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THE EFFECT OF FERTILIZATION WITH BORON AND POTASSIUM ON SOME NATURAL AND FLOWERING TRAITS OF THE GAZANIA PLANT

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Abstract

A Factorial experiment was conducted at the Center of Albadia and Sawa Lake Studies - Almuthanna University during the autumn season 2018 – 2019, To study the effect of potassium fertilization and foliar spraying with boron and the interaction between them in the vegetative and flowering growth of Gazania plant. The first factor using three concentrations of potassium (0, 2 and 4 g .bag^{-1}) which symbolized by K1, K2 and K3 respectively, and three concentrations of boron (0, 25 and 50 mg. L^{-1}) which symbolized by B1, B2 and B3, respectively. The complete randomization design (C.R.D) was followed in the experiment with three replicated. The results showed a significant increase when using potassium in the height of the plant 25.90 cm. The number of leaves 27.19 leaf.plant^{-1}, The fresh weight of the vegetative growth 47.48 g, The fresh and dry weight of the roots 13.54 g and 3.98 g respectively and the roots length 26.01 cm and the number of flowers 6.59 flowers .plant^{-1} and dry weight of flowers 4.70 g. Differences were not significant in the dry weight of the vegetative growth and the number of offshoots.plant^{-1}. While the treatment of B3 gave the highest values of vegetative growth and significantly excelled on the treatments B2 and B1 in all traits such as the fresh weight of the vegetative growth 39.78 g, the dry weight of the roots 3.69 g, the root length 25.81 cm, the number of flowers 6.04 flower. plant^{-1} and the dry weight of the flowers 4.26 g, While treatment B3 did not differ significantly from treatment B2 in some of the studied traits, there was a significant interaction between the treatments in many of the studied traits.

***Keywords*:** Gazania, Potassium, Boron, Nutrients

Introduction

Gazania splendens L. belong to the Asteraceae family (Alkatib, 2000). It is one of the perennial herbaceous ornamental winter plants, the plant reaches a height of 15 cm. The leaves are long Linear, full-edged, the bottom surface is silver in color. The leaves are with lobes shape at the beginning of their formation, and the flowers are multicolored, their diameter amounted to (7-10 cm). They open in the daytime and close at night. It is characterized by the presence of black dots at the base of the ray orangey florets, and these flowers often appear in summer and autumn, The Gazania plants propagation with seeds or the division of old plants because they form many offshoots in the same year and the plants are cultivated in pots or directly in the ground (Al-Zorfi *et al.*, 2012).Potassium is the third most important nutritional element, where it affects maintaining the water balance due to its control over opening and closing stomata, and its percentage in plant tissues ranges between (2-6)% of the dry weight of plant while it is found in the soil in different quantities, the total ranges between (0.1 - 4%) (Al-Jumaili and Al-Jumaili, 2012). 78% of the potassium enters the root capillaries using the Diffusion method, while 20% of it enters the Mass Flow method and the plant absorbs the potassium depending on its concentration in the feeding medium. In the few concentrations, the transport of potassium by means of carriers occurs, and it represents the active transport, while in the high concentrations the cell membrane is more permeable and negative transport movement prevails with the flow of the Transpiration stream and the potassium moves easily in the tissue of the Xylem and Phloem and its concentration reaches 80% of the total ions in them, With confirmation that its quantities in Phloem are more than in the Xylem, potassium accumulates in the Vacuole and is prepared for the needs of bio metabolism, and it can move with magnesium in a different direction and by electroneutral pumps across the membrane (Tuma *et al.*, 2004). Potassium plays an important role in a number of bioactivities such as photosynthesis, protein representation, enzyme activity, Phloem transport, and regulating the osmotic potential of cells as well as cell expansion, thickening, and safety of walls (Taiz and Zeiger, 2003). Potassium also plays an important role in stabilizing CO_2, controlling Turgor pressure and regulating the content of (Zhao *et al.*, 2001). There are limited quantities of it in the cytoplasm to sustain some bio processes there, except that the amounts of potassium that exist in the food Vacuole may reach 90%, and it works to regulate the osmotic content for the purpose of the expansion and expansion of plant cells and high levels of it contribute to the plant's resistance to sudden environmental changes such as stress of heat, cold and frost, As well as its role in the synthesis of sclerinocyte cells, vascular bundles, and stalk strength (Zaman *et al.*, 2015). Failure to maintain sufficient quantities of the element in the root zone has caused a decrease in the plant's efficient use of water and the occurrence of several problems that lead to a decrease in the quantity and quality of yield, which is the key to the fertilization process because it is an osmotic regulator and affects the balance of entry of ions and the representation of proteins as well as increasing resistance Plants for stresses such as heat stress, cold, dehydration, high optical density and reduce damage due to diseases and insects (Mickkelsen, 2008). The concentration of potassium in the Meristematic tissue increases due to its high mobility (Raza *et al.*, 2015). (Al-Zarfi *et al.*, 2012) showed that adding potassium fertilizer at three levels (0, 1.5 and 3 g.pot^{-1} fertilizer) to the cassava plant contributed to significant differences in the number of leaves^{-1} and the dry weight of the vegetative group, root length and dry weight The number of roots, the number of roots and the number of flowering plants, the number of offshoots, number of flowers and the dry weight of the flowers. foliar feeding is a supplement to ground fertilization, and its success depends on many factors such as

