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RESPONSE TO FOLIAR SPRAY OF MICRO-NUTRIENTS (ZN, FE AND CU) IN RESPECT TO GROWTH AND FLOWER PRODUCTIVITY OF CHINA ASTER *(CALLISTEPHUS CHINENSIS* (L.) NEES) CV. PRINCESS

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Abstract

The experimental, as field trials were conducted during winter season of 2001-2002 to study the "Response to foliar spray of micro-nutrients (Zn, Fe and Cu) in respect to growth and flower productivity of China Aster *(Callistephus chinensis* (L.) NEES) cv. Princess" in plot A-7 of the R.B.S. College, Agricultural Farm, Bichpuri, Agra in randomized block design with nine treatments *i.e.* T_1- Control (Spray of Zinc sulphate 0.0%), T_2- (Spray of Zinc sulphate 0.2%), T_3 - (Spray of zinc sulphate 0.4%), T_4 - (Spray of Ferrous sulphate 0.0%), T_5 - (Spray of Ferrous sulphate 0.2%), T_6 - (Spray of Ferrous sulphate 0.4%), T_7 - (Spray of copper sulphate 0.0%), T_8 - (Spray of copper sulphate 0.2%), T_9 - (Spray of copper sulphate 0.4%). It was observed that overall that maximum plant height was find out in treatment T_5 (64.48cm), maximum diameter of main stem (cm) was recorded in treatment T_5 (3.17), maximum number of leaves was found in treatment T_5 (126.62), maximum plant spread along and across the row (cm) was found in treatment T_5 (38.70), maximum number of laterals was found in treatment T_5 (31.89), maximum Length of longest leaf (cm) was found in treatment T_5 (10.96cm), maximum width of the longest leaf (cm) was found in treatment T_5 (7.60cm), maximum green weight of plant canopy at final was found in treatment T_5 (403.51), maximum dry weight of plant canopy at final was found in treatment T_5 (73.33), maximum date of visibility of flower bud was found in treatment T_5(132.51), maximum date of colour break was found in treatment T_5(140.55), maximum date of full blooming was found in treatment T_5(160.66), maximum date of harvesting of floral heads was found in treatment T_5(162.73), maximum fresh weight of floral head (g) was found in treatment T_5(5.10), maximum length of floral head (cm) was found in treatment T_5(3.27cm), maximum width of floral head (cm) was found in treatment T_5(6.40cm), maximum length of floral stalk (cm) was found in treatment T_5(22.05cm) and maximum diameter of floral stalk (cm) was found in treatment T_5 (0.29cm).

Key words : Zinc sulphate, ferrous sulphate, copper sulphate, growth and China aster.

Introduction

Flowers symbolize purity, beauty, love, passion and tranquility. Although, flowers are mute beauties, they convey the best message of love, joy and affection. They are highly esteemed for their sanctity. Even the birth and death of a human is associated with flowers. More than 150 countries were involved in Floriculture trade during 2000. International flower market is at Alsmeer in the Netherlands. Contribution of Netherlands in international floriculture trade is 57% followed by Colombia 14%, Israel 4%, Kenya & Ecuador 3%, Thailand and Spain 2% and India 2%. Germany 21% is the largest importer of live plants followed by France 12% and Germany is the biggest market of flower products of 2 billion US $ followed by U.S.A., UK, the Netherlands and France in 2000 (Singh, 2002).

Per capita consumption of flowers is highest in Switzerland (87.1 Euro) followed by Norway (56.7), the Netherlands (51.3), Australia (43.6) and Belgium (40.8 Euro). Per capita consumption off fee plants is highest in Norway (53.6 Euro) followed by Germany (47.2), Denmark (41.8), Sweden (41.3) and Switzerland (318,6 Euro) (Anonymous, 2000). [The flower council of Holland (FIora-culture International, June, 2002:6)].

In India, total area under flower crops is estimated about one lakh hectare and trade Rs. 350 crores in 2000-2001 and the maximum area is in Karnataka (20801 ha) followed by Tamil Nadu (18120 ha), Andhra Pradesh

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(18087ha) and West Bengal (13227 ha) in 1999-2000 (Singh, 1998). Indian flower export during 1999-2000 and 2000-01 was Rs. 105.16 and 121.12 crores, respectively [APEDA].

