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# RESPONSE OF FOLIAR FEEDING OF MICRONUTRIENTS ON QUALITY TRAITS AND ECONOMICS OF BITTER GOURD (*MOMORDICA CHARANTIA* L.) UNDER CENTRAL ZONE OF (U.P.)

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## ABSTRACT

The field experiment was conducted at Vegetable Research Farm, Kalyanpur of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh during *kharif* season of 2019 the response of micronutrients on different quality traits and economics of bitter gourd. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Fourteen different treatments of micronutrients combination were tested against the control. Results of the experiment revealed that application of foliar feeding of mixture of all micronutrients (boric acid @ 100 ppm + zinc sulphate @ 100 ppm + ammonium molybdate @ 50 ppm + copper sulphate @ 100 ppm + ferrous sulphate @ 100 ppm + manganese sulphate @ 100 ppm) ($T_7$) produced significantly highest T.S.S content (5.45 $^0$Brix), Vitamin-C content (64.62mg/100g), Cost of cultivation (53,881.0Rs/ha.), Gross return (1,84,408.0Rs/ha.) Net return (1,30,527.0Rs/ha) and B:C ratio (3.42). Significantly highest zinc content (85 ppm), Iron content (426 ppm) and copper content (22 ppm) were found in fruits with the application of zinc sulphate @ 100 ppm ($T_2$), ferrous sulphate @ 100 ppm ($T_5$) and copper sulphate @ 100 ppm ($T_4$) respectively. The lowest values of quality traits and economics were recorded in control.

**Key words**: Bitter gourd, Quality, Micronutrients, Foliar feeding and Economic return.

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Bitter gourd (*Momordica charantia* L.) is one of the important vegetable crop belonging to the family cucurbitaceae.. In terms of medicinal properties, bitter gourd ranks first among the cucurbits due to higher nutritive value being rich in all the essential vitamins and minerals especially vitamin C (96 mg/100g), iron (2.0 mg/100g), phosphorus (38 mg/100g) and calcium (23 mg/100g) (Gopalan, 1993). It is designated as 'plant insulin' which has been found highly beneficial and lowering the blood and urine sugar level. The bitter gourd plants are used as an anthelminthic, purgative and pain reliever and to treat haemorrhoids, internal parasites and rashes. A seed extract has the capacity to inactivate certain cancerous tumours and may have anti-leukemic activity and also helps in ameliorate the effects of diabetes mellitus. In India, the production of bitter gourd was 1137 thousand MT on an area of 97 thousand hectares during 2017-18 (DAC & FW, 2018). Micronutrients such as iron, zinc, boron, manganese etc. have been reported to play a vital role in modifying the growth and development of many horticultural crops. The deficiency of micronutrients adversely affects the production of vegetable besides quality. Therefore, the current study includes foliar feeding of micronutrients to evaluate its influence on quality traits and economic return of bitter gourd.

## MATERIALS AND METHODS

The soil of experimental field is sandy loam in texture and soil pH was 7.7, which showed slightly alkaline reaction. The soil was low in organic carbon 0.37%, low in available N 152.0 kg/ha, medium in available P 14.4 kg/ha and low in available K 181.0 kg/ha at initiation of experiment. The experiment was laid out in randomized block design with three replications fifteen different treatments. The bitter gourd variety 'Kalyanpur Barahmasi' was used in the experiment. The crop was sown on 3rd July with the spacing of 1.50m x 0.60m. Seeds were treated with carbendazim systemic fungicide containing 50% WP @ 2.5 g/kg

seed before sowing of the seed for the protection of crop plants from seed borne diseases. Recommended dose of fertilizers (NPK) was applied @ 60, 80 and 60 kg/ha. The entire quantities of phosphorus and potassium and half of nitrogen were applied as basal and rest amount of nitrogen was applied in two split doses at 25 DAS and 45 DAS as top dressings. Total three foliar sprays were given at an interval of 10 days starting from 40 days after sowing. Other package of practices was adopted recommended for the region. The observations were taken on their quality attributes and economics of bitter gourd and subjected to analysis of variance with mean comparison of 5% level of significance.

