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# EFFECT OF ORGANIC MANURES AND BIOFORTIFICATION OF SELENIUM ON PHYSIOLOGICAL AND FLOWERING PARAMETERS OF CUCUMBER (*CUCUMIS SATIVUS* L.)

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**ABSTRACT**

A field experiment was carried out to study the "Effect of organic manures and biofortification of selenium on physiological and flowering parameters of cucumber (*Cucumis sativus* L.). The study was conducted during two seasons viz., Season I (February-May 2019) and Season II (July-October 2019). The experiment was carried out following the principles of randomized block design with fifteen treatments which were replicated thrice. The organic manures used in the experiment were farmyard manure (25 t $ha^{-1}$), enriched manure (1 t $ha^{-1}$) along with consortium of biofertilizers (2 kg $ha^{-1}$). The selenium in the form of sodium selenate ($Na_2SeO_4$) was used at varying concentrations (5, 10 and 20 µg $L^{-1}$) as soil and foliar application. The physiological parameters viz.,chlorophyll content index and dry matter production per plant were recorded the highest in which EM @ 1 t $ha^{-1}$ + CBF @ 2 kg $ha^{-1}$ + Se (20 µg $L^{-1}$) as foliar was applied. The flowering parameters viz., days to first male flower appearance, node number of first male flower, number of male flowers per vinewere found to be minimum in the treatment that received FYM @ 25 t $ha^{-1}$ + CBF @ 2 kg $ha^{-1}$ + Se (20 µg $L^{-1}$) as foliar application. The days to first female flower appearance, node number of first female flower, number of female flowers per vine, fruit set percentage andsex ratio were observed to be superior in the treatment that received EM @ 1 t $ha^{-1}$ + CBF @ 2 kg $ha^{-1}$ + Se (20 µg $L^{-1}$) as foliar application in both the seasons respectively.

***Keywords:*** Cucumber, Organic manures, Biofortification, Selenium, Physiological parameters, Flowering parameters

## INTRODUCTION

Cucumber *(Cucumis sativus* L.) is one of the highly demanded faster maturing vegetable in India belonging to the family cucurbitaceae. The fruits and seeds of cucumber have cooling effect because of the higher water content and have many essential nutrients required for the human body. It is useful in preventing constipation and indigestion. Silica present in the fruit helps in strengthening the connective tissues in the human body (Okonmah *et al*., 2011). Globally, organic farming assists in paving the way for sustainable agricultural system by protecting the environment from indiscriminate use of chemical fertilizers. Use of organic amendments such as, farmyard manure, enriched manure and consortium of biofertilizers provide all the major nutrients required for growth of the crop. In addition, it enriches soil with the organic acids thereby improving overall nutritional quality of plants (Bardhan *et al*., 2018). It also enhances the availability of beneficial microbes in the soil and acts as an eco-friendly component in organic farming.

Selenium is an important micronutrient in enhancing overall health of the plants. Supplementation of selenium to plants through foliar or soil application in order to enhance the nutritional quality during plant growth rather than during crop processing is known as selenium biofortification. It prevents the risk of thyroid, cancer and cardiovascular disease in humans. Hence, World Health Organisation has recommended 50-55 µg Se per day in human diet all over the world. Selenium is taken in to plants by the sulphate transporters and is assimilated through sulphur assimilating pathway (Gupta *et al*., 2017). It is also involved in the scavenging of free radicals and provides protection against oxidative damage when the stress condition prevails in plants. Hence the present experiment was conducted to study the effect of organic manures and biofortification of selenium on physiological and flowering parameters of cucumber (*Cucumis sativus* L.).

