EFFECT OF FOLIAR APPLICATION WITH POTASSIUM AND ZINC ON GROWTH, POD YIELD AND SEED PRODUCTION OF OKRA

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ABSTRACT

Two field experiments were carried out at the College of Agriculture/ University of Baghdad during spring season 2017 on okra "Petra" to study foliar application of potassium and zinc on growth, green pod yield and seed production of okra. Split plot within RCBD design was used with three replicates for both experiments where potassium factor was used within main plot and zinc in sub-plot. Potassium sprayed with concentrations (0, 2000, 4000, and 6000) mg.l^{-1} while zinc sprayed with the concentrations (0, 30, and 60) mg.l^{-1}. Results were showed that the potassium spray with concentrations 4000 mg.l^{-1} and the zinc spray with 30 mg.l^{-1} was superiored in plant height (114.36 and 111.60 cm.plant^{-1}). Leaf area (271.46 and 267.86 dcm^2.plant^{-1}). Total chlorophyll (60.54 and 52.11 mg.100g^{-1} fresh weight). Fresh pods number (59.22 and 56.82 pod.plant^{-1}). Fresh pod weight (5.59 and 5.15 gram.pod^{-1}). Plant yield (331.84 and 301.39 gram.plant^{-1}), respectively. While the potassium spray with concentration of 6000 mg.l^{-1} and the zinc spray with 60 mg.l^{-1} was superiored in seeds germination (92.22 and 90.67 %). Rapidity germination (10.28 and 9.99 day). Specific gravity (98.09 and 97.93 seed.5 gram^{-1}). Oil in seeds (21.82 and 21.70 %). Carbohydrate in seeds (33.98 and 33.42 %). Protein in seeds (22.01 and 21.70 %), respectively. It could be recommended to use foliar of 4000 mg.l^{-1} potassium and 30 mg.l^{-1} zinc to increase growth and green pod yield and recommended to use foliar of 6000 mg.l^{-1} potassium and 60 mg.l^{-1} zinc to improve seed qualities.

Keyword: major elements, micro elements, nutrients feeding, *Abelmoschus esculentus* L.(Moench)
Part of M.Sc. thesis of the first author.

تأثير رش البوتاسيوم والزنك في نمو وحاصل القرنات وبذور الباميا

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المستخلص

نفذت تجربتين حقليتين في كلية الزراعة / جامعة بغداد (مجمع الجادرية) للموسم الربيعي 2017، بهدف دراسة تأثير رش البوتاسيوم والزنك في النمو والحاصل وأنتاج بذور الباميا صنف بترا نفذ البحث كتجربة عاملية وفق نظام الالواح المنشقة وفق تصميم القطاعات الكاملة المعشاة بثلاثة مكررات حيث اعتبر البوتاسيوم معاملات رئيسية والزنك معاملات ثانوية. رش البوتاسيوم بتركيز (0،2000،4000،6000) ملغم K.لتر$^{-1}$ ورش الزنك بتركيز (0،30،60) ملغم Zn.لتر$^{-1}$.اظهرت النتائج تفوق معاملة رش البوتاسيوم بتركيز 4000 ملغم K.لتر$^{-1}$ ومعاملة رش الزنك بتركيز 30 ملغم Zn.لتر$^{-1}$ معنوياً في زيادة ارتفاع النبات (114.36 و 111.60 سم.نبات$^{-1}$) والمساحة الورقية (271.46 و 267.86 دسم^2.نبات$^{-1}$) والكلوروفيل الكلي (60.54 و52.11 ملغم.100غم$^{-1}$ وزن طري) وعدد القرنات الخضراء (59.22 و 56.60 قرنة.نبات$^{-1}$) ووزن القرنات الخضراء (5.59 و5.25 غم.قرنة$^{-1}$) وحاصل النبات (331.84 و 301.39 غم.نبات$^{-1}$) بالتتابع. بينما تفوقت معاملة رش البوتاسيوم بتركيز 6000 ملغم K.لتر$^{-1}$ ومعاملة رش الزنك بتركيز 60 ملغم Zn.لتر$^{-1}$ معنوياً في زيادة نسبة الانبات (92.22 و 90.67 %) وسرعة الانبات (10.28 و9.99 يوم) والوزن النوعي (98.09 و 97.93 بذرة.5 غرام$^{-1}$) ونسبة الزيت في البذور (21.82 و20.66 %) ونسبة الكاربوهيدرات في البذور (33.98 و 33.42 %) ونسبة البروتين في البذور (22.01 و 21.70 %) بالتتابع. يمكن التوصية بأستعمال 4000 ملغم.لتر$^{-1}$ بوتاسيوم و30 ملغم.لتر$^{-1}$ زنك لزيادة النمو وحاصل القرنات الخضراء والتوصية بأستعمال 6000 ملغم.لتر$^{-1}$ بوتاسيوم و60 ملغم.لتر$^{-1}$ في تحسين صفات البذور.

