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Effect of micronutrients on growth and yield of radish and carrot under calcareous soil environment

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Abstract

The study was carried out to evaluate the effect of micronutrients on growth and yield of radish and carrot under calcareous soil environment. The land was medium fertile with pH 7.6 and silty loam in texture. This study was laid out in randomized complete block design with three replications and each replication was consisted with eleven plots. This study included two experiments and conducted with eleven treatments, namely T_1 = control, T_2 = Zn, T_3 = B, T_4 = Zn+B, T_5 = Zn+B+Mo, T_6 = Zn+B+Mn, T_7 = Zn+B+Cu, T_8 = Zn+B+Cl, T_9 = Zn+B+Mo+Mn, T_{10} = Zn+B+Mo+Mn+Cu and T_{11}. In this experiment, Zn, B, Mo, Mn, Cu, Cl were applied in the rate of 3, 3, 0.5, 4, 1, 20 kg/ha and N, P, K, S were used in the rate of 150, 100, 50, 20 kg/ha as basal. Data were recorded in 30, 45 and 60 DAS for radish but in case of carrot, it was in 30, 60 and 100 DAS. This recorded data were analyzed with MSTAT-C . The growth characters of radish like plant height (52.39 cm) and breadth of largest leaf was found to be highest in T_2 (Zn) and the lowest value was in control. The highest number of leaves per plant (32.63) was found in T_5 while the maximum length of largest leaf (44.24 cm) was in T_4. All yield characters like length of root (30.13 cm), diameter of root (14.50 cm), fresh weight of plant (1119.0 g) and fresh weight of individual root (680.0 g) were observed to be maximum in T_4 (Zn+B).

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Introduction

Radish and carrot are two popular and important vegetable crops in Bangladesh. They are mainly winter vegetable crops and they become available in Bangladeshi markets as early as September and lasts as late as May. However, nowadays radish can be grown any time of the year in Bangladesh (Rashid, 1983). In 2007-08 seasons the annual production of carrot is 10430 M. tones from 2850 acres of land at 3660 kg/acre. On the other hand the production of radish at the same time is 267048 M. tones from 68058 acres of land in a rate of 3924 kg/acre (USDA 2008). The total radish and carrot production of several years.

This production rate of radish and is very poor compared to other country and is decreasing day by day because of the depletion of soil fertility status in Bangladesh. Soil fertility status mostly depends on the content of organic matter and very little on the chemical fertilizer which is not negligible. A good soil should have an organic matter content more than 3%. But in Bangladesh most soils have less than 1.5%, some soils have less than 1% organic matter. These condition is now being more worsing because of intensive cropping with high yielding variety with large scale of chemical fertilizers (Jahiruddin *et.al* 1994), intensive use of land without proper management and imbalanced use of fertilizer, trend of monocroppping specially wetland rice cultivation (Ali and Wakatsuki, 1998).

To overcome these causes, organic matter should be supplied along with other chemical fertilizers like NPK and other micronutrients. These fertilizers should be in balanced proportion. Micronutrient is needed very small quantity but it is not be neglected by the use of other fertilizers. The deficiency effect of micronutrient is varied from very small to large. It is equally important in plant nutrition as macronutrients. The experimented area belongs to High Ganges River Floodplain soils (AEZ 11) which is one of the most important calcareous soils of Bangladesh containing large amount of $CaCo_3$ as well as high concentration of available C^{2+} in that soil. The pH is generally ranges from 7.0 8.5 but in most of the upland soils ranges between 8.0-8.5 (Alam, 2006).

The scientific name of commonly used Radish is *Raphanus sativus* Linn and the chromosome number of Radish is 2n = 18. There are four types of radish commonly cultivated in various regions of the world; these are small and cool season radish, large radish with wider range of temperature adaptation, rat-tail or mougri radish forming no fleshy roots but forming long slender (20-60 cm) pods and the last one is fodder radish also producing no fleshy roots. All four types of radish belong to the species *Raphanus sativus* L. All the four types intercross freely among each other and also with related wild species.

