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Short communication

Evaluating micronutrients effects on yield and quality attributes of chrysanthemum (*Dendrathemum Grandiflorum* Tzeuleu) cv.CO1

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The Asteraceae family includes Chrysanthemum (*Dendranthema grandiflora* T.), believed to have originated in the northern hemisphere, particularly Europe and Asia, with its roots traced back to China (Carter, 1990). Chrysanthemum exhibits 9 basic chromosomes, but its chromosome count (2n) varies widely from 36 to 75, with the majority being hexaploid. The name "chrysanthemum" is derived from the Greek words "chryos" (gold) and "anthemon" or "anthos" (flower). Ranked second only to roses, chrysanthemums are among the most commonly purchased cut flowers in the global flower trade (Bhattacharjee and De, 2003), maintaining fifth position as potted plants. Apart from their striking colors, chrysanthemums are valued for their extended vase life, durable flowers, uniform blooming, tall upright stems, long internodes, and abundant central blooms, making them an ideal choice for floral arrangements. A balanced plant nutrition regimen is indispensable for achieving optimal flower crop production. Of utmost importance is the quality of the flowers, as it directly influences market value. The integrated provision of micronutrients alongside macronutrients, in sufficient quantities and appropriate proportions, stands out as a critical determinant governing both the quality and yield of flower crops (Ganesh and Kannan, 2013). Micronutrients are recognized as indispensable components for optimal plant growth, yield, and quality, paralleling the significance of macronutrients. Historically, the natural provision of these trace elements by soil obviated the necessity for external micronutrients supplementation (Ganesh and Kannan, 2013). However, in contemporary agricultural practices, it is imperative to ensure the uptake of micronutrients by plants either from the soil or through foliar application to foster robust crop growth and yield, while maximizing the efficient utilization of applied nitrogen (N), phosphorus (P), and potassium (K). The absence of adequate micronutrients predisposes plants to physiological disorders, resulting in compromised growth and diminished yields (Zende, 1996). Micronutrients play integral roles in various metabolic and cellular functions, albeit with varying requirements among plant species. These micronutrients encompass Boron (B), Iron (Fe), Zinc (Zn), Copper (Cu), Chloride (Cl), Manganese (Mn), Molybdenum (Mo), and Nickel (Ni). Functionally, they serve as catalytically active cofactors of enzymes, activate enzymes, or fulfil structural roles in stabilizing proteins. Enhanced growth characteristics attributed to micronutrients application are often attributed to heightened photosynthetic and metabolic activities, particularly related to cell division and elongation. Therefore, the present study has been carried out to evaluate the micronutrients effects on yield and quality attributes of Chrysanthemum (*Dendrathemum grandiflorum* Tzeuleu) cv. CO 1.

The field experiment was conducted in the Department of Horticulture, Faculty of Agriculture, Annamalai University, and Tamil Nadu in chrysanthemum (*Dendrathemum grandiflorum* Tzeuleu) cv.CO 1. The experimental site situated approximately 6 km west of the Bay of Bengal, positioned at 11°24' North latitude and 79°41' East longitude, with an altitude of +5.79 meters above mean sea level. The maximum mean temperature range from 29.7ºC to 38.3ºCwith a mean of 32.4ºC, while the minimum temperature range from 21.10ºC to 27.0ºC with a mean value of 25.3ºC. Its receives an annual rainfall of 1500 mm with a relative humidity of 85%. Employing a Randomized Block Design (RBD), treatments were administered at five different intervals, utilizing two distinct application methods, with three **K.**