Keeping all the facts mentioned above in view, Indian floriculture has a very bright future, which is evident from the latest statistics with respect to export of floriculture products to the tune of Rs. 103 crores during 1998-99. Similarly, it had made a big dent at the domestic level also. At present, people in India seem to be aware of the varied use of flowers with considerable attention from the Government. The yearly growth curve seems to be moving upwards every year (Raghava and Dadlani, 2000). China Aster belongs to the family Asteraceae genus callistephus [*Callistephus chinensis* (L.) NEES] which is one of most popular, showy, well know annuals. The flowers have wide range of type, size and shape and are having very good keeping quality. All colours except the pure yellow are present in Aster which is used as cut flower in vases and floral decoration and for making garlands, bouquets etc. Copper is capable of acting as electron carriers in enzyme system which brings about oxidation-reduction in plants (Brady,1980). It is an essential constituent of enzyme as well as for plant system. Copper is a constituent of chlorophyll and therefore helps the synthesis of chlorophyll. Copper deficiency is evident as chlorosis, withering and often distortion of the terminals leaves (De, 1990).

Materials and Methods

The experimental as field trials were conducted during winter season of 2001-2002 to study the "Response to foliar spray of micro-nutrients (Zn, Fe and Cu) in respect to growth and flower productivity of China Aster *(Callistephus chinensis* (L.) NEES) Cv. Princess" in plot A-7 of the R.B.S. College, Agricultural Farm, Bichpuri, Agra. The research farm is situated at 27°10°N latitude and 70°50° longitude at a height of 168.4 m above the mean sea level which lies in the seal-arid and sub-tropical region of Uttar Pradesh at the distance of eleven kilometers in South-West of Agra City on Agra-Bhratpur Raod.

The experiment was laid out in Randomized Block Design with 9 treatments *i.e.*, $\mathbf{T_1}$- Control (Spray of Zinc sulphate 0.0%), $\mathbf{T_2}$- (Spray of Zinc sulphate 0.2%), $\mathbf{T_3}$ - (Spray of Zinc sulphate 0.4%), $\mathbf{T_4}$ - (Spray of Ferrous sulphate 0.0%), $\mathbf{T_5}$ - (Spray of Ferrous sulphate 0.2%), $\mathbf{T_6}$ -(Spray of Ferrous sulphate 0.4%), $\mathbf{T_7}$ - (Spray of copper sulphate 0.0%), $\mathbf{T_8}$ - (Spray of copper sulphate 0.2%), $\mathbf{T_9}$ - (Spray of copper sulphate 0.4%). Observations of vegetative parameters *i.e.* height of the plant (cm), diameter of main stem (cm), number of leaves, plant spread along and across the row (cm), number of laterals, length of longest leaf (cm), width of the longest leaf (cm), fresh and dry weight of plant canopy at final (g) less roots, flower buds and ploral heads, date of visibility of flower bud, date of colour break, date of full blooming, date of harvesting of floral heads, fresh weight of floral head (g), length of floral head (cm), width of floral head (cm), length of floral stalk (cm), diameter of floral stalk (cm).