## MATERIALS AND METHODS

The experiment on "Effect of organic manures and biofortification of selenium on physiological and flowering parameters of cucumber (*Cucumis sativus* L.) was conducted in the farmer's field, Koneripalayam village, Perambalur District of Tamil Nadu. The experimental field was situated at 11°13' N latitude and 78°52' E longitude at an altitude of 98 M above mean sea level. The experiment was carried out following the principles of randomized block design with fifteen treatments which were replicated thrice. The treatments comprised of $T_1$ – (Control - RDF), $T_2$ – FYM + CBF, $T_3$ – FYM + CBF + Se (5 µg) as soil application, $T_4$ – FYM + CBF + Se (10µg) as soil application, $T_5$ – FYM + CBF + Se (20 µg) as soil application, $T_6$ – FYM + CBF + Se (5µg $L^{-1}$) as foliar application, $T_7$ – FYM + CBF + Se (10 µg $L^{-1}$) as foliar application, $T_8$ – FYM +

**Table 1.** Effect of organic manures and biofortification of selenium on physiological parameters of cucumber

| Tr.No | Chlorophyll content index | | | Dry matter production (g plant-1) | | |
|---|---|---|---|---|---|---|
| | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean |
| T1 | 43.83 | 47.02 | 45.43 | 330.08 | 342.17 | 336.13 |
| T2 | 38.22 | 41.98 | 40.10 | 202.33 | 227.14 | 214.74 |
| T3 | 41.78 | 45.14 | 43.46 | 285.15 | 303.04 | 294.10 |
| T4 | 47.14 | 51.08 | 49.11 | 423.10 | 440.37 | 431.74 |
| T5 | 50.48 | 54.60 | 52.54 | 488.65 | 520.13 | 504.39 |
| T6 | 52.83 | 57.48 | 55.16 | 540.38 | 572.61 | 556.50 |
| T7 | 49.72 | 53.41 | 51.57 | 476.87 | 485.14 | 481.01 |
| T8 | 57.40 | 61.58 | 59.49 | 609.74 | 626.02 | 617.88 |
| T9 | 40.10 | 43.50 | 41.80 | 230.24 | 266.80 | 248.52 |
| T10 | 46.56 | 50.27 | 48.42 | 405.18 | 421.25 | 413.22 |
| T11 | 56.34 | 60.71 | 58.53 | 593.12 | 610.76 | 601.94 |
| T12 | 60.14 | 63.67 | 61.91 | 650.37 | 667.25 | 658.81 |
| T13 | 45.18 | 48.74 | 46.96 | 374.11 | 382.20 | 378.16 |
| T14 | 51.79 | 56.15 | 53.97 | 522.90 | 558.43 | 540.67 |
| T15 | 62.77 | 66.10 | 64.44 | 697.20 | 720.58 | 708.89 |
| S.ED | 0.55 | 0.73 | 0.64 | 10.70 | 11.57 | 11.14 |
| CD (p=0.05) | 1.10 | 1.45 | 1.28 | 21.40 | 23.13 | 22.27 |

**Table 2.** Effect of organic manures and biofortification of selenium on flowering parameters of cucumber

| Tr.No | Days to first male flower appearance | | | Node number of first male flower | | | Number of male flowers per vine | | |
|---|---|---|---|---|---|---|---|---|---|
| | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean |
| T1 | 31.85 | 26.68 | 29.27 | 6.07 | 4.48 | 5.28 | 96.27 | 110.23 | 103.25 |
| T2 | 33.56 | 28.62 | 31.09 | 6.69 | 5.05 | 5.87 | 102.36 | 116.55 | 109.46 |
| T3 | 32.41 | 27.34 | 29.88 | 6.28 | 4.65 | 5.47 | 98.69 | 112.55 | 105.62 |
| T4 | 29.63 | 24.20 | 26.92 | 5.10 | 3.67 | 4.39 | 89.49 | 103.18 | 96.34 |
| T5 | 28.75 | 24.40 | 26.58 | 4.79 | 3.40 | 4.10 | 87.22 | 101.15 | 94.19 |
| T6 | 31.18 | 25.84 | 28.51 | 5.74 | 4.18 | 4.96 | 94.06 | 107.69 | 100.88 |
| T7 | 30.45 | 25.10 | 27.78 | 5.46 | 3.94 | 4.70 | 91.85 | 105.28 | 98.57 |
| T8 | 27.66 | 23.52 | 25.59 | 4.37 | 3.05 | 3.71 | 83.14 | 96.20 | 89.67 |
| T9 | 34.12 | 29.35 | 31.74 | 6.90 | 5.23 | 6.07 | 106.14 | 117.85 | 112.00 |
| T10 | 32.94 | 28.11 | 30.53 | 6.47 | 4.84 | 5.66 | 100.15 | 114.12 | 107.14 |
| T11 | 31.35 | 26.18 | 28.77 | 5.85 | 4.29 | 5.07 | 94.53 | 108.56 | 101.55 |
| T12 | 30.66 | 25.26 | 27.96 | 5.55 | 4.02 | 4.79 | 92.16 | 106.05 | 99.11 |
| T13 | 29.95 | 24.59 | 27.27 | 5.23 | 3.75 | 4.49 | 89.96 | 103.65 | 96.81 |
| T14 | 29.11 | 24.68 | 26.90 | 4.90 | 3.49 | 4.20 | 87.45 | 101.62 | 94.54 |
| T15 | 28.21 | 23.96 | 26.09 | 4.58 | 3.23 | 3.91 | 85.23 | 97.40 | 91.32 |
| S.ED | 0.25 | 0.22 | 0.24 | 0.09 | 0.07 | 0.08 | 0.63 | 0.64 | 0.64 |
| CD (p=0.05) | 0.49 | 0.43 | 0.46 | 0.17 | 0.14 | 0.16 | 1.25 | 1.28 | 1.27 |

