was recorded and statistically analyzed. Among the treatments, T_3 - $ZnSO_4$ at 0.5% had significantly increased the plant height (37.80 cm), (83.40 cm) and (97.60 cm) at 30 DAS, 60 DAS and at the harvesting stage. The data pertaining to the highest plant girth (2.70 cm), (4.90 cm) and (7.80 cm) at 30 DAS, 60 DAS and at the harvesting stage was recorded in T_3 - $ZnSO_4$ at 0.5%. The earliest days to first flowering was recorded in T_3- $ZnSO_4$ - 0.5% (34.0 days) on par with T_2- $MgSO_4$ - 0.5% (34.0 days). With the respect to days to 50 % flowering was recorded in T_3- $ZnSO_4$ - 0.5% (37.0 days).The highest number of nodes per plant at harvest was recorded in T_3- $ZnSO_4$ - 0.5% (23.50). The earliest days to first picking was recorded in T_3- $ZnSO_4$ - 0.5% (41.40 days). The Highest days to final picking was recorded in T_3- $ZnSO_4$ - 0.5% (87 days).The highest total number of fruits per plant was recorded in T_3- $ZnSO_4$ - 0.5% (23.60).The highest fruit length was noticed in T_4- $FeSO_4$ - 0.5% (23.50 cm).The highest fruit diameter was recorded in T_4- $FeSO_4$ - 0.5% (7.5 cm). The highest fruit weight was registered in T_4- $FeSO_4$ - 0.5% (22.50).The highest number of seeds was registered in T_4- $FeSO_4$ - 0.5% (47.30).The highest fruit yield was recorded in T_4- $FeSO_4$ - 0.5% (270.50g). The Highest fruit yield per plot was recorded in T_4- $FeSO_4$ - 0.5% (7.56 kg).

KEY WORDS: Bhendi, micro nutrients, growth, flower, yield.

INTRODUCTION

Okra (*Abelmoschus esculentus* L) is commonly known as bhendi or lady's finger belonging to family Malvaceae. It is an important fruit vegetable crop cultivated in various states of India. Several species of the genus Abelmoschus are grown in many parts of the world among them *Abelmoschus esculentus* is most commonly cultivated in Asia and has a great commercial demand due to its nutritional values. Okra is cooked with meat for flavoring and because of high mucilaginous content, the fruits are ideal for both thickening and flavoring stews and soups. The fruits can also be boiled or fried and eaten as a vegetable. Okra is cultivated for its immature fruits to be consumed as a fresh and canned food as well as for seed purpose. Fruits of okra contain a mucilaginous substance that thickens the soup and stews. Okra has a relatively good nutritional value and is a good complement in developing countries where there is often a great alimentary imbalance. It is a good source of vitamin A, B, C and is also rich in protein, carbohydrates, fats, minerals, iron and iodine. Fruit contains Moisture (89.6 percent), K (103 mg), Ca (90 mg), Mg (43 mg), P (56 mg), vitamin C (18 mg) in 100 g of fresh fruit. Metals such as iron and aluminium are found between 500 and 4000 ppm. India ranks first in the world with 5,784.0 thousand tonnes (72% of the total world production) of ladyfinger/okra Anon (2005). It is also cultivated in Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon. Andhra Pradesh is the leading okra producing state which has production of around 1184.2 thousand tons from an area of 78.90 thousand ha, with a productivity of 15 tons/ha. It is followed by West Bengal (862.1 thousand tons from 74.00 thousand ha with 11.70 tons/ha productivity). The fruits are harvested when immature and eaten as a vegetable. The roots and stems of okra are used for cleaning the cane juice from which gur or jaggery is prepared. Ladyfinger provides an important source of vitamins, calcium, potassium and other minerals, which are often lacking in the diet of developing countries. The absorption takes place through the stomata's of leaves and also through the leaf cuticle. Zinc, boran and molybdenum have been successfully used in the past by many workers for plant growth and quality in the form of foliar spray on the leaves but very little work has been done with reference to the use of micro-nutrients on the growth and yield of okra. Keeping in view the above facts, the present investigation was laid out to find out the effect of micronutrients management (zinc, boran and molybdenum) on growth and yield of okra. This study was therefore initiated to investigate the effect of micronutrients that improve bhendi growth, fruit yield and quality.

MATERIALS AND METHODS

The experimental field is situated at the south farm of Vanavarayar Institute of Agriculture Manakkadavu, Pollachi. Which is located at 10.7 ^{0} N and 76 ^{0} E with an altitude of 195 m above MSL. The experiment was laid out in randomized block design with eight treatments and replicated three times. Spaced at 60 x 30 cm were selected for the experiment. Two plots were selected for each replication for the study. Treatments details are T_1: Foliar application of $MnSO_4$ .0.5%, T_2: Foliar application of $MgSO_4$ - 0.5%, T_3: Foliar application of $ZnSO_4$ - 0.5%, T_4: Foliar application of $FeSO_4$ - 0.5%,T_5: Foliar application of $CuSO_4$ - 0.5%,T_6: Foliar application of Borax - 0.5%,T_7: Water spray, T_8: Control and imposition of treatments are foliar spray at 20 and 40 DAS.

