*Journal of Crop and Weed, 9(2):138-141(2013)*

# Response of garlic to foliar application of some micronutrients

**M. CHANCHAN, J. K. HORE AND S. GHANTI**

*Department of Spices and Plantation Crops*
*Bidhan Chandra Krishi Viswavidyalaya*
*Mohanpur-741252,Nadia, West Bengal*

*Received: 05-04-2013, Revised 15-10 -2013, Accepted: 20-10-2013*

**ABSTRACT**

*The investigation was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidhyalaya, Nadia, West Bengal during 2009-11 to find out the effect of micronutrients on growth and yield of garlic cv. katki. Three concentrations of four micronutrients namely zinc sulphate (0.1, 0.25 and 0.50%), borax (0.1, 0.2 and 0.3%), ferrous sulphate (0.1, 0.2 and 0.3%) and manganese sulphate (0.1, 0.25 and 0.50%) were applied as foliar spray at 45, 60 and 75 days after planting. Maximum leaf number (9.45), number of cloves (29.23), weight of bulb (27.18g) and projected yield (7.13 t/ha) were recorded with borax @ 0.2%. Plants under zinc sulphate @ 0.25% recorded maximum plant height (61.72 cm), number of roots (102.56), length of cloves (3.05 cm) and neck thickness (1.08 cm). Borax @ 0.2% was found most effective for yield improvement of garlic followed by zinc sulphate 0.25%.*

***Keywords:*** Borax, ferrous sulphate, garlic, manganese sulphate and zinc sulphate

Garlic (*Allium sativum* L.) is an important bulb crop next to onion. The cloves of garlic bulb are used in flavouring of various vegetarian and non-vegetarian dishes. The significance of this spice is increasing owing to its wide range of medicinal properties. India ranks second in the world in respect of area and production. From India, large amount of dehydrated garlic products are exported to Japan, UK, Italy, Turkey, Germany and France. Most of the researches on nutrition of garlic limit the recommendation for major nutrients like N, P, and K, but micro-nutrients also play a vital role in deciding the growth and development of plants. The lack of experimental evidence on the response of garlic to the micro-nutrients necessitated the assessment of the efficacy of Zn, B, Fe and Mn in order to achieve its productivity potential. The present experiment was, therefore, undertaken to assess the efficacy of micro-nutrients on growth and yield of garlic under new alluvial plain of West Bengal.

## MATERIALS AND METHODS

The experiment was carried out during winter season of two consecutive years i.e., 2009-10 and 2010-11 in the research station located at 23.5º N latitude and 89º E longitude, with an altitude of 9.75 m above the mean sea level. The soil of the experimental field was Gangetic alluvial with sandy clay loam texture, good water holding capacity, well drained with moderate soil fertility status and soil pH of 6.9. The organic carbon, total nitrogen, available phosphorous, potassium contents are 0.63%, 0.084%, 18.07 kg.ha$^{-1}$ and 194.49 kg.ha$^{-1}$ respectively. The available zinc, boron, manganese and iron contents of the soil are 0.57, 0.4, 2.5 and 11.35 mg.kg$^{-1}$ respectively.

The cloves of garlic cv. Katki were planted during first week of November in 2.0 m x 1.0 m plot at 20 cm x 15 cm spacing. Four micronutrients namely zinc as zinc sulphate ($ZnSO_4.7H_2O$) @ 0.10, 0.25 and 0.50%, boron as borax ($Na_2B_4O_7$) @ 0.1, 0.2 and 0.3%, iron as ferrous sulphate ($FeSO_4.7\ H_20$) @ 0.1, 0.2 and 0.3% and manganese as manganese sulphate ($MnSO_4.H_2O$) @ 0.10,0.25 and 0.50% were applied as foliar spray along with a sticker at 45, 60 and 75 days after planting (DAP). There were 13 treatments including control. The experiment was laid out in RBD with three replications. The uniform dose of FYM @ 20 t.ha$^{-1}$ and NPK @ 150:125:150 kg.ha$^{-1}$ were applied. Full dose of FYM, $P_2O_5$, $K_2O$ and ½ N were applied as basal and remaining ½ N was applied at 45 DAP. First irrigation was given immediately after planting. The observations on growth parameters like plant height and number of leaves were recorded at 90 DAP. Five bulbs were selected randomly from each replication after cleaning and weighed. Total number of cloves from randomly selected five bulbs of each replication was counted. The total weight of the bulb per plot was recorded to obtain the yield per plot. The projected yield per hectare was calculated on the basis of yield per plot, considering 75% area occupied by garlic in the present experiment. The data were subjected to statistical analysis, following the methods of Panse and Sukhatme (1985).

