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Efficacy of macro and micro-nutrients as foliar application on growth and yield of Dahlia hybrida L. (Fresco)

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Abstract

Dahlia (*Dahlia hybrida)* cv. Fresco is an ornamental plant that provides colourful flowers to landscape areas and flower gardens. A field study was conducted to evaluate the growth and yield response of *Dahlia hybrida* to four foliar fertilizer treatments, viz. T_0, control (no foliar application of nutrients); T_1, NPK (17:17:17); T_2, NPK (15:32:7) + micro power); T_3, NPK (15:32:7) + chelated mix micro-nutrients. The results endorsed the benefits of foliar fertilization by witnessing the improved growth traits of the plant. T_1 treatment significantly promoted the number of flower plant^{-1}, number of leaves plant^{-1}, diameter of bud, diameter of flower, fresh weight of flower and dry weight of flower of the dahlia. In addition to this, T_2 and T_3 improved the growth of the dahlia. T_2 treatment increased the leaf area, number of branches per plant, days to first flower emergence, blooming period and number of tubers per plant, while T_3 treatment improved the plant height and also length of the branches. The results regarding growth and yield showed a significant response to the foliar application of macro and micro-nutrients. It is confirmed from the results that combination of macro and micro-nutrients as foliar application enhanced the growth and yield of *Dahlia hybrida* positively.

Key words: *Dahlia hybrida*, Macronutrients, Micro-nutrients, Foliar, Growth

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1. Introduction

Dahlia hybrida L. (Fresco) belongs to the Family Asteraceace. Dahlias are native to mountainous region of Mexico. It is estimated that around 1000 different varieties are being grown around the world [1-2]. This plant is a highly valued decorative flowering plant and provides variety of colours to landscape areas and flower gardens. It is commonly sown as bedding plant. Most of varieties are sown from seeds but the major cultivars are propagated by cuttings of stem or by tubers [3]. It is a perennial, with tuberous root system and it grows straight. Dahlia has different type of flowers, including; orchid, anemone and ball like forms. Dahlia provides a number of flower colors and it also have single flower with two colors. It is valued for different uses like a beautiful cut flower and garden displays [4].

Multinutrient foliar fertilization can be a useful method of providing balanced plant nutrition in horticulture [5]. Many studies have highlighted the benefits of foliar fertilization in improving plant growth, crop yield, nutrient uptake, and product quality and environmentally safe. This technique can ensures immediate translocation of nutrients to various plant organs via leaf tissues under various nutrient deficiencies [6-12]. Foliar application method can be another choice to the old soil fertilization method to keep away from the harm of fertilizers by leach down and thereby minimize the earth water contamination. According to literature survey, many reports are available about foliar fertilizers on many plants as chrysanthemum, rose, tuberose and iris plants [13-16].

As part of efforts to explore the various flora [17-19] the present research was carried out to evaluate the impact of foliar application of macro and micro-nutrients on growth, yield and development of *Dahlia hybrida* (Fresco).

2. Material and Methods

The present study was carried out at Floriculture Research area, Institute of Horticulture Sciences, University of Agriculture Faisalabad (31°25' N, 73°09' E), during the session of 2011-2012 on decorative plant *Dahlia hybrida* L. (Fresco) where maximum average temperature 30±2°C and humidity 73% were recorded. The plant *Dahlia hybrid* was transplanted in soil in field area and grown up there. Present study was planned to monitor the effects of foliar application of macro and micro-nutrients on growth and flowering of *Dahlia hybrida* L. (Fresco). The NPK main

source of macro-nutrients and Zn, B, Fe, Cu and Mn were the main sources of micro-nutrients.

2.1. Treatments

Foliar application of different commercial formulations of macro and micro-nutrients were prepared. Four treatments were applied that were: T_0, control (no foliar application of nutrients); T_1, NPK (17:17:17); T_2, NPK (15:32:7) + micro power); T_3, NPK (15:32:7) + chelated mix micro-nutrients. Micro power contain N, 1%; K_2O, 1%; Zn, 2.5%; B, 1%; Fe, 1%; Mn, 1% and Cu, 2% nutrients and chelated mix micro-nutrients (CMM) also contained Zn, 1.5%; B, 2%; Fe, 2%; Mn, 2% and Cu, 1% nutrients. Each treatment had ten healthy and vigorous plants of each cultivar that were replicated thrice. Both micro-nutrients (Micro power and chelated mix micro-nutrients) and macro-nutrients with all combinations were applied through foliar spray at 6 to 8 ml per 100 ml after 40 days of transplanting and subsequently two more applications were done after 15 days interval. First irrigation was given just after transplanting while subsequent irrigation was applied when needed. Cultural and management practices like weeding, irrigation, hoeing etc. were similar for all treatments in all replications throughout the experiment.

