

EFFECT OF FOLIAR SPRAY OF POTASSIUM AND ZINC ON GROWTH AND YIELD OF OKRA

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ABSTRACT

A field experiment was carried out at the College of Agriculture / University of Baghdad to study the effect of spraying different concentrations of potassium sulphate 44%K as a source of potassium element in four concentrations (0,2000,4000,6000) mg K.l⁻¹ and refer to them K₀, K₁, K₂ and K₃ respectively and were considered as main plot and zinc sulphate 22%Zn as a source of zinc element in three concentrations (0, 30, 60) mg Zn.l⁻¹ and refer to them Zn₀, Zn₁ and Zn₂ respectively for the spring season 2017. Split plot experiment in Randomized complete Block Design (RCBD) with three replicates was adapted where potassium factor represented main plot and zinc factor in sub-plot. The means were compared at least significant difference (L.S.D) at 0.05 probability level. Results showed that spraying of potassium K₂ superior increased plant high to 114.36 cm.plant⁻¹, leaf area to 271.46 dcm², total chlorophyll to 60.54 mg.100g⁻¹ fresh weight, fresh pods number to 59.22 pod.plant⁻¹, fresh pod weight to 5.59 g.plant⁻¹, plant yield to 331.84 g.plant⁻¹. While Zn₁ significantly increased plant high to 111.60 cm.plant⁻¹, leaf area to 267.86 dcm², chlorophyll to 52.11 mg.100g⁻¹ fresh weight, fresh pods number to 56.82 pod.plant⁻¹, fresh pod weight to 5.25 g.pod⁻¹, and plant yield to 301.39 g.plant⁻¹

Key words: Potassium, Zinc, Foliar spray.

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تأثير رش البوتاسيوم والزنك في نمو وحاصل الباميا

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الخلاصة:

نفذت تجربة حقلية في كلية الزراعة / جامعة بغداد لدراسة تأثير رش تراكيز مختلفة من كبريتات البوتاسيوم 44%K بتركيز (6000،4000،2000،0) ملغم.لتر⁻¹ ورمز لها K₃,K₂,K₁,K₀ بالتتابع وكبريتات الزنك 22%Zn بتركيز (60،30،0) ملغم.لتر⁻¹ ورمز لها Zn₂,Zn₁,Zn₀ بالتتابع في نمو وحاصل نبات الباميا للموسم الربيعي 2017. نفذت التجربة وفق نظام القطع المنشقة (split plot Design) وفق تصميم القطاعات العشوائية الكاملة (RCBD) وبثلاث مكررات حيث اعتبر البوتاسيوم معاملات رئيسية والزنك معاملات ثانوية. قورنت متوسطات المعاملات على مستوى احتمال 0.05. وظهرت النتائج تفوق معاملة الرش بالبوتاسيوم K₂ في ارتفاع النبات 114.36 سم.نبات⁻¹ والمساحة الورقية 271.46 دسم.نبات⁻¹ والكلوروفيل الكلي 60.54 ملغم.100 غرام⁻¹ وزن طري وعدد القرونات الخضراء 59.22 قرنة.نبات⁻¹ ووزن القرونات الخضراء 5.59 غرام.قرنة⁻¹ وحاصل النبات 331.84 غرام.نبات⁻¹ واعطت معاملة الزنك Zn₁ تفوق معنوي في زيادة ارتفاع النبات 111.60 سم.نبات⁻¹ والمساحة الورقية 267.86 دسم.نبات⁻¹ والكلوروفيل الكلي 52.11 ملغم.100 غرام⁻¹ وزن طري وعدد القرونات الخضراء 56.82 قرنة.نبات⁻¹ ووزن القرونات الطرية 5.25 غرام.قرنة⁻¹ وحاصل النبات 301.39 غرام.نبات⁻¹.

كلمات مفتاحية: بوتاسيوم ، زنك ، الرش الورقي.

البحث مستل من رسالة ماجستير للباحث الاول.

