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Al-Karawi & Al-Jumaily

المجلة العراقية لبحوث السوق وحماية المستهلك

STUDY OF SOME GROWTH CRITERIA AND YIELD OF SOYBEAN CROP WITH THE EFFECT OF BORON AND SOME GROWTH REGULATORS

***Ali W. R. Al-Karawi*[1], *Jassim M. A. Al-Jumaily*[2]**
[1]Diyala Directorate of Agriculture, Diyala, Iraq. aliwassmi530@gmail.com
[2]Professor PhD., Department of Field Crops, College of Agriculture, University of Baghdad, Baghdad, Iraq. jassim. @coagri.uobaghdad.edu.iq

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ABSTRACT

The study was conducted at research station A, department of field crops, college of agricultural engineering sciences, university of Baghdad during summer 2021 to evaluate the effect of boron and some growth regulators on some growth criteria and yield of soybean crop (cv. shimaa). The experiment was carried out according to split plots by using randomized complete block design with three replications. The main plots included three concentrations of boron (75, 150 and 225) mg.L^{-1}, the sub-plots included three levels of growth regulators, spraying kinetin (100 mg. L^{-1}), spraying ethrel (200 mg.L^{-1}) and spraying kinetin (100 mg.L^{-1}) + spraying ethrel (200 mg.L^{-1}) as well as spraying of distilled water as control treatment. The findings revealed that the spraying of ethrel at 200 mg.L^{-1} gave the lower means of plant height (114.68 cm), and gave the higher means of No. of branches (5.60 branch. plant^{-1}), leaf area (97.86 dcm^{2}), plant dry weight (206.64 g plant^{-1}) and this led to give higher means of seed yield (2.715 ton. ha^{-1}), while the concentrations of growth regulators did not significantly affect the leaf area index. Boron concentrations affected most of studied traits, 150 mg.L^{-1} of boron effect on most of traits and gave higher means of plant height (143.93cm), No. of branches (6.21 branch plant^{-1}), leaf area (111.53 dcm^{2} plant), leaf area index (7.47), plant dry weight (246.45 g), this led to give higher means of seed yield (3.071 ton.ha^{-1}). Result showed that boron and some growth regulators interaction have a significant effect on some characteristics under study. It has achieved spray treatments Boron with 150 mg.L^{-1} and ethrel of 200 mg.L^{-1} gave the higher means of No. of branches (6.97 branch plant^{-1}), leaf area (114.26 dcm^{2}.plant), LAI (7.62), plant dry weight (265.24 g.plant^{-1}).

Keywords: Soybean, boron, growth factors.

دراسة بعض معايير النمو والحاصل لمحصول فول الصويا بتاثير البورون وبعض منظمات النمو

***علي وسمي رشيد الكروي* [1]، *جاسم محمد عباس الجميلي*[2]**
1دائرة زرعة ديالى، ديالى، العراق. aliwassmi530@gmail.com
2قسم علوم المحاصيل الحقلية، كلية العلوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق. jassim. @coagri.uobaghdad.edu.iq