Results and Discussion

The data given in tables showed that the vegetative growth parameters were significantly influenced by different treatments. The maximum plant height was find out in treatment $\mathbf{T_5}$ (64.48cm) (table 1) significantly superior than others followed by treatment $\mathbf{T_8}$ (61.02cm), which was also reported by Deshmukh and Wavhal (1998) tested the effects of Fe foliar sprays (0.1,0.2 or 0.3%) on 5-week-old seedlings of China aster cv. Powder Puff at Pune in 1995 and concluded that Fe at 0.3% had the greatest positive effect os plant height, spread, cut flower yield and flower quality.The maximum Diameter of main stem(cm) (table 1) was recorded in treatment $\mathbf{T_5}$ (3.17) which statistically at par others followed by treatment $\mathbf{T_8}$ (2.86). Similar results was also observed by Bhattacharjee and Singh (2000) studied change in T.S.S, TFAA and diameter of main stem sprayed with $ZnSO_4$ (0.5%) and $FeSO_4$ (1-2%). The maximum number of leaves (table 1) direction was found in treatment $\mathbf{T_5}$ (126.62), which was superior than others followed by treatment $\mathbf{T_8}$ (122.10). Kumar (2003) on the basis of results obtained in the present investigation,it may be derived that for achieving highest production and number of leaves, *i.e.* foliar spray of each of Zn, Fe and Mn at 0.3% concentration at 30 and 45 days of its planting. The maximum plant spread along and across the row (cm) (table 1) direction was found in treatment $\mathbf{T_5}$ (38.70), which was superior than others followed by treatment $\mathbf{T_8}$ (37.72). Bik (1961) reported that lime induced chlorotic roses could be rectified by applying 5g chelated 330 fe per plant.The maximum number of laterals (table 1) direction was found in treatment $\mathbf{T_5}$ (31.89), which was superior than others followed by treatment $\mathbf{T_8}$ (27.62). Gangadhara *et al*. (1992) in field trial in the *kharif* season of 1987 at Dharwad, Karnataka sunflowers were given the recommended application of 37.5 kg N+5kg P+39.5kg/ha alone or with 50kg $ZnSO_4$, or 12 or 25kg $MnSO_4$/ha. The maximum length of longest leaf (cm) (table 1) direction was found in treatment $\mathbf{T_5}$(10.96cm), which was superior than others followed by treatment $\mathbf{T_8}$ (10.50cm). The maximum width of the longest leaf (cm) (table 1) direction was found in treatment $\mathbf{T_5}$(7.60cm), which was superior than others followed by treatment $\mathbf{T_8}$ (7.35cm). Kumar *et al*. (2002) reported that foliar application of Zn significantly improve flower bud appearance, number of flowers, diameter of flower, width of leaf in carnation

Table 1 : Effect of foliar spray of micro-nutrients (Zn, Fe, Cu) singly and combination on growth 2001-02.

Treatments	Notations	Characters									
		Height of the plant (cm)	Diameter of main stem(cm)	Number of leaves	Plant spread along and across the row (cm)	Number of laterals	Length of longest leaf (cm)	Width of the longest leaf (cm)	Green weight of plant canopy at final	Dry weight of plant canopy at final	Date of visibility of flower bud
T_1 Control (Spray of Zinc sulphate 0.0%)	Z_0	35.30	2.31	67.40	27.70	16.55	8.89	6.15	149.44	48.28	106.73
T_2 (Spray of Zinc sulphate0.2%)	Z_1	52.37	2.67	112.98	35.50	23.44	10.03	7.11	293.33	62.54	121.81
T_3 (Spray of Zinc sulphate0.4%)	Z_2	56.89	2.64	118.74	37.18	25.18	10.59	7.28	324.73	67.37	126.66
T_4 (Spray of Ferrous sulphate 0.0%)	F_0	42.71	2.47	85.74	33.66	18.66	9.26	6.55	213.25	55.09	114.25
T_5 (Spray of Ferrous sulphate 0.2%)	F_1	64.48	3.17	126.62	38.70	31.89	10.96	7.60	403.51	73.33	132.51
T_6 (Spray of Ferrous sulphate 0.4%)	F_2	55.51	2.73	113	35.93	24.73	10.37	7.16	318.77	64.91	124.29
T_7 (Spray of copper sulphate 0.0%)	C_0	49.13	2.54	99.62	34.08	20.99	9.94	6.81	269.03	60.02	119.03
T_8 (Spray of copper sulphate 0.2%)	C_1	61.02	2.86	122.10	37.72	27.62	10.50	7.35	360.73	69.70	128.73
T_9 (Spray of copper sulphate 0.4%)	C_2	50.52	2.55	104.59	34.44	22.11	9.83	6.96	283.10	61.31	119.99
SEm.		0.089	0.068	0.097	0.051	0.078	0.037	0.037	0.091	0.051	0.115
C.D. (P=0.05)		0.266	0.203	0.292	0.153	0.233	0.111	0.111	0.273	0.154	0.345

cv. Chaband Red. The maximum green weight of plant canopy at final (table 1) direction was found in treatment **T_5** (403.51), which was superior than others followed by treatment **T_8** (360.73). Adams *et al*. (1980) studied the effect if nutrients on the production and quality of glass house carnation grown in peat sand substrate. They revealed that copper deficiency depressed growth slightly. The maximum dry weight of plant canopy at final (table 1) direction was found in treatment **T_5** (73.33), which was superior than others followed by treatment **T_8** (69.70).