This crop can withstand so diversified climate that the crop is grown in tropical, subtropical and even in temperate countries. Opinion regarding its place of origin varies among scientists. Katyal and Chadha (1985) stated China and India to be its native lands.
Rashid (1976) mentioned that a hundred gram of edible root contains 1% protein, 4% carbohydrate, little fat, 15 calories, negligible vitamin A, 0.03 mg thiamine, 0.03 mg riboflavin, 0.30 mg niacine, 25.00 mg vitamin C, 30 mg calcium and 1.00 mg iron. Radish has reportedly a cooling effect on human body and is thought suitable for patients suffering from piles, liver troubles, enlarged splin and jaundice (Katyal and Chadna, 1985). It may be possible to reap reasonable radish harvest using organic manure alone as plant food. Anonymous (1983) recommends a fairly high dose of chemical fertilizers in radish.

Carrot is one of the most ancient vegetables. Its history has been confused with that of parsnip, for the Romans ate it as pastinaca, a name later transferred to the parsnip when carrot became *Carota*.

Materials and methods

Location of the experimental plot

The experiment field was situated at Shampur, Rajshahi, just beside the Regional Wheat Research Institute, during the period from November 2008 to February 2009.

Characteristics of soil

The characteristics of soil of the experimented plot were silty loam in texture and the pH was 7.6. This plot was medium fertile and medium high and under the 'High Ganges River Flooplain' (AEZ 11). The soil of the experimented field was experimented in the laboratory of Soil Resource Development Institute (SRDI), Shampur, Rajshahi and the total result is given in the Appendix 3.

Climate

The climate of the area was characterized by heavy precipitation during the months from April to September and small or no rainfall during other months of the year. Maximum and minimum air temperature, rainfall, relative humidity and day length for the period of the experiment are presented in Appendix 4. These data were collected from the weather observation centre, Shampur, Rajshahi.

Materials

The variety was 'Shinkuroda 5 Sun' of carrot and 'Mino Early Long White' of radish were applied in my experiment. Both of these two variety were collected from the local market.

Treatments of the investigation

The effect of 11 different treatments of six micronutrients (Zn, B, Mn, Mo, Cu and Cl) on the growth and yield of radish and carrot were observed in this experiment and this was the main objective. This experiment was conducted on the basis of one factor as follows.

Design and layout

Randomized Complete Block Design (RCBD) was followed in my experiment and it was laid into 3 replications and each replication contained 11 plots and finally it reached to 33 plots.

Land preparation

The experimental plot was ploughed twice by the help of country plough and then the leveling was followed. The clods were broken and weeds removed from the field to obtain desirable tilth. The basal doses of fertilizers were mixed into the soil during the final land preparation.

Application of fertilizers

As basal dose urea, TSP, potassium sulphate and gypsum were used at the rate of 150, 100, 50, 20 kg/ha in each of the experimental plots. At the time of final land preparation I have applied TSP, potassium sulphate and gypsum at a time and urea was applied in three splits. The first dose of urea was given at the time of final land preparation with other basal doses of fertilizers and the other two doses were given at 30 days interval.

Intercultural operations

Irrigations were given as and when felt necessary by seeing the soil moisture condition. However, irrigations were followed by the time of applications of fertilizers.

Weeding and thinning

Weeding were done at regular intervals to break the soil crust and keep the land weed free after each irrigation for facilitating good aeration and avoid weed competition. Thinning was done in the overpopulated plot for both radish and carrot when it was necessary and there was no need to use any type of pesticides and insecticides.

Harvesting

I harvested radish roots after 60 days from sowing and harvested carrot roots after 100 days from sowing. I harvested radish and carrot roots manually and light irrigation was given before harvesting to facilitate lifting of roots.

The data of height of the plant, spread of plant canopy, number of leaves per plant, length of largest leaf, breadth of largest leaf were collected at 30, 45, 60 days for radish and 30, 60, 90 days for carrot. Other parameters were recorded at the time of harvest.

Plant height

Height of the plant was taken in cm from ground level

to the tip of the longest leaf of the head and it was taken with the help of meter scale.

Number of leaf per plant

Number of leaf per plant was counted manually.

Length of largest leaf

Length of largest leaf was measured manually and it was taken from the base of petiole to the tip with the help of meter scale.

Breadth of largest leaf

Breadth of largest leaf was measured in cm with the help of meter scale.

