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Studies on the effect of micronutrient on the growth of orchid (*Dendrobium nobile*) CV. Sonia white under shade net house

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Abstract
The present investigation "Studies on the effect of micronutrient on the growth of orchid (*Dendrobium nobile*) cv. Sonia white under shade net house" was conducted during Rabi 2016-17 at shade net house of COE-AIB lab, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G). The experiment was laid out in Completely Randomly Design with three replication, there were nine treatments (T_1) RDF = 0.2 % of NPK @ 20:10:10, (T_2) RDF + $CuSO_4$ (500 ppm), (T_3) RDF + $CuSO_4$ (1000 ppm), (T_4) RDF + $FeSO_4$ (1000 ppm), (T_5) RDF + $FeSO_4$ (1500 ppm), (T_6) RDF + $ZnSO_4$ (1000 ppm), (T_7) RDF + $ZnSO_4$ (1500 ppm), (T_8) RDF + $MnSO_4$ (250 ppm), (T_9) RDF + $MnSO_4$ (500 ppm) were given to plant as a foliar application at fortnightly intervals. The result indicated that the treatment T_4 [RDF + $FeSO_4$ (1000 ppm)] performed better in the observation recorded on growth parameter *viz.*, plant height (cm), (per plant), leaf length (number of leaves cm).

Keywords: Orchid, micronutrient, plant growth, vegetative parameters

Introduction
Orchids are one of the most pampered plants and occupy top position among all flowering plants valued for cut flower production, as potted plants and their longer lasting vase life which fetches a very high price in the international market. It is excellent for garden and can be grown in beds, pots, baskets etc. They account for 27% of global cut flower production in terms of value (Singh, 1986). It has beautiful flowers and one of the momentous groups of flowering plant belongs to largest and most multiform family orchidaceae (Singh and Roy, 2004). They exhibit an incredible range of diversity in shape and size of their flowers. Orchid can't uptake nutrient significantly from root so foliar nutrient application is very widespread practice in orchid cultivation. Nitrogen, Phosphorus and Potassium with different concentration is commonly used as foliar spray. Orchid should be potted in small container according to the size of the plants. It prefers plastic pots which retain moisture longer than mud pots (Patil and Singh, 2003). Orchids are slow growing slow release fertilizer mixtures (NPK) can be used to get best result Application of spray nutrient containing NPK with different concentration varied on the basis of growth stage of plants. During vegetative growth large quantities of nitrogen are required. Nutrient solution of NPK plays a vital role in the growth and development of orchid. Micronutrient play vital role in the growth and development of plant due to their stimulatory and catalytic effect on metabolic process and ultimately on flower yield and quality (koasha *et al*. 2011). Micronutrients are to be necessarily taken up by the plant growing media (soil, coco peat, husk etc.) or supplemented through foliar application for good growth and yield of crop. In recent times, the use of micronutrients is gaining popularity among the flower growers because of their beneficial nutritional support and their role in enhancing the flower quality. Though micronutrients are required in smaller quantities, they are very essential for the growth and development of the plant and have a direct bearing on the yield attributes of most of the flowering plants. Foliar application is recommended by several investigators as an alternative fertilization method to improve the growth and flowering of orchid. It is difficult to get good quality cut flowers of orchid under open field condition. Hence orchid cultivars have to be grown under protected conditions that provides favorable environment for the growth of plants by protecting the crop from heavy winds, pest, disease and other climatic conditions. It favors orchids for faster growth and production of larger and greener leaves with high dry matter content.