CBF + Se (20 µg $L^{-1}$) as foliar application, $T_9$ – EM + CBF, $T_{10}$ – EM + CBF + Se (5µg) as soil application, $T_{11}$ – EM + CBF + Se (10µg) as soil application, $T_{12}$ – EM + CBF + Se (20 µg) as soil application, $T_{13}$ – EM + CBF + Se (5µg $L^{-1}$) as foliar application, $T_{14}$ – EM + CBF + Se (10 µg $L^{-1}$) as foliar application, $T_{15}$ – EM + CBF + Se (20 µg $L^{-1}$) as foliar application. The cucumber variety 'Green Long' produced by Suvarna Hybrid seeds; Bangalore were used for the experiment. It is a variety most suitable for salad purpose. The field was laid out into beds of 2 m x 2 m size. Three pits were made in each of the treatment plots. The standard package of practices for the crop was followed. The soil and foliar application of sodium selenate was done according to the treatment schedule in two split doses viz., 25 days and 50 days after sowing. The physiological parameters such as, chlorophyll content index and dry matter production per plant were observed. The flowering parameters such as, days to first male flower appearance,

**Table 3.** Effect of organic manures and biofortification of selenium on flowering parameters of cucumber

| Tr.No | Days to first female flower appearance | | | Node number of first male flower | | | Number of male flowers per vine | | |
|---|---|---|---|---|---|---|---|---|---|
| | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean |
| T1 | 31.85 | 26.68 | 29.27 | 6.07 | 4.48 | 5.28 | 96.27 | 110.23 | 103.25 |
| T2 | 33.56 | 28.62 | 31.09 | 6.69 | 5.05 | 5.87 | 102.36 | 116.55 | 109.46 |
| T3 | 32.41 | 27.34 | 29.88 | 6.28 | 4.65 | 5.47 | 98.69 | 112.55 | 105.62 |
| T4 | 29.63 | 24.20 | 26.92 | 5.10 | 3.67 | 4.39 | 89.49 | 103.18 | 96.34 |
| T5 | 28.75 | 24.40 | 26.58 | 4.79 | 3.40 | 4.10 | 87.22 | 101.15 | 94.19 |
| T6 | 31.18 | 25.84 | 28.51 | 5.74 | 4.18 | 4.96 | 94.06 | 107.69 | 100.88 |
| T7 | 30.45 | 25.10 | 27.78 | 5.46 | 3.94 | 4.70 | 91.85 | 105.28 | 98.57 |
| T8 | 27.66 | 23.52 | 25.59 | 4.37 | 3.05 | 3.71 | 83.14 | 96.20 | 89.67 |
| T9 | 34.12 | 29.35 | 31.74 | 6.90 | 5.23 | 6.07 | 106.14 | 117.85 | 112.00 |
| T10 | 32.94 | 28.11 | 30.53 | 6.47 | 4.84 | 5.66 | 100.15 | 114.12 | 107.14 |
| T11 | 31.35 | 26.18 | 28.77 | 5.85 | 4.29 | 5.07 | 94.53 | 108.56 | 101.55 |
| T12 | 30.66 | 25.26 | 27.96 | 5.55 | 4.02 | 4.79 | 92.16 | 106.05 | 99.11 |
| T13 | 29.95 | 24.59 | 27.27 | 5.23 | 3.75 | 4.49 | 89.96 | 103.65 | 96.81 |
| T14 | 29.11 | 24.68 | 26.90 | 4.90 | 3.49 | 4.20 | 87.45 | 101.62 | 94.54 |
| T15 | 28.21 | 23.96 | 26.09 | 4.58 | 3.23 | 3.91 | 85.23 | 97.40 | 91.32 |
| S.ED | 0.25 | 0.22 | 0.24 | 0.09 | 0.07 | 0.08 | 0.63 | 0.64 | 0.64 |
| CD (p=0.05) | 0.49 | 0.43 | 0.46 | 0.17 | 0.14 | 0.16 | 1.25 | 1.28 | 1.27 |

