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EFFECT OF SPRAYING WITH ORGANIC FERTILIZERS AND ZINC ON GROWTH AND FLOWERING OF *FREESIA HYBRIDA*

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ABSTRACT

The experiment was carried out in the nursery of the Faculty of Agriculture-University of Kufa in the canopy covered with green saran during the fall agricultural season 2019-2020 to demonstrate the response of the freesia plant to spraying with amino acids and zinc and its effect on growth and flowering. The mounds were grown on 23/10/2019 in plastic pots of 25 cm in diameter and 22 cm in height that contain an agricultural medium consisting of river sand and peat moss in a ratio of 1: 3. The treatments included spraying amino acids with four concentrations (0, 2, 4 and 6 ml.L^{-1}) and spraying with zinc in four concentrations (0, 10, 20 and 30 mg. L^{-1}) and their interactions. The spraying was carried out twice for both factors where the first spraying was at the first true leaf appeared, and the second spraying was 21 days after the first spray. The results showed that spraying the freesia plant with amino acids at a concentration of 6 ml. L^{-1} with zinc at a concentration of 20 and 30 mg.L^{-1} led to a significant increase in growth indicators including plant height, number of leaves, total chlorophyll in leaf, number of flowering inflorescences, length of flower stalk, number of florets per inflorescences, leaf content of nitrogen and zinc which were significantly different from all the other treatments and interactions.

Keywords: Freesia, flowers, ornamentals, growth, micronutrients

Introduction

Freesia *Freesia hybrida* plants belong to the Iridaceae family, which is a winter annual corm with thin and pointed leaves, it is considered one of the important bulbs in the production of cut flowers (Emonger, 2004). The flowers are conical or funnel with six parts and are carried on a floral stand inclined at an angle of 90 with the rest of the original flower stand and have a combed flower in different colors including yellow, red, white and purple and have a distinct aromatic smell when they bloom in spring (Al-zurfy *et al*., 2018) . The original habitat of the plant is southern Africa, and it is cultivated in places without frost, high humidity and light winds (Al-Batal, 2010). Freesia is grown in ponds, and it is also successful in pots and is suitable for commercial crops (Imanishi, 1993, Chalabi and Khayyat, 2013).

Amino acids are organic compounds that are the basic building blocks of proteins (Rai, 2002 and Mello 2015). They stimulate the growth of plant cells and contain an acid group (COOH) and basic (2NH) and have an important role in building other organic compounds such as vitamins and Growth hormones. Amino acids are also a store of carbon and energy and affect the building and activity of some enzymes and have a role in protecting plants from various stresses by stimulating carbon metabolism processes and increasing the effectiveness of antioxidant enzymes (Tantawy and others, 2009 and Cornily, 2014). Saeed and Mahmoud (2017) showed that spraying amino acid at a concentration of 100 mg.l-1 on Debonair chrysanthemum morifolium Ramak increased plant height, number of leaves, number of flowers, flower diameter and flower life.

Zinc is one of the micro nutrients that are important for the growth, development and completion of the plant life cycle. It is necessary to regulate sugar consumption and increase the energy required for the production of chlorophyll. It also helps in the manufacture of auxins and is involved in the formation of the enzyme carbonic anhydrase important in stimulating the decomposition of carbonic acid into CO_2 and water (Kessel, 2006 and Abdul Wahid, 2014) during the process of photosynthesis.

Zinc is also one of the micro-nutrients that its deficiency causes an imbalance in plant growth because of its effect on activating a number of plant enzymes (Colemon, 1992, Abdel-Abbas and others, 2017) in addition to being important for the formation of the amino acid Tryptophan, the main substance in the hormone of Andole acid. Acetic (IAA), essential in plant cell division and elongation, nitrogen bioprocesses, and starch synthesis (Weisany *et al*., 2011).

The results of Al-Karawi and Abdul-Kadhim (2019) indicate that foliar spraying with zinc at a concentration of 60 mg. L^{-1} on the *Dahlia hybrid* L. gave the best results in the indicators under study as the plant height, number of branches, number of flowers and flower diameter increased. Therefore, the research aimed to determine the efficiency of spraying with amino acids and zinc at different concentrations and their effect on the production of cut flowers and prolonging the flower life of imported commercial freesia flowers grown in pots under shade conditions.

Materials and Methods

The experiment was carried out in the horticulture nursery belonging to the Faculty of Agriculture - University of Kufa during the fall season 2019 to study the response of freesia bulbs to spraying with amino acids and zinc and the effect of treatments on growth and flowering indicators. Freesia bulbs were planted on 10/23/2019 in plastic pots of 25 cm in diameter and 22 cm in height filled with planting soil consisting of river sand and peat moss in a ratio of 1: 3, respectively.