كلمات مفتاحية: العناصر الكبرى، العناصر الصغرى، التغذية الورقية، *Abelmoschus esculentus* L. (Moench).
مستل من رسالة ماجستير للباحث الاول.

*Received:24/5/2018, Accepted:6/8/2018

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is one of the summer vegetable crops, which belongs to Malvaceae. Central Africa, Eritrea, Ethiopia, Egypt and Sudan considered as their original region (20). Its nutritional importance comes from containing carbohydrates, proteins and some minerals (15). Okra seeds contains proteins 22.30-37.02%, oil 2.65-23.99% and carbohydrate 29.44-44.03% (16). Foliar spray is ideal and successful method in Iraqi agriculture due to high pH of the soil, calcareous soil, and a dry hot climate in summer season, which leads to a loss in nutrients. In addition, a loss occurs due to the leaching in the sandy soils, like what 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 elements for opening and closing the stomata. 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 entry as a catalyst in chlorophyll formation (10). Potassium increases the concentration of carbohydrates because of its function in nitrogen element absorption by the plant and convert it to proteins (17). Furthermore, the forms of potassium decreases because of cultivation and the correlation of rest forms of potassium with each other (11). Al-Mtory (8) revealed that spraying okra plants with 30 mml^{-1} potassium nitrate increased plant height (76.33 $cm.plants^{-1}$), pod number (43.69 $pods.plants^{-1}$), pod weight mean (3.88 $g.pod^{-1}$) and total productivity (2.654 $t.h^{-1}$). Al-Hilfy et al. (6) showed that the higher concentration of potassium on white mustard plant increased plant yield, seed yield, seed number per silique and the weight of 1000 seeds. Al-Hilfy and Al-Salmani (5) showed that spraying 6000 mg $K.l^{-1}$ of potassium increased the peanut seed yield. Zinc is one of the elements, which considered significant in activating number of enzymes. It is also needed by plant for formation tryptophan, which consists of the indole acetic acid hormones, which is necessary to cells elongate. The lack of zinc affects pollen production as it is important in cells division and the production of secondary meristem cells therefore, it is necessary to increase the cells thickens (3). While, the lack of zinc will affects the vital processes including the manufacture of carbohydrates and auxin production (21). Taher (32) reported that spraying zinc sulfate at concentrations of 25 $mg.l^{-1}$ increases okra plant height (156.18 $cm.plant^{-1}$). Zaver (35) reported that spraying zinc sulfate at concentration of 0.5% significantly increased okra plant height (76.19$cm.plant^{-1}$), total yield (226.19 $g.plant^{-1}$), total chlorophyll content (4.54 $mg.g^{-1}$), seeds germination (82.89%) and protein in seeds (22.96%). Alisawi and Hameed (7) showed that the concentration 40 mg $Zn.l^{-1}$ was superior regarding number of $seeds.pod^{-1}$ and the highest seed weight in Faba Bean. The objective of this study to estimate the effect of potassium and zinc on growth, pod yield and seed production of okra

