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# Repercussion of different levels of vermicompost and foliar application of micronutrients on quality of cabbage (*Brassica oleracea* var. *capitata*)

**Ashok Kumar Meena, Raja Ram Bunker, SP Singh, Ram Lakhan Meena, Rakesh Chouhan and Suresh Kumar Meena**

**Abstract**
This field experiment was conducted to study the Effect of different levels of vermicompost and foliar application of micronutrients on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata)* during *rabi* season of 2019-20 at Horticulture Farm, Department of Horticulture, S.K.N College of Agriculture, Jobner, Jaipur, Rajasthan. The experiment was consisting 16 treatments *viz*., four levels of vermicompost (control, vermicompost @ 5.0 t/ha, vermicompost @ 7.5 t/ha and vermicompost @ 10 t/ha) and four levels of foliar application of micronutrient (control, iron @ 0.5%, boron @ 0.2% and zinc @ 0.5% per ha) with the combination was laid out in FRBD (Factorial Randomized Block Design) with three replications.

TSS content, protein content, NPK and micronutrient (Zn, B, Fe) content in head of cabbage. Although, application of vermicompost @ 7.5 t/ha was found statistically at par to vermicompost @ 10 t/ha. While, the significant decrease days at maturity was found in treatment vermicompost @ 10 t/ha over control and $V_1$ (vermicompost @ 5 t/ha). Similarly, foliar application of micronutrient at Zn @ 0.5% significantly increased quality parameters of cabbage, but it was found statistically at par with Fe @ 0.5% for quality attributes.

**Keywords:** Vermicompost, micronutrients, quality, cabbage

## Introduction
Cabbage (*Brassica oleracea* var. *Capitata* L.) is the most important cole crops which belongs to family Brassicaceae and normal having chromosome, no. 2n= 18 and it originated at Western Europe and Mediterranean region. It is mainly grown intemperate region for seed production. However, it's cultivation is successful in the tropical and sub-tropical regions of the world. Cabbage is herbaceous, biennial, dicotyledonous flowering plant distinguished by a short stem up to which a compact mass of leaves, usually green but in some varieties having red or purplish in colour. Compact mass of leaves is known as head, which is economically yield of cabbage.

Cabbage is rich source of vitamins and minerals. It contains, vitamin-A (2000 IU), thiamine (0.06 mg), riboflavin (0.03 mg), vitamin-C (124 mg), potassium (114 mg), phosphorus (44 mg), calcium (39 mg), sodium (14.1 mg) and iron (0.8 mg) per 100 g edible part. Cabbage is used as salad, boiled, cooked, cured, pickling and dehydration purposes. It neutralizes acidity and improves digestion and appetite (Katyal and Chadha, 1985) [7].

Vermicompost play important role increase humic acid content in reducing C:N ratio and provide the nutrients in the readily available form to the plants such as nitrate, exchangeable phosphorus, soluble potassium, calcium and magnesium. It also contains biologically active substances such as plant growth regulators. It improves physical, chemical and biological properties of soil. It improves soil physical properties like structure and water holding capacity of soil. It is also rich in growth hormones, vitamins and acts as biocide against diseases and nematodes. Poor nutrient economy of light textured soils necessitates the need for supplementing fertilizer with organic manures. It helps to buffer soils against rapid chemical changes and also supplies plant nutrient including micronutrients. The application of vermicompost alone and in combination with N, P and S have been reported to decrease bulk density, improves soil porosity and increase the water holding capacity of soil (Mahaswarapa *et al*., 1999) [9].

The foliar application of micronutrients reduces the cost owing to the lesser quantities required nutrients and better absorption through the foliage of plants. In cultivation of cabbage, nutrition is one of the most important factor which increases the quality and productivity of cabbage. It is reported that, the use of micro-nutrients plays an important role in enhancing the translocation of carbohydrates from the site of synthesis to the storage organ and also helps in increasing growth, yield and quality of cabbage. (Janny *et al*. 2008) [6].