The maximum date of visibility of flower bud (table 1) direction was found in treatment **T_5**(132.51), which was superior than others followed by treatment **T_8** (128.73). The maximum date of colour break (table 1) direction was found in treatment **T_5**(140.55), which was superior than others followed by treatment **T_8** (136.66). The maximum date of full blooming (table 1) direction was found in treatment **T_5**(160.66), which was superior than others followed by treatment **T_8** (157.59). The maximum date of harvesting of floral heads (table 1) direction was found in treatment **T_5**(162.73), which was superior than others followed by treatment **T_8** (159.73). Manishla *et al.* (1999) reported that foliar application of $ZnSO_4$ (1.5%) significantly increased shoot length and number of flowers per plant in rose cv. Super star. The maximum fresh weight of floral head (g) (table 1) direction was found in treatment **T_5**(5.10), which was superior than others followed by treatment **T_8** (4.70). The maximum length of floral head (cm) (table 1) direction was found in treatment **T_5**(3.27cm), which was superior than others followed by treatment **T_8** (3.10cm). The maximum width of floral head (cm) (table 1) direction was found in treatment **T_5**(6.40cm), which was superior than others followed by treatment **T_8** (6.30cm). Bandyopadhyay *et al*. (1996) recorded increased length of flower stalk and average flower yield by the foliar spray with $ZnSO_4$ (1%) and marigold cv. African Giant over control. The maximum length of floral stalk (cm) (table 1) direction was found in treatment **T_5**(22.05cm), which was superior than others followed by treatment **T_8** (20.82cm). Bhattacharjee (1993) notice significant promotion of plant height and flower yield in rose cv. Raktagandha by foliar application $ZnSO_4$ (1%). The maximum diameter of floral stalk (cm) (table 1) direction was found in treatment **T_5** (0.29cm), which was superior than others followed by treatment **T_8** (0.27cm).

Table 2 : Effect of foliar spray of micro-nutrients (Zn, Fe, Cu) singly and combination on flower productivity 2001-02.

Treatments	Notations	Leaf length (cm) and Leaf width (cm)							
		Date of colour break	Date of full blooming	Date of harvesting of floral heads	Fresh weight of floral head (g)	Length of floral head (cm)	Width of floral head (cm)	Length of floral stalk (cm)	Diameter of floral stalk (cm)
T_1 Control (Spray of Zinc sulphate 0.0%)	Z_0	115.25	131.96	134.07	2.50	2.17	4.92	11.11	0.19
T_2 (Spray of Zinc sulphate0.2%)	Z_1	129.55	148.81	150.95	4.02	2.78	5.62	17.97	0.24
T_3 (Spray of Zinc sulphate0.4%)	Z_2	134.77	154.58	156.69	4.49	3.04	6.08	20.11	0.25
T_4 (Spray of Ferrous sulphate 0.0%)	F_0	122.21	138.99	141.07	3.24	2.44	5.53	15.13	0.21
T_5 (Spray of Ferrous sulphate 0.2%)	F_1	140.55	160.66	162.73	5.10	3.27	6.40	22.05	0.29
T_6 (Spray of Ferrous sulphate 0.4%)	F_2	132.22	151.81	153.92	4.24	2.83	6.12	18.71	0.24
T_7 (Spray of copper sulphate 0.0%)	C_0	127.40	145.48	147.62	3.70	2.59	5.50	16.50	0.23
T_8 (Spray of copper sulphate 0.2%)	C_1	136.66	157.59	159.73	4.70	3.10	6.30	20.82	0.27
T_9 (Spray of copper sulphate 0.4%)	C_2	128.14	147.33	149.44	3.96	2.66	5.56	17.02	0..23
SEm(±)		0.076	0.088	0.077	0.017	0.015	0.027	0.029	0.001
C.D. (P=0.05)		0.227	0.263	0.231	0.050	0.045	0.080	0.086	0.003

Conclusion

From the results summarized above, it may safety be concluded that foliar spray of Zinc, Iron and Copper each at 0.2% concentration through $ZnSO_4$, $FeSO_4$ and $CuSO_4$ respectively when done separately and in combination was found more effective on growth, flowering and flower yield of China aster.

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