RESULT AND DISCUSSION

I. Effect of micronutrients on growth and flower attributes

Micronutrients significantly increased growth parameters such as plant height, plant girth, Days to first flowering, number of nodes per plant and days taken to 50% flowering. Growth promoters and nutrients have been defined as the chemicals that enhance the cell division and cell elongation in the shoot apex and increase the plant height physiologically without formative effects (Scurfield and Moore, 1958). Present study result revealed that the among the micronutrients, T_3 - $ZnSO_4$ at 0.5% concentration significantly increased the plant height (37.80 cm) and Followed by T_2- $MgSO_4$ - 0.5% were recorded plant height (34.50 cm)over the T_8 - control (26.20 cm). Data on plant height at 60 DAS was significantly influenced by micronutrient treatments (Table 1). All the micronutrients significantly increased plant height compared to control. Maximum plant height was recorded with T_3 - $ZnSO_4$ at 0.5% (83.40 cm) followed by T_2-$MgSO_4$ - 0.5% (77.80 cm) over the T_8 - control (62.50 cm). At the harvesting stage, maximum plant height was recorded with T_3 - $ZnSO_4$ at 0.5% (97.60 cm) followed by T_2- $MgSO_4$ - 0.5% (87.50 cm) over the T_8 - control (69.20 cm), earliest days to first flowering was recorded in T_3- $ZnSO_4$ - 0.5%(34.0 days) on par with T_2- $MgSO_4$ - 0.5%(34.0 days). The highest days taken for first flowering were registered inT_8- Control (37.50 days). With respect to days to 50 per cent flowering was recorded in T_3- $ZnSO_4$ - 0.5% (37.0 days) followed by T_2- $MgSO_4$ - 0.5% (40.0 days). The highest days taken for 50 per cent flowering was registered in T_8- Control (47.30 days) (Table: 1).

TABLE 1. Effect of micronutrients on morphological parameters of bhendi

Treatment details	Plant height (cm)			Plant girth (cm)			Days to first flowering	Days to 50 per cent flowering
	30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest		
T_1- $MnSO_4$ - 0.5%	32.60	73.50	85.70	2.30	4.20	7.20	34.6	42.3
T_2- $MgSO_4$ - 0.5%	34.50	77.80	87.50	2.50	4.60	7.60	34.0	40.0
T_3- $ZnSO_4$ - 0.5%	37.80	83.40	97.60	2.70	4.90	7.80	34.0	37.0
T_4- $FeSO_4$ - 0.5%	29.20	67.90	84.60	2.10	4.20	7.30	35.0	41.3
T_5- $CuSO_4$ - 0.5%	30.40	70.50	78.40	2.30	4.40	7.20	35.6	38.3
T_6- Borax - 0.5%	29.00	68.90	73.80	2.20	4.10	7.20	34.6	38.0
T_7- Water spray	27.50	63.70	70.70	1.90	3.80	7.10	36.0	42.6
T_8- Control	26.20	62.50	69.20	1.70	3.60	6.80	37.5	47.3
SEd	1.42	3.29	3.67	0.10	0.20	0.35	1.72	2.10
CD (0.5%)	3.04	7.05	7.86	0.22	0.42	0.75	3.70	4.29

Among the micronutrients, ZnSO4 - 0.5% and followed by MgSO4 -0.5% has shown a significant increase in plant height, plant girth, Days to first flowering, number of nodes per plant and days taken to 50 % flowering. The application of zinc might have improved the efficiency in growth due to increase in moisture, auxin and chlorophyll content of tissue. The increased vegetative growth by zinc application was also been reported by Singh and Mayura (1978), Srihari *et al*. (1987) and Medhi and Kakati (1994). Zinc is a component of carbonic anhydrase, as well as several dehydrogenases and auxin production which in turn enhance plant growth. However, iron is necessary for the biosynthesis of chlorophyll and cytochrome, leading to increase in the biosynthesis of materials and growth (Mohsen Kazemi, 2013). Data indicated that the application of micronutrients $ZnSO_4$ (0.5%) and $MgSO_4$ (0.5%).The highest growth parameters, plant height, plant girth, Days to first flowering, number of nodes per plant and days taken to 50% flowering as compared to control. These results are in conformity with Barbara (1965) in brinjal. Similar results were also reported by Bharat Sing *et al*. (1998) and Paliwal *et al*. (1999). Application of zinc, boron, and micronutrient mixture has been reported in increasing plant height of tomato (Hatwar *et al*, 2003). Increase in plant height may be attributed to the role of zinc in auxin synthesis and association of boron with development of cell wall and cell differentiation that help of root and shoot growth of plants (Basavarajeswari *et al*, 2008). According to Das and Mahapotra (1974) and Das and Sahoo (1975) foliar application of boron at0.5 and 105 ppm to potato and brinjal crops, respectively gave significant increase in plant height,, number of branches and leaves and main stem thickness. Similarly Popushoi and Shatrova (1976) reported that treatment of egg plants with boron at 0.15% stimulated growth and development. Das and Dash (1977) conducted a field experiment to evaluate the effect of urea and micronutrients spray on tomato cv. Pusa Ruby and found that application of Boron, Molybdenum, Copper and Zinc stimulated the vegetative growth.