الخلاصة

نفذت التجربة في الحقول التابعة لقسم المحاصيل الحقلية – المحطة البحثية A - كلية علوم الهندسة الزراعية – جامعة بغداد/ الجادرية أثناء الموسم الصيفي لعام 2021 لدراسة دور البورون وبعض منظمات النمو في نمو وحاصل ونوعية فول الصويا صنف Shimaa، اذ طبقت التجربة على وفق ترتيب الالواح المنشقة Split-Plots Design بأستعمال تصميم القطاعات الكاملة المعشاة وبثلاثة مكررات، وتضمنت الألواح الرئيسة رش ثلاثة تراكيز من البورون 75 و150 و225 ملغم.لتر$^{-1}$، بينما تضمنت الألواح الثانوية ثلاثة معاملات من منظمات النمو (رش الكاينتين بالتركيز 100 ملغم.لتر$^{-1}$ ورش الإثريل بالتركيز 200 ملغم.لتر$^{-1}$ ورش الكاينتين بالتركيز 100 ملغم.لتر$^{-1}$+ الإثريل بالتركيز 200 ملغم.لتر$^{-1}$) فضلا عن معاملة المقارنة (رش النباتات بالماء المقطر فقط)، أظهرت نتائج التجربة ان معاملة رش الإثريل بالتركيز 200 ملغم.لتر$^{-1}$ أعطت أقل متوسط لارتفاع النبات 114.68 سم، وتفوقت بإعطائها أعلى عدد للأفرع في النبات 5.60 فرع.نبات$^{-1}$ والمساحة الورقية 97.86 سم^{2} ووزن النبات الجاف 206.64 غم.نبات$^{-1}$، بينما لم تؤثر تراكيز منظمات النمو التي رشت معنوياً في دليل المساحة الورقية، وأثرت تراكيز البورون المرشة معنوياً في أغلب الصفات المدروسة، إذ تفوقت النباتات التي رشت بالتركيز150 ملغم.لتر$^{-1}$ على باقي التراكيز في الصفات أرتفاع النبات 143.93 سم وعدد الأفرع في النبات 6.21 فرع.نبات$^{-1}$ والمساحة الورقية 111.53 سم^{2}.نبات$^{-1}$، ودليلها 7.47، والوزن الجاف للنبات 246.45 غم، الأمر الذي أنعكس وبشكل إيجابي على زيادة حاصل البذور الكلي 2.715 طن.هكتار$^{-1}$، وكان التداخل بين تراكيز البورون ومنظمات النمو معنوياً في الصفات قيد الدراسة، فقد حققت معاملة رش البورون بالتركيز 150 ملغم.لتر$^{-1}$ مع الإثريل بالتركيز 200 ملغم.لتر$^{-1}$ أعلى النتائج للصفات عدد ألافرع، المساحة الورقية ودليلها، الوزن الجاف بلغت 6.97 فرع.نبات$^{-1}$، 114.26 سم^{2}.نبات$^{-1}$، 7.62، 265.24 غم.نبات$^{-1}$ الأمر الذي أنعكس وبشكل إيجابي على زيادة حاصل بذور الكلي 3.071 طن.هكتار$^{-1}$.

الكلمات المفتاحية: فول الصويا، بورون، منظمات النمو.

INTRODUCTION

Soybean (*Glycine max* L). is a legume crop, its seeds contain a high percentage of protein ranging between 30-50% and an oil content of 18-24%, in addition to its use in the pharmaceutical and food industries, there are factors that increase the growth and yield of soybean per unit area, by using growth regulators that have an effect on specialized areas for growth, the processes of carbon metabolism, the transport system and the sites of accumulation in the reproductive organs, among the plant growth regulators are kinetin and ethrel, the Kinetin is a chemical substance that has a vital role in regulating growth by activating cell division in addition to its biological activity in the differentiation of vegetative tissues into buds, it also works to encourage the growth of buds and modulate of apical dominance, which leads to push the plant towards increase the reproductive buds and its reflection in increase the seed yield **(Negal *et al*., 2001).** As for Ethrel, it is a growth impediment dependent on synthetic growth regulators and its effect depends on breaking the apical dominance and partition of the metabolites between the different parts of the plant and raising its ability to exploit these products to increase the yield and its components **(Devi *et al*., 2011).** Growth regulators alone did not increase the yield, but soybeans need nutrients that contribute in increase of growth and seed yield, the importance of microelements, including boron, has been proven in the process of pollination, fertilization in leguminous crops, and it is reducing the flowers fall and cells division, pollen production, an increase in the fertilization process, and conveys the carbohydrates to the active areas of growth, especially in the reproductive stages of the plant, then an increase in the yield components and an increase in seed yield **(Allen & Pilbeam, 2006)**. The study aims to evaluate the effect of spraying the boron and growth regulators ethrel and kinetin on the growth, yield soybean.

MATERIALS AND METHODS

The study was conducted at research station A, department of field crops, college of agricultural engineering sciences, university of Baghdad, located within 44 east longitude and 33 north latitude, during the summer 2021, The experiment was carried out according to split plots by using randomized complete block design with three replications. The main plots included three concentrations of boron (75, 150 and 225) mg.L^{-1}, the sub plots included three levels of growth regulators, spraying kinetin (100 mg.L^{-1}), spraying ethrel (200 mg.L^{-1}) and spraying kinetin (100 mg.L^{-1}) + spraying ethrel (200 mg.L^{-1}) as well as spraying of distilled water as control treatment, spraying ethrel at 200 ppm and spraying of ethrel 200 ppm + kinetin 100 mg.L^{-1}.