## RESULTS AND DISCUSSION

The recorded data clearly indicated that the foliar application of various micronutrients brought significant improvement in different quality character of fruits presented in Table-1 and graphically represented in fig-1. The mixture of all micronutrients ($T_7$) recorded maximum TSS content (5.45$^0$Brix) in fruits, which was statistically at par with multiplex @ 4 ml/litre of water ($T_{14}$) and these both treatments ($T_7$ and $T_{14}$) are significantly superior to all other treatments. Lowest TSS content (3.50 $^0$Brix) was noticed under control treatment. The similar results are also proposed by **Rab and Haq (2012)** in tomato, **Dongre *et al.* (2000)** in cabbage and **Baghel and Sarnaik (1988)** in onion. The plant sprayed with zinc sulphate @ 100 ppm recorded maximum zinc content in fruits (85.00 ppm) and this treatment was found superior to rest of the treatments. The lowest zinc content (27.00 ppm) in fruits was observed under control ($T_0$).**Ain *et al.* (2016)** and **Maurya and Lal (1975)** reported the effect of zinc application on different fruit parameters. The highest iron content of 426 ppm was found in fruits harvested from plants treated with ferrous sulphate @ 100 ppm ($T_5$), which showed statistical equality to mixture of all micronutrients ($T_7$), multiplex @ 4ml/ litre of water ($T_{14}$) and mixture of all micronutrients without Cu ($T_{11}$) with iron content of 410 ppm, 405 ppm and 399 ppm in fruits, respectively. The minimum iron content of 291 ppm was recorded under control treatment.**Karan *et al.* (2007)** in okra and **Rawat and Mathpal (1984)** and **Lalit and Srivastava (2005)** in tomato crop also reported the effect of micronutrient application on quality parameters of fruits. The highest copper content of 22 ppm was found in fruits harvested from plants treated with copper sulphate @ 100 ppm ($T_4$), which showed statistical equality to mixture of all micronutrients without copper ($T_{11}$),

multiplex @ 4ml/ litre of water ($T_{14}$) with copper content of 21 ppm, in both fruits. The minimum copper content of 16 ppm was recorded under control treatment. The result observed by Aref *et al*.(2011).The highest Vitamin-C content of (64.62mg/100g) was found in fruits harvested from plants treated with mixture of all micronutrients ($T_7$), which showed statistical equality at par with the treatments $T_9$, $T_{10}$, $T_{11}$, $T_4$ and $T_9$ respectively). The minimum Vitamin-C content of (61.55mg/100g) was recorded under control treatment. These findings reported by Nighat *et al*.(2016)

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**Table- 1.0 Response of foliar feeding of micronutrients on quality traits of bitter gourd (*Momordica charantia* L.)**

| Treatment Details | TSS content in fruits ($^0$Brix) | Zinc content in fruits (ppm) | Iron content in fruits (ppm) | Copper content in fruits (ppm) | Vitamin-C content in fruits (mg/100) |
|---|---|---|---|---|---|
| **Control (only water spray)** | 3.50 | 27.00 | 291.00 | 16.00 | 61.55 |
| **Boric acid @100 ppm** | 5.04 | 46.00 | 373.00 | 18.00 | 63.07 |
| **Zinc sulphate @100 ppm** | 4.24 | 85.00 | 336.00 | 20.00 | 63.40 |
| **Ammonium molybdate @50 ppm** | 3.64 | 45.00 | 358.00 | 17.00 | 62.57 |
| **Copper sulphate @100 ppm** | 3.73 | 37.00 | 353.00 | 22.00 | 63.84 |
| **Ferrous sulphate @100 ppm** | 3.86 | 43.00 | 426.00 | 18.00 | 62.47 |
| **Manganese sulphate @100 ppm** | 4.05 | 38.00 | 360.00 | 19.00 | 62.86 |
| **Mixture of all (B+Zn+Mo+Cu+Fe+Mn)** | 5.45 | 76.00 | 410.00 | 20.00 | 64.62 |
| **Mixture of all without B** | 3.68 | 42.00 | 365.00 | 18.00 | 64.31 |
| **Mixture of all without Zn** | 4.78 | 35.00 | 386.00 | 18.00 | 63.76 |
| **Mixture of all without Mo** | 4.47 | 41.00 | 376.00 | 20.00 | 64.25 |
| **Mixture of all without Cu** | 3.79 | 68.00 | 399.00 | 21.00 | 64.02 |
| **Mixture of all without Fe** | 4.88 | 53.00 | 348.00 | 20.00 | 62.78 |
| **Mixture of all without Mn** | 4.65 | 71.00 | 384.00 | 20.00 | 63.34 |
| **Multiplex @ 4 ml/litre of water** | 5.38 | 73.00 | 405.00 | 21.00 | 62.68 |
| **SEm±** | **0.15** | **1.87** | **12.81** | **0.47** | **0.30** |
| **CD (P=0.05)** | **0.43** | **5.41** | **37.10** | **1.39** | **0.89** |