Materials and Methods

The experiment will be carried out during the year 2016-17 at the shade net house of COE-AIB, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) An orchid cv. Sonia white, procured from Government Horticulture Nursery Bana Distt.-Raipur (Govt. by Directorate of Horticulture, C.G. Govt.). In this experiment will be conducted in the shade net house completely randomized design number of treatment is 09, numbers of replication 03 and total numbers of pots is 135 brief in treatment are T_1: RDF, T_2: RDF+ Cu 500 ppm, T_3: RDF+ Cu 1000 ppm, T_4: RDF + Fe 1000 ppm, T_5: RDF + Fe1500 ppm, T_6: RDF + Zn 1000 ppm, T_7: RDF + Zn 1500 ppm, T_8: RDF + Mn 250 ppm, T_9: RDF + Mn 500 ppm thirty five days and healthy and uniform tissue cultured plants were selected as experimental material. The micronutrients which were used in experiment were Copper sulphate, Zinc sulphate, Manganese sulphate and ferrous sulphate. A Shade net house covered with green plastic net, having shade percentage (60%). It was used for growing of orchid, provided partially controlled atmosphere and environment by reducing light intensity and effective heat during day time to the orchid crop. Growing system hygienic way of planting was followed, since they produce roots from base and are more susceptible for contamination by soil borne microorganisms. Hence plants were potted and placed on the raised platform. Planting was taken up immediately after receiving the plants in the earthen pots of size 6" x 4" with 8 drainage holes each of 2 cm diameter (to drain the excess water and for free movement of air). Orchids require a suitable potting medium for growth and development and it varies with type of orchid and the environmental conditions (Kang, 1972 and Fitch, 1981). Growing medium for *Dendrobiums*, should be moist but never be soggy (Rajeevan *et al*., 2008). A mixture of charcoal, broken brick and tile pieces in equal quantity was used as a potting media (Paul 1992). After planting, the potting media were immediately irrigated thoroughly to maintain the optimum moisture condition. The irrigation was done twice a day for the plants during hot months and once a day during cool months, besides water was also sprinkled once a day to the floor for maintaining the temperature and humidity inside the greenhouse. Application of fertilizers RDF @ 0.2 % of NPK is sprayed using 20:10:10 water soluble fertilizer given as foliar spray at fortnightly intervals. The quantity of water required for fertigation was about half liter per plant and it was applied manually. EC and pH of the fertilizer mixture solution was maintained at 1.1-1.3 (ms/cm) and its pH at 5.8-6.0 for acceptable range. The experimental treatments RDF+$CuSO_4$ (500 ppm), RDF+$CuSO_4$ (1000 ppm), RDF+$FeSO_4$ (1000 ppm), RDF+$FeSO_4$ (1500 ppm), RDF+$ZnSO_4$ (1000 ppm), RDF+$ZnSO_4$ (1500 ppm), RDF + $MnSO_4$ (250 ppm), RDF+$MnSO_4$ (500 ppm), was spray at 15, 30, 45, 60, Days after planting. Different observations were recorded with the help of essential tools and equipment and these data statistically analyzed.

Results and Discussion

1. Growth Parameters

1.1 Plant Height (cm)

The observations on plant height of orchid under protected condition were recorded at 30, 60, 90 and 120 days after planting (DAP) and data are presented in table 1 Plant height was found significant differences among the different treatment 30, 60, 90 and 120 DAP the range of plant height were 8.19 to 13.40 cm, 10.88 to 15.43 cm, 11.67 to 17.73 cm and 13.33 to 20.16 cm respectively. At 30 DAP, the maximum plant height (13.40 cm) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was found *at par* with treatment T_6 (12.43 cm) but significantly superior over rest of the treatments. The minimum plant height (8.19 cm) was observed in treatment T_1 (RDF). At 60 DAP, the maximum plant height (15.433 cm) was noted with treatment T_4 (RDF + Fe 1000), which was found *at par* with treatment T_6 (14.17cm) but significantly superior over rest of the treatments. The minimum plant height (10.88 cm) was observed with treatment T_1 (RDF). At 90 DAP, the maximum plant height (17.73 cm) was recorded with treatment T_4 (RDF + Fe 1000), which was *at par* with treatment T_6 (16.50 cm whereas treatment T_3 (15.23 cm), T_2 (14.93 cm), T_5 (14.50 cm), T_7 (14.31 cm), T_8 (14.13 cm), T_9 (12.87 cm) and T_1 (11.67 cm) were found significant differ with T_4.The minimum plant height (11.67 cm) was observed with treatment T_1 (RDF).Similar trend were found at 120 DAP the maximum plant height (20.16 cm) was recorded with treatment T_4 (RDF + Fe 1000), which was *at par* with treatment T_6 (19.11 cm) but significantly superior over rest of the treatment. Here both the micronutrient are enhanced the growth and development of plants. Similar results were also reported by, Kumar and Arora (2000) [16] in Gladiolus, Joshi *et al*. (2003) [13] in Rose, Doshra *et al*. (2004) in Marigold and Balkrishan *et al*. (2005) [3] in Marigold.