**Table 4.** Effect of organic manures and biofortification of selenium on sex ratio and fruit set percentage of cucumber

| Tr.No | Sex ratio | | | Fruit set percentage | | |
|---|---|---|---|---|---|---|
| | Season I | Season II | Pooled Mean | Season I | Season II | Pooled Mean |
| T1 | 9.40 | 9.09 | 9.24 | 66.89 | 73.37 | 70.13 |
| T2 | 11.42 | 10.74 | 11.08 | 58.26 | 65.90 | 62.08 |
| T3 | 10.01 | 9.70 | 9.86 | 64.00 | 71.81 | 67.90 |
| T4 | 8.06 | 7.53 | 7.80 | 72.97 | 75.69 | 74.33 |
| T5 | 7.42 | 7.00 | 7.21 | 73.98 | 77.91 | 75.94 |
| T6 | 7.59 | 6.98 | 7.28 | 76.77 | 78.79 | 77.78 |
| T7 | 7.97 | 7.42 | 7.70 | 75.09 | 77.22 | 76.15 |
| T8 | 6.27 | 5.97 | 6.12 | 80.45 | 84.12 | 82.29 |
| T9 | 11.29 | 10.67 | 10.98 | 61.17 | 70.14 | 65.65 |
| T10 | 9.09 | 8.55 | 8.82 | 72.14 | 75.81 | 73.97 |
| T11 | 7.30 | 6.84 | 7.07 | 80.00 | 83.73 | 81.87 |
| T12 | 6.00 | 5.86 | 5.93 | 81.51 | 88.18 | 84.84 |
| T13 | 8.45 | 8.07 | 8.26 | 69.30 | 74.09 | 71.69 |
| T14 | 7.20 | 6.73 | 6.96 | 75.97 | 78.48 | 77.22 |
| T15 | 5.39 | 5.25 | 5.32 | 84.49 | 89.27 | 86.88 |
| S.ED | 0.04 | 0.03 | 0.04 | 0.25 | 0.33 | 0.29 |
| CD (p=0.05) | 0.08 | 0.07 | 0.08 | 0.50 | 0.65 | 0.33 |

node number of first male flower, number of male flowers per vine, days to first female flower appearance, node number of first female flower, number of female flowers per vine, fruit set percentage and sex ratio were observed. The experimental data were statistically analyzed using the methods suggested by Panse and Sukhatme (1994). The critical difference was worked out at 5 per cent probability for significance. The pooled mean data of two seasons was also observed using the statistical procedure.

## RESULTS AND DISCUSSION

### Effect of organic manures and biofortification of selenium on physiological parameters

The study showed significant influence in the physiological parameters such as, chlorophyll content index and dry matter production (Table 1) due to the application of organic manures and biofortification of selenium. The

chlorophyll content index (62.77 and 66.10) and dry matter production (697.20 g plant$^{-1}$and 720.58 g plant$^{-1}$) in first and second season respectively was recorded to be superior in $T_{15}$ which received EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20µg L$^{-1}$) as foliar application. The pooled mean data on chlorophyll content index (64.44) and dry matter production (708.89 g plant$^{-1}$) showed that the highest was recorded with the application of EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) as foliar application.