MATERIAL AND METHODS

Tow field experiments were carried out at the research station of the College of Agriculture/ University of Baghdad Al-Jadreya during spring season 2017 to study the effect of spraying potassium sulphate 44% K as a source of potassium with four concentrations (0, 2000, 4000, 6000) mg $K.l^{-1}$ and refer to it as K_0, K_1, K_2 and K_3 respectively, and zinc sulphate 22% Zn as a source of zinc element in three concentrations (0, 30, 60) $mg.l^{-1}$ and refer to it as Zn_0, Zn_1 and Zn_2 on growth, yield in first experiment and seed production in second experiment of okra. Tillage, preparation and leveling were performed. A split plot design experiment was carried out using (RCBD) with three replicates each one contained 12 (treatment) thus; we have 72 units for both experiment each one has 36 units. Potassium occupied the main plots and Zinc occupied the sub plots. The experiment was carried out in area of 300 m^2 with dimensions of 20m × 15m and was divided in forms of lines with 6m in length (3m for growth and yield experiment and 3m for seed production experiment) 0.75m between lines and 0.30m within the line. The experimental unit was 2.25 m^2 with dimensions of 3 x 0.75m contained 10 plants for each unit. Okra cv. Betra seeds were soaked for 24 hours before planting and the seeds were planted in 25/3/2017. Potassium fertilizers was blocked from soil fertilization in the 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. Plants were sprayed when reached 15cm in height, then with a period of 15 days between each spray, Potassium sulfate sprayed first after three days zinc sulphate was sprayed. The collected data was analyzed using statistical analysis of variance the means were compared by least significant difference (LSD) with (0.05) probability level (9). All agronomic practices were carried out uniformly for the whole experiment when needed.

Studied characters

First experiment: Plant high (cm) was measured at the end of the season from the contact area of the stem with the soil to the top of the plant. Three plants were selected randomly to determine. Chlorophyll concentration in leaves ($mg.100g^{-1}$ fresh weight) according to Goodwin method (14). Leaf area ($dcm^2.plant^{-1}$) determined by Digimizer program and multiplied by the number of plant leaves. Green pods number ($pod.plant^{-1}$) was calculated by dividing the total pods of the experimental units on the number of plants per experimental units. Mean pod weight ($g.pod^{-1}$) was calculated by dividing the yield of green pods in experimental units on the number of green pod per experimental units. Plant yield ($g.plant^{-1}$) was calculated for all the experimental units and divided on the number of plants.

Second Experiment: Specific gravity ($seeds.5g^{-1}$) of seeds was collected from 5 gram weight (13). Germination rapidity (day) was determined according to Maguire (19) and seeds germination (%) was determined according to Mohammed (26) using (CRD) design with three replicate each one contained 12 experimental units thus, we have 36 units each one contained 100 seeds and placed in laboratory refrigerators at a temperature of 25cº and 85% humidity. Protein in seeds (%) was determined by measuring nitrogen in seeds flour then multiplied by fixed factor which is 6.25 (1). Carbohydrate in seeds (%) was determined according to Joslyn (18). Oil in seeds (%) was determined according to Razon (29).