Fresh weight of plant

Fresh weight of plant was taken manually and measured in gm.

Fresh weight of leaves per plant

Just after uprooting the plant, the whole leaves of individual plant are taken in hand operating scale and measured in gm

Fresh weight of individual root

Fresh weight of individual root was recorded just after uprooting the plant with the help of manual balance and it was measured in gm.

Length of root

Length of root was measured in cm and it was taken from the tip of the root to the bottom with the help of meter scale.

Diameter of root

Diameter of root was measured in cm with the help of meter scale.

Root yield

This character was measured in every plot converted into t / ha.

Statistical analysis

The data for various characters under study were statistically analyzed to ascertain the significance of the experimental results. The mean for all the treatments were calculated and the analysis of variance for each of the characters under study was performed by F (variance ratio) test.

Difference between pair wise treatment means were tested by Duncan's Multiple Range Test (DMRT).

Correlation analysis

Correlation analysis was also done in this experiment. For both, radish and carrot, this analysis was examined to identify the characters whether positively correlated or not.

Economical analysis

In this experiment cost analysis was also observed. It was done to observe the cultivation of these vegetables whether economically suitable or not.

Results and discussion

Effect of Micronutrients on the Growth and Yield

Plant height

The micronutrient elements affect significantly on plant height of radish. In this experiment, maximum plant height was observed when Zn was applied alone. The height of radish varied from 33.73 to 27.20 (cm) at 30 days after sowing and 47.27 to 38.02 (cm) at 45 days after sowing and 52.39 to 43.38 (cm) at 60 days after sowing. At 30 days after sowing the highest value of plant height was 33.73 (cm) at treatment T_2 and the lowest value was 27.20 (cm), obtained from T_1 (Control). At 45 days after sowing the highest value of plant height was 47.27 (cm) at treatment T_2 which was statistically similar at T_9 and the lowest value was 38.02 (cm) at treatment T_1 (Control) which was significantly similar with the treatments of T_{10}, T_5, and T_8

Number of leaves per plant

The leaf production ability of the plant was significantly increased by the application of various nutrient elements. At 30 days after sowing, the highest number of leaves was produced at the treatment of T_4 and this was 15.90 which were significantly.

Table 1. Combination of micronutrients.

Treatments	Rates (kg/ha)					
	Zn	B	Mo	Mn	Cu	Cl
T_1 = Control	-	-	-	-	-	-
T_2 = Zn	3	-	-	-	-	-
T_3 = B	-	3	-	-	-	-
T_4 = Zn+B	3	3	-	-	-	-
T_5 = Zn+B+Mo	3	3	0.5	-	-	-
T_6 = Zn+B+Mn	3	3	-	4	-	-
T_7 = Zn+B+Cu	3	3	-	-	1	-
T_8 = Zn+B+Cl	3	3	-	-	-	20
T_9 = Zn+B+Mo+Mn	3	3	0.5	4	-	-
T_{10} = Zn+B+Mo+Mn+Cu	3	3	0.5	4	1	-
T_{11} = Zn+B+Mo+Mn+Cu+Cl	3	3	0.5	4	1	20

Length of largest leaf

This character was influenced by the use of different treatments of micronutrients. The length of the largest leaf affected the yield of radish significantly. The highest length was recorded at 30 days after sowing was 34.68 (cm) which was significantly similar with T_3. After 45 days after sowing the length was 41.30 (cm) and this value was significantly similar with all treatments except T_5 and T_{11}. The highest value of largest leaf at 60 days after sowing was 44.24 (cm) and it was significantly similar with T_3, T_2 and T_5. All these highest measured leaves were found at the treatment of T_4. The lowest length at 30 days was 29.60 at control, and there was no similarity with other treatments. After 45 days after sowing, the lowest value was 38.56 (cm) at control was significantly similar with T_{11}, T_5, T_{10}, T_8, T_7, and T_9 and 60 days after sowing the lowest value was 40.23 at T_{10} followed by control and it was statistically similar with T_1, T_{11}, T_6, T_8 and significantly similar with T_7, T_9 and T_5.