the concentration and shape of the element, the degree of its reaction, the type and cultivars cultivated. Boron is taken by the plant in the form of BO_3 ions, and its solubility decreases with increasing pH in the growth medium and among the factors affecting the leaves absorption of the boron. Chemical, pH, physiological, climatic factors, type, cultivar and plant age. Ibrahim *et al.* (2015). Boron is absorbed by the plant in the form of boric acid H_3BO_3 and the free absorption of boron depends on the concentration difference. (Al-Sahaf, 1989). (Amin and Al-Fatlawi, 2009) indicated that spraying dahlia and Ranunculus plants with boron at concentrations (0, 29.5, 59, and 88.5 mg. L^{-1}) caused a significant increase in most growth traits such as the number of flowers, flower diameter, and the fresh weight of the flower in addition to the root length and Dry weight to dahlia roots only. Boron is very important in the formation of flowers, as its shortage causes a failure to form the flowers, or they may be sterile flowers, or the flowers fall out if there is not enough boron. (Ajami, 2016). Boron does not enter in the synthesis of enzymes, that is, it affects the biological processes in the plant that activates some enzymes such as catalyses, Peroxidase and Amylase, as well as its role in the process of protein formation because the lack of boron leads to the accumulation of nitrates in the plant and the lack of protein formation due to the low rate of nitrate reduction and formation Amino acids increase the vitamin C and B complex vitamins and increase the plant's efficiency in resistance of fungal and insect diseases. (Abu Dahi and Al-Younes, 1988). Al-Fatlawi, (2007) indicated that spraying the dahlia and Ranunculus plants with boron at concentrations (0, 29.5, 59 and 88.5 mg. L^{-1}) caused a significant increase in most of the traits of vegetative growth (plant height, main stem diameter, leaf area and fresh and dry weight of the vegetative group), and the researcher Ahmed *et al*., 2010, used different concentrations of boron on three cultivars of Rosa hybrid, found significant differences in plant height, number of leaves, leaf area and number of flowers. In recent years, potassium began to be used with some micronutrients, including boron, to accelerate plant growth and increase productivity, with the possibility of improving the growth and production of the Gazania plant grown in southern Iraq for foliar fertilization and the possibility of increasing the plant's ability to withstand the conditions of the southern region of drought and high levels of irrigation water salinity which It is to some extent an attribute inherent in the central and southern regions of Iraq, in addition to the badia Al-Samawah, which has millions dunums of which part can be used to grow some medicinal plants. And the establishment of factories to manufacture medicines in addition to the possibility of spreading the cultivation of many medicinal plants, the most important of which is Gazania plant and the encouragement of farmers in the central and southern regions of Iraq to grow some medicinal plants and using the techniques of foliar spraying with Macro and Micronutrients and knowing the extent of the plant's tolerance to different levels of stress and dealing professionally with some technologies Modern in agricultural production to increase the resistance of plants to the stresses resulting from high temperatures and lack of water and salinity, as dry and semi-dry climates prevail in central and southern Iraq, and for the purpose of understanding all of this it was decided to conduct this study.