The experiment coefficients included testing the effect of two factors, the first is spraying amino acids (Free amino acids 11.50%, total amino acids 20%, organic matter 15% and total nitrogen 6.5%) at four concentration levels (0, 2, 4 and 6 ml.L^{-1}, and the second factor is spraying zinc at concentrations of 0, 10, 20 or 30 mg. L^{-1}. The spraying was applied twice for both factor, the first spray was when at appearance of true leaf, while the second spray was 21 days after the first one. The experiment parameters were distributed globally according to R.C.B.D Randomized Complete Block Design (Al-Rawi and Khalaf Allah, 2000). The experiment included five pots for each treatment and three replicates (240 pots). The comparison was made according to the least significant difference test (L.S.D) and the probability level (0.05).

The measurements under study included indicators of vegetative growth, which are plant height (cm), total number of leaves (leaf.$plant^{-1}$). Leaf content of total chlorophyll dye (mg. 100 g^{-1}) (Goodwin, 1976) and flowering indicators represented by the number of days required to emergence of the first flower bud (day), the number of flowering inflorescences (flower.$plant^{-1}$), the length of the flower pistol (cm), the number of flowers in a flower (a flower - a $plant^{-1}$). In addition to the chemical indicators, which are the estimated percentage of nitrogen in the leaves % (Black, 1965), leaf content of zinc (mg. Kg^{-1}) and flowers content of anthocyanin (mg.100 gm^{-1}) (Rodriguez-Amaya, 2001)

Results and Discussion

It is noted from the results (Table 1) that spraying the freesia plant with amino acids at a concentration of 6 ml.l^{-1} with zinc at a concentration of 30 mg.l^{-1} led to a significant increase in the indicators of vegetative growth as the plant height, number of leaves and leaf content of total chlorophyll increased compared to the control and other interaction treatments.

The results also showed that spraying the plant with amino acids at a concentration of 6 ml.$^{-1}$ interfering with zinc at a concentration of 30 mg. 1 $liter^{-1}$ resulted in significant increase flowering indicators including significant reduction in the number of days required for the emergence of the first flowering and an increase in the number of flowering inflorescences and the length flower stalk, number of florets per inflorescences compared to the control treatment that gave the lowest rates for the mentioned indicators. Similarly, the highest increase in the chemical indicators including leaf content of nitrogen and zinc and flower content of anthocyanin dye was recorded in the interaction treatment of spraying with amino acids at 6 ml^{-1} liter and zinc at 30mg.L^{-1} with a significant difference from most other treatments, including the control treatment that resulted in the lowest values.

The amino acid spray treatments have resulted in an increase in the vegetative growth characteristics, including plant height, number of leaves, and leaf content of total chlorophyll in building cells and thus increasing the vegetative growth of the plant (Rai, 2020; Taiz and Zeige, 2006). The increase in the leaf content of chlorophyll is always related to nitrogen in the amino acid synthesis, since nitrogen is involved in the formation of chlorophyll as well as the formation of amino acids that are included in the formation of chloroplasts, which increases the leaf chlorophyll content (Micelli-Guterrez *et al.*, 2007). The amino acids play a role in increasing the content of plant tissues from proteins through the amino acid fusion and synthesis of proteins. They have an effect on the vital processes that lead to improving metabolism during stress conditions by contributing to the building of antioxidant compounds. This was reflected in the improvement and increase of vegetative growth (Balbaa and Abdel-Aziz, 2007; Yaish, 2015).

The increase in flower growth characteristics may also be attributed to the improvement of the vegetative growth of the plant, and thus the possibility of increasing the production and accumulation of active substances in the photosynthesis process, which leads to an increase in the number of flowering inflorescences and thus an increase of flowers in each flowering. The reason may be due to the role of amino acids in the cell division of the branch apex, leading to a change in the shape and size of the apex and transforming it into a crest or floral primordial instead of the vegetative buds. These places have high metabolic activity to attract carbohydrates manufactured in these flower buds for the purpose of their final distinction for the emergence of flower parts (Weaver, 2013). The reason may be due to the effect of amino acids in activating endogenous hormones that help increase the number and quality of florets and thus the possibility of increasing the syphilis population (Martin and Tauguy, 2001).

The amino acid spray also increased the nutrient content of the leaves, since the amino acids are an important source of nitrogen, as the combination of these acids helps in the photorespiration process, producing energy that helps eliminate the osmotic effort (Tan *et al.*, 2008 and Goya, 2011). Likewise, the increase in the anthocyanin pigment in the flowers is attributed to the role of amino acids in improving the characteristics of vegetative growth and increasing the efficiency of the photosynthesis process to manufacture the compounds included in the pigments. Increasing the nitrogen content of the leaves in general leads to an increase in pigments, especially anthocyanin (Martin, 2002).

