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RESEARCH ARTICLE

EFFECT OF MICRONUTRIENTS ON MORPHOLOGICAL CHARACTERS OF SPINACH (SPINACIA OLEARACEA L.)

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Abstract

The present investigation was aimed to study the effect of different concentrations of micronutrients on morphological characters of Spinach (*Spinacia oleracea* L.) which included shoot and root length, total height per plant, fresh and dry weight per plant, number of leaves per plant and leaf area per plant. The experiment was carried out in four replications. Experimental treatment included seven micronutrients i.e.$CaCl_2$, $CuSO_4$, $MgSO_4$, $MnSO_4$, $ZnSO_4$, H_3BO_3 and $FeSO_4$ with four levels of different concentrations (0, 1, 10, 100 ppm and stock). Results showed that shoot, root length, total height per plant, fresh and dry weight per plant, number of leaves per plant and leaf area per plant were higher in 1 ppm concentration of micronutrients. At 10, 100 ppm concentration of micronutrients and pure stock, all parameters decreased significantly. Thus results signify that Spinach requires micronutrients in trace amount and it is essential for proper growth and development of Spinach.

Introduction

Spinach (*Spinacia oleracea* L.) is an edible flowering plant belonging to family Amaranthaceae. It is native to central and south western Asia. It is an annual plant (rarely biennial) which is a high nutritional value vegetable and is extremely rich in antioxidants, especially when fresh, steamed or quickly boiled (Victor *et al*., 1949). It is a rich source of vitamin A, vitamin C, vitamin E, vitamin K, magnesium, manganese, folate, betaine, iron, vitamin B_2, calcium, potassium, vitamin B_6, folic acid, copper, protein, phosphorus, zinc, niacin, selenium and omega-3 fatty acids, opioid peptides called rubiscolins. Polyglutamyl folate (Vitamin B_9 or folic acid) is a vital constituent of cells and Spinach is a good source of folic acid.

Recently, various evidences available indicated increasing research on micronutrient requirements in staple grains due to their critical importance in human diet (Welch and Graham, 2005). Hence, future emphasis on micronutrients may expand from their role in crop production, to their importance in the main staple foods with leafy vegetables in diets for sustaining human and animal health in view of bio-fortification. Thus the present investigation was carried out to assess the role of supplemented micronutrients on growth and development in Spinach.

Material and Methods

The experiment was carried out in four replications. Micronutrients with 1 ppm, 10 ppm, 100 ppm and pure stock was prepared by using $CaCl_2$, $CuSO_4$, $MgSO_4$, $MnSO_4$, $ZnSO_4$, H_3BO_3 and $FeSO_4$. Distilled water treatment served as control. Morphologically healthy seeds of Spinach were first surface sterilized with 1% of $HgCl_2$ for 2 minutes and then washed with distilled water to remove toxic elements. A pot culture experiment was conducted during 2012-2014 to study the influence of foliar application of micronutrients on physiology of Spinach. Soil selected for this

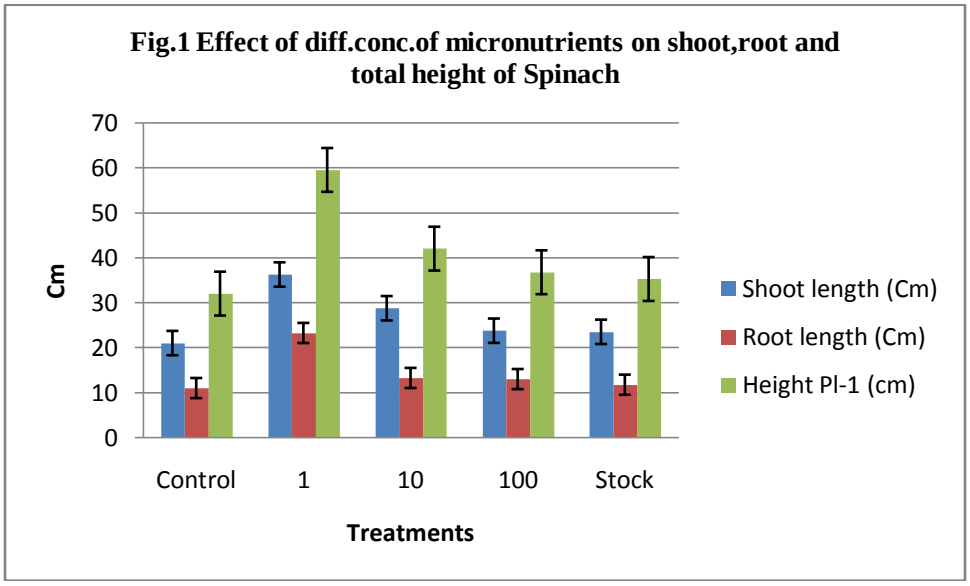
study was very low quality which contains very less quantity of macronutrients as well as micronutrients. The physico-chemical properties of experimental soil are listed in the table 1. All soil properties were analyzed by standard analytical techniques (Miller, A. L., 1982 and Jackson, M. L., 1973).