II. Influence of micronutrients on yield and yield attributes

Improvement in yield according to Humphries (1979) could happen in two ways *i.e*., by adopting the existing varieties to grow better in their environment or by altering the relative production of different plant parts so as to increase the yield of economically important parts. The growth regulators and micronutrients are capable of redistribution of dry matter in the plant thereby bringing about an improvement in yield which depends not only on the accumulation of photosynthates during crop growth and development but also on its partitioning in the desired storage organs. These in turn, are influenced by the efficiency of metabolic processes within the plant system.

In the present investigation, it is observed that the number of fruits, number of seeds, fruit length and fruit yield increased due to micronutrients ($ZnSO_4$, $MgSO_4$, $FeSO_4$ and Borax). The increase in fruit yield could be attributed to betterment in the growth parameters. Among the treatment significantly, the earliest days to first picking was recorded in T_3- $ZnSO_4$ - 0.5% (41.40 days) on par with T_2- $MgSO_4$ - 0.5% (42.30). The highest days to first picking were registered in T_8- Control (47.60 days). With respect to highest days to final picking was recorded in T_3- $ZnSO_4$ - 0.5% (87 days) followed by T_6- Borax - 0.5% (85 days) . The lowest days to final picking was registered in T_8- Control (77 days). The highest total number of fruits per plant was recorded in T_3- $ZnSO_4$ - 0.5% (23.60) followed by T_6- Borax - 0.5% (21.90). The lowesttotal number of fruits per plant was registered in T_8- Control (12.50). The highest fruit length was noticed in T_4- $FeSO_4$ - 0.5% (23.50 cm) followed by T_3- $ZnSO_4$ - 0.5% (21.70 cm) and the lowest fruit length was registered in T_8- Control (13.80 cm). With respect to fruit diameter significantly differed due to treatments and it ranged from 5.60 to 7.50 cm. The highest fruit diameter was recorded in T_4- $FeSO_4$ - 0.5%(7.5 cm) followed by T_3- $ZnSO_4$ - 0.5%(7.20 cm) and the lowest fruit diameter was registered in T_8- Control (5.60 cm)Similar result was reported by Syed Asghar *et al*. (1997) in okra with planofix. The number of days taken to final picking was maximum with $ZnSO_4$ – 0.5% (87 days) and followed by Borax – 0.5% (85 days). This may be due to increase in the number of nodes on main axis of plant. The highest fruit yield was recorded in T_4- $FeSO_4$ - 0.5% (270.50g) followed by T_3- $ZnSO_4$ - 0.5% (255.20g) and the lowest fruit yield were observed in T_8- Control (204.40g). With the respect to fruit yield per plot, the highest fruit yield per plot was recorded in T_4- $FeSO_4$ - 0.5% (7.56 kg) followed by T_3- $ZnSO_4$ - 0.5% (7.30 kg) (Table: 2). The lowest fruit yield per plot was recorded inT_8 - control (4.24 kg). This is in agreement with the findings of earlier researchers who have explained that the application of GA_3 increased the number of fruits per plant (Mahesh kumar and Sen, 2005).

Among the micronutrients, $ZnSO_4$ 0.5% recorded maximum fruit weight, Fruit length, fruit girth and number seeds per fruit, which might be due to the fact that zinc plays an important role in the fundamental processes involved in the cellular mechanism and respiration. This is in line with the findings of Kokare *et al*. (2006).