1.2 Number of leaves per plant

The number of leaves per plant was counted at 30, 60, 90, and 120 days after planting and data is presented in table 2, Number of leaves per plant was found significant differences among the different treatment at 30, 60, 90 and 120 DAP and the range of leaf number 2.90 to5.60, 3.60 to 6.13, 3.97 to 6.47 and 4.27 to 6.83 respectively. At 30 DAP, the maximum number of leaves (5.60) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was exhibited significantly differ with most of the treatment except T_6 (5.23). The minimum number of leaves per plant (2.90) was noted with the treatment T_1 (RDF). At 60 DAP, the maximum number of leaves (6.13) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (5.70), T_2 (5.07 cm) and T_8 (4.98). The minimum number of leaves per plant (3.60) was noted with the treatment T_1 (RDF). At 90 DAP, the maximum number of leaves (6.47) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (6.13) where as significant difference was found with rest of the treatments. The minimum number of leaves per plant (3.97) was noted with the treatment T_1 (RDF). At 120 DAP, the maximum number of leaves (6.83) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (6.43), T_7 (5.83), T_8 (5.82) and T_2 (5.8) whereas significant difference was found with rest of the treatments. The minimum number of leaves per plant (4.27) was noted with the treatment T_1 (RDF). At 90 DAP, the maximum number of leaves (6.47) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (6.13) where as significant difference was found with rest of the treatments. The minimum number of leaves per plant (3.97) was noted with the treatment T_1 (RDF). At 120 DAP, the maximum number of leaves (6.83) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (6.43), T_7 (5.83), T_8 (5.82) and T2 (5.8) whereas significant difference was found with rest of the treatments. The minimum number of leaves per plant (4.27) was noted with the treatment T1 (RDF). Similar results were also reported by Muthumanickam *et al.* (1999) [20] and Jadhav (2004) in gerbera, Juhari *et al*. (2005), Balakrishnan (2005) [3] in

Marigold, Rao (2005) [25] in Gladiolus and Pal. *Et al.* (2016) in Gerbera. S.

1.3 Leaf length (cm)

The leaf length of plant was recorded at 30, 60, 90, and 120 days after planting and data is presented in table 3, Leaf length was found significant differed among the different treatment at 30, 60, 90 and 120 DAP. At 30 DAP, the maximum leaf length (7.98 cm) was noted with treatment T_4 (RDF + Fe 1000 ppm) which was found *at par* with treatment T_6 (7.53), T_3 (7.47 cm), T_7 (7.47 cm), T_8 (7.40 cm), T_5 (7.01 cm), T_2 (6.82 cm), T_9 (6.75 cm).The minimum leaf length (6.24 cm) was noted with the treatment T_1 (RDF). At 60 DAP, the maximum leaf length (8.60 cm) was recorded with foliar application of treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (8.10 cm), T_7 (7.97 cm), T_8 (7.90 cm), T_3 (7.87 cm), T_2 (7.4 cm) and T_9 (7.23 cm). The minimum leaf length (6.61 cm) was noted with the treatment T_1 (RDF). At 90 DAP, the maximum leaf length (9.20 cm) was noted with foliar application of treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with T_6 (8.40 cm), T_3 (8.30 cm), T_2 (8 cm), T_8 (8.27 cm), and T_7 (8.23 cm). The minimum leaf length (6.93 cm) was noted with the treatment T_1 (RDF). In case of 120 DAP, the maximum leaf length (9.67 cm) was recorded with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with treatment T_6 (8.87 cm), T_8 (8.77 cm), T_3 (8.77 cm) whereas treatments T_7 (8.67 cm), T_5 (8.40 cm), T_2 (8.37 cm), T_9 (8.10 cm) and T_1 (7.30 cm) were observed significantly differ with T_4. The minimum leaf length (7.30 cm) was noted with the treatment T_1 (RDF).

1.4 Width of leaf (cm)

The width of leaf was observed at 30, 60, 90 and 120 days after planting and data is presented in table 4, At 30 DAP, the maximum width of leaf (2.60 cm) was recorded with treatment T_4 (RDF + Fe 1000 ppm) which was *at par* with treatment T_6 (2.17 cm), but significantly superior over rest of the treatments. The minimum width of leaf (1.15 cm) was observed with treatment T_1 (RDF). At 60 DAP, the significantly maximum width of leaf (2.83 cm) was recorded with treatment T_4 (RDF + Fe1000 ppm) which was *at par* with treatment T_6 (2.40cm), whereas T_7 (2.27cm), T_2 (2.07 cm), T_3 (2.03 cm), T_8 (2.00 cm), T_9 (1.60 cm) and T_1 (1.43 cm) were observed significantly differ with treatment T_4. The minimum width of leaf (1.43 cm) was observed with treatment T_1 (RDF).At 90 DAP, the maximum width of leaf (3.07 cm) was recorded with treatment T_4 (RDF + Fe1000 ppm) which was *at par* with T_6 (2.63 cm). The minimum width of leaf (1.60 cm) was observed with treatment T_1 (RDF). At 120 DAP, the significantly maximum width of leaf (3.27 cm) was recorded with foliar application of treatment T_4 (RDF + Fe 1000 ppm) followed by
T_6 (2.83cm) and T_7 (2.73 cm).The minimum width of leaf (1.77 cm) was observed with treatment T_1 (RDF). The maximum width of leaves was found in that treatment which recorded Fe at 1000 ppm it may be due to optimum enzymatic activity and metabolic reaction within the plants regulated or stimulated by iron content. Similar result found in Ganga *et al.* (2009) [9] in Orchid, De *et al.* (2013) in Orchid, and An and *et al.* (2016) [1] in Orchid.