Introduction:

Abelmoschus esculentus L. (Moench) is one of the summer vegetable crops which belong to Malvaceae family. Central Africa, Eritrea, Ethiopia, Egypt and Sudan considered as their original region (13). Its nutritional importance comes in terms of containing carbohydrates, proteins and some minerals (10). Foliar spray is a success method in Iraq due to high pH soil, calcareous soil, and a dry hot climate in summer season, which leads to a loss nutrients, many of nutrients are not available due to sedimentation, adsorption, oxidation and volatilization mobilization that are not ready to be absorbed by the root. In addition to the loss of leaching in the sandy soils, like what is happens to potassium, which is important in the process of regulating the osmosis potential and increase the plant ability to save water by controlling the element to opening and closing the stomata and it also stimulates the process of photosynthesis in addition to the relationship of potassium in the process of protein composition and increase the proportion of oil, and it's enter as a catalyst in chlorophyll formation (7). Zinc is one of essential elements which considered important in activate number of enzymes also it is needed by plant in formation tryptophan which consists of the hormone indole acetic acid which is necessary to elongate cells, the lack of zinc effects on pollen producing as its important in the division of cells and producing of secondary meristem cells so it is necessary to increase the thickness of the cells (2). The lack of zinc will effects on the vital processes, including the manufacture of carbohydrates by preventing to build RNA and in photosynthesis process in addition to the manufacture of proteins and it has a significant role to produce auxin (14). Taher (17) reported that spraying zinc sulfate at concentrations of 25 mg.l⁻¹ he found increase in height plant to 156.18 cm. Chlorophyll to 1.598 mg.l⁻¹ and

spraying with a concentration of 12.5 mg.l⁻¹ led to increase pod weight to 4.10 g.pod⁻¹. Zayer (19) reported that spraying zinc sulfate at concentration of 0.5% was significantly increase plant height to 76.19 cm.plant⁻¹, leaf area to 181.69 cm².leaf⁻¹, total yield to 226.19 g.plant⁻¹ and total chlorophyll content to 4.54 mg.g⁻¹.

Potassium is an important elements in plant nutrition. It is moveable element as nitrogen and phosphorus within the plant tissues, therefore the effect of potassium deficiency appear first on the lower leaves or old ones (3). Also it is increases the concentration of carbohydrates because of its function in absorption of nitrogen element by the plant and converted to proteins (11). Al-Mtory (5) notice spray potassium nitrate on okra plants, treatment 30 mml⁻¹ of potassium nitrate superior increased highest plant to 76.33 cm.plants⁻¹ and pod number to 43.69 pods.plants⁻¹ and content of chlorophyll in leaves to 2.53 mg.g⁻¹ fresh weight⁻¹, average of pod weight to 3.88 g.pod⁻¹ and total productivity 2.654 t.h⁻¹. An experiment carried out by Khan (12) with different fertilization level of potassium on okra plant he found treatment 80 kg.h⁻¹ significantly increased plant height to 68.83 cm.plants⁻¹, pod number to 31 pod.plant⁻¹ and total productivity to 6.66 t.h⁻¹.

Therefore, the study aimed to show the best level effect of potassium, zinc and their Interaction, which achieves the highest growth and yield of okra plant.

Material and Methods:

The experiment was carried out in one of the scientific research station in collage of agriculture / University of Baghdad (Jadriya) for spring season 2017 to study the effect of foliar spray of potassium and zinc on growth and yield of okra. The experiment was carried out according to split plot design in Randomized Complete Block Design (RCBD) with three replicates each one contained 12 treatment, to study the effect