**Materials and Methods**

Field experiment entitled "Effect of Different Levels of Vermicompost and Foliar Application of Micronutrients on Growth and Yield of Cabbage (*Brassica oleracea* var. *capitata*)" was conducted at horticulture farm, Department of Horticulture S.K.N. College of Agriculture, Jobner (Jaipur) during *Rabi* season, 2019-20. Geographically, Jobner is situated 45 km in West of Jaipur on $26^0$5' North latitude, $75^0$ 20' East longitude and at an attitude of 427 meters above mean sea level. This region falls under Agro-Climatic Zone-III A (Semi- Arid Eastern Plain zone) of Rajasthan.

**Details of treatments**

| **A. Organic manures** | **Symbols** |
|---|---|
| 1. Control | $V_0$ |
| 2. Vermicompost (5t/ha) | $V_1$ |
| 3. Vermicompost (7.5t/ha) | $V_2$ |
| 4. Vermicompost (10t/ha) | $V_3$ |

| **B. Micronutrients** | |
|---|---|
| 1. Control (Water spray) | $M_0$ |
| 2. Iron (0.5%) | $M_1$ |
| 3. Boron (0.2%) | $M_2$ |
| 4. Zinc (0.5%) | $M_3$ |

**Details of the treatments along with combinations**

| Treatment | Combination | Treatment | Combination |
|---|---|---|---|
| $T_1$ | $V_0M_0$ | $T_9$ | $V_2M_0$ |
| $T_2$ | $V_0M_1$ | $T_{10}$ | $V_2M_1$ |
| $T_3$ | $V_0M_2$ | $T_{11}$ | $V_2M_2$ |
| $T_4$ | $V_0M_3$ | $T_{12}$ | $V_2M_3$ |
| $T_5$ | $V_1M_0$ | $T_{13}$ | $V_3M_0$ |
| $T_6$ | $V_1M_1$ | $T_{14}$ | $V_3M_1$ |
| $T_7$ | $V_1M_2$ | $T_{15}$ | $V_3M_2$ |
| $T_8$ | $V_1M_3$ | $T_{16}$ | $V_3M_3$ |

Variety Golden Acre it takes about 65-80 days from transplanting to head formation. It has fewer outer leaves which are cup shaped and arranged in two whorls. The heads are solid, short core and weighing of about 1.0-1.5 kg.

**Quality attributes**

**Total soluble solids (ºBrix)**

The Total soluble solids (TSS) present in head juice was estimated by using Erma Hand Refractometer (0-$32^0$B). The observed reading was corrected using temperature correction chart to obtain TSS value at 20 °C. The estimation was done in triplicate and the mean value was taken.

**Protein content in the head (%)**

The sample of cabbage head was analysed separately for nitrogen content (%) by colorimetric method. Nitrogen content multiplied with 6.25 factors to calculate crude protein content in head (A.O.A.C., 1960) [1].

**N, P, K, B, Fe, Zn content (%) in head**

The head of cabbage collected at harvest from each plot were dried and there after ground to a fine powder for estimation of NPK content methods.

**Nitrogen content (%)**

Nitrogen content in head was estimated by using Nesselar,s reagent in spectrophotometer method.

**Phosphorus content (%)**

Phosphorus was estimation by determined spectrophotometer method using Triacid Ammonium Molybdate-Ammonium Vabnadete solution.

**Potassium content (%)**

Potassium content in head was estimated by using flame photometer method including Triacid, Potassium standard solution (Richards, 1954) [11].

**Zinc content (ppm)**

Zn content in head of cabbbage plant was determined by the analysis of suitable aliquat of digest-II with atomic absorption spectrophotometer (AAS) method (Lindsay and Norwell, 1978) [8].

**Iron content (ppm)**

Fe content in heads of cabbage plant was also determined by the analysis of suitable aliquat of digest-II with atomic absorption spectrophotometer (AAS) method (Lindsay and Norwell, 1978) [8].

**Boron content (ppm)**

The head samples were analyzed separately for boron content (%) by calorimetric method (Hatcher and Wilcox, 1950) [50] using curcumin and resulted were expressed in terms of ppm.

**Result and Discussion**

**Quality Attributes**

**Total soluble solids (TSS)**

**Vermicompost:** The data regarding to total soluble solids mentioned in table 1 revealed that the different levels of vermicompost gave significant results. The significantly maximum total soluble solids (7.49%) was observed in treatment $V_3$ (vermicompost @ 10 t/ha) and found statistically at par with treatment $V_2$ (7.29%). The increase in TSS content in cabbage under treatment $V_3$ was found to be 21.79 and 9.99 percent higher as compared to control and $V_1$ (vermicompost @ 5.0 t/ha), respectively.