Data regarding different parameters like plant height (cm), leaf area (cm^2), were taken by measuring tape and digital leaf area meter (Top YMJ-A), respectively. Numbers of flowers plant-1, number of leaves plant-1, numbers of branches, length of branches (cm), blooming period (days), days to 1st flower emergence were noted. Diameters of buds and flowers (cm) were measured by digital Vernier caliper. Fresh weight of flower (g) was taken by digital weighing balance and flower dried in the shade and then transferred into the oven at 65°C for 48 h to dry. The experiment was laid out according to Randomized Complete Block Design (RCBD). There were four treatments comprising 10 plants in each treatment, making a total population of 120 plants with three replications.

Data were reported as mean (n = 3 × 3 × 1) ± standard deviation. Data were analyzed by analysis of variance (ANOVA) using Minitab 2000 Version 13.2 statistical software (Minitab Inc., Pennysalvania, USA).

3. Results and Discussion

3.1. Foliar application of macro and micro-nutrients on different plant characteristics of Dahlia hybrida L. (Fresco).

Fertilization improves the plant growth and development by providing essential nutrients. For plant height, analysis of variance demonstrated significant results for all treatments at 5% level of probability. Results showed that plants which fertilized with macro and micro-nutrients solutions increased their height as compared to control treatment. Maximum height of plant *D. hybrida* was obtained (30.3 cm) under treatment T_3, NPK (15:32:7) + chelated mix micro-nutrients, While treatment T_1, NPK (17:17:17); (28.7 cm) and T_2, NPK (15:32:7) + micro power) (27.9 cm) showed similar growth and treatment means were not significantly different from each other, Where the minimum plant height was observed with control T_0 treatment (23.9 cm) (Table 1).

Leaf area represents the foliage of plants that give excellent results after foliar spraying of micro nutrients. The food prepares by leaves and maximum leaf area provides more food to body of the plant to kept it healthy. Effect of macro and micro nutrients on total leaf area was significant for all treatments Maximum leaf area (16.5 cm^2) was obtained for plants which were under T_2 treatment, followed by T_3 (14.06 cm^2) and T_1 (13.65 cm^2) treatments. While minimum total leaf area was observed with T_0 control (10.48 cm^2) treatment (Table 1). Our results of improved plant height and leaf area by foliar application of nutrients are in agreement with the earlier reports of other flowering plants that require balance nutrition at early stages of growth [20-23]. Improvement in growth characters such as plant height and leaf area by the application of nutrients may exist due to enhanced photosynthetic and other metabolic activity which leads to an increase in various plant metabolites responsible for cell division and elongation as opined by Hatwar *et al*. [24].

Application of macro and micro nutrients solution increased the number of leaves per branch in T_1 (101) as compared to control followed by T_2 (88.8), T_3 (86.9) and T_0 (62.9), respectively. The number of leaves per plant directly influenced the flower quality. Due to foliar spray of macro and micro-nutrients greater number of leaves produced and better quality flowers. Therefore T_1 treatment showed greater number of leaves per branch and remaining treatments also showed better results. These results are related to the finding of Manna *et al*. [25] who studied the effect of foliar spray of nutrients on plant to increase the concentration in leaves so that to produce healthy leaves. Effect of macro and micro nutrients on number of branches per plant was significant. The least significance difference comparison test shows that maximum number of branches per plant were obtained with application of treatment T_2 (21.9), followed by T_3 (20.1) and T_1 (16.5) treatments, While minimum number of branches were observed in control T_0 treatment (12.5) (Table 1). Usha bala *et al.* [26] conducted experiment on gladiolus to determine the effect of foliar spray of nutrients to increase the number of branches per plant

Data represent the mean values of length of branches per plant where a foliar application of macro and micro nutrient was applied. The T_3 treatment (18.8 cm) showed the maximum length of branches per plant, where nutrients solution was applied as foliar spray. The minimum length of branches was resulted in T_0 control (12.2 cm) treatment. The foliar spray of macro and micro nutrients increases the length of branches per plant in T_2 (18.2 cm) as compared to control followed by T_1 (15.2 cm), respectively. The length of branches reflects the foliage of plants. As a result of excellent vegetative growth of the plant, other parameters reflecting better growth. All of this due to foliar sprays of micro nutrients. Our results are in line with Nahed & Balba, [27] conducted foliar spray of nutrients in blue sage (*Salvia farinacea* L) that enhanced the length of main inflorescence and other foliage parameters. Foliar spray application of macro and micro nutrients enhanced the production of tubers $plant^{-1}$. Maximum numbers of tubers were obtained with treatment T_2 (6.63).

Table 1: Effect of foliar application of macro and micro-nutrients on different plant characteristics of Dahlia hybrida L. (Fresco).