*Email: chanchan.meinam17@gmail.com*

## RESULTS AND DISCUSSION

Plant height recorded at 90 days after planting revealed the significant variations among different treatments (Table 1). The maximum plant height of 63.26 cm and 61.72 cm were noticed with zinc sulphate 0.25% in 2009 and pooled data but maximum plant height of 61.53 cm was recorded during 2010 with borax 0.2%. As per pooled analysis, the higher plant heights were associated with the medium concentration of all four micro-nutrients, the highest concentration leads to reduction of plant height. The medium concentration of borax 0.2% recorded maximum number of leaves of 10.17 and 9.45 in 2009 and pooled data respectively but manganese sulphate 0.25% recorded highest leaf number during 2010. The lowest leaf number (8.02) was noticed in control plants during 2009 but plant under manganese sulphate 0.50% produced minimum leaf number (6.94, 7.52) in 2010 and in pooled data.

**Table 1: Influence of micronutrients on vegetative growth of garlic**

| Treatments | Plant height (cm) | | | Leaf number | | | No. of roots plant$^{-1}$ | | | Neck thickness (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | Pooled | 2009 | 2010 | Pooled | 2009 | 2010 | Pooled | 2009 | 2010 | Pooled |
| $ZnSO_4$ 0.10% | 58.05 | 59.25 | 58.65 | 8.38 | 8.02 | 8.20 | 92.35 | 75.95 | 84.15 | 1.12 | 1.04 | 1.08 |
| $ZnSO_4$ 0.25% | 63.26 | 60.17 | 61.72 | 9.45 | 8.81 | 9.13 | 98.42 | 106.70 | 102.56 | 1.06 | 0.82 | 0.94 |
| $ZnSO_4$ 0.50% | 60.18 | 57.45 | 58.82 | 8.86 | 8.44 | 8.65 | 102.16 | 88.34 | 95.25 | 0.95 | 0.87 | 0.91 |
| $Na_2B_4O_7$ 0.1% | 56.28 | 58.74 | 57.51 | 8.26 | 8.86 | 8.56 | 86.34 | 76.52 | 81.43 | 0.12 | 0.90 | 0.96 |
| $Na_2B_4O_7$ 0.2% | 59.28 | 61.53 | 60.41 | 10.17 | 8.73 | 9.45 | 105.81 | 91.53 | 98.67 | 0.96 | 1.00 | 0.98 |
| $Na_2B_4O_7$ 0.3% | 59.25 | 57.52 | 58.39 | 9.51 | 8.91 | 9.21 | 83.04 | 91.60 | 87.32 | 1.08 | 1.02 | 1.05 |
| Fe $SO_4$ 0.1% | 58.15 | 54.26 | 56.21 | 9.42 | 7.70 | 8.56 | 84.12 | 88.92 | 86.52 | 0.94 | 0.82 | 0.88 |
| Fe $SO_4$ 0.2% | 56.25 | 56.82 | 56.24 | 8.75 | 7.55 | 8.15 | 82.47 | 74.09 | 78.28 | 0.98 | 0.86 | 0.92 |
| Fe $SO_4$ 0.3% | 52.26 | 52.32 | 52.29 | 8.35 | 7.51 | 7.93 | 73.56 | 62.32 | 67.94 | 0.83 | 0.79 | 0.81 |
| Mn $SO_4$ 0.10% | 57.15 | 54.83 | 55.99 | 8.56 | 8.96 | 8.76 | 74.51 | 61.99 | 68.25 | 1.03 | 0.93 | 0.98 |
| Mn $SO_4$ 0.25% | 57.85 | 56.28 | 57.07 | 9.83 | 8.91 | 9.37 | 82.16 | 74.52 | 78.34 | 0.97 | 0.93 | 0.95 |
| Mn $SO_4$ 0.50% | 55.28 | 53.34 | 54.31 | 8.10 | 6.94 | 7.52 | 87.31 | 82.95 | 85.13 | 0.98 | 0.90 | 0.94 |
| Control | 55.42 | 51.28 | 53.35 | 8.02 | 7.44 | 7.73 | 83.15 | 65.61 | 74.38 | 0.91 | 0.81 | 0.86 |
| **S.Em.(±)** | **1.529** | **1.538** | **1.084** | **1.106** | **0.694** | **0.653** | **1.326** | **1.172** | **0.885** | **0.260** | **0.212** | **0.168** |
| **LSD (0.05)** | **4.462** | **4.488** | **3.083** | **NS** | **NS** | **NS** | **3.871** | **3.419** | **2.516** | **NS** | **NS** | **NS** |