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replications and seventeen treatments viz. T_1-Control, T_2- 25t FYM ha^{-1} + RDF of N, P and K, T_3-T_2 + Zinc sulphate @ 0.5 % foliar spray on 30 and 60 DAT, T_4-T_2 + Zinc sulphate @ 0.5% foliar spray on 25, 50 and 75 DAT, T_5-T_2 + Ferrous sulphate @ 0.5 % foliar spray on 30 and 60 DAT, T_6-T_2 + Ferrous sulphate @ 0.5 % foliar spray on 25, 50 and 75 DAT, T_7-T_2+ Borax @ 0.5 % foliar spray on 30 and 60 DAT, T_8-T_2 + Borax @ 0.5% foliar spray on 25, 50 and 75 DAT, T_9-T_2 + Manganese sulphate 0.5 % foliar spray @ 30 and 60 DAT , T_{10}-T_2 + Manganese sulphate 0.5% foliar spray @ 25, 50 and 75 DAT , T_{11}-T_2 + Copper sulphate 0.5% foliar spray @ 30 and 60 DAT , T_{12}-T_2 + Copper sulphate 0.5% foliar spray @ 25, 50 and 75 DAT , T_{13}-T_2 + Mixture of all micronutrients @ 0.5% foliar spray on 30 and 60 DAT, T_{14}-T_2 + Mixture of all micronutrients @ 0.5% foliar spray on 25, 50 and 75 DAT, T_{15}-T_2 + Soil application of micronutrients mixture @ 12.5 kg ha^{-1} as basal , T_{16}-T_2 + Soil application of micronutrients mixture @ 12.5 kg ha^{-1} in split as basal, 30 and 60 DAT, T_{17}-T_2 + Soil application of micronutrients mixture @ 12.5 kg ha^{-1} in split as basal, 25, 50 and 75 DAT. Micronutrients mixture were applied via spraying at 25, 50, and 75 days after transplanting (DAT). The recommended fertilization rate, consisting of Urea, Diammonium Phosphate, and Muriate of Potash at a ratio of 125:120:20 NPK kg/ha, was adhered to. At transplanting, half of the nitrogen dose and the complete doses of phosphorus pentoxide (P_2O_5) and potassium oxide (K_2O) were applied in a circular band, while the remaining half of the nitrogen dose was applied to the soil 40 days after-transplanting. Chrysanthemum seedlings were transplanted with a spacing of 45 × 35 cm in ridges and furrows during the years 2019-2020. Measurements were conducted on five randomly selected plants. Statistical analysis of the experimental data was performed following the procedures outlined by Panse and Sukhatme (1978). Significant results were identified, and critical differences were determined at the 5% significance level to draw statistical inferences.

The application of a micronutrients mixture significantly impacted yield and quality parameters (Table 1). Treatment T_{17} showed the highest flower yield per plant (201.74 g) and per hectare (21.14 t ha^{-1}), with 89.91 flowers per plant. Treatment T_{16} followed closely with values of 87.78 flowers per plant, 188.54 g flower yield per plant, and 20.86 t ha^{-1} flower yield per hectare. Conversely, the control treatment (T_1) recorded the lowest values viz., 63.02 flowers per plant, 84.63 g flower yield per plant, and 15.64 t ha^{-1} flower yield per hectare. The increase in flower production can be attributed to the micronutrients mixture's influence on photosynthesis, auxin breakdown (IAA), and protein synthesis, promoting physiological functions conducive to higher flower yield. Similar findings were reported by Hardeep *et al.* (2003) in Tuberose, Shyala *et al.* (2019) in African marigold, Pawar *et al.* (2019) in marigold, Shaheen *et al.* (2015) in Oriental lily, Khan and Iqbal (2021) in gladiolus and Thakur (2022) in Chrysanthemum.

Treatment T_{17} exhibited the highest flower stalk length (8.92cm), flower head weight (2.48 g $flower^{-1}$), and flower head diameter (6.40cm), followed by T_{16} with (8.57cm), (2.46 g $flower^{-1}$), and (6.20cm) respectively. Conversely, the control group (T_1) showed the lowest values for all parameters such as flower stalk length (5.90cm), flower head weight (2.13 g $flower^{-1}$), and flower head diameter (3.58cm). This disparity suggests enhanced nutrient production, influencing quality metrics like stalk length, flower weight, and diameter. The increased stalk length may stem from stimulated cell division, protein synthesis, and higher dry matter content, potentially affecting apical dominance, consistent with Ahmad *et al.* (2010) in Rose and Joseph *et al.* (2019) in China aster. Micronutrient mixtures likely contributed to higher flower weight and diameter by regulating cell wall permeability, enhancing water movement, and boosting food material production, leading to larger ray florets and increased cell size, as supported by Vanlalruati *et al.* (2019) on chrysanthemum, Swetha *et al.* (2022) on Gaillardia, and Thakur *et al.* (2022) on chrysanthemum.