1.5 Leaf area (cm^2)

The leaf area was observed at 30, 60, 90 and 120 days after planting and data is presented in table 5 and fig. 4.5 At 30 DAP, the significantly maximum leaf area (20.71 cm^2) was recorded with treatment T_4 (RDF + Fe 1000 ppm) followed by T_7 (14.38 cm^2), T_3 (13.26cm^2), T_9 (12.96 cm^2), T_2 (11.760 cm^2), T_5 (11.27 cm^2), and T_1 (6.99 cm^2). The minimum leaf area (6.99 cm^2) was observed with treatment T_1 (RDF). At 60 DAP, the maximum leaf area (24.29 cm^2) was recorded with treatment T_4 (RDF + Fe 1000 ppm) followed by T_6 (19.50 cm^2), T_7 (18.03 cm^2), T_3 (16.05 cm^2), T_9 (15.13 cm^2), T_2 (14.942 cm^2), T_5 (14.062 cm^2), and T_1 (9.372 cm^2). The minimum leaf area (9.37 cm^2) was observed with treatment T_1 (RDF). At 90 DAP, the maximum leaf area (28.15 cm^2) was recorded with treatment T_4 (RDF + Fe 1000 ppm) which was significantly higher than all the treatments. The minimum leaf area (11.02 cm^2) was observed with treatment T_1 (RDF). At 120 DAP, the maximum leaf area (31.49 cm^2) was recorded with treatment T_4 (RDF + Fe 1000 ppm), followed by T_6 (24.86 cm^2), T_7 (23.68 cm^2), T_3 (23.09 cm^2), and T_8 (22.51 cm^2). The minimum leaf area (12.85 cm^2) was observed with treatment T_1 (RDF).The maximum leaf area was recorded with RDF + Fe 1000 ppm followed by RDF + Zn 1000 ppm and it may be due to good growth of plants with showed in previous growth parameters. Similar result found in De *et al.* (2013) in Orchid, Chopde *et al*. (2015) in Gladiolus, Saini *et al*. (2015) in Chrysanthemum.

1.6 Leaf area index (cm^2)

The leaf area index was observed at 30, 60, 90 and 120 days after planting and data is presented in table 6 At 30 DAP, the maximum leaf area index (0.86 cm^2) were recorded with treatment T_4 (RDF + Fe 1000 ppm) followed by T_6 (0.68 cm^2), T_7 (0.60 cm^2), T_3 (0.55 cm^2), T_9 (0.53 cm^2), T_2 (0.48 cm^2), T_5 (0.47 cm_2), and T_1 (0.29 cm^2). The minimum leaf area index (0.29 cm^2) was observed with treatment T_1 (RDF). At 60 DAP maximum leaf area index (0.9 cm^2) were recorded in T_4 (RDF +Fe 1000 ppm) followed T_7 (0.75 cm^2), T_6 (0.7 cm^2), T_3 (0.66 cm^2), T_2 (0.62 cm^2), T_5 (0.58 cm^2), T_9 (0.53 cm^2), T_8 (0.51 cm^2). The minimum leaf area index (0.46 cm^2) recorded in T_1 (RDF alone). 90 DAP the maximum leaf area index (1.14 cm^2) were recorded in T_4 (RDF+ Fe 1000 ppm) and which was *at par* with T_6 (0.92 cm^2) but significantly superior over rest of the treatment.. At 120 DAP, the maximum leaf area index (1.29 cm^2) was recorded with treatment T_4 (RDF + Fe 1000 ppm), whereas minimum leaf area index (0.53 cm^2) was observed with treatment T_1 (RDF).The leaf area was found maximum under T_4 (RDF + Fe 1000 ppm) followed by T_6 and it may be due to more leaves and maximum width of leaf which is recorded under some treatments similar result found in Kabir *et al.* (2012) [14] in orchid, Soni *et al.* (2015) [9] in Gerbera and mourya *et al*. (2014) in Gladiolus.