The fruit yield depends on the accumulation of photo assimilates and partitioning in different plant parts. The yield in okra was found to be strongly influenced by the application of different growth regulators and thus indicating the importance of these compounds in increasing the yield potential through their effect on various growth and yield parameters. Irrespective of growth promoters and micronutrients tested, all the growth promoter and micronutrients showed superiority in yield when compared to control. In the present study, among the micronutrients tested it is noticed that the application of $FeSO_4$–0.5% had significantly increased the fruit yield over control. It is well known that iron is found in two well defined proteins viz., heme proteins and iron-sulphur proteins which are associated with PS-I and PS-II of electron transport chain. It is also known to play an important role in the activity of cytochrome oxidase, activation of catalase and peroxidase and involved in ferridoxin mediated electron chain (Marschner, 1986). Similar results were reported by Bhanavase *et al*. (1994) with the application of $FeSO_4$ in soybean.

TABLE 2. Effect of micronutrients on flowering and yield attributes in bhendi

Treatment details	Days to first picking	Days to final picking	Total number of fruits per plant	Fruit yield per plant (g)	Fruit yield per plot(kg)
T_1- $MnSO_4$ - 0.5%	44.3	82	17.3	240.4	6.51
T_2- $MgSO_4$ - 0.5%	42.3	83	18.8	253.4	6.90
T_3- $ZnSO_4$ - 0.5%	41.4	87	23.6	255.2	7.30
T_4- $FeSO_4$ - 0.5%	43.6	83	17.2	270.5	7.56
T_5- $CuSO_4$ - 0.5%	44.0	82	17.2	241.6	6.60
T_6- Borax - 0.5%	42.0	85	21.9	250.7	7.10
T_7- Water spray	45.0	80	16.2	227.3	5.65
T_8- Control	47.6	77	12.5	204.4	4.24
SEd	2.14	3.98	0.90	11.55	0.31
CD (0.5%)	4.42	8.45	1.92	24.12	0.66

REFERENCES

Anonymous (2005) Statistical data on horticultural crops in Karnataka (2004-2005) Published by government of Karnataka, Department of Horticulture, Lalbagh, Bangalore.

Basavarajeshwari Patil C Hosamani Ajjappalavara, R.M. P., Naik, P.S., Smitha, B.H., R.P. and Ukkund, K.C. (2008) Effect of Foliar Application of Micronutrients on Growth and Yield components of Tomato (*Lycopersicone sculentum* Mill.). *Karnataka J. Agric. Sci.*,21(3) : 428-430.

Bharat Singh Naruka, I.S. and Laxman Singh (1998) Effect of foliar application of nitrogen (urea) and gibberellic acid (GA3) on growth and yield of okra (*Abelmoschus esculentus* L. Moench) cv. Sawani. *Progressive Horticulture*, 30(3-4):175-180.

Biswas, N.K., Nath, P.S., Das, S., De, B.K. and Bhattacharyya, I. (2008) Field screening of different varieties/ lines of bhendi (*Abelmoschus esculentus* (L.) Moench) against yellow vein mosaic virus disease in West Bengal, *Research Crops*, **9(**2): 342-344

Hulamani, K.H. (1988) Effect of growth regulators and nutrients on growth and yield of Byadgichilli under rainfed conditions of Dharwad. M.Sc. (Agri.) Thesis, *University of Agricultural Sciences*, Dharwad.

Kokare, R. T., Bhalerao, R.K., Prabu, T., Chavan, S. K., Bansoda, A.B. and Kachare, G.S. (2006) Effect of plant growth regulators on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench]. *Agricultural Science Digest*. **26**(3): 178-181

Marschner, H. (1986) Mineral nutrition of higher plants. Academic Press, Harcourt Brace, London, pp. 269-271

Maurya, C.P. and Lal, H. (1987) Effect of IAA, NAA and GA on growth and yield of onion (*Allium cepa*L.) and vegetable chilli (*Capsicum annum* L.). *Prog.Hort*. 19(3-4): 203-206.

Medhi, G. and Kakati, R.N. (1994) Effect of micronutrients in increasing the growth and yield of Bhendi (*Abelmoschus esculentus* (L.) Moench). *Horticultural Journal* 7(2):155-158.

Mohapatra, A.K., Nath, P.S. and Chowdhury, A.K. (1995) Incidence of Yellow vein mosaic virus of okra *(Abelmoschus esculentus* L. Moench.) under field conditions, *Journal of Mycopathological Research*, **33**(2): 99-103

Sahoo, S.C., Mishra, S.N. and Mishra, S.M. (1990) Association of traits in segregating population of chilli (*Capsicum annuum* L.). *Indian Journal of Agricultural Sciences*, **60**: 233-236.

Srihari I Singh, B. P. and Rao, D.V.R. (1987) Effect of foliar sprays of zinc and molybdenum on growth and yield of okra (*Abelmoschus esculentus* L. Moench) cv. Pusa Sawani. *Progr. Hort.* 13:31-34.

Syed Asghar Hussain, S.A. and Nawab Ali. (1997) Sarhad Journal of Agriculture. 13: 5, 449.