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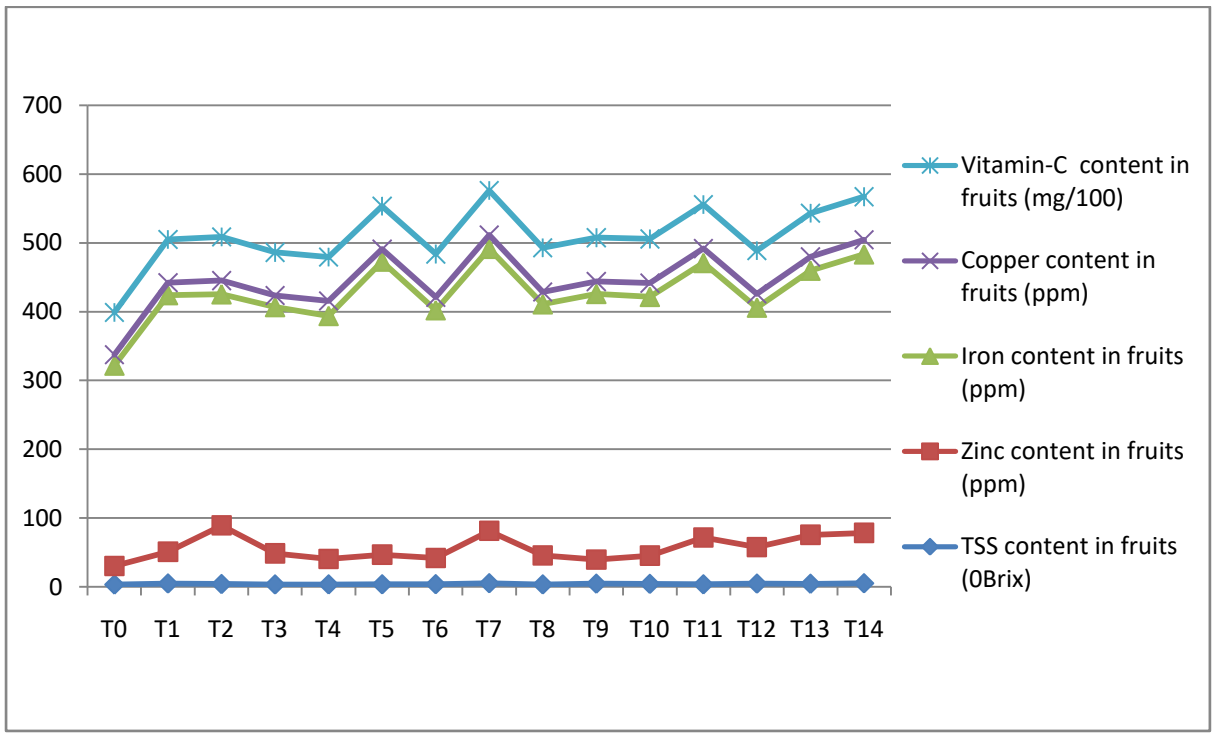