Before sowing seeds, 10.22 gm triple phosphate (as source of P), 7.66 gm urea (as source of nitrogen) and 7.66 gm potassium sulphate (as source of potassium) were mixed in each tray in order to maintain same level of N, P and K. After 10 days seeds were then germinated in moist soil in plastic tray containing maintained quantity of N, P and K. After that Spinach seedlings were treated with foliar spray of different concentrations (0, 1, 10, 100 ppm and stock) and each treatment had four replicates. Plants were allowed to grow for 45 days. In these 45 days, foliar spray was given in 15 days interval. After 6 weeks, plants were harvested and growth parameters like shoot and root length per plant, total height per plant, number of leaves per plant, fresh and dry weight per plant and leaf area were determined.

Results and Discussion

Table 1. Physico-chemical properties of the experimental soil

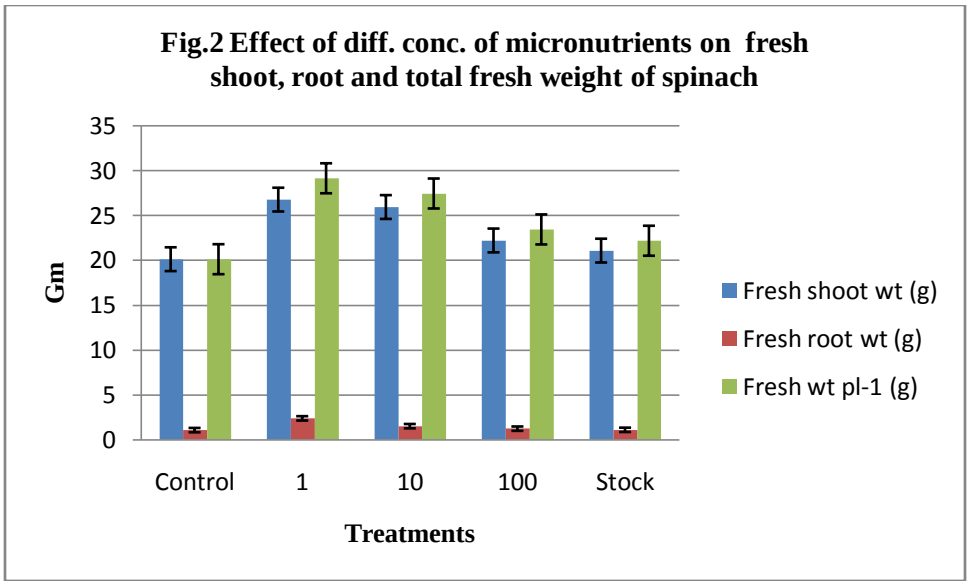
Sr. No.	Soil characteristics	Value
1	P^H (soil-water 1:2)	8.18
2	Electrical conductivity (µSm–1)	0.24
3	Cation exchange capacity (cmol (p+) kg^{-1})	28
4	Water-holding capacity (%)	57.59
5	Organic carbon (%)	0.42
6	Total N (Kg/acre)	0.042
7	Available P (Kg/acre)	2.13
8	Available K (Kg/acre)	53.76
9	Fe (ppm)	1.6
10	Zn (ppm)	1.1
11	Mg (PPM)	2.1
12	Cu (PPM)	2.8
13	Mn (PPM)	2.1



The lower concentration of micronutrients (1 ppm) significantly increased the shoot and root length over control. But as the concentration of micronutrients was increased (10,100, stock), the shoot length as well as root length decreased. This data indicated that essential quantity of micronutrients is prerequisite to proper growth and development of Spinach.