The increased chlorophyll content index in leaves might be due to the favourable response of enriched manure from which efficient assimilation of nitrogen takes place. As a result of boosted nitrogen which serves as an essential component of chlorophyll, plant photosynthetic activity continues to improve leading to increased chlorophyll content index. The combined effect of biofertilizer application had also improved establishment of the relationship between the source and sink and is also attributed to increase in chlorophyll content index in plants. Another important reason for the increase in chlorophyll content in leaves might be due to the supplementation of selenium through foliar spray as it improves the stability of membranes and involved in synthesis of pigments by protection of chloroplast enzymes or stimulation of plastids to chloroplast development. The reports are similar with the earlier findings of Filek *et al*., (2010), Wang (2011) in *Trifolium repens* and Yao *et al*., (2011). Optimum level of nitrogen supply is essential for effective partitioning of the accumulated dry matter to the economic sink. The reason for enhanced dry matter production might be due to the readily available form of nitrogen in the enriched manure which improved the nitrogen activity and helped in accumulation of dry matter. Singh *et al*., (2012) in bottle gourd reported that higher translocation to plant parts was possible due to better sink capacity of organic amendments which resulted in the increase in dry matter production. Similar findings were recorded by Patil *et al*., (2003) in knolkhol and Ademe *et al*., (2012) in shallot.

**Effect of organic manures and biofortification of selenium on flowering parameters**

The results of the present investigation in two seasons of crop culture indicated significant differences in flowering parameters such as, days to first male flower appearance (27.66, 23.52), node number of first male flower (4.37, 3.05) and number of male flowers per vine (83.14, 96.20) for first and second season respectively was found to be minimum in the treatment that received FYM 25 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) as foliar application. The pooled mean data on days to first male flower appearance (25.59), node number of first male flower (3.71) and number of male flowers per vine (89.67) were found to be favourable which received FYM 25 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) as foliar application.

The days to first female flower appearance (32.56, 28.42), node number of first female flower (6.86, 5.71), number of female flowers per vine (15.80, 18.55), fruit set percentage (84.49, 89.27) and sex ratio (5.39, 5.25) for first and second season respectively was found to be maximum in the treatment that received foliar application of EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$). The pooled mean data on days to first female flower appearance (30.49), node number of first female flower (6.29), number of female flowers per vine (17.18), fruit set percentage (86.88), sex ratio (5.32) (Table 4) were found to be favourable to crop yield in the treatment receiving foliar application of EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$).

The significant decrease in days to first flowering appearance (Table 2) might be due to the combined application of enriched manure and consortium biofertilizers resulting in enhanced reproductive phase. Another reason for earlier appearance of female flowers might be due to the better translocation of nutrients to the aerial parts which has a profound influence in fruit yield. The enhanced photosynthetic activity favoured the early initiation of flowers in the crop. The results of the present findings are in agreement with the earlier reports of Vishwakarma *et al*., (2007) in spine gourd, Prativa and Bhattarai (2011) in tomato, Parmar *et al*., (2011) and Gill *et al*., (2012) in bitter gourd. Kakkar and Sawhney (2002) reported that the polyamines which are present in the selenium treated plants enhance the plant growth and developmental processes including stimulation of cell division, embryogenesis, senescence, floral development.

From the results obtained, it can be concluded that foliar application of EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) were found to be significantly best in favouring the physiological parameters. The flowering attributes such as, days to first male flower appearance, node number of first male flower and number of male flowers per vinewere found to be minimum in the treatment that received FYM 25 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) as foliar application. The days to first female flower appearance, node number of first female flower, number of female flowers per vine, fruit set percentage and sex ratio were significantly enhanced by the foliar application of EM 1 t ha$^{-1}$ + CBF 2 kg ha$^{-1}$ + Se (20 µg L$^{-1}$) in both the seasons respectively.

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