*NS = Non significant*

The number of roots per plant was significantly influenced by different levels of micro-nutrients. The maximum number of roots of 105.81 and 106.70 were noticed in borax 0.2% and zinc sulphate 0.25% during 2009 and 2010 respectively. In pooled data maximum number of roots (102.56) was observed in zinc sulphate 0.25% followed by borax 0.2% (98.67) and zinc sulphate 0.50% (95.25). The least root number was associated with ferrous sulphate 0.3% in the year 2009 (73.56), 2010 (62.32) and in pooled data (67.94). The decreasing trend in root number was noticed with increasing concentration of ferrous sulphate but opposite trend was noticed with manganese sulphate. In case of both zinc sulphate and borax medium concentration exhibited the higher number of roots per plant. The neck thickness was also influenced by the different levels of micro-nutrient. The maximum thickness of 1.12 cm, 1.04 cm and 1.08 cm were noticed during the 2009, 2010 and in pooled data in zinc sulphate 0.10% sprayed plants followed by plants under borax 0.2% treatment . The minimum thickness of 0.83 cm, 0.79 cm, and 0.81 cm were noticed in plants under ferrous sulphate 0.3% in the respective year and in pooled data.

Data presented in Table 2, indicated that different levels of micronutrient had significant variations on number of cloves. Maximum number of cloves of 31.13 and 27.38 were observed with borax 0.2% and zinc sulphate 0.25% during the year 2009 and 2010. The minimum number of 22.85 and 20.71 were noticed with plants under ferrous sulphate 0.3% in both the years. In pooled data, the maximum clove number was associated with borax 0.2% followed by zinc sulphate 0.25% (29.23) as compared to 21.78 under ferrous sulphate 0.75%. The maximum clove length of 3.12 cm, 3.10 cm and 3.05 cm were observed in plants grown with zinc sulphate 0.50%, manganese sulphate 0.50% and zinc sulphate 0.50%

during the year 2009, 2010 and in pooled data respectively. The minimum length of 2.82 cm and 2.73 cm were recorded in manganese sulphate 0.50% and untreated control during the respective years. But in pooled data the minimum length (2.79 cm) was noticed under control plants. Maximum weight of bulb of 28.13 g and 26.78 g were recorded in plants under borax 0.2% and zinc sulphate 0.25% during the year 2009 and 2010 as compared to least bulb weight of 19.28 g and 18.16 g under manganese sulphate 0.50% and ferrous sulphate 0.3% during the respective years. In pooled data, the maximum bulb weight of 27.18 g was observed in borax 0.2% followed by zinc sulphate 0.25% (25.77 g) and borax 0.3% (24.40 g) as compared to minimum weight of 19.14 g under untreated control. The decreasing trend in weight of bulb was noticed with the increasing concentration of both ferrous sulphate and manganese sulphate. In zinc sulphate and borax, the maximum weight was noticed at their medium concentration.