Materials and Method

The research was conducted in the Center of Albadia and Sawa Lake Studies-Almuthanna University for the agricultural season 2018-2019 with two factors to study the effect of potassium and boron fertilizers on the traits of vegetative and flowering of the Gazania plant. The first factor was three levels of potassium fertilizer (potassium sulfate) containing (48% K_2O) which is (0, 2, 4) gm.bag^{-1} and in two batches the first one a week after cultivation and the second one month after the first addition, The second factor is three levels of boron are (0, 25 and 50) mg.L^{-1} in the form of boric acid H_3PO_3 contains (17% B) was weighed 140.5 and 281 mg of boric acid and each of these weights was dissolved in a liter of water to obtain a concentration of 25 and 50 mg.L^{-1}, respectively, at the average of two sprayer, the first after two weeks of cultivation and the second after a month from the first spray. Gazania plant seeds were cultivation in Trayes cork dishes on 10/20/2018, Filled with the growing media, peat moss, homogeneous plants were selected to grow. They were spread and cultivated in black polyethylene bags, size 1 kg by one plant/pots filled with growing media river soil + peat moss in a percentage of 3:1. The pots were divided according to the design followed in the experiment, and after a week of transportation and cultivation, potassium fertilizer was added in two batches, the first was when cultivation the seedlings, and the second after a month from the first. Filled with the growing media, peat moss, homogeneous plants were selected to grow. They were spread and cultivated in black polyethylene bags, size 1 kg by one plant/pots filled with growing media river soil + peat moss in a percentage of 3:1. The pots were divided according to the design followed in the experiment, and after a week of transportation and cultivation, potassium fertilizer was added in two batches, the first was when cultivation the seedlings, and the second after a month from the first, All service operations were conducted from irrigation and weeding as needed and for all treatments, witness plants were sprayed with distilled water.

Statistical analysis

A factorial experiment was designed according to completely randomized designs C.R.D and three replicates for each treatment. The arithmetic mean was compared using the Least Significant Difference (LSD) under the 0.05 probability level. Using the Genestat program, the vegetative traits were measured, which are the plant height, the number of leaves and the fresh and dry weight for the vegetative and the fresh and dry weight for the root system, root length, the number of offshoots, the number of flowers and the dry weight of the flowers.

Results and Discussion

Table (1) showed that most of the traits of vegetative and flowering growth have been significantly affected by potassium fertilization levels of the Gazania plant, where the potassium fertilizer K3 resulted in giving the highest average of studied traits, there were no significant differences for potassium fertilization in the two dry weight traits of the vegetative growth and the number of offshoots. This can be explained by the role of potassium, which plays an important role in a number of Biology activities such as photosynthesis, protein representation, enzyme activity, transport by Phloem, regulating the Osmotic pressure for cells, as well as cell expansion, thickening of walls and integrity (Taiz and Zeiger,

2003). Potassium also plays an important role in stabilizing CO_2, controlling Turgor pressure and regulating chlorophyll content (Zhao *et al.*, 2001). There are limited quantities of it in the cytoplasm to sustain some bio-processes there, except that the amounts of potassium that exist in the food vacuole may reach 90%, and it works to regulate the osmotic content for the purpose of the expansion and expansion of plant cells and high levels of it contribute to the plant's resistance to sudden environmental changes such as heat, cold and frost stresses, as well as its role in the secularization of sclerinic cells, vascular bundles and the strengthening of the stem of the plant (Zaman *et al.*, 2015). Failure to maintain sufficient quantities of the element in the root zone has caused a decrease in the plant's efficient use of water and the occurrence of several problems that lead to a decrease in the quantity and quality of the yield, which is the key to the fertilization process because it is a osmotic regulator and affects the balance of entry of ions and the representation of proteins as well as increasing resistance Plants for stresses such as heat stress, cold, dehydration, high optical density and reduce damage due to diseases and insects (Mickkelsen, 2008). The buildup of potassium increases in Meristematic tissue due to its High susceptibility to motion (Raza *et al.*, 2015). or perhaps the increase in the traits of growth may be due to the fact that the potassium is one of the necessary elements for plant growth and development, although it does not enter into the composition of any of the cellular components and plays the catalyst role in many bioprocesses, including the process of protein formation and photosynthesis (Taiz and Zeiger 2003). This leads to an increase in the vegetative growth of the plant, represented by plant height and number of leaves, as well as the role of potassium in stimulating the different enzymatic systems and regulating the osmotic pressure of cells and the process of opening and closing the stomata (Abu Dahi and Al-Younes, 1988 and Al-Nuaimi, 1999). It is due to the role of potassium in maintaining cell swelling pressure and contributing to improving cell growth and elongation and with nitrogen present, they contributed to increased vegetative growth and improvement of metabolic processes and then increased plant height (Zaman *et al.*, 2015) and potassium plays an effective role in the division of the Meristem cells and the absorption of nutrients. The presence of potassium in a balanced manner with the rest of the other elements leads to the formation of a good root system that reflects positively on the increase of the plant's absorption of nutrients, as well as the role of potassium in increasing the leaf area. Also, the lack of potassium causes an increase in the speed of breathing and a decrease in the manufacture of carbohydrates. Thus, adding it leads to a clear decrease in the speed of breathing and an increase in the rate of photosynthesis through also increasing the surface area, which increases the amount of manufactured carbohydrates (As-Sahaf, 1989). The reason for the increase in the number of flowers with the increase in potassium fertilization levels may be due to improving the growth of the vegetative growth, such as plant height and number of leaves, and then all of that was reflected on flower growth and by controlling the quantities of sugars processed to the Meristematic regions that are able to form the primary structures of flower Primordia as well as a number of functions Potassium, These include activating a number of enzymes, encouraging protein production, and stimulating the absorption of nutrients and carbohydrates, thereby increasing the number of flowers (Al-Abbasi, 2009). or perhaps it is due to the role of potassium by activating the Nitrate Reductase enzyme and this works to reduce nitrates inside the plant and convert them into ammonia and then to amino acids (Al-Sahaf, 1989), which are linked together to form proteins and thus improve the plant's nutritional and physiological condition.