Treatments	Plant height (cm)	Leaf area (cm^2)	Number of leaves $branch^{-1}$	Number of branches $plant^{-1}$	Length of branches (cm)	Number of tubers $plant^{-1}$
T_0	23.9±0.62	10.9±0.73	62.9±1.81	12.5±0.60	12.2±0.85	2.88±0.68
T_1	28.7±0.80	13.6±0.81	101±1.13	16.5±0.59	15.2±0.52	4.66±0.71
T_2	27.9±0.92	16.5±0.91	88.8±1.66	21.9±0.21	18.2±0.65	6.63±0.52
T_3	30.3±0.65	14.1±0.31	86.9±0.87	20.1±0.82	18.8±0.23	5.87±0.41

Data are expressed as the mean ± standard deviation; Results differ significantly ($p < 0.05$).

Table 2: Foliar application of macro and micro-nutrients on different flower characteristics of Dahlia hybrida L. (Fresco).

Treatments	Diameter of bud (cm)	Diameter of flower (cm)	Blooming period (Days)	Fresh weight of flower (g)	Dry weight of flower (g)	Number of days to 1^{st} flower emergence	Number of flower $plant^{-1}$
T_0	2.06±0.12	5.44±0.30	28±0.81	2.51±0.16	0.36±0.04	117±2.55	7.68±0.21
T_1	3.43±0.20	8.06±0.53	38.6±1.05	3.54±0.20	0.46±0.01	107±2.49	12.8±0.94
T_2	3.13±0.12	6.30±0.22	50.3±1.09	2.88±0.07	0.37±0.03	92.3±2.05	10.7±0.50
T_3	3.10±0.16	6.08±0.45	49.3±1.24	2.79±0.02	0.40±0.01	95.3±1.29	10.5±0.63

Data are expressed as the mean ± standard deviation; Results differ significantly ($p < 0.05$)

The order of tubers per plants under different treatments was as followed T_2 (6.63) > T_3 (5.87) >T_1 (4.66)> T_0 (2.88). The plants under control treatment produced minimum number of tubers (Table 1).

3.2. Foliar application of macro and micro-nutrients on different flower characteristics of Dahlia hybrida L. (Fresco)

When treatments were compared with each other it is evident that T_1 treatment showed high value of bud diameter (3.43 mm) while the lowest bud diameter (2.06 mm) was obtained by T_0 (control) respectively. Treatments T_2 and T_3 also showed marked increase in plants bud diameter (Table 2). The maximum flowers diameter (8.06 cm) obtained from the plants which were under treatment T_1 .The minimum flowers diameter obtained in T_0 control treatment where no nutrients solution applied as foliar spray. The nutrients solution increased the diameter of flowers in T_2 (6.30 cm) as compare to control followed by T_3 (6.08 cm) treatment (Table 2). Mona *et al*. [28] studied the response of schefflera plant to foliar fertilizer spray increased all growth parameters significantly specially flower diameter.

Application of foliar spray of macro and micro nutrients significantly affected the on blooming period of flowers. The least significance difference comparison test showed that maximum mean of blooming period of *Dahlia hybrida* (50.3 days) was obtained under T_2 treatment followed by T_3 (49.3 days) and T_1 (38.6 days) respectively, while the minimum blooming period was observed with control T_0 treatment (28 days) (Table 2).

It is illustrated from results that T_1 treatment showed highest value of fresh and dry weight of flowers (3.54 g, 0.46 g) respectively and presented significant differences against all other treatments while lowest values of fresh and dry weights (2.51 g, 0.36 g) were found in T_0 (control) treatment. While other treatments also showed considerable increase in fresh and dry weights of flowers as compared to control treatments. Increase in reproductive growth may take place because of application of all essential micro-nutrients in proper concentrations. Our results are in agreement with earlier reports of [21, 29] who argued that with the application of essential nutrients fresh and dry weight of a flower increased in plants. It is evident from the emergence results that days for flower emergence was

shortened with increased fertilization of micro nutrients. The emergence days were shortest for plants fertilized with T_2 treatment level and longest for the plants which received no fertilization *i.e.* T_0. Application of micro nutrients solution decreases the number of days of flower emergence in T_2 (92.3 days) as compared to control followed by T_3 (95.3 days), T_1 (107 days) and T_0 (117 days) (Table 2). The fertilization level of micro nutrients improves the growth and productivity of plants. These results are in line with Sharaf and El-Naggar [30] who stated that carnation has greater response to foliar application of nutrients.

Number of flowers plant^{-1} in *D. hybrida* was highest in T_1 treatment (12.8) followed by T_2 (10.7), T_3 (10.5) respectively and minimum numbers of flowers were shown by T_0 control treatment. Ahmad and co-workers [31] also reported that micro-nutrients application give early and maximum flowering/plant. There was 14% greater numbers of flowers produced with nutrients application compared with the control plants [32, 33].

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