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Effect of copper and zinc as a supplement fertilizer on growth of radish *(Raphanus sativus)* root and foliage

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Abstract

The foliar spray of copper (0.3%) and znc (0.4%) solution at 15 and 25 days of growth improved the plant height, fresh weight and root size of radish (*Raphanus* sativus L.). The application of copper and zinc along with N, P, K fertilizers improved crop growth more than the control. The concentration of 0.6% copper and 0.8% sinc showed some toxic effect and reduced growth of leaves and root but was better than the no application of Cu and Zn elements.

Key words: Copper, Zinc, growth, toxic, vitamins.

Radish (*Raphanus sativus* L.) crop is not given as much attention as other vegetable crops. Farmers do not apply even the major nutrients like N, P, K to their radish crop fields. Reports on use of micronutrient by the researcher are also scanty in India as well as abroad. People have choosen mostly tomato, potato, okra in their research projects. Particularly the farmers in Meerut region are not aware and habitual of applying micronutrient in radish crop. Many of the radish growers even do not provide major nutrients (N, P, K) in their fields. Looking at the importance of micronutrients, we decided to find out the effect of micronutrients particularly copper and zinc in the study.

Materials and Methods

Meerut region is situated in Western Uttar Pradesh with tropical climate, semi-arid conditions with extremes of weathers. Most of the rainfalls between June and September. Summers are hot and winters are cold with frost. Temperature ranges 8.9°C to 27.2°C from December to January. During the experiment temperature ranges are 7.5°C to 14.5°C. Relative humidity remains from 70-90%. Experimental plot soils are sandy loam. The soil pH was found to be 8.0. Before sowing the experiment the plots were manured with farm yard manure, urea and superphosphate . Farm yard mannure was mixed well before the sowing.

Radish variety Pusa Rashmi was sown on October 9. The micronutrient copper and zinc were used in following combinations in triplicate fields of random plot design of 3.0 × 1.35 m area. Cu_0 = 0.0%, Cu_1 = 0.3%, Cu_2 = 0.6%, Zn_0 = 0.0%, Zn_1= 0.4%, Zn_2 = 0.8% Cu as $CuSO_4$ and Zn as $ZnSO_4$ was used. The Cu_0Zn_0, Cu_0Zn_1, Cu_0Zn_2, Cu_1Zn_0, Cu_1Zn_1, Cu_1Zn_2, Cu_2Zn_0, Cu_2Zn_1, Cu_2Zn_2.

Micronutrients were applied on folige after 15 and 25 days of sowing the seeds. The observations of leaf and radish root parameters were taken at 15, 25 and 35 days after sowing. Required plants were collected from three beds separately and observation data and average of triplicate samples were recorded. Fresh weight of leaves (g), total dry weight of whole plant (g), total plant height including roots (cm), root weight (g), and root length (cm) were considered in this experiment. Yield of radish crop was also recorded. Statistical analysis of the observed data was done by the technique of "Analysis of variance" and significance was tested by 'F' test by the following formula.

Critical Difference (C.D.) = $\sqrt{\frac{ErrorVariance}{n}\times t}$ at 5% level of probability.

$$SEM \pm = \sqrt{\frac{ErrorVariance}{n}}$$

Results and Discussion

Data-showed that combination of Cu_1, Zn_1 doses produced the maximum height of radish plant at 15 days growth (39.0 cm) against the control treatment Zn_0Cu_0 (38.3 cm). The results were statistically singnificant as the SEm± found to be 0.7 and C.D. at 5% level was 2.1. The increase in Zn or Cu concentration to Zn_1 level increased the plant height to 33.1 cm over control 23.3 cm, but Zn_2 level further decreased the height than control value 19.7 cm). Similarly Cu application was also effective at

Cu_1 level. Higher dose of Cu_2 inhibited the growth (Table -1). The effect of Zn and Cu concentrations showed the similar behaviour of plant growth at 25 days of growth. Zn_1Cu_1 dose was found to be better 50.2 cm height and statistically significant (SEM± 0.07, C.D. at 5% - 2.01). The observations recorded at 35 days growth were also better at Zn_1 Cu_1 level than other doses (55.3 cm height) and statistically significant (SEM± 0.72, C.D. at 5% 2.10) (Table 1).

The spray of copper and zinc combination (Cu_1 Zn_1) on 15 day produced longest sized root (21.6 cm), where as minimum length observed was 10.6 cm at Cu_2 Zn_2 concentrations. Results obtained at 25 days growth were similar to 15 day growth as Cu_1Zn_1 produced longest root (70.0) and smallest at Cu_2Zn_1 (33.8 cm). Data obtained at both intervals were statistically significant. Observations on day 35 were not recorded.