1.7 Stem diameter (cm) and root length (cm)

The stem diameter were recorded at 30, 60, 90, and 120 days after planting and data is presented in table 7, Plant stem diameters were found non-significant among related treatments at observations. At 30 DAP, the maximum stem diameter (0.55 cm) was noted with the treatment T_4 (RDF + Fe 1000 ppm) whereas minimum stem diameter (0.31 cm) was noted with the treatment T_1 (RDF). At 60, 90 and 120 DAP, the maximum stem diameter noted were under the treatment T_4 (RDF + Fe 1000 ppm) whereas minimum stem diameter was noted with the treatment T_1 (RDF). The stem diameter was recorded maximum in T_4 (RDF + Fe 1000 ppm) and it may be due to better growth off plant indicated by previous growth observations. The maximum root length (7cm) was noted with treatment T_4 (RDF +Fe1000 ppm)

which was found *at par* with treatment T_6 (6.8 cm), whereas T_3 (5.43cm), T_5 (5.23 cm), T_9 (5.2 cm), T_2 (5.06 cm), T_7 (5.03 cm), T_8 (4.9 cm), and T_1 (4.64 cm) were observed significantly differ with T_4. The minimum root length of plant (4.64 cm) was recorded with the treatment T_1 (RDF alone). Iron acts as an important catalyst in the enzymatic reactions of the metabolism and would have helped in larger biosynthesis of photo assimilates thereby enhancing growth of the plants. Similar results were also reported by Muthumanickam *et al.* (1999) [20], and Jadhav (2004) in Gerbera, and Balakrishnan (2005) [3] in Marigold.

Table 1: Effect of foliar application of micronutrient on plant height (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	8.19	10.88	11.66	13.33
T_2 RDF + Cu 500 ppm	10.02	12.80	14.93	17.66
T_3 RDF + Cu 1000 ppm	11.07	13.24	15.23	18.30
T_4 RDF + Fe 1000 ppm	13.40	15.43	17.73	20.16
T_5 RDF + Fe1500 ppm	10.22	11.64	14.5	16.66
T_6 RDF + Zn 1000 ppm	12.43	14.17	16.5	19.100
T_7 RDF + Zn 1500 ppm	9.89	11.55	14.31	16.50
T_8 RDF + Mn 250 ppm	9.46	12.06	14.13	17.00
T_9 RDF + Mn 500 ppm	09	11.66	12.87	15.76
S. Em±	0.60	0.68	0.74	0.639
C.D at 1%	1.82	2.05	2.19	1.93

Table 2: Effect of foliar application of micronutrient on leaf length (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	2.9	3.6	3.97	4.27
T_2 RDF + Cu 500 ppm	4.27	5.07	5.17	5.8
T_3 RDF + Cu 1000 ppm	3.97	4.67	5.63	5.73
T_4 RDF + Fe 1000 ppm	5.6	6.13	6.47	6.83
T_5 RDF + Fe1500 ppm	3.83	5	5.5	5.73
T_6 RDF + Zn 1000 ppm	5.23	5.7	6.13	6.43
T_7 RDF + Zn 1500 ppm	4.07	4.93	5.43	5.83
T_8 RDF + Mn 250 ppm	4.33	4.98	5.47	5.8
T_9 RDF + Mn 500 ppm	3.23	3.87	4.23	4.77
S. Em±	0.34	0.4	0.32	0.35
C.D at 1%	2.9	3.6	3.97	4.27

Table 3: Effect of foliar application of micronutrient on number of leaves (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	6.24	6.61	6.93	7.3
T_2 RDF + Cu 500 ppm	6.82	7.4	8	8.37
T_3 RDF + Cu 1000 ppm	7.22	7.87	8.3	8.77
T_4 RDF + Fe 1000 ppm	7.98	8.6	9.2	9.67
T_5 RDF + Fe1500 ppm	7.01	7.67	7.97	8.4
T_6 RDF + Zn 1000 ppm	7.53	8.1	8.4	8.87
T_7 RDF + Zn 1500 ppm	7.47	7.97	8.23	8.67
T_8 RDF + Mn 250 ppm	7.40	7.9	8.27	8.77
T_9 RDF + Mn 500 ppm	6.75	7.23	7.7	8.1
S. Em±	0.44	0.4	0.47	0.46
C.D at 1%	1.3	1.39	1.41	1.35