Breadth of largest leaf

Maximum breadth of the largest leaf was observed when Zn was applied alone. At 30 DAS, the highest value was 11.00 (cm) at T_2, was significantly similar with T_4 where Zn was applied with B and the lowest value was 8.33 (cm) at control, was significantly similar with T_8. 11.67 (cm) and 14.12 (cm); significantly similar with T_4, T_{11}, T_3, T_9, T_5 and T_7 were the maximum breadth of largest leaf at 45 and 60 day after sowing. These two values were observed at T_2.

Length of root

The length of radish root was significantly affected with the treatments and one of the yields contributing character. The highest length was 30.13 (cm) and observed at T_4. This value was significantly similar with T_{10}, T_9, T_5 and T_{11}. The lowest root length was 27.51 (cm) at control and it was significantly similar with T_8.

Diameter of the root

In radish, the diameter of the root was highly recorded when Zn was used with B. The highest diameter was 14.50 (cm) and it was statistically similar with T_3 and significantly similar with T_5, T_{11}, T_9 and T_2. At control, the lowest value was recorded and the value was 12.20 cm which was significantly similar with T_7, T_8, T_{10} and T_6.

Fresh weight of plant

The fresh weight of plant was significantly influenced by different micronutrient elements. The weight of radish plant was varied from 1119 to 685.7 (g). The highest value (1119 g) was noticed at T4. This value was statistically different with others. At the treatment of T7, the lowest weight (685.7 g) was

measured which was significantly similar with T8 and control.

Fresh weight of individual root

For radish, the fresh weight of individual root was found to vary from 680.0 to 425.0 g. The maximum fresh weight of individual root was resulted from the treatment T_4 and it was significantly similar with T_2.

Conclusion

The experiment was conducted at a field at shampur, Rajshahi, just beside the Regional Wheat Research Institute, during the period of from November, 2008 to February, 2009 to study the effect of micronutrients on growth and yield of radish and carrot. This study was comprised with two individual experiments which were laid out in randomized complete block design at two different adjacent fields with three replications and each replication contains eleven plots. The radish plot was 1.5 m x 0.6 m and the carrot plot was 1.5m x 0.5m.

Excluding iron (Fe), eleven different treatments of six micronutrients were applied in this experiment. Urea, TSP, potassium sulphate, gypsum at the rate of 150, 100, 50 and 20 t/ha were used as basal dose. TSP, potassium sulphate, gypsum were applied in three equal split. The first dose of urea was given at the time of final land preparation and the other two doses were given at 20 and 40 DAS for radish. For carrot, the next two doses of urea were given at 30 and 60 DAS. Irrigation and other intercultural operations were done when it was necessary.

For radish, data from growth characters (plant height, number of leaves per plant, length of largest leaf, breadth of largest leaf) were collected at 30 DAS, 45 DAS and 60 DAS (days after sowing) and data from yield characters (length of root, diameter of root, fresh weight of plant, fresh weight of root, root yield) were collected at 60 DAS. Maximum yield (75.56 t/ha) was obtained from the plot where Zn and B were applied at a time and the next best yield (73.89 t/ha) was found a T_2 (Zn). The lowest yield (47.22 t/ha) was found at T_7 (Zn+B+Cu), followed by control (T_1). Maximum plant height (52.39 cm) and maximum breadth of largest leaf (14.12 cm) were recorded at T_2 (Zn) and maximum number of leaves per plant (32.63) was found at T_5 (Zn+B+Mo).

The other characters like length of largest leaf (44.24 cm), length of root (30.13 cm), diameter of root (14.50 cm), fresh weight of plant (1119.0 g) and fresh weight of root (680.0 g) responded highly at T_4(Zn+B).

References

Alam MN. 2006. Effect of vermicompost and some chemical fertilizers on yield and yield components of selective vegetable crops. Ph.D. Thesis. Faculty of Agriculture, University of Rajshahi, Bangladesh. p-1.

Alekseeva AM, Raskazov MA. 1976. The effect of boron on the yield and storability of carrots. Nauchnye Trudy Voronezh. S. –Kh. Int **85,** 5-13. [Cited from Horticulture Abstracts **48(2),** 141].

