Effect of fertilizing with potassium and a mixture of boron and zinc on the yield traits of cotton plant (*Gossypium hirsutum L.*)

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Abstract

A field experiment was conducted during the summer season 2019 in Kirkuk province to study the effect of spraying with potassium, zinc and boron mixture on the yield traits of cotton plant (*Gossypium hisrutum* L.)A factorial experiment was applied according to the Randomized Complete Block Design (RCBD) and it included two factors: the first represented by three concentrations of potassium fertilizer 10.5.0% and the second was the addition of the microelements zinc and boron in a mixture and individually at a concentration of Zn15B8,B8,Zn15.0%.The results showed that there were significant differences between the concentrations of potassium, zinc mixture and boron in all the studied traits, where the third concentration of potassium fertilizer and zinc and boron mixture gave the highest average for the traits of the total number of nuts, the number of nut, the weight of nut, and the cotton yield in the first harvest, and the yield cotton in the second harvest, and the total cotton yield.

تأثير التسميد بالبوتاسيوم وخليط البورون والزنك على صفات الحاصل لنبات القطن

Gossypium hirsutum L.

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الخلاصة

نفذت تجربة حقلية خلال الموسم الصيفي 2019 في محافظة كركوك لدراسة تأثير الرش بالبوتاسيوم وخليط زنك والبورون على صفات الحاصل لنبات القطن (*Gossypium hisrutum* L.) طبقت تجربة عاملية وفق تصميم القطاعات العشوائية الكاملة R.C.B.D وشملت عاملين: تمثل الأول بثلاث تراكيز من سماد البوتاسيوم 10,5,0% والثاني إضافة العناصر الصغرى الزنك والبورون بشكل خليط وبصور منفردة بتركيز Zn15B8,B8,Zn15,0% ,أوضحت النتائج وجود فروق معنوية بين تراكيز البوتاسيوم وخليط الزنك والبورون في جميع الصفات المدروسة إذ أعطى التركيز الثالث من سماد البوتاسيوم وخليط الزنك والبورون أعلى متوسط لصفة عدد الجوز الكلي,وعدد الجوز المتفتح ,ووزن الجوزة الوحدة,و حاصل القطن القطن الزهري في الجنية الأولى ,وحاصل القطن الزهري في الجنية الثانية,وحاصل القطن الزهري الكلي.

Introduction

The cotton crop, *Gossypiu hirsutum* L., is one of the most important economic crops in the world. It is cultivated for two main reasons: fiber and oil. The fibers are used in the textile industry and the oil that is extracted from the seeds (20), In Iraq, the cultivated areas of this crop reached (925) dunums in 2017, and increased with an estimated increase of 32.7% compared to 2016 with 697 dunums (2).Foliar nutration is of high importance in reducing environmental risks and rapid treatment to reduce nutrient deficiencies, and it is an economical method in effort and time, as well as a very necessary method in preventing the depletion of nutrients in the leaf. As the lack of these elements leads to a reduction in the amount of dry matter in the seeds during their fullness period in order to maintain the efficiency of carbon metabolism (11) The spraying of potassium has an important

relationship in many vital activities inside the plant, as it is one of the macro nutrients that cannot be dispensed with as It is important in vital activities (28), Studies indicate that the cotton crop's need for zinc is great, where its deficiency in the soil leads to many problems, the most important of which are: the small size of the leaves, increased thickness and yellowing, the appearance of bronze spots, the small number of nodes on the stem, the small size of the nuts and their small number, in addition to the fall of flowers (22),It was found that spraying zinc on the cotton crop contributes to increasing the fiber yield and also reduces the toxicity of other elements due to its effect on the efficiency of the biofilm (23).