According to Das and Mahapotra (1974) and Das and Sahoo (1975) foliar application of boron at 0.5 and 105 ppm to potato and brinjal crops, respectively gave significant increase in plant height,, number of branches and leaves and main stem thickness. Same results were found by Popushoi and Shatrova (1976). They reported that treatment of egg plants with boron at 0.15% stimulated growth and development. Hatwar et al, (2003) found that increased plant height by application of zinc, boron and micronutrient mixture in tomato plant. While Basavarajeswari et al, 2008, observed that 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 helps root and shoot growth of plants.

So it can be concluded that micronutrient concentration of 1 ppm stock might show significant level of shoot and root length growth of Spinach. Also higher concentration was toxic to the Spinach plants impacting reduced shoot and root length.



According to Fig.2, foliar spray with lower concentration of micronutrients (1 ppm and 10 ppm) significantly increased the fresh shoot weight and fresh root weight over control. But as the foliar concentration of micronutrients was increased (100, stock) the fresh shoot weight in addition to fresh root weight decreased.

Mohamed El-Sayed Ahmed et al., 2011 showed that foliar application of magnesium had significant effects on vegetative growth characters of cauliflower which included foliage fresh weight, plant height, leaves fresh weight in both seasons. Similar results were reported in potato plant by Awad and El-Ghamry in 2007.

In the present investigation, increase in fresh weight due to low concentration of micronutrients may be due to increase in water uptake.

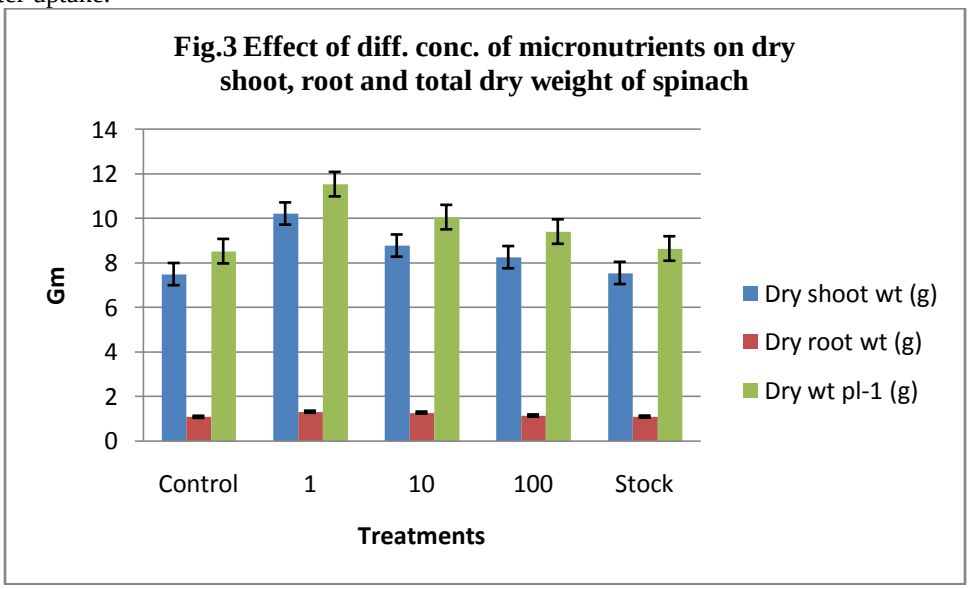


Fig.3 indicated that foliar spray with lower concentration of micronutrients mostly 1 ppm significantly increased the dry shoot weight and dry root weight over control. But as the foliar concentration of micronutrients was increased (10,100, stock) dry shoot weight along with dry root weight decreased.Ahmed et al., 2011 proved that foliar spray with 0.50 and 0.75% Mg and 30 and 45 µg/l Mo significantly enhanced leaves dry weight in cauliflower.