Ali MS, Jahan MS. 2001. Final completion report on "Coordinate Project of Vermiculture: Production of Vermicompost and its use in Upland and Hortcultural Crops." BARC, Dhaka. 21 p.

Ali MM, Wakatsuki T. 1998. Changes in soil properties between 1967 and 1995 in Bangladesh. Bangladesh Journal of Environmental Science **4,** 101-110.

Anonymous. 1983. A bulletin on Tasaki San Mula – 1 : A newly developed high yielding radish variety. Citrus and Vegetable Seed Reseach Centre, BARI, Joydebpur, Gazipur.

Becker G. 1962. Handbuch der Pflanzenzuchtung **6,** 23–78.

Borisov VA, Petrov NP, Novikov VS. 1977 Khimiya v Sel'skom Khozyaistve **15,** 40–42.

Campbell JD, Gusta LV. 1966. The response of carrots and onions to micronutrients on an organic soil in Manitoba. Canad. Plant Science **46,** 419-423.

Dhesi NS, Padda DS, Malik BS. 1964. Effect of different doses of nitrogen at two levels of potash on the development and yield of carrot Journal of Scientific Research Ludhiana **1(1),** 50-55.

Fischer HG, Dauranona E. 1961 . Bol. Fac. Agron. Univ. Montevideo **53,** 18.

Gupta UC, Chipman EW, Mackay DC. 1970 Proc. Soil Science Society of America Journal **34,** 762-764.

Homutescu V, Cazaceanu A, Cazaceanu T. 1963. The influence of the microelements boron and zinc on the production of carrots. Lucr. Sti. Inst. Agron. Iasi, 223-230 p.

Islam MS, Razia S, Hossain KM. 1982. Effect of different fertilizer elements on the growth and yield of potato. Bangladesh Journal of Agriculture **7(3-4),** 56-63.

Jahiruddin M, Islam MN, Hashem MA, Islam MR. 1994. Influence of S. Zn and B on yield and nutrient uptake of BR2 rice. Progressive agriculturists **5(1),** 75-79.

Jana JC, Mukhopadhyay TP. 2002. Yield and quality of cauliflower seeds as influenced by added boron, Molybdenum and zinc in West Bengal. Bangladesh Journal of Agriculture **27(1),** 1- 4.

Joshi OL, Chauhan KS. 1985. Effect of nitrogen and sulphur on vegetative growth, yield and quality of radish. Indian j. Hort., **42(3 and 4),** 263 – 267.

Kanwar JS, Malik BS. 1970. Root yield and marketable quality of carrots as influenced by chemical fertilizers. Indian journal of horticulture **27,** 48-53.

Katyal SLK, Chadha KL. 1985. Vegetable growing in India. Oxford and IBH publishing Co PVT Ltd. New Delhi. 53–55 p.

Kelly WC, Somers GF, Ellis GH. 1952. The effect of boron on the growth and carotene content of carrots. The American Society for Horticultural Science **59,** 352-360.

Kevorkov AP. 1972. The effect of boron and molybdenum on root and seed yields in carrots. Trudy vsesoyuznogo Nauchno Issledovatel' skogo Instituta Udobreniya I Agropochvovedeneya. **53,** 225-230. [Cited from Journal of Applied Horticulture **44(1-6),** 223].

Kirtikar KR, Basu BD. 1935. Indian Medicinal Plants (Lolit Mohan Basu), Allahabad.

Kononovich AL. 1971. The effect of microelements on the quantity and quality of carrot yield. Uchenye Zapiski Blagoveshchenskogo Gosudarstvennogo Pedagogicheskogo Instituta **17,** 17-19. [citd from Horticulture Abstracts **42(1-4),** 497.

Lucas MD, De Freitas FC. 1960. Agron. Lusit, **22,** 205–212.

Mackevic VI. 1992. Bull appl bot genet plant breed **20,** 517–557.

Mathur SP, Belanger A. 1987. Communications in Soil Science and Plant Analysis **18,** 615-624.

Mathur SP, Levesque M, Sanderson RB. 1989. The influence of zinc on the yield of carrot. Communications in soil Science and plant Analysis, **20(17/18),** 1809-1820.