Table 1 : The effect of adding potassium fertilizer on some natural traits of the Gazania plant

The dry weight of flowers g.plant^{-1}	The number of flowers. plant^{-1}	The number of off shoots. plant^{-1}	Root length (cm)	Dry weight of the root system g.plant^{-1}	Fresh weight of the root system g.plant^{-1}	Dry weight of the total vegetable g.plant^{-1}	Fresh weight of the total vegetable g.plant^{-1}	The number of leaves $^{-1}$	Plant height (cm)	Traits / Potassium
2.64	3.63	5.40	21.43	1.74	10.64	5.21	29.42	20.01	15.90	**K1**
3.78	5.45	6.19	23.52	2.70	12.38	6.37	36.75	23.69	20.61	**K2**
4.70	6.59	7.09	26.01	3.98	13.54	7.13	47.48	27.19	25.90	**K3**
0.75	1.38	**NS**	3.47	1.26	2.67	**NS**	6.67	4.95	5.99	**L.S.D 0.05**

From Table-2 - it is clear that the boron spray has a significantly excelled effect in most of the studied traits, where boron stimulates enzymes and transports carbohydrates from their production areas to storage areas and has a primary role in protein representation and regulation of the ratio between calcium and potassium and cell division and increasing plant growth It is very important for the growth and germination of the pollen tube with flowers and the completion of the pollination and fertilization process. In the event of deficiency, death occurs for flowers and fertilization fails. (Aith and Al-Saeedi, 2016). And boron is one of the necessary Micro nutrients that are few in movement and transmission in the plant. The plant needs it in small quantities because of its basic role in forming cell walls and facilitating the movement and transmission of photosynthesis products from the leaves to the active areas in plants Such as the transfer of sugars easily through the cellular membranes after their union with boron with a complex composition of sugar and borate-sugar complex. This compound has its movement through the cell membranes easier than the movement of sugar molecules. Boron also stimulates the formation of phenolic compounds and regulates the enzymatic activity of the plant and is important for cell division and the transmission of some stimulating hormones (Sharif and Mohammad, 2016). In addition to protecting IAA and its transfer, thus increasing cell division and expansion in growth centers, which gives more chance for growth and branch formation. (Hadhili and Al-Jubouri, 2015). Boron enters the structure of the important pectin material in building the cell wall and the wall of the pollen tube and has an important role in the phenomenon of signal transmission and membranous receptor activity, as its

deficiency affects the building and stability of glycoproteins in the cellular membrane important in the continuation of the symbiosis, and boron stimulates the construction of nuclear proteins, especially RNA. The increase in the number of flowers and the dry weight of them when spraying with boron can be explained by the encouraging role of this element in pollen germination and the growth of the pollen tube as well. The lack of boron causes the death of developing peaks and flowering, and boron stimulates some physiological processes in the flowering stage and increases the level of carbohydrates traveling to Effective areas during the reproductive stage, as may be due to the role of boron in fertilization and fertilization. (Al-Sahaf, 1989). Thus, the number of flowers increases and Flower Dropping decrease, in addition to the ability of the boron element to increase the readiness of nutrients such as nitrogen, phosphorus, potassium and boron, which are important in stimulating the work of enzymes, cell division, building proteins, and increasing the manufacture of nutrients that help the growth of plant tissues, which helped increase the number of flowers. (Al-Fatlawi, 2007). The decrease in the amount of boron contributes to reducing the activity of the HL reaction and It prevents movement or flow of the E.T.C. electron transport chain. In thylakoid membranes compared to the presence of the element in sufficient quantities, this decrease is associated with a decrease in the activity of the second photovoltaic system PS11, in addition to the importance of boron in physiological activities to form Callose, which is one of the many important sugars for the growth of the wall of pollen tube through the formation of borate complex compounds-Borate-Callose Complexes, The RNA is affected by a strong and rapid degree when boron deficiency and the largest amounts of it are converted to DNA. It has been observed the weak formation of uracil, which is the main component of the RNA, and is also considered the starting compound Precursors for energy-rich phosphates. Jabeen and Ahmed (2011). Moreover, at the zero levels of boron, the concentrations of Abscisic acid ABA are high, and with increased boron levels in the feed medium, the concentrations of ABA will decrease and there are negative effects of ABA on the development and growth of the vegetative branches (Moshayek and Neumann, 2006).