of spraying potassium sulphate 44%K as a source of potassium element in four concentrations (0,2000,4000,6000) mg.l⁻¹ and refer to them K₀, K₁, K₂ and K₃ respectively and were considered as main plot and zinc sulphate 22%Zn as a source of zinc element in three concentrations (0, 30, 60) mg.l⁻¹ and refer to them Zn₀, Zn₁ and Zn₂ respectively and were considered as sub-plots. The experiment was carried out in area 300 m² dimensions 20m x 15m and was divided in form of lines with 3m length and 0.75m between lines, area experimental unit 2.25 m² dimensions 3 x 0.75 m contained 10 plant for each unit. Petra okra seeds were soaked for 24 hours before planting, the seeds were planted in 25/3/2017 distance between each plant was 0.30 m. Potassium fertilization had been blocked from soil fertilization in experiment thus the source of potassium was only by foliar spray. The plants were sprayed four times with the solutions mentioned during the growth period. The first spray was when plant height reached 15cm, 15 days in between each spray. Potassium sulfate sprayed first. Three days later, zinc sulfate was sprayed. The obtained data analyzed according to Genstat. The means were compared at least significant difference (LSD) at 0.05 probability level (6). All agronomic practices were carried out uniformly for whole experiment when needed. At the maturity ten plants from each line were selected randomly to study following plant parameters: Plant high (cm), chlorophyll concentration in leaves which determined according to Goodwin method (9), Leaf area determined by digimizer program and was multiplied by the number of plant leaves (dcm².plant⁻¹). Pods number (pod.plant⁻¹), Average pod weight (g.pod⁻¹), plant yield (g.plant⁻¹).

Results and discussion:

The results in Table 1 revealed that K₂ treatment was superior significantly in increasing plant height to 114.36 cm.plant⁻¹, leaf area per plant to 271.46 dsm².plant⁻¹

and chlorophyll concentration to 60.54 mg.100g⁻¹ fresh weight compare to control treatment K₀ which gave the shortest plant height of 95.98 cm.plant⁻¹, and gave the smallest leaf area per plant of 177.61 dsm².plant⁻¹, and gave the less chlorophyll concentration of 35.96 mg.100g⁻¹ fresh weight. Potassium has a positive effect on division and expansion cells due to the suitable pressure it provides. The expansion cell depends on the accumulation of potassium in order to increase the osmosis stress in cell, in addition to its important role in activating 65 enzymes responsible for synthetic materials production that interfere in Plant production and vital activity thus its increase the plant high (15). Potassium increases photosynthesis by increasing the leaf area of the plant through controlling the water balance process by regulating the opening and closing of stomata as well as the element importance in the division and expansion of cells, more than that its improves the performance of growth regulator that involve in cells expansion which affect positively on increase height plant (18). Potassium has a relationship in raising efficiency of the plant by maintaining the plastids from destruction in order to make high performance of mitochondria needs to a potassium element (7). The increased of nitrogen element due to potassium spraying may have increased the concentration of chlorophyll for the importance of nitrogen in composition of the porphyrin which intervene in chlorophyll formation (16).

The results in Table 1 showed significant effect of zinc, potassium and their Interaction treatments in increasing plant height, Leaf area, and Chlorophyll content in leaves. The analysis revealed that Zn₁ treatment was superior significantly in increasing plant high to 111.60 cm.plant⁻¹, leaf area per plant to 267.86 dsm².plant⁻¹ and chlorophyll concentration to 52.11 mg.100g⁻¹ fresh weight compare to control treatment Zn₀ which gave the shortest plant height of

99.40 cm.plant⁻¹ and gave the smallest leaf area per plant of 164.89 dsm².plant⁻¹ and gave the less chlorophyll concentration of 44.14mg.100g⁻¹ fresh weight. The increase of height plant when spray zinc on the plant is return to the element importance in formation amino acid tryptophan, which consists of the natural hormone IAA which is necessary to extends and increase the cells division and expansion thus increasing in plant height, zinc lack in leaves leads to a decrease leaf area for plant (16). Zinc also helps in formation process of chlorophyll indirectly through

its effect on formation of energy compounds and amino acids (1).

The analysis showed that Interaction K₂Zn₁ treatment was superior significantly in increasing plant high to 123.80 cm.plant⁻¹, leaf area per plant to 338.18 dsm².plant⁻¹ and chlorophyll concentration to 65.30 mg.100g⁻¹ fresh weight compare to control treatment K₀Zn₀ which gave the shortest plant height of 88.47 cm.plant⁻¹ and gave the smallest leaf area per plant of 142.67 dsm².plant⁻¹ and gave the less chlorophyll concentration of 28.10 mg.100g⁻¹ fresh weight.

Table 1. Effect of foliar spray of Zinc, Potassium and their Interaction on characterizes vegetative growth for Spring Season 2017.