**Fig.- 1.0 Response of foliar feeding of micronutrients on quality traits of bitter gourd (*Momordica charantia* L.)**

## ECONOMIC RETURN & COST BENEFIT RATIO

Recorded data clearly indicated that the foliar application of various micronutrients brought significant improvement in economic return & cost benefit ratio of bitter gourd presented in Table-2 and graphically represented in fig.2, reported that foliar application of multiplex @ 4 ml/liter of water ($T_{14}$) required highest cultivation cost of Rs. 54,270.0/ha followed by mixture of all micronutrients ($T_7$) with Rs. 53,881.0/ha and mixture of all micronutrients without Mn ($T_{13}$) with Rs. 53,736.0/ha. The minimum cultivation cost of Rs. 50,252.0/ha was noticed in control treatment ($T_0$).The maximum gross income of Rs. 1,84,408.0/ha was obtained when crop was sprayed with mixture of all micronutrients ($T_7$). It was followed by multiplex @ 4ml/litre of water ($T_{14}$) with 1,80,042.0/ha and boric acid @ 100 ppm ($T_1$) with Rs. 1,74,344.0/ha. The minimum gross income of Rs. 1,49,258.0/ha was found in control treatment ($T_0$).The maximum net income of Rs. 1,30,527.0/ha was noticed with foliar

application of mixture of all micronutrients ($T_7$) followed by multiplex @ 4ml/litre of water ($T_{14}$) with Rs. 1,25,772.0/ha, boric acid @ 100 ppm with 1,23,064.0/ha and mixture of all micronutrients without Mo ($T_{10}$) with Rs. 1,20,796.0/ha. The least net income of Rs. 99,006.0/ha was recorded in control treatment ($T_0$).The benefit: cost ratio is also affected by foliar application of micronutrients and has been depicted in Table-2.0. An intense examination of the data clearly showed that there is a marked variation in benefit: cost ratio due to foliar application of micronutrients. The crop grown under foliar spray of all micronutrients ($T_7$) gave highest benefit: cost ratio of 3.42 nearly followed by foliar spray of boric acid @ 100 with 3.40. The least benefit: cost ratio of 2.89 was obtained when crop was raised with foliar application of mixture of all micronutrients without Zn ($T_9$). These findings are in conformity with the observations of Bhatt *et al*. (2004), Patil *et al.* (2008) and Singh and Verma (1991) in tomato, who obtained maximum benefit cost ratio with micronutrients combinations.

**Table- 2.0 Response of foliar feeding of micronutrients on economic return of bitter gourd (*Momordica charantia* L.)**

| Treatment details | Cost of cultivation (Rs/ha) | Gross return (Rs/ha) | Net return (Rs/ha) | B:C ratio |
|---|---|---|---|---|
| **Control (only water spray)** | 50,252.0 | 1,49,258.0 | 99,006.0 | 2.97 |
| **Boric acid @100 ppm** | 51,280.0 | 1,74,344.0 | 1,23,064.0 | 3.40 |
| **Zinc sulphate @100 ppm** | 50,432.0 | 1,64,872.0 | 1,14,440.0 | 3.27 |
| **Ammonium molybdate @50 ppm** | 51,991.0 | 1,57,028.0 | 1,05,037.0 | 3.02 |
| **Copper sulphate @100 ppm** | 50,557.0 | 1,59,692.0 | 1,09,135.0 | 3.16 |
| **Ferrous sulphate @100 ppm** | 50,484.0 | 1,63,873.0 | 1,13,389.0 | 3.25 |