**Micronutrient:** The total soluble solids in cabbage also influenced significantly with the foliar spray of different micronutrient. The maximum total soluble solids (7.46%) was observed in treatment $M_3$ (Zn @ 0.5%) although, it was found statistically at par with $M_1$ (Fe @ 0.5%). The significant increase in total soluble solids in $M_3$ was noted to be 20.91 and 9.22 percent more than control and $M_2$ (Boron @ 0.2%), respectively.

**Protein content (%)**

**Vermicompost:** A perusal of the data revealed that application of different levels of vermicompost had

significant effect on protein content of cabbage head Table 1 The maximum protein content (2.78%) was found under the treatment $V_3$ (vermiocmpost @ 10 t/ha) followed by $V_2$ (vermicompost @ 7.5 t/ha) (2.72%) over control and $V_1$. The increased in protein content under treatment $V_3$ was found to be 30.52 and 12.55 percent higher as compared to control and $V_1$ (vermicompost @ 5.0 t/ha), respectively.

**Micronutrient:** The data presented in the table 1 revealed that foliar application of micronutrient. The treatment $M_3$ (zinc @ 0.5%) significantly increased the protein content (2.75%) upto maximum level over control and $M_2$ whereas, it was observed statistically at par with treatment $M_1$ (2.70%). The increase in protein content of head under $M_3$ (zinc @ 0.5%) was to the tune of 28.50 and 10.44 percent over control and $M_2$, respectively.

**Nitrogen content (%)**

**Vermicompost:** The data table 2 showed that nitrogen content in cabbage head was significantly influenced by different levels of vermicompost. The maximum N content (0.444%) was found under the treatment $V_3$ (vermicompost @ 10 t/ha), being statistically at par with treatment $V_2$ which was found significantly superior control and $V_1$. The increase in N content under treatment $V_3$ was found to be 30.21 and 12.41 percent higher as compared to control and $V_1$, respectively.

**Micronutrient:** N content was also influenced significantly by foliar application of micronutrient Table 2 Highest (0.441%) and minimum (0.343%) nitrogen content was observed under treatment $M_3$ and $M_0$. However, treatment $M_3$ and $M_1$ were observed statistically at par to each other. The increase in N content in under treatment $M_3$ was noted to be 28.57 and 10.53 percent more than control and $M_2$, respectively.

**Phosphorus content (%)**

**Vermicompost:** The data related to the phosphorus content are presented in table 2 revealed that the different levels of vermicompost significantly influenced the phosphorus content in cabbage head. The maximum (0.303%) phosphorus content in cabbage was recorded under $V_3$ (vermicompost @ 10 t/ha) and minimum (0.225%) under control. The treatment $V_3$ remained statistically at par with treatment $V_2$ (vermicompost @ 7.5 t/ha). The increase in phosphorus content in cabbage under treatment $V_3$ (vermicompost @ 10 t/ha) was observed as 34.67 and 13.91 percent higher as compared to control and $V_1$, respectively.

**Micronutrient:** A perusal of data regarding phosphorus content in cabbage also influenced significantly with the foliar spray of micronutrient table 2 the maximum phosphorus content (0.301%) observed in treatment $M_3$ (zinc @ 0.5%) which was statistically at par with $M_1$ (Fe @ 0.5%). The increase in phosphorus content in $M_3$ was noted to be 32.02 and 11.90 percent more than control and $M_2$ (Boron @ 0.2%), respectively.

**Potassium content (%)**

**Vermicompost:** A perusal of the data revealed that application of different levels of vermicompost had significant effect on potassium content of cabbage head table 2 the maximum potassium content (2.831%) was found under the treatment $V_3$ (vermiocmpost @ 10 t/ha). The treatment $V_3$ found statistically at par with treatment $V_2$. The increased in potassium content under treatment $V_3$ was found to be 34.17 and 8.38 percent higher as compared to control and $V_1$ (vermicompost @ 5.0 t/ha), respectively.