Table 2 : The effect of adding boron on some natural traits of the Gazania plant

The dry weight of flowers g.plant^{-1}	The number of flowers. plant^{-1}	The number of off shoots. plant^{-1}	Root length (cm)	Dry weight of the root system g.plant^{-1}	Fresh weight of the root system g.plant^{-1}	Dry weight of the total vegetable g.plant^{-1}	Fresh weight of the total vegetable g.plant^{-1}	The number of leaves $^{-1}$	Plant height (cm)	Traits / Boron
3.42	4.39	5.36	20.89	1.82	11.54	5.66	35.02	23.85	18.50	**K1**
3.45	5.23	6.45	24.26	2.91	11.33	6.21	35.52	22.09	20.25	**K2**
4.26	6.04	6.87	25.81	3.69	13.69	6.85	39.78	24.95	**23.99**	**K3**
0.75	1.38	**NS**	3.47	1.26	**NS**	**NS**	6.67	**NS**	**NS**	**L.S.D 0.05**

The results of Table-3 also showed a significant increase in the traits of vegetative growth when using the potassium fertilizer level K3 (4 g bag^{-1}) with spraying with Boron B3 at a concentration of 50 mg liters-1 the height of the plant increased and the number of leaves and the fresh and dry weight of the vegetative growth and the fresh and dry weight The root system, root length, and the number of offshoots which amounted to 27.54 cm and 28.63 leaves per plant^{-1} and 11.55 g. plant^{-1} and 3.72 g. plant^{-1} and 4.62 g. plant^{-1} and 2.19 g .plant^{-1} and 6.01 cm and 3.51, respectively. The same words apply to the traits of flowering growth, as the aforementioned treatment gave the highest average of flowering growth traits, as the number of flowers and the dry weight of the flowers increased to 2.35 plant.flowers^{-1} and 1.31g.flower $^{-1}$, respectively.

Table 3 : Effect of Interaction between Potassium and Boron Fertilizers on some natural traits of the Gazania plant

The dry weight of flowers g.plant^{-1}	the number of flowers. plant^{-1}	the number of off shoots. plant^{-1}	root length (cm)	dry weight of the root system g.plant^{-1}	fresh weight of the root system g.plant^{-1}	dry weight of the total vegetable g.plant^{-1}	fresh weight of the total vegetable g.plant^{-1}	The number of leaves $^{-1}$	plant height (cm)	Boron levels	Potassium levels
1.96	2.64	4.26	18.93	1.30	9.24	4.32	25.83	18.82	12.32	**B1**	
2.12	3.31	5.92	21.54	1.87	10.21	5.28	28.61	19.92	15.82	**B2**	**K1**
3.86	4.94	6.04	23.84	2.06	12.48	6.04	33.84	21.30	20.65	**B3**	
3.75	4.81	5.11	20.14	1.82	11.86	5.93	36.41	24.60	18.4	**B1**	
3.51	5.46	6.35	24.74	2.36	11.64	6.24	34.66	21.54	19.64	**B2**	**K2**
4.10	6.08	7.12	25.68	3.94	13.66	6.95	39.20	24.94	23.80	**B3**	
4.56	5.73	6.71	23.60	2.36	13.53	6.73	42.84	28.14	24.80	**B1**	
4.72	6.92	7.10	26.52	4.52	12.14	7.11	43.30	24.82	25.30	**B2**	**K3**
4.82	7.12	7.46	27.91	5.08	14.95	7.56	46.31	28.63	27.54	**B3**	
1.31	2.35	3.51	6.01	2.19	4.62	3.72	11.55	8.57	10.73	**LSD 0.05**	

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