	Plant height (cm.plants ⁻¹)				Leaf area (dcm ² .plant ⁻¹)				Chlorophyll concentration			
Treat.	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean
K 0	88.47	104.73	94.73	95.98	142.67	177.81	212.36	177.61	28.10	38.15	41.63	35.96
K 1	97.07	99.47	105.87	100.80	144.32	266.38	212.20	207.63	42.80	46.15	47.37	45.44
K 2	103.93	123.80	115.33	114.36	191.59	338.18	284.63	271.46	56.60	65.30	59.72	60.54
K 3	108.13	118.40	107.33	111.29	180.98	289.09	275.38	248.49	49.07	58.85	52.67	53.53
Mean	99.40	111.60	105.82		164.89	267.86	246.14		44.14	52.11	50.35	
L.S.D	K	Zn	Interaction		K	Zn	Interaction		K	Zn	Interaction	
0.05	8.69	4.50	10.47		24.37	15.94	32.94		2.69	1.97	3.89	

The results in Table 2 revealed significant effect of zinc, potassium and their Interaction treatments in increasing Pods number, Pods weight and Plant yield.

The analysis showed that K₂ treatment was superior significantly in increasing pod number to 59.22 pod.plant⁻¹, pod weight to 5.59 g.pod⁻¹ and Plant yield to 331.84 g.plant⁻¹ compare to control treatment K₀ which gave the less pods number of 34.56 pod.plant⁻¹ and gave the less pods weight per plant of 4.62 g.pod⁻¹ and gave the less plant yield of 201.85 g.plant⁻¹.

The analysis showed that Zn₁ treatment was superior significantly in increasing pods number to 56.82 pod.plant⁻¹, Pods weight per plant to 5.25 g.pod⁻¹ and Plant yield to 301.39 g.plant⁻¹ compare to control treatment Zn₀ which gave the less Pods number of 45.76 pod.plant⁻¹ and gave the less Pods weight per plant of 4.81

g.pod⁻¹ and gave the less Plant yield of 223.27 g.plant⁻¹.

The analysis showed that Interaction K₂Zn₁ treatment was superior significantly in increasing pod number to 64.00 pod.plant⁻¹, pods weight per plant to 5.83 g.pod⁻¹ and plant yield to 372.97 g.plant⁻¹ compare to control treatment K₀Zn₀ which gave the less pods number of 37.07 pod.plant⁻¹.and gave the less pods weight per plant of 4.11 g.pod⁻¹, and gave the less plant yield of 152.68 g.plant⁻¹.

The significant effect of spraying okra plants by zinc and potassium and their Interaction on the production quantity is due to the role of the two elements to improve the plant's ability to obtain its nutrient needs which increased the plant's efficiency in photosynthesis and thus increase the vegetative growth in addition to the positive role of zinc in increasing flower fertilization and its effect in pollen

production and increasing of flowers number (1). Which positively affected in increase flowers number and flower fertilization then increase pod number, pod weight and plant yield.

The results were agreed with Al-Dulaimi (4) and Al- Ubaydi (8) where they notice a significant increase in the pod number, pod weight and total yield when spraying zinc on bean plants.

Table 2. Effect of foliar spray of Zinc, Potassium and their Interaction on characterizes vegetative growth for Spring Season 2017

	Pods number (pod.plant ⁻¹)				Pods weight (g.pod ⁻¹)				Plant yield (g.plant ⁻¹)			
Treat.	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean
K 0	37.07	50.07	42.97	34.56	4.11	4.82	4.93	4.62	152.68	240.94	211.93	201.85
K 1	41.20	50.60	47.47	46.42	4.69	4.74	4.96	4.80	193.09	239.27	235.18	222.51
K 2	50.50	64.00	63.17	59.22	5.42	5.83	5.52	5.59	274.05	372.97	348.51	331.84
K 3	54.27	62.60	53.43	56.77	5.04	5.62	5.21	5.29	273.26	352.37	278.33	301.32
Mean	45.76	56.82	51.76		4.81	5.25	5.15		223.27	301.39	268.49	
L.S.D	K	Zn	Interaction		K	Zn	Interaction		K	Zn	Interaction	
0.05	2.2	2.62	4.6		0.25	0.14	0.32		14.62	13.64	24.82	

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