Table: 2. shows effect of concentration of micronutrients on the no. of leaves and leaf area per plant of Spinach

Sr. No.	Treatment (ppm)	No. of leaves pl^{-1}	Leaf Area Cm^2 pl^{-1}
1	Control	13.67±1.85	60.21±0.34
2	1	22.67±0.67	76.67±0.12
3	10	21.35±0.37	70.12±0.65
4	100	17.60 ±0.65	61.27±0.13
5	Stock	14.20±0.55	61.12±0.10

± SEM

Table 2, showed that micronutrient concentration with 1 ppm considerably increased not only number of leaves per plant but also leaf area per plant. As concentration of micronutrients increased, both decreased effectively. Increase in plant growth characters *viz*. plant height, number of leaves per plant and leaf area per plant by application of micronutrients may be due to their involvement in chlorophyll formation, which might have helped to favour cell division, meristematic activity in apical tissue, expansion of cell and formation of new cell wall (Singh *et al*, 1979). Influence of boron either singly or in combination with other micronutrients have been reported in increasing number of leaves per plant in several crops (Medhi and Kakati, 1994).

Conclusion

From the present investigation it has been observed that higher concentrations of micronutrients combination (10,100 ppm and stock) adversely affect growth of Spinach .

References

Awad, E.M.M. and A.M. El-Ghamry (2007): Effect of humic acid, effective microorganisms (EM) and magnesium on potatoes in clayey soil. J. Agric. Sci.Mansoura Univ., 32: 7629-7639.

Basavarajeswari CP., Hosamni RM., Ajjappalavara PS., Naik BH., Smitha RP and Ukkund (2008): Effect of foliar application of micronutrients on growth, yield components of Tomato *(Lycopersicon esculentum* Mill*): Karnataka J. Agri. Sci*.. 21(3): 428-430.

Das RC and Mahapatra P (1974): Studies on the effect of mineral nutrients and growth chemicals on the growth, yield and quality of brinjal (*Solanum melongena* L.) M.Sc(Ag) Thesis submitted to Orissa University of Agriculture and Technology, Bhubaneswar.

Das RC and Sahoo KC (1975): Foliar treatments of nutrition on potato (*Solanum tuberosum* L) variety Kufri Sindhuri. *Res. J. of Orissa Univ. of Agri. and Tech*. 5(1-2):96-103.

Hatwar GP., Gondane SM., Urkade SM and Gahukar OV (2003): Effect of micronutrients on growth and yield of chilli. *Soils and Crops*.13 (1):123-125.

Jackson, M. L. (ed.), (1973): *Soil Chemical Analysis*, Prentice-Hall of India Pvt Ltd, New Delhi.

Medhi G and Kakati RN (1994): Effect of micronutrients in increasing the growth and yield of bhendi (*Ablemoschus esculentum* L.). *Hort. J.* 7 (2): 155-158.

Miller, A. L. and Keeney, D. R. (eds), (1982) :*Methods of SoilAnalysis, Part 2*, Agronomy Monograph 9, American Society ofAgronomy, Wisconsin, USA.

Mohamed El-Sayed Ahmed, Abdelnaser , Abdelghany Elzaawely and Mohamed Basiouny El-Sawy (2011): Effect of the Foliar Spraying with Molybdenum and Magnesium on Vegetative Growth and Curd Yields in Cauliflower (Brassica oleraceae var. botrytis L.). World Journal of Agricultural Sciences 7 (2): 149-156.

Popushai IS and Shatrova GZ (1976): The roles of minor elements in increasing eggplant resistance to wilt .Vertisillen wilt Kulturnnnykh Resistance. *Maldamiam Stiinica*: pp.3-8.

Singh SS and Maurya AN (1979):A note on the effect of Zn application on the growth, yield and quality of okra (*Abelmoschus esculentum* L.). *Haryana J. Hort. Sci*. 5(3-4): 258-259.

Victor R. Boswell (1949): "Garden Peas and Spinach from the Middle East". Reprint of "Our Vegetable Travelers" *National Geographic Magazine*, Vol. 96:2. (WWW: Aggie Horticulture.)

Welch, R.M.and Graham, R.D. (2005): Agriculture: the real nexus for enhancing bioavailable micronutrients in food crops. *Journal of Trace Elements in Medicine and Biology*, 18:299 – 307.