**Micronutrient:** The data presented in the table 2 revealed that foliar application of micronutrient. The treatment $M_3$ (zinc @ 0.5%) significantly increased the potassium content (2.824%) upto maximum level over control and $M_2$ whereas, it was observed statistically at par with treatment $M_1$ (2.741%). The increase in potassium content of head under $M_3$ (zinc @ 0.5%) was to the tune of 33.52 and 7.83 percent over control and $M_2$, respectively.

**Boron content (PPM)**

**Vermicompost:** The data of boron content mentioned in table 2 revealed that the different levels of vermicompost gave significant results. The maximum boron content (49.55 ppm) was observed in treatment $V_3$ (vermicompost @ 10 t/ha) and found statistically at par with $V_2$ (vermicompost @ 7.5 t/ha) although, it observed significantly superior over control and $V_1$. The increase in boron content in cabbage under treatment $V_3$ was found to be 18.80 and 8.64 percent higher as compared to control and $V_1$ (vermicompost @ 5.0 t/ha), respectively.

**Micronutrient:** The boron content in cabbage also influenced significantly with the foliar spray of micronutrient (Table 2). The maximum (49.57 ppm) and minimum (41.69) boron content was observed in treatment $M_2$ and $M_0$. The treatment $M_2$ was found statistically at par with treatment $M_3$. The increase in boron content in $M_2$ (Boron @ 0.2%) was noted to be 18.90 and 8.56 percent more than control and $M_1$ (iron @ 0.5%), respectively.

**Iron content (PPM)**

**Vermicompost:** The data related to the iron content are presented in table 2 revealed that the different levels of vermicompost significantly influenced the iron content in cabbage head. The maximum (8.10 ppm) iron content in cabbage was recorded under $V_3$ (vermicompost @ 10 t/ha) and minimum (6.61 ppm) under control. The treatment $V_3$ remained statistically at par with treatment $V_2$ (vermicompost @ 7.5 t/ha). The increase in iron content in cabbage under treatment $V_3$ (vermicompost @ 10 t/ha) was observed as 21.08 and 10.20 percent higher as compared to control and $V_1$, respectively.

**Micronutrient:** A perusal of data regarding iron content in cabbage also influenced significantly with the foliar spray of micronutrient table 2 the maximum iron content (8.12 ppm) observed in treatment $M_1$ (Fe @ 0.5%) which was statistically at par with $M_3$ (Zn @ 0.5%). The increase in iron content in $M_1$ was noted to be 21.56 and 10.03 percent more than control and $M_2$ (Boron @ 0.2%), respectively.

**Zinc content (PPM)**

**Vermicompost:** A perusal of the data revealed that application of different levels of vermicompost had significant effect on zinc content of cabbage head table 2 the maximum zinc content (14.35 ppm) was found under the treatment $V_3$ (vermicompost @ 10 t/ha). The treatment $V_3$ was

found statistically at par with treatment $V_2$. The increased in zinc content under treatment $V_3$ was found to be 19.68 and 9.96 percent higher as compared to control and $V_1$ (vermicompost @ 5.0 t/ha), respectively.

**Micronutrient**

The data presented in the table 2 revealed that the foliar application of micronutrient. The treatment $M_3$ (zinc @ 0.5%) significantly increased the zinc content (14.36 ppm) upto maximum level over control and $M_2$ whereas, it was observed statistically at par with treatment $M_1$ (Fe @ 0.5%). The increase in zinc content of head under $M_3$ (zinc @ 0.5%) was to the tune of 19.87 and 9.62 percent over control and $M_1$, respectively.

**Effect on quality**

The results of present investigation indicated that different levels of vermicompost, increased TSS, protein content and N, P, K, B, Fe and Zn in head. The Table (1,2) show that application of vermicompost @ 10 t/ha increased the TSS, protein content and N, P, K, B, Fe and Zn in head, which were significantly higher over to control and vermicompost @ 5.0 t/ha, but at par to vermicompost @ 7.5 t/ha.

The increase in protein content might be due to better availability of desired and required quantity of N in root zone of the crop resulting from its solublization called by organic acid and produced from the decaying of the organic matter. The increase in protein may also be due to the increased activity of nitrate reductase enzymes which might helped in synthesis of amino acids and protein (Yadav and Vijaya Kumari 2004) [15]. The increased TSS in vermicompost enriched treatment combination might be attribute to greater moment and availability of essential nutrients to the plants that might help in higher TSS of cabbage head.