Table 4: Effect of foliar application of micronutrient on leaf width (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	1.15	1.43	1.6	1.77
T_2 RDF + Cu 500 ppm	1.60	2.07	2.31	2.6
T_3 RDF+Cu 1000 ppm	1.77	2.03	2.43	2.67
T_4 RDF + Fe 1000 ppm	2.6	2.83	3.07	3.27
T_5 RDF + Fe1500 ppm	1.6	1.83	2.13	2.33
T_6 RDF + Zn 1000 ppm	2.17	2.4	2.63	2.83
T_7 RDF + Zn 1500 ppm	1.93	2.27	2.53	2.73
T_8 RDF + Mn 250 ppm	1.76	2	2.3	2.57
T_9 RDF + Mn 500 ppm	1.38	1.6	1.8	2.03
S. Em±	0.17	0.14	0.15	0.14
C.D at 1%	0.52	0.42	0.46	0.42

Table 5: Effect of foliar application of micronutrient on leaf width (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	6.99	9.37	11.02	12.85
T_2 RDF + Cu 500 ppm	11.7	14.94	17.63	21.7
T_3 RDF+Cu 1000 ppm	13.26	16.05	19.66	23.09
T_4 RDF + Fe 1000 ppm	20.71	24.29	28.15	31.49
T_5 RDF + Fe1500 ppm	11.27	14.06	17.04	19.65
T_6 RDF + Zn 1000 ppm	16.29	19.5	22.19	24.86
T_7 RDF + Zn 1500 ppm	14.38	18.03	20.84	23.68
T_8 RDF + Mn 250 ppm	12.96	15.13	19.04	22.51
T_9 RDF + Mn 500 ppm	9.28	12.24	13.87	16.49
S. Em±	1.05	1.25	1.53	1.3
C.D at 1%	3.13	3.72	4.5	3.86

Table 6: Effect of foliar application of micronutrient on leaf area (cm^2)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1 RDF	6.99	9.37	11.02	12.85
T_2 RDF + Cu 500 ppm	11.7	14.94	17.63	21.7
T_3 RDF + Cu 1000 ppm	13.26	16.05	19.66	23.09
T_4 RDF + Fe 1000 ppm	20.71	24.29	28.15	31.49
T_5 RDF + Fe1500 ppm	11.27	14.06	17.04	19.65
T_6 RDF + Zn 1000 ppm	16.29	19.5	22.19	24.86
T_7 RDF + Zn 1500 ppm	14.38	18.03	20.84	23.68
T_8 RDF + Mn 250 ppm	12.96	15.13	19.04	22.51
T_9 RDF + Mn 500 ppm	9.28	12.24	13.87	16.49
S. Em±	1.05	1.25	1.53	1.3
C.D at 1%	3.13	3.72	4.5	3.86

Table 7: Effect of foliar application of micronutrient on stem diameter (cm) and root length (cm)

Treatment	30 DAP	60 DAP	90 DAP	120 DAP	Root length (cm)
T_1 RDF	0.31	0.4	0.44	0.46	4.64
T_2 RDF + Cu 500 ppm	0.41	0.45	0.49	0.53	5.07
T_3 RDF + Cu 1000 ppm	0.44	0.47	0.51	0.54	5.43
T_4 RDF + Fe 1000 ppm	0.55	0.59	0.62	0.65	7.00
T_5 RDF + Fe1500 ppm	0.43	0.49	0.48	0.51	5.23
T_6 RDF + Zn 1000 ppm	0.47	0.53	0.56	0.58	6.87
T_7 RDF + Zn 1500 ppm	0.39	0.44	0.47	0.5	5.03
T_8 RDF + Mn 250 ppm	0.42	0.44	0.47	0.5	5.20
T_9 RDF + Mn 500 ppm	0.37	0.41	0.44	0.47	4.97
S. Em±	0.05	0.05	0.05	0.05	0.18
C.D 1 %	NS	NS	NS	NS	0.53

Fig 1: Root length T_1 condition

Fig 2: Root length T4 condition

Conclusion

Foliar application of treatment T4 [RDF 0.2% (20:10:10) + FeSO4 (1000 ppm).

Performed better in the observations on growth parameter *viz*., plant height, number of leaves, length of leaves, width of leaves, stem diameter, leaf area, leaf area index, length of root and number of roots showed with T4.

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