Maurya AN, Rai KN, Lal S. 1977. Effects of boron and nitrogen fertilizers on radish (*Raphanus sativus*). International Journal of Experimental Agriculture **13(3),** 301-303.

Maurya KR, Singh BK. 1985. Effect of boron on growth, yield, protein and ascorbic acid content of radish. Indian Journal of Horticulture **42(3/4),** 281-283.

Nelyubova GL, Mukha NA, Mazepova KV. 1972. The sensitivity of carrots to boron under different levels of nitrogen nutrition. Doklady Moskovskoi Sel' Skokhozyalstvennoi Akademii K.A. Timiryazeva **169,** 89-94. [Cited from Abstracts **42(1-4),** 742].

Nordestgaard A. 1978. Tidsskrift Planteavl **82,** 397 -409.

Palkovies M, Gyori D. 1984. Trials of boron fertilization on rusty brown forest soil in potatoes. Novenyter meles, **33(3),** 265-273. [Cited from Potato Abstracts **11(3),** 252.

Peplinska M, Machala M. 1971. Roczniki Wyzszej Szkoly Rolniczej w Poznaniu, No. **50,** 149–159 p.

Pizer NH, Caldwell TH, Burgess GR, Jones JLO. 1966. The Journal of Agricultural Science **66,** 303-314.

Protch S, Islam MS. 1984. Nutrient status of some of the more important Agricultural soils of Bangladesh. In: Proc. Int. Cong. Mtg. Common. IV, International Union of Soil Sciences 97-105 p.

Quaggio JA, Ramos VJ. 1986. Potato response to lime and boron application. Revista Brasileira De Ciencia Dosolo. **10(3),** 247-251 [Cited from potato Abstracts **6(1),** 187.

Rashid MM. 1976. Bangladesher Shabji. Bangla Academy, Dhaka, 300–308 p.

Rashid MM. 1983 Shabjir Chash. Begum Shahla Rashid. Bangladesh Agricultural Research Institute's residential quarters, Joydebpur, Gazipur, 106-110.

Rasp H. 1985. The effect of added trace elements in a 12 years crop rotation, Landwirtschaftliche Foreschurng **38(4),** 395-403.

Salonen M. 1961. The response of carrots and beet root to various fertilizer treatments compared with Swedes and potatoes. Maatalous ja Koetoim **15,** 205-212.

Schuphan W, Weiller H. 1967. Qual. Plant. Mater. Veg., **15 ,** 81 – 101.

Sharma J. 1981. Agric. Sci. Digest, **1,** 79 – 81. Sharma, S.K. 2002. Effect of Boron and Molybdenum on seed production of cauliflower. Indian Journal of. Horticulture **59 (2),** 177–180.

Smoter J, Migasowa M. 1980. Biuletyn Warzywniczy **24,** 269-283.

Szwonek E. 1980c. Biuletyn Warzywniczy **24,** 255-267.

Talukder ASMHM, Nabi SM, Anwar MN, Shaheed MMA, Ara MA. 2001. Influence of Zn, B, and Mo on papaya in grey terrace sol. Bangladesh J. Agril. Res. **26(4),** 471-478.

Tariq and Mott. 2006. The response of carrots and beet root to various fertilizer treatments compared with Swedes and potatoes. Maatalous ja Koetoim **15,** 205-212.

Tkacuk VN. 1967. Carotene and chlorophyll in carrot leaves in relation to methods of seed treatment with zinc at different rates. Nauc. Zap. Belocerkovsk. Sel. –hoz. Inst., 13, 186-9. [cited from Horticulture Abstracts **38(3),** 744.

USDA, 2008. United States Department of Agriculture. National Nutrient Database for Standard Reference, Release 22.

Whitaker TW. 1949. Proc. Amer. Soc. Hort. Sci., **53,** 305–308.

Wisniewska H. 1980. Principles of fertilizing Nantes carrots, grown for stecklings and seed, with major and minor elements. VII. Fertilization with Zinc. Biuletyn Worzywniczy **24,** 223-238. [cited from Horticulture Abstracts. **53(11),** 777 (1983)].

Zaporozhan ZE. 1971. Nauchnyi Trudy Ukrainskoi Sel'skokhozyaistvennoi Akademii **57,** 158-160.