The average plant dry weight at 15, 25 and 35 days of growth. At 15th day plant dry weight was maximum (15 g) at Cu_1Zn_1 and minimum at Cu_2Zn_2 levels (0.06 g). Similar observations were recorded at 25 day growth where Cu_1Zn_1 dose produced maximum plant dry weight (4.9g) and Cu_2Zn_2 produced minimum (2.3 g). Dry weight recorded at 35 days were like earlier growth period. Maximum dry weight recorded was at Cu_1Zn_1 dose (11.5g) and minimum at Cu_2Zn_2 (5.8g). All above observations were statistically significant.

The Zn and Cu combination sprayed on radish crop increased the leaf yield per plant over the control value of 10.0 g to 13.9 g with Zn_1Cu_1 concentration on 15ty day growth. Minimum leaf weight observed was 8.8g at Zn_2Cu_2 concentration. Data recorded were significant with SEM± 0.09 and C.D. at 5% is 0.28.

The observations at 25th and 35th day growth were similar to 15th day growth such that maximum leaf weight was 49.0 g at 25th day and 101.2 g at 35th day at Cu_1Zn_1 concentrations and minimum weight was 19.7 g and 52.3g at 25th and 35th day respectively. Statistical significant of data was also seen at these intervals.

We then measured the length of radish root to asses the growth of crop on application of Zn and Cu concentration at 15day growth. The maximum root length observed was 19.0 cm at Cu_1Zn_1 treatment and minimum (4.3 cm) at Cu_2Zn_2 combination even lower than control value of 9.0 g. Similarly Cu_1Zn_1 combination increase the root length to 26.5 cm at 25th day and minimum was 19.2 cm. Both these observations were statistically significant data for 35th day were not recorded.

Another growth parameter measured was the fresh weight of radish root. The observations were recorded in (Table 2). In this case the Zn_1Cu_1 combination gave better results than other. The length root was 9.6 cm on 15th day, 28.3 cm on 25th day and 74.3 cm on 35th day growth. Minimum values for root growth were 4.3, 14.3 and 31.3 cm respectively on 15th, 25th and 35th days of growth. As the observations were statistically significant for this parameter also.

Micronutrients when supplied to radish crop along with manure, N, P and K, it affected the plant growth as a whole as compared to control. Maximum growth observed was at 0.4% Zn in combination with Cu at 0.3%. It may be possible that Zn induces the synthesis of tryplophan, an amino acid, which is the processor of IAA. IAA stimulates the plant growth and

Table 2: Yield (q/ha) of radish crop at harvest stage in response to Cu and Zn application.

Cu, Zn levels	Cu_0	Cu_1	Cu_2
Zn_0	260.96	264.96	249.03
Zn_1	266.40	274.01	257.37
Zn_2	253.80	258.43	241.37
SEm±	-	0.59	-
C.D. at 5%	-	1.67	-

Table 1: Cu and Zn application effect on fresh weight (g) of radish root at 15, 25 and 35 days of growth

Cu, Zn levels	After 15 days			After 25 days			After 35 days		
	Cu_0	Cu_1	Cu_2	Cu_0	Cu_1	Cu_2	Cu_0	Cu_1	Cu_2
Zn_0	5.9	7.5	4.6	20.8	26.2	17.1	43.6	67.8	37.3
Zn_1	8.0	9.6	6.0	26.0	28.2	24.6	64.6	74.3	60.3
Zn_2	4.9	6.7	4.3	16.0	24.1	14.3	33.0	53.1	34.3
SEm±	-	0.16	-	-	0.29	-	-	1.42	-
C.D. (5%)	-	0.50	-	-	0.88	-	-	4.09	-

act as plant hormone. The results obtained at different growth stages were similar and statistically significant. The doses of both Cu and Zn reduced the crop growth causing adverse effect. Copper also improves plant metabolism by activating the enzymes of lipid, lignin and synthesis of other compounds. Copper increase chlorplast synthesis. Deficiency of copper results in chlorosis and some other diseases.

These effects of Cu and Zn were reflected for the all parameter of radish crop under study in our experiments of the same levels of Zn_1Cu_1. The higher dose like Zn_2 and Cu_2 in combined form were found to be toxic and resulted poor growth even than control plot yield. These minerals also serves as the cofactors of different matabolic enzymes in radish and also in other plants. Copper is a cofactor of cytochrome oxidase an enzyme involved in energy production.

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