RESULTS AND DISCUSSION

Vegetative characters

Results in Table 1 reveal a significant effect of potassium, zinc and their interaction for increasing plant height, leaf $area.plant^{-1}$ and chlorophyll concentration. K_2 treatment was significantly superiored in increasing plant height (114.36 $cm.plant^{-1}$), leaf $area.plant^{-1}$ (271.46 $dsm^2.plant^{-1}$) and chlorophyll concentration (60.54 $mg.100g^{-1}$ of fresh weight) compared to control treatment K_0 which gave the shortest plant height (95.98 $cm.plant^{-1}$), lowest leaf $area.plant^{-1}$ (177.61 $dsm^2.plant^{-1}$) and had the lowest chlorophyll concentration (35.96 $mg.100g^{-1}$ of fresh weight). Potassium had a positive effect on division and expansion of cells due to the suitable pressure it provides. The cell expansion depended on the accumulation of potassium in order to increase the osmosis stress in cells, in addition to its important role in activating 65 enzymes responsible for synthetic material production that interfere in plant production and vital activity thus it increases the plant height (22). 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 its importance in the cells division and expansion (33). Potassium has a relationship in raising efficiency of the plant by maintaining the plastids from destruction (10). The increase of nitrogen due to potassium spraying may have an effect on increasing the concentration of chlorophyll due to the importance of nitrogen in porphyrin structure, which interfere in chlorophyll formation (25) in table 1. Results showed significant effect of Zinc for increasing plant height, leaf area and chlorophyll content in leaves. Zn_1 treatment were significantly superiored in increasing plant height (111.60 $cm.plant^{-1}$), leaf $area.plant^{-1}$ (267.86 $dsm^2.plant^{-1}$) and chlorophyll concentration (52.11 $mg.100g^{-1}$ of fresh weight) compared to control treatment Zn_0 which produced the shortest plant height (99.40 $cm.plant^{-1}$), lowest leaf $area.plant^{-1}$ (164.89 $dsm^2.plant^{-1}$) and the lowest chlorophyll concentration (44.14$mg.100g^{-1}$ fresh weight). The increase of plant height when sprayed with zinc is due to the element importance in tryptophan amino acid formation, which consists of the natural hormone IAA that is necessary to extend and increase cells division and expansion thus, increasing in plant height. Zinc lack in leaves leads to a decrease in plant leaf area (25). Zinc also helps in the process of indirectly chlorophyll formation through its effect on formation of energy compounds and amino acids (2). Mohammed and al-Naqeeb (25) founded that foliar application of Zn concentrations from zero to 120 mg $Zn.l^{-1}$ increased dry matter weight in cotton plant. Mnagd and Abed Algailany (23) showed that the concentration of 60 mg $Zn.l^{-1}$ was significantly higher in plant length, dry weight. Interaction of K_2Zn_1 was significantly differed and superiored in plant height (123.80 $cm.plant^{-1}$), leaf $area.plant^{-1}$ (338.18 $dsm^2.plant^{-1}$) and chlorophyll concentration (65.30 $mg.100g^1$ of fresh weight) compared to control treatment K_0Zn_0 which gave the shortest plant height (88.47 $cm.plant^{-1}$), smallest leaf $area.plant^{-1}$ (142.67 $dsm^2.plant^{-1}$) and lowest chlorophyll concentration (28.10 $mg.100g^1$ of fresh weight).

Plant yield and it's component

Results in Table 2 reveal a significant effect of potassium, zinc and their interaction for increasing pods number, pods weight and plant pods yield. K_2 treatment was significantly superiored in increasing pod number (59.22 $pod.plant^{-1}$), pod weight (5.59 $g.pod^{-1}$) and plant yield (331.84 $g.plant^{-1}$) when compared with the control treatment K_0 which gave the lowest pods number (34.56 $pod.plant^{-1}$), lowest pods $weight.plant^{-1}$ (4.62 $g.pod^{-1}$) and lowest plant pods yield (201.85 $g.plant^{-1}$). Results showed that Zn_1 treatment was significantly superiored in increasing pods number (56.82 $pod.plant^{-1}$), pods $weight.plant^{-1}$ (5.25 $g.pod^{-1}$) and plant pods yield (301.39 $g.plant^{-1}$) when compared to plants of control treatment Zn_0 which produced lowest pods number (45.76 $pod.plant^{-1}$), lowest pods $weight.plant^{-1}$ (4.81 $g.pod^{-1}$) and gave the lowest plant yield (223.27 $g.plant^{-1}$). Mnagd and Abed Algailany (23) showed that the concentration of 60 mg $Zn.l^{-1}$ was significantly higher in early yield, plant yield and total yield. Interaction between K_2Zn_1 was significant differed and superiored in increasing pods number (64.00 $pod.plant^{-1}$),pods $weight.plant^{-1}$ (5.83 $g.pod^{-1}$) and plant pods yield (372.97 $g.plant^{-1}$) compared to control treatment K_0Zn_0 which gave lowest pods number (37.07 $pod.plant^{-1}$), lowest pods $weight.plant^{-1}$ (4.11 $g.pod^{-1}$) and produced the lowest plant pods yield (152.68 $g.plant^{-1}$). The significant effect of foliar application of potassium, zinc and their interaction on the production quantity of okra plant is due to the role of the two elements to improve the plant's ability to obtain its nutrients it needs which increased the plant's efficiency in photosynthesis and thus, increasing 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 (2), which positively affected the increase of flowers number and flower fertilization then increase pod number, pod weight and plant yield. The results were compatible with Al-Dulaimi (4) and Al- Ubaydi (12) where they obtained a significant increase in the pod number, pod weight and total yield when spraying zinc on bean plants.