The higher concentration of nutrients in plant under vermicompost fertilization in due to adequate supply of nutrients. Thus crop manured with higher dose of vermicompost had utilized more nutrients as compared to lower doses resulting in increased NPK content and micronutrient. The increased photosynthetic efficiency there by more dry matter production and nutrient concentration in plants seems to be major factor responsible reflecting higher NPK content and micronutrient (B, Fe and Zn) under the influence of vermicompost application. The results obtained in the present investigation are in close conformity with the findings of Gupta *et al.* (1999) [4], Tanwar *et al.* (2003) [14], Sharma *et al.* (2009) [13] and Mohapatra (2013) [10], Ali *et al.* (2018) [2], in broccoli and cabbage.

**Table 1:** Effect of different levels of vermicompost and foliar application of micronutrients on TSS (%)

| Treatment | TSS | Protein content |
|---|---|---|
| **Different levels of vermicompost** | | |
| $V_0$ (Control) | 6.15 | 2.13 |
| $V_1$ (Vermicompost @ 5.0 t/ha) | 6.81 | 2.47 |
| $V_2$ (Vermicompost @ 7.5 t/ha) | 7.29 | 2.72 |
| $V_3$ (Vermicompost @ 10 t/ha) | 7.49 | 2.78 |
| S.Em+ | 0.15 | 0.05 |
| CD (p=0.05) | 0.42 | 0.16 |
| **Micronutrients** | | |
| $M_0$ (Control) | 6.17 | 2.14 |
| $M_1$ (Iron @ 0.5%) | 7.28 | 2.70 |
| $M_2$ (Boron @ 0.2%) | 6.83 | 2.49 |
| $M_3$ (Zinc @ 0.5%) | 7.46 | 2.75 |
| S.Em+ | 0.15 | 0.05 |
| CD (p=0.05) | 0.42 | 0.16 |
| CV (%) | 7.28 | 7.44 |

**Table 2:** Effect of different levels of vermicompost and foliar application of micronutrients on N, P and K B Fe Zn content (%) in head

| Treatment | N content | P content | K content | B content | Fe content | Zn content |
|---|---|---|---|---|---|---|
| **Different levels of vermicompost** | | | | | | |
| $V_0$ (Control) | 0.341 | 0.225 | 2.110 | 41.71 | 6.69 | 11.99 |
| $V_1$ (Vermicompost @ 5.0 t/ha) | 0.395 | 0.266 | 2.612 | 45.61 | 7.35 | 13.05 |
| $V_2$ (Vermicompost @ 7.5 t/ha) | 0.435 | 0.295 | 2.746 | 47.81 | 7.95 | 13.91 |
| $V_3$ (Vermicompost @ 10 t/ha) | 0.444 | 0.303 | 2.831 | 49.55 | 8.10 | 14.35 |
| S.Em+ | 0.005 | 0.004 | 0.037 | 0.74 | 0.10 | 0.19 |
| CD (p=0.05) | 0.015 | 0.011 | 0.107 | 2.14 | 0.28 | 0.54 |
| **Micronutrients** | | | | | | |
| $M_0$ (Control) | 0.343 | 0.228 | 2.115 | 41.69 | 6.68 | 11.98 |
| $M_1$ (Iron @ 0.5%) | 0.433 | 0.292 | 2.741 | 45.66 | 8.12 | 13.86 |
| $M_2$ (Boron @ 0.2%) | 0.399 | 0.269 | 2.619 | 49.57 | 7.38 | 13.10 |
| $M_3$ (Zinc @ 0.5%) | 0.441 | 0.301 | 2.824 | 47.75 | 7.90 | 14.36 |
| S.Em+ | 0.005 | 0.004 | 0.037 | 0.74 | 0.10 | 0.19 |
| CD (p=0.05) | 0.015 | 0.011 | 0.107 | 2.14 | 0.28 | 0.54 |
| CV (%) | 4.54 | 4.66 | 4.98 | 5.57 | 4.44 | 4.85 |

**Conclusion**

On the basis of one year experimental results, it may be concluded that application of vermicompost @ 7.5 t/ha was found statistically at par to vermicompost @ 10 t/ha. Thus application of vermicompost @ 7.5 t/ha ($V_2$) and foliar application of Zn @ 0.5% ($M_3$) may be recommended for cabbage crop.

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