Soil service process was carried out before planting, such as plowing and leveling, the field was divided into plots, with a distance 50 cm between the experimental units, the area of the experimental unit was 2.5 m × 2.5 m, which contained 3 lines, with the distance between lines 75 cm, and between the plants 20 cm, the plant density becomes 66666 plants.h^{-1} **(Al-Jumaili & Sarhan, 2010)**. Irrigation was carried out and the experimental land was left for 3 d to dry the soil. Soybean seeds of Shimaa variety were planted on 23 June, 2021 at a depth of 2-3 cm by 2-3 seeds in the hole, then reduced to one plant after two weeks of planting, the experiment land was fertilized with nitrogen fertilizer in the form of urea (46% nitrogen) with an amount of 160 kg N.h^{-1} in two times, and superphosphate fertilizer (46% P_2O_5) was added at a rate of 80 kg P_2O_5.h^{-1} before planting **(Ali, 2012)**, the crop service was carried out by irrigation and weeding whenever necessary.

Preparation of growth regulators and Boron

1. the kinetin was dissolved by using alcohol (50% alcohol) with the addition of 2-3 drops of HCL acid and put on a hot plate stirrer at a temperature of 50°C with stirring

continuously to ensure complete dissolution, spray the growth regulator (kinetin) at the beginning of flowering stage R1 and repeat the spray at flowering is completed R2.

2. 7 mL of a growth retardant solution (48% ethrel) was put in a volumetric flask and complete the volume to 1 liter by adding distilled water to get the concentrations 200 mg.L^{-1} and it was diluted to the required volume, spray ethrel at the beginning of flowering stage R1 and repeat the spray when flowering is completed R2.
3. Boric acid H_3BO_3 (17% boron) was used as a source of boron, as the specified weight of the element was dissolved in a quantity of distilled water and shaken until complete dissolution, spray boron at the beginning of flowering R1 after three days of spraying growth regulators and repeat the spray when flowering is completed R2, and use a solution of Al-Zahi as a spreader material by placing 2-3 drops.l^{-1} to increase the efficiency of absorption and cause the full wetness and reduce the water tension on the plant **(Abu Dhahi *et al.*, 2001)**, and spraying process were carried out in the evening using hand-sprayer 16-liter , As for the control treatment, its plants were sprayed with distilled water only.

Studied traits

When the plant reached full maturity, five plants were randomly selected for calculating the Traits, plant height (cm) , the number of branches, leaf area (dcm2), leaf area index, plant dry weight (g), total seed yield (tons.h^{-1}),

LA = 0.624 + (0.723) (L .W) **(Wiersma & Bailey, 1975)**

Statistical analysis

The results were analyzed using the statistical program, GenStat according to the used design, and the means were compared with L.S.D test at the 0.05 probability level **(Steel & Torrie, 1980)**.

RESULTS AND DISCUSSION

Plant height (cm)

The findings of (Table 1) indicated that spraying of different concentrations of growth regulators led to significant differences between the averages in this trait. Spraying of ethrel at a concentration 200 mg.L^{-1} reduced the plant height to 114.68 cm as compared with the control treatment, that gave higher rate in the height 158.07 cm. The decrease in plant height may be due to the role of ethrel under this concentration in causing opposite effects to the effects of gibberellins in plants by preventing or impeding a conversion of the compound Geranyl pyrophosphate to Coponyl pyrophosphate, which represents the first step in the chain of gibberellin biosynthesis in the subapical meristem area that represents the primary meristem for elongation and then a reduction in plant height **(Atiya & Jadoua, 1999)**. These results agree with what was obtained by **Kaur *et al*. (2015)** & **Al-Darraji & Al-Jumaily (2020)** who indicated that spraying of ethrel led to a significant decrease in the plant height of soybean. The concentration 150 mg.L^{-1} gave the higher average amounted to 143.93 cm, and the concentration 225 mg.L^{-1} gave the lower average amounted to 84.08 cm. Therefore, boron has an important role in transporting metabolic compounds to active growth areas such as meristematic tissues, which contribute to increase in the cells division and the elongation, which is positively reflected in the increase in plant height **(Al-Dulaimi *et al*., 2007)**. These results agree with what was obtained by **Devi *et al*. (2012)**. The interaction between boron concentrations and growth regulators was not significant in this trait.