Also, the significant effect of zinc spray on indicators of vegetative growth is due to the role of zinc in building the amino acid tryptophan, which is the building block for the plant hormone (IAA) necessary to elongate cells and break apical dominance (MacDonald, 2000 and Cakmak, 2008). Zinc is also important in activating the enzymes responsible for building protein and chlorophyll and increasing the representation of the enzyme carbon-anhydrase important for CO_2 stabilization and stomatal opening by synthesizing an adequate level of HCO-3 in the guard cells (Hassan *et al*., 2013). Zinc also increases the leaf content of chlorophyll indirectly through its direct effect on the formation of amino acids and energy compounds for a large number of enzymes that participate in the manufacture of carbohydrates, fats, proteins and nucleic acids, thus increasing the size of the shoots (Hammadi and Abbas, 2012).

Regarding flower growth indicators, zinc spray improved the vegetative growth characteristics, which reflected positively on reducing the number of days required for flowering and by continuing to supply photosynthetic products to the vegetative buds to convert them into flower buds, which led to early flowering (Amir *et al*., 2008). Zinc also has an important role in stimulating the production of gibberellin and auxin, and in reducing the effect of absisic acid (Sharaf *et al*., 2009). In addition to the effect of zinc on the formation of the amino acid tryptophan, which is important in the manufacture of the hormone endole acetic acid (IAA), which is necessary for the division and elongation of plant cells and its expansion, which affects the increase in the elongation of the pregnant syphilis and the number of florets (Abdul Wahid, 2014). The increase in the zinc content in the leaves is due to the direct spraying of zinc, which led to an increase in its quantity in the plant and an increase in its absorption in the leaves (Kalifa *et al*., 2011). The increase in zinc increased the anthocyanin pigment. The trace elements, including zinc, increase the products of photosynthesis and manufacture with carbohydrates, which are transformed within the metabolic pathways in the plant into a chalcone synthase and then Naringenia, which is oxidized to form anthocyanin in the cell vacuoles (Davies, 2005).

Table 3 : Effect of spraying freesia *Freesia hybrida* plants with different concentrations of amino acids and zinc on vegetative, flowering and nutritional traits

Amino acids ml.L^{-1} X Zinc mg.L^{-1}		**Plant height cm**	**Total No. of leaves Leaf. plant^{-1}**	**Leaf total chlorophyll mg.100g^{-1}**	**No. of days for emergence of first flowering bud**	**No. of inflorescence per plant**	**Length of flower stalk**	**No. of flowers per inflorescence**	**Leaf content of nitrogen %**	**Leaf content of zinc mg.Kg^{-1}**	**Flower content of anthocyanin**
0	Zn 0	40.60	6.00	57.70	146.65	2.00	45.50	13.00	1.39	25.23	6.96
	Zn 10	41.63	6.01	58.51	145.60	2.33	46.43	13.31	1.47	26.32	7.41
	Zn 20	44.60	6.04	63.02	144.31	2.66	46.50	14.10	1.50	26.73	7.33
	Zn 30	44.50	6.10	65.80	144.00	3.00	47.04	16.16	1.65	27.51	8.00
2	Zn 0	52.93	6.03	67.62	144.30	2.00	46.25	13.06	1.80	28.01	8.13
	Zn 10	54.60	7.00	70.00	143.31	2.00	49.73	15.00	1.59	29.05	7.53
	Zn 20	54.36	7.33	71.11	143.30	2.33	52.42	16.01	1.77	28.68	8.62
	Zn 30	56.03	7.04	73.00	142.60	2.66	53.64	20.02	2.38	29.42	9.20
4	Zn 0	54.90	7.00	64.80	140.31	3.00	46.65	13.53	2.40	28.89	9.30
	Zn 10	58.20	7.04	71.11	139.23	2.66	58.74	18.13	1.90	29.97	8.00
	Zn 20	57.23	7.33	72.41	140.61	3.33	55.02	19.10	2.89	31.04	9.72
	Zn 30	57.63	7.33	76.80	140.00	3.00	53.02	20.00	2.38	31.77	10.88
6	Zn 0	60.13	7.33	65.21	138.01	3.00	47.56	14.56	2.91	31.86	9.94
	Zn 10	57.13	7.66	76.31	138.01	3.00	56.77	22.00	3.56	33.59	11.91
	Zn 20	57.46	8.44	75.30	139.00	4.00	**63.10**	23.60	3.78	**38.26**	13.08
	Zn 30	64.43	9.33	**18.90**	137.30	4.00	63.10	24.31	2.99	37.31	11.57
L.S.D. (P≤0.05)		2.130	2.130	3.342	2.226	0.588	2.343	1.935	0.570	1.191	0.526

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