Treatment T_{17} showed the highest xanthophyll content (1.589mg g^{-1}) and carotenoid content (1.57mg g^{-1}), followed by Treatment T_{16} with 1.550mg g^{-1} and 1.54mg g^{-1} respectively. Conversely, Treatment (T_1) Control had the lowest xanthophyll content (1.440mg g^{-1}) and carotenoid content (1.08mg g^{-1}). The superior quality of marigold flowers in these treatments may result from increased assimilation of essential nutrients and the deposition of plant growth regulators and enzymes in flower cells facilitated by the

Table 1: Effect of micronutrients on yield and quality attributes of Chrysanthemum

Treatment	No. of flowers per plant	Flower yield per plant (g)	Flower yield per ha^{-1} (t ha^{-1})	Flower stalk length (cm)	Flower head weight (g flower^{-1})	Flower head diameter (cm)	Xanthophyll content (mg g^{-1})	Carotenoid content (mg g^{-1})	Visual scoring	Shelf life (days)
T_1	63.02	84.63	15.64	5.90	2.13	3.58	1.440	1.08	6.11	6.73
T_2	65.19	87.23	16.08	6.17	2.25	3.82	1.446	1.11	6.41	6.81
T_3	83.49	113.54	20.05	7.82	2.24	5.74	1.570	1.45	8.01	8.27
T_4	85.64	116.14	20.46	8.20	2.36	5.98	1.575	1.50	8.67	8.44
T_5	71.60	94.83	17.35	6.68	2.15	3.89	1.537	1.21	6.79	7.31
T_6	74.35	100.21	18.10	6.88	2.18	4.76	1.447	1.27	6.98	7.52
T_7	72.53	96.40	17.56	6.74	2.15	4.53	1.450	1.23	7.00	7.37
T_8	75.26	101.80	18.33	6.97	2.17	4.87	1.531	1.28	7.04	7.60
T_9	73.45	98.30	17.84	6.81	2.14	4.63	1.541	1.25	7.52	7.44
T_{10}	76.19	103.32	18.54	7.05	2.20	4.92	1.563	1.30	7.65	7.67
T_{11}	67.32	90.13	16.52	6.24	2.23	4.02	1.490	1.14	7.72	6.96
T_{12}	69.47	92.63	16.96	6.47	2.22	4.23	1.577	1.19	7.78	7.14
T_{13}	77.09	104.47	18.73	7.14	2.25	4.08	1.530	1.31	8.18	7.73
T_{14}	79.22	107.66	19.12	7.39	2.23	5.28	1.571	1.36	8.21	7.92
T_{15}	81.36	110.64	19.61	7.61	2.22	5.48	1.569	1.42	8.45	8.09
T_{16}	87.78	188.54	20.86	8.57	2.46	6.20	1.550	1.54	8.81	8.60
T_{17}	89.91	201.74	21.14	8.92	2.48	6.40	1.589	1.57	9.18	8.75
S. Ed	1.06	2.24	0.32	0.17	0.02	0.17	0.01	0.01	0.16	0.74
CD (p =0.05)	2.13	4.48	0.64	0.35	0.04	0.34	0.02	0.04	0.33	2.13

physiological roles of micronutrients. This enhancement in xanthophyll and carotenoid content aligns with findings by Karuppaiah (2014) in chrysanthemum and supported by Shyala *et al.* (2019) in African marigold.

Treatment T_{17} demonstrated excellent quality aspects for chrysanthemum flowers, with a visual scoring of 9.18 and a shelf life of 8.75 days. Following closely, T_{16} showed values of 8.81 for visual scoring and 8.60 days for shelf life. In contrast, the control (T_1) exhibited the lowest visual scoring (6.11) and flower longevity (6.73 days). This improvement in quality and longevity is attributed to the suppression of ethylene and abscisic acid, resulting in attractive flowers with extended shelf life. Enhanced levels of carbohydrates and essential nutrients, as well as the deposition of plant growth regulators and enzymes facilitated by micronutrients application, contribute to the superior quality in the best treatment. Similar findings have been observed by Sowmiya and Karuppaiah (2019) in jasmine , Shyala *et al.* (2019) in African marigold, Joseph *et al.* (2019) in china aster, and Wilson *et al.* (2023) in gerbera. From the results, it can be concluded that soil application of micronutrients mixture @12.5 kg ha^{-1} in split as basal, 25, 50 and 75 DAT was found to have beneficial effect on yield and quality attributes of chrysanthemum.

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