Materials and methods

The study was conducted using three levels of potassium fertilization (10,5,0)% and four concentrations of the macro elements zinc and boron (Zn15B8,B8,Zn15%) on the yield trait of cotton crop. The factorial experiment was conducted according to Randomized Complete Block Design (RCBD) , with three replications, and the number of experiment units is 36 experimental units, each replicate includes 12 experimental units. As the planting was conducted on 1/5 in stripes with (4-3) seeds in each pit .The process of thinning the plants was conducted one month after planting, the plants were also irrigation when needed, nitrogen fertilizer was added in the form of urea (46% N) at an amount of 160 kg/ha (6) and phosphate was added in the form of triple superphosphate (P2O5) at a rate of 120 kg/ha (9). Statistical analysis of all results was conducted on the basis of analysis of variance for the studied traits according to factorial experiments by designing Randomized Complete Block Design (RCBD) using a computer according to the statistical analysis program (25). The comparison between the averages of the treatments was done using Duncan's multiple range choice (5).

studied traits : Total nut count/plant. Number of blooming nuts/plant, Weight of one nut (g),The yield of flower cotton in the first harvest(kg/ha-1),The yield of flower cotton in the second harvest(kg/ha-^{1}),Total flower cotton yield (kg/ha)

Results and Discussion

1- Number of total nuts/plant.

The results in Table (1) indicate that there are significant differences between the three potassium concentrations in the total number of nuts, where the third concentration of potassium fertilizer (K10) was recorded. The highest average for the trait was 52.25 nut.plant^{-1} excelled on the first and second treatment, and the comparison treatment recorded lowest average for the trait 42.58 nut.plant^{-1}.This may be due to the importance of potassium, which contributes to increasing the process of photosynthesis and the transfer of its products to the new growth areas in the plant (emergent nuts), which is reflected in the continuation of their death and increase in their number. Thus, the addition of potassium led to an increase in the total number of nuts. These results are in agreement with the findings of F (15), (17), (19).The results also showed that spraying the microelements zinc and boron leads to significant differences between the treatments, where the boron and zinc mixture was significantly excelled, and the highest average was recorded for the trait as 54.96 nut.plant^{-1} . The results showed that there were significant differences between the treatments when adding each of boron and zinc separately, where the concentration of boron was superior to the concentration of zinc, and each recorded 51.26 and 45.8 nut.plant^{-1}, respectively. While the control treatment recorded the lowest average of the trait, which was 38.24 nut.plant^{-1}. The reason may be that zinc and boron increase the physiological activity of the plant and contribute to an increase in the metabolism process, which was clearly used in building the fruiting branches of the plant, which increases the total number of nuts. The reason for the increase in the total number of nuts may be due to an increase in plant growth, an increase in

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the number of its branches, an increase in flower buds, and a decrease in the percentage of their fall when treated with zinc and boron. These results agreed with (14). and 21) indicates that the increase in the yield of nut when potassium is added at the third concentration may be due to the increase in the transfer of photosynthesis products from their sources in the leaves to the reproductive parts. Whereas, the addition of potassium stimulated the vegetative growth, which led to an increase in the production of carbohydrate and its transfer to the reproductive parts was enhanced by the addition of potassium.

Table (1) Effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the trait of total nut number/plant.

first factor	second factor			second factor average
	K0	K5	K10	
0	h 34.16	36.46 h	44.1 f	38.24 d
Zn15%	g 39.36	47. e	51.03 d	45.8 c
B8%	46.7 e	52.50 cd	54.60 cb	51.26 b
Zn+B	50.10 d	55.50 b	59.30 a	54.96 a
The first factor average	42.58 c	47.86 b	52.25 a	

* Similar letters indicate that there are no significant differences in the trait between the studied treatments

2- The number of nut/plant.