**Table 2: Influence of micronutrients on yield and yield parameters of garlic**

| | No. of cloves bulb$^{-1}$ | | | Length of cloves(cm) | | | Weight of bulb (g) | | | Projected yield (t.ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **2009** | **2010** | **Pooled** | **2009** | **2010** | **Pooled** | **2009** | **2010** | **Pooled** | **2009** | **2010** | **Pooled** |
| Zn $SO_4$ 0.10% | 28.15 | 24.89 | 26.52 | 2.93 | 2.81 | 2.87 | 24.32 | 20.30 | 22.31 | 6.38 | 5.33 | 5.86 |
| Zn $SO_4$ 0.25% | 29.56 | 27.38 | 28.47 | 2.98 | 2.94 | 2.96 | 24.76 | 26.78 | 25.77 | 6.50 | 7.03 | 6.76 |
| Zn $SO_4$ 0.50% | 26.47 | 22.13 | 24.30 | 3.12 | 2.98 | 3.05 | 21.16 | 22.14 | 21.65 | 5.55 | 5.81 | 5.68 |
| $Na_2B_4O_7$ 0.1% | 27.45 | 20.87 | 24.16 | 2.96 | 2.86 | 2.91 | 24.42 | 22.12 | 23.27 | 6.41 | 5.81 | 6.11 |
| $Na_2B_4O_7$ 0.2% | 31.13 | 27.33 | 29.23 | 3.04 | 2.90 | 2.97 | 28.13 | 26.23 | 27.18 | 7.38 | 6.89 | 7.13 |
| $Na_2B_4O_7$ 0.3% | 28.82 | 24.60 | 26.71 | 3.09 | 2.95 | 3.02 | 24.05 | 24.75 | 24.40 | 6.31 | 6.50 | 6.41 |
| Fe $SO_4$ 0.1% | 26.84 | 25.84 | 26.34 | 2.95 | 2.77 | 2.86 | 23.51 | 22.41 | 22.96 | 6.17 | 5.88 | 6.03 |
| Fe $SO_4$ 0.2% | 26.56 | 21.90 | 24.23 | 3.02 | 2.88 | 2.95 | 21.98 | 19.38 | 20.68 | 5.77 | 5.09 | 5.43 |
| Fe $SO_4$ 0.3% | 22.85 | 20.71 | 21.78 | 2.97 | 2.89 | 2.93 | 20.28 | 18.16 | 19.22 | 5.32 | 4.77 | 5.05 |
| Mn $SO_4$ 0.10% | 28.10 | 25.54 | 26.82 | 2.94 | 2.74 | 2.82 | 25.59 | 22.23 | 23.91 | 6.72 | 5.85 | 6.28 |
| Mn $SO_4$ 0.25% | 26.45 | 24.27 | 25.36 | 2.91 | 2.85 | 2.88 | 23.82 | 18.54 | 21.18 | 6.25 | 4.87 | 5.56 |
| Mn $SO_4$ 0.50% | 23.18 | 21.24 | 22.21 | 2.82 | 3.10 | 2.96 | 19.28 | 20.18 | 19.73 | 5.06 | 5.30 | 5.18 |
| Control | 25.62 | 21.46 | 23.54 | 2.85 | 2.73 | 2.73 | 19.56 | 18.72 | 19.14 | 5.13 | 4.91 | 5.02 |
| **S.Em.(±)** | **0.964** | **1.004** | **0.696** | **0.495** | **0.403** | **0.312** | **1.821** | **1.716** | **1.251** | **0.436** | **0.487** | **0.327** |
| **LSD (0.05)** | **NS** | **NS** | **NS** | **1.334** | **1.176** | **0.887** | **5.314** | **5.008** | **3.557** | **1.271** | **1.422** | **0.929** |