Table (1): Effect of spraying boron and some growth regulators on plant height (cm), number of branches per plant (branch.plant^{-}1)

Boron concentrations (B) (mg.L^{-1})	Growth regulators (Gr) mg.L^{-1}			(B) Mean
	Kinetin 100	**Ethrel 200**	**Ethrel + Kinetin 100 200**	
75	126.80	124.93	130.13	127.29
150	145.60	142.47	143.73	143.93
225	83.60	76.63	92.00	84.08
Gr mean	118.67	114.68	121.95	
Control mean	**158.07**			
LSD 0.05 interaction	**NS**			
LSD 0.05 GR	**5.18**			
LSD 0.05 boron	**6.28**			

Number of branches per plant (branch.plant^{-1})

It is noted from the results of (Table 2) there are significant differences in the number of branches per plant, as the spraying with ethrel at a concentration of 200 mg.L^{-1} led to the higher average in number of branches reaching 5.60 branches, with an increase of 47.36% as compared with the control treatment that gave the lower average for the trait 3.80 branch. The process of emergence and development of lateral branches in the plant is related to the phenomenon of apical dominance, which is under the control of plant hormones, especially auxins. Here, the physiological activity of growth impediments appears, including ethrel when sprayed with the appropriate concentration, which acts as anti-auxin compounds by reducing the levels of tryptophan, which has an important role in the biosynthesis of auxin **(Suh & Lee, 1997)**, which led to reducing the effect of apical dominance and then increase in the number of branches in the plant, this result agrees with what was found by **Kaur *et al*. (2015); Bramhankar *et al.* (2018); Al-Darraji & Al-Jumaily (2020)** that there was a significant effect of the ethrel concentration on the number of branches of soybean plants.

There are significant differences between the concentrations of boron in the number of branches in the plant, as the concentration of 150 mg.L^{-1} gave the higher average for the trait amounted to 6.21 branches and an increase of 63.42% compared to the control treatment, which gave the lower average amounted to 3.80 branches. The interaction between the concentrations of boron and the growth regulators was significant, where the combination between boron 150 mg.L^{-1} with ethrel 200 mg.L^{-1} gave the higher value, reached 6.97 branches. The increase in the number of branches may be due to the positive and effective role of boron in transporting carbohydrates from the source to the downstream and providing them in a right time to the modern and effective growth centers, which gave an opportunity for the formation and growth of branches in the plant **(Al-Ani, 1991)**, and these results are consistent with the findings of **Al-Jumaili (2014); Al-Naimi (2019)** showed that there was a significant effect of boron concentrations on the number of branches of the soybean plant.

Table (2): Effect of spraying boron and some growth regulators on number of branches per plant (branch.plant^{-1}).

Boron concentrations (B) (mg.L^{-1})	Growth regulators (Gr) mg.L^{-1}			(B) Mean
	Kinetin 100	**Ethrel 200**	**Kinetin + Ethrel 100 200**	
75	6.00	6.27	4.63	5.63
150	6.00	6.97	5.67	6.21
225	3.20	3.57	3.30	3.36
Gr mean	5.07	5.60	4.53	
Control mean	**3.80**			
LSD 0.05 interaction	**0.67**			
LSD 0.05 GR	**0.39**			
LSD 0.05 boron	**0.39**			

Leaf area (dm^2)

The effect of growth regulators were significant on the leaf area, as the spraying with ethrel at a concentration of 200 mg.L^{-1} gave the higher means, which reached 97.86 dm^2, and did not differ significantly from the kinetin at a concentration of 100 mg.L^{-1}, which gave 96.34 dm^2 compared to the control treatment, which gave the lower average for the trait was 87.03 dm^2 (Table 3). Ethrel play important role in cell division activating, reducing apical dominance and increase the physiological activities, thus increase the plant growth, such as the leaf area and the number of leaves per plant **(Suh & Lee, 1997)**, and these results are consistent with the results of **Kaur *et al*. (2015); Sahane *et al*. (2015a)**, as well as the role of kinetin in increasing the number of grana inside the chloroplasts, thus increasing the surface area of leaves **(Abu Zaid, 2000)**, and these results are in agree with **Kumar *et al*. (2020).**