The results in Table (2) indicate that there are significant differences between the three potassium concentrations in the trait of the number of blooming nuts, as the third concentration of potassium fertilizer (k10) excelled and gave the highest average of the trait was recorded at 48.19 nut.plant^{-1}, while the control treatment recorded the lowest mean of the phenotype amounted to 37.15 nut.plant^{-1}.The reason is that potassium fertilization led to an increase in the concentration of potassium in the plant, which in turn contributes to stimulating photosynthesis and other vital processes and increases the transfer of photosynthetic products to the main Sink. These results are in agreement with (8), (11), (15), (17) who indicated that increasing potassium fertilization has a significant effect on the trait. The results indicated in Table (3) also showed that there were significant differences when spraying the microelements boron and zinc. The boron and zinc mixture excelled, and the highest average for the trait was 52.23 nut.plant^{-1}.The reason may be due to the role of micro-elements in increasing the carbonization process and their contribution to the transfer of represented substances, which led to a reduction in the percentage of nuts . Boron and zinc to the cotton plant.

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Table (2) Effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the number of opening nuts/plant.

first factor	second factor			second factor average
	K0	K5	K10	
0	28 h	31.83 hg	38.30 f	32.71 d
Zn15%	33.70 g	43.03 ed	47.66 cd	41.46 c
B8%	40.53 ef	ed 43.66	49.20 cb	b 44.46
Zn+B	46.36 cd	b 52.73	57.60 a	52.23 a
The first factor average	37.15 c	42.81 b	48.19 a	

* Similar letters indicate that there are no significant differences in the trait between the studied treatments

3- The unit weight of nuts (g).

The results in Table (3) showed that there were significant differences between potassium concentrations in the trait of nuts weight. The third potassium concentration was excelled, and the highest average for the trait was 3.49 g, and it did not differ significantly from the second concentration, as it recorded an average of 3.48 g, excelled on the first treatment.The control treatment recorded the lowest average of 3.08 g. This may be due to the fact that the increase in potassium fertilization increases the potassium concentration in the plant, stimulates the photosynthesis process and vital processes, and contributes to the transfer of photosynthesis products to the main estuary, which in turn contributes to the increase in the weight of the nut.These results agree with (1) and (10, 24)), who indicated that potassium fertilization has a significant effect on the weight of the nut.

The results showed that there were significant differences when spraying the microelements zinc and boron, as the mixture of boron and zinc was superior, and the highest average for the traits was 3.76 g.The reason is that boron increases the transport of nutrients towards the newly developed areas, and this agrees with the findings of (3), (26).Zinc also contributes to the role of cell formation and seed development, Those who showed that increasing the addition of boron and zinc as a spraying on the vegetative mass increases the average weight of the nut.

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Table (3) Effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the nut weight (g).

first factor	second factor			second factor average
	K0	K5	K10	
0	2.62 h	fg 3.10	fg 3.11	2.94 d
Zn15%	g 2.94	3.47 dc	3.37 df	3.26 c
B8%	3.18 fe	3.58 dc	3.57 dc	b 3.44
Zn+B	3.59 bc	ba 3.79	3.91 a	3.76 a
The first factor average	3.08 b	3.48 a	3.49 a	

*** Similar letters indicate that there are no significant differences in the trait between the studied treatments**

4- trait of the flowering cotton yield in the first harvest (kg. ha^{-1}).

The results in Table (4) indicated that there were significant differences between potassium concentrations in the trait of the flower cotton yield, where the third concentration of potassium fertilizer (k10) was excelled, and the highest average for the trait was 2147.42 kg .ha^{-1}, and the control treatment recorded the lowest average for the trait amounted to 1730.67 kg .ha^{-1}.The reason is that the increase in potassium fertilization led to a significant increase in cotton yield. As it is absorbed by the plant, which increases its concentration in the leaves, and this is reflected positively on most of the vital processes that occur inside the plant, which causes an increase in the yield. These results agree with both.(29), (9), (7). The results showed that there were significant differences when spraying the microelements zinc and boron, where the zinc and boron mixture excelled, and the highest average for the trait was 2145.67 kg .ha^{-1}respectively. These results agree with both (12) (21), who showed that the increase in the addition of the microelements boron and zinc led to a significant increase in the trait.