Quality of seeds

Results in Table 3 shows significant effect of potassium, zinc and their interaction for oil, protein and carbohydrate in seeds.K_3 treatment was significantly superiored for increasing oil in seeds (21.82%), protein in seeds (22.01%) and carbohydrate in seeds (33.98%) compared to control treatment K_0 which had lowest oil in seeds (18.30%), while K_1 gave lowest protein in seeds (19.25%) and gave lowest carbohydrate in seeds (31.79%). Plants that are well fertilized with potassium delayed the leaves aging, increased their leaf area, and thus, increased the preparation of materials produced by photosynthesis, which provide it to meristem texture used mainly in proteins formation. Potassium very important for DNA synthesis and replication while very necessary for cell division, also important in separation proteins from the ribosome thus, providing an opportunity to create a new protein, as it is necessary for a resultant transmission of photosynthesis products for filling stored parts. Potassium leads to give a rich carbohydrate seeds because of stimulating the transfer of carbohydrates from leaves to the stored parts (3). These findings were in accordance with results founded by Sawan et al. (30) who observed that spraying potassium rates significantly effects oil in seeds (19.83%) and protein in seeds (22.37%) on cotton plants. Result indicate that Zn_1 treatment was significantly superiored in increasing oil in seeds (20.66%), protein in seeds (21.70%) and carbohydrate in seeds (33.42%) compared to control treatment Zn_0 that gave lowest oil in seeds (19.57%), protein in seeds (19.42%) and carbohydrate in seeds (31.75%). Zinc acts as a pH regulator thus high oil content may be due to the effect of zinc in reducing nitrogen percentage in plant (3). These results were in accordance with results founded by Zaver (35) who observed that spraying zinc significantly effects on protein in seeds (22.96%) on okra plant. In addition, these findings were in accordance with results founded by Rahman et al. (28), who observed that spraying zinc significantly effects protein in seeds (19.08%) on okra plant. Also Sawan et al. (31) reported that cotton plant responded to 60 ppm zinc, which gave 19.78% oil in seeds and 22.26% protein in seeds. Naqeeb et al. (27) indicated that highest response of cotton to foliar application of Zn in three sprays gave a high oil in seeds (19.32%). Interaction of K_3Zn_2 treatment was significantly superior in increasing oil in seeds (22.25%), protein in seeds (23.31%) and carbohydrate in seeds (34.54%) compared to control treatment K_0Zn_0 that gave lowest oil in seeds (17.25%), while K_1Zn_0 gave lowest protein in seeds (18.76%) and the treatment K_0Zn_0 gave lowest carbohydrate in seeds (30.50%).