*NS = Non significant*

The maximum projected yield of 7.38 t.ha$^{-1}$ and 7.03 t.ha$^{-1}$were observed in borax 0.2% and zinc sulphate 0.25% during the year 2009 and 2010 as compared to minimum yield of 5.06 t.ha$^{-1}$ and 4.77 t.ha$^{-1}$ with manganese sulphate 0.50% and ferrous sulphate 0.3% in the respective year. Significant variations among different treatments were observed. As per pooled data, the maximum yield of 7.13 t.ha$^{-1}$was recorded with borax 0.2% followed by zinc sulphate 0.25% (6.76 t.ha$^{-1}$) and borax 0.35 (6.41 t.ha$^{-1}$) as compared to lowest yield (5.02 t.ha$^{-1}$) under untreated control. The medium concentration of both zinc sulphate and borax gave higher yield but decreasing trend in yield was noticed in both ferrous sulphate and manganese sulphate with increasing the concentration. Among different micronutrients, borax @ 0.2% and zinc sulphate @ 0.25% and 0.50% gave promising results in most of the cases followed by manganese sulphate and ferrous sulphate. The improvement on growth and yield of garlic might be due to the enhanced enzymatic and photosynthetic activity and greater translocation rate due to the influence of boron. The favourable effects of boron might be attributed due to its involvement in cell division and cell expansion. Selvaraj *et al*. (2002) also reported increased in bulb yield with boron application in garlic. Sharangi *et al*. (2003) found increased plant height and number of leaves with the application of boron.

It is clear from the results that the medium concentration of zinc sulphate showed the better response on growth and yield of garlic. Zinc application increased the photosynthetic activity which ultimately resulted in improving the growth. Under zinc application, improved root system helped the plant in better absorption of water and other nutrients dissolved in it and consequently they improved different organs and also the entire plant. The entire favourable effect was also attributed to the

fact that the zinc was essential in nitrogen metabolism (Asana *et al*. 1971).

Zinc was also found responsible for larger size of bulb. This fact is due to improved physiological activities like photosynthesis during which food manufactured by the plant and translocated in the bulb. Zinc helped in translocation of constituents from one part to the other. Zinc application markedly increased the number of cloves per bulb and weight of cloves. The improvement in weight and number of cloves might be due to increase in size and weight of bulb under the influence of zinc, might be due to rapid transformation and storage of food material in the bulb which ultimately increased the number of cloves per bulb and weight of cloves. The improved vegetative growth of plant and yield attributing characters due to zinc application has also direct relation in improvement of bulb development and increase in bulb yield. These results are in the conformity with the findings of Sharangi *et al.* (2003), and Srivastava *et al.* (2005) in garlic. From yield maximisation point of view, the most effective treatment was borax 0.2% followed by zinc sulphate 0.25% and boron 0.3% under alluvial plains of West Bengal for garlic production.

## REFERENCES

Asana, R.D., Sarin, R.D. and Saxena, M.N. 1971 . *Hand Book of Manures and Fertilizers*. ICAR, New Delhi, pp.160-94.

Panse, V.G. and Sukhatme, P.V. 1995. *Satistical Methods for Agricultural Workers*, ICAR, New Delhi.

Selvaraj, N., Natarajan, S., Selvaraj, V.M., Prabitha, A. and Mathews, S. 2002. Effect of foliar application of micronutrients on the growth and yield of garlic. *South Indian Hort*., **50**:159-68.

Sharangi, A.B., Pariari, A., Datta, S. and Chatterjee, R. 2003. Effect of boron and zinc on growth and yield of garlic in New Alluvial Zone of West Bengal. *Crop Res.*, **25**: 83-85.

Srivastava, R., Agarwal, A., Tiwari, R.S. and Kumar, S. 2005. Effect of micronutrients, zinc and boron on yield, quality and storability of garlic (*Allium sativum*). *Indian J. Agric. Sci.*, **75**:157-59.