Table (4) The effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the traits of the flowering cotton yield in the first harvest (kg. ha^{-1}).

first factor	second factor			second factor average
	K0	K5	K10	
0	d 1694	d 1730	1753 d	c 1725.67
Zn15%	1683 d	2103.67 c	2162.33 bc	1983 b
B8%	d 1753.67	2180 bc	ba 2265.67	2066.44 ab
Zn+B	d 1792	2236.33 bc	2408.67 a	a 2145.67
The first factor average	1730.67 c	2062.50 b	2147.42 a	

*** Similar letters indicate that there are no significant differences in the trait between the studied treatments.**

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5- The yield of flowering cotton in the second harvest (kg. ha^{-1}).

The results in Table (5) indicate that there are significant differences between the three potassium concentrations in the traits of the flowering cotton yield in the second harvest .The third potassium concentration (K10) excelled and recorded the highest average for the trait of 1074.08 kg .ha^{-1}, excelled on the first and second treatments. The control treatment recorded the lowest average for the trait, which was 865.75 kg .ha^{-1}. The reason may be due to the effect of potassium fertilization on the increase in the average weight of the nut(g) and on the number of nut, which is positively reflected on the cotton yield in the second harvest , These results agree with (15), (17), who indicated that the addition of potassium had a significant effect on the trait of the flower cotton yield in the second harvest .The results showed that there were significant differences when spraying the microelements zinc and boron, where the mixture of zinc and boron was superior, and the highest average of the trait was 1070.56 kg .ha^{-1}, as well as zinc and boron separately, and their averages were 991.56 and 1033.33 kg .ha^{-1}, respectively. While the control treatment recorded the lowest average for the trait, which was 863.44 kg H-1, and the reason is that the increase in the flower cotton yield may be due to the increase in the weight of the nut and the number of nut, and that these results are in agreement with the findings of (16), (11).

Table (5) The effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the traits of the flowering cotton yield in the second harvest (kg .ha^{-1}).

first factor	second factor			second factor average
	K0	K5	K10	
0	847.33 c	865 c	878 c	c 863.44
Zn15%	842 c	b 1051.67	1081 b	991.56 b
B8%	c 877.33	1090 b	ba 1132.67	ab 1033.33
Zn+B	896.33 c	1110.67 b	1204.67 a	1070.56 a
The first factor average	865.75 c	1029.33 b	1074.08 a	

* Similar letters indicate that there are no significant differences in the trait between the studied treatments.

6 Total flowering cotton yield (kg .ha^{-1}).

The results in Table (6) indicate that there are significant differences between potassium concentrations in the trait of the flowering cotton yield, and the third concentration of potassium (k10) was excelled, and the highest average of the trait was recorded at 3221.92 kg .ha^{-1}, excelled on the first and second treatments. The control treatment recorded the lowest average for the trait, which amounted to 2596.42 kg H-1, due to the effect of potassium fertilizer on increasing the weight of the nuts and the number of nut, which is reflected in the cotton flower yield. The results showed that there were significant differences when spraying the microelements zinc and boron in the trait of the cotton yield, where the mixture of boron and zinc was significantly excelled on the mixture of boron and zinc, which recorded the highest average of the trait amounting to 3210.33 kg .ha^{-1}.This may be due to the increase in the number of total and nut, and this is reflected in the increase in yield, as well as the importance of the microelements boron and zinc in transporting sugars and activating many enzymes. These results are consistent with (4), (11), (12).

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Table (6) Effect of spraying with potassium and microelements (zinc and boron) and the interaction between them on the trait of flowering cotton yield (kg .ha^{-1}).

first factor	second factor			second factor average
	K0	K5	K10	
0	c 2541.3	2595 c	2632.7 c	2589.67 c
Zn15%	2525 c	3155 b	3243.3 b	2974.44 b
B8%	2631 c	b 3270	3398.3 ba	3099.78 ab
Zn+B	2688.3 c	b 3329.3	3613.3 a	3210.33 a
The first factor average	2596.42 c	3087.33 b	3221.92 a	

* Similar letters indicate that there are no significant differences in the trait between the studied treatments.

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