| | | | | |
|---|---|---|---|---|
| **Manganese sulphate @100 ppm** | 50,397.0 | 1,57,731.0 | 1,07,334.0 | 3.13 |
| **Mixture of all (B+Zn+Mo+Cu+Fe+Mn)** | 53,881.0 | 1,84,408.0 | 1,30,527.0 | 3.42 |
| **Mixture of all without B** | 52,853.0 | 1,54,068.0 | 1,01,215.0 | 2.91 |
| **Mixture of all without Zn** | 53,701.0 | 1,55,104.0 | 1,01,403.0 | 2.89 |
| **Mixture of all without Mo** | 52,142.0 | 1,72,938.0 | 1,20,796.0 | 3.32 |
| **Mixture of all without Cu** | 53,576.0 | 1,68,406.0 | 1,14,830.0 | 3.14 |
| **Mixture of all without Fe** | 53,649.0 | 1,55,437.0 | 1,01,788.0 | 2.90 |
| **Mixture of all without Mn** | 53,736.0 | 1,70,422.0 | 1,16,686.0 | 3.17 |
| **Multiplex @ 4 ml/litre of water** | 54,270.0 | 1,80,042.0 | 1,25,772.0 | 3.32 |

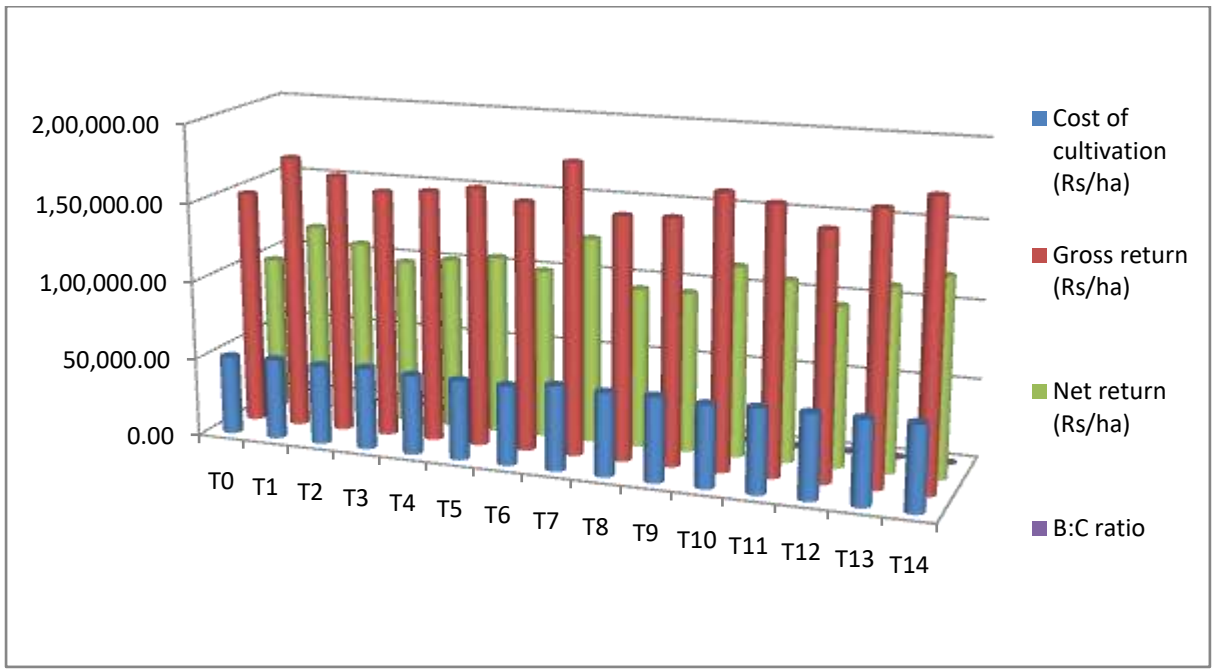


**Fig- 2.0 Response of foliar feeding of micronutrients on economic return of bitter gourd (*Momordica charantia* L.)**

It may be concluded from the present results the foliar feeding application of mixture of all micronutrients either individually or in their combinations improved quality traits, economic return and B:C ratio of bitter gourd cv. Kalyanpur Barahmasi. Among all the treatments combined application of all micronutrients ($T_7$) significantly resulted in better quality traits, higher economic returns and B:C ratio as compared to all other treatments.

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