Germination percentage, germination rapidity and specific gravity of okra seeds

Results in Table 4 K_3 treatment was significantly superiored in increasing seeds germination (92.22%), germination rapidity (10.28 day) and specific gravity (98.09 seed.5g^{-1}) compared to control treatment K_0 that gave lowest seeds germination (82.00 %), germination rapidity (11.01 day) and specific gravity (106.22 seed.5g^{-1}). Results showed that Zn_1 treatment was significantly superiored for increasing seeds germination (90.67%), germination rapidity (9.99 day), and specific gravity (97.93 seed.5g^{-1}) compared to control treatment Zn_0 that gave lowest seeds germination (81.17 %), germination rapidity (11.40 day) and specific gravity (104.88 seed.5g^{-1}). Results showed that K_3Zn_2 interaction treatment was significantly superiored for increasing seeds germination (96.67%), germination rapidity (9.86 day) and specific gravity (95.60 seed.5g^{-1}) compared to control treatment K_0Zn_0 that gave lowest seeds germination (75.33%), specific gravity (109.60.48 seed.5g^{-1}), while K_1Zn_0 gave lowest germination rapidity (12.20 day). The high rate of germination might be affected by the participation of potassium and zinc in provision the nutritional status of the plant, which is positively reflected seeds filling with nutrients such as carbohydrates and proteins, which decomposes after seeds, absorb water to glucose, amino acids and phosphate ions that are easily absorbed by the embryo. Also, the role of zinc in the manufacture of tryptophan, which is a source of oxyin formation in plant tissues, especially in endosperm and embryo (34).Foliar application has an important role in improving growth and yield of okra plant, as a result of increasing photosynthesis products. The intermediate concentration of potassium (4000 mg.l^{-1}) and zinc (30 mg.l^{-1}) are suitable for growth and pods yield of okra plant. While the high concentration of potassium (6000 mg.l^{-1}) and zinc (60 mg.l^{-1}) are suitable for seed production of okra plant.

Table 1. Effect of foliar application with Potassium, Zinc and their Interaction on characterizes vegetative growth

	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	

Table 2. Effect of foliar application with Potassium, Zinc and their Interaction on okra yield

	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	

Table 3. Effect of foliar application with Potassium, Zinc and their Interaction on oil, protein and carbohydrate percentage of okra seeds

	Oil in seeds (%)				Protein in seeds (%)				Carbohydrate in seeds (%)			
Treat.	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean
K 0	17.25	19.14	18.52	18.30	18.80	20.03	21.36	20.06	30.50	32.72	33.59	32.27
K 1	19.86	20.74	21.59	20.73	18.76	19.27	19.72	19.25	30.73	32.05	32.58	31.79
K 2	19.60	19.67	20.28	19.85	19.79	19.86	22.40	20.68	32.04	32.31	32.95	32.43
K 3	21.56	21.64	22.25	21.82	20.31	22.40	23.31	22.01	33.72	33.68	34.54	33.98
Mean	19.57	20.30	20.66		19.42	20.39	21.70		31.75	32.69	33.42	
L.S.D	K	Zn	Interaction		K	Zn	Interaction		K	Zn	Interaction	
0.05	0.78	0.43	0.97		1.56	0.55	1.68		1.20	0.54	1.38	

Table 4. Effect of foliar application with Potassium, Zinc and their Interaction on germination percentage, germination speed and Specific gravity of okra seeds

	Seeds germination (%)				Germination speed (day)				Specific gravity (seeds.5g)			
Treat.	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean	Zn 0	Zn 1	Zn 2	Mean
K 0	75.33	86.67	84.00	82.00	12.13	11.08	9.82	11.01	109.60	105.60	103.47	106.22
K 1	84.00	83.33	86.00	84.44	12.20	10.52	10.01	10.91	105.07	101.33	96.40	100.93
K 2	81.33	87.33	96.00	88.22	11.25	10.66	10.26	10.72	102.67	98.53	96.27	99.16
K 3	84.00	96.00	96.67	92.22	10.03	10.94	9.86	10.28	102.20	96.47	95.60	98.09
Mean	81.17	88.33	90.67		11.40	10.80	9.99		104.88	100.48	97.93	
L.S.D	K	Zn	Interaction		K	Zn	Interaction		K	Zn	Interaction	
0.05	3.81	3.29	6.59		0.51	0.52	0.94		0.16	0.17	0.30	

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