Boron concentrations were significantly affected in the leaf area, where the concentration of 150 mg.L^{-1} gave the higher average for this trait, reaching 111.53 dm^2, with an increase of 28.15% compared to the control treatment, which gave the lower average in leaf area of 87.03 dm^2. The increase in the leaf area may be due to the positive role of boron in increasing the division of leaf cells and increasing their expansion, which was reflected in the increase of leaf area, this result agrees with the results of **Al-Dulaimi & Al-Mohammadi (2014); Al-Jumaili (2014)** showed that a significant effect of boron on the leaf area of the soybean plant. The interaction between the concentrations of boron and the growth regulators was significant, where the combination between boron 150 mg.L^{-1} with ethrel 200 mg.L^{-1} gave the higher value in leaf area, reached 114.26 dm^2 and it did not differ significantly from the combination between boron 150 mg.L^{-1} with kinetin 100 mg.L^{-1} in the leaf area, which amounted to 111.24 dm^2.

Table (3): Effect of spraying boron and some growth regulators on leaf area (dcm^2).

Boron concentrations (B) (mg.L^{-1})	Growth regulators (Gr) mg.L^{-1}			(B) Mean
	Kinetin 100	**Ethrel 200**	**Kinetin + Ethrel 100 200**	
75	106.34	98.52	82.14	95.67
150	111.24	114.26	109.10	111.53
225	71.45	80.81	83.41	78.56
Gr mean	96.34	97.86	91.55	
Control mean	**87.03**			
LSD 0.05 interaction	**6.98**			
LSD 0.05 GR	**4.03**			
LSD 0.05 boron	**5.65**			

Leaf area index

The results of (Table 4) indicated that no significant differences between the concentrations of growth regulators in the soybean plants in this trait, while the concentrations of boron were significantly affected on this trait, as the concentration of 150 mg.L^{-1} gave the higher average, amounted to 7.44 with an increase rate of 28.28% compared to the control treatment, which gave the lower average, which was 5.80. The leaf area index represents the ratio between the leaves area to the area occupied by the plant, and in the circumstances of this research, any increase in the leaf area will result in an increase in its index because the occupied area by the plant from the ground is fixed. The increase in the leaf area index is due to the positive and effective role of boron in the growth of the developing apex and the increase in the speed of growth of meristematic tissues and the activation of the growth of cell membranes, and all this led to an increase in the leaf area and then its index **(Asad *et al.*, 2003)**, this result is consistent with the findings of **Al-Jumaili (2014); Al-Naimi (2019)**. The interaction between the concentrations of boron and the growth regulators was significant, where the combination between boron 150 mg.L^{-1} with ethrel 200 mg.L^{-1} gave the higher value in leaf area index of 7.62 and did not differ significantly from the combination between boron 150 mg.L^{-1} with kinetin 100 mg.L^{-1} in the leaf area index, which amounted to 7.42.

Table (4): Effect of spraying boron and some growth regulators on leaf area index.

Boron concentrations (B) (mg.L^{-1})	**Growth regulators (Gr) mg.L^{-1}**			**(B) Mean**
	Kinetin 100	**Ethrel 200**	**Kinetin + Ethrel 100 200**	
75	7.09	6.57	5.48	6.38
150	7.42	7.62	7.27	7.44
225	4.76	5.39	5.56	5.24
Gr mean	6.42	6.53	6.10	
Control mean	**5.80**			
LSD 0.05 interaction	**0.91**			
LSD 0.05 GR	**NS**			
LSD 0.05 boron	**0.33**			

Dry plant weight (g.plant^{-1})

The results of (Table 5) showed that the effect of growth regulators was significant on the dry weight of the plant, as the spraying with ethrel at a concentration of 200 mg.L^{-1} achieved the higher average, reached 206.64g, while the kinetin at a concentration of 100 mg.L^{-1} achieved the lower average for the trait was 193.00 g. The superiority of the sprayed plants with ethrel at a concentration of 200 mg.L^{-1} may be attributed to the increase in the vegetative growth represented by the number of branches in the plant and the leaf area (Table 2 and 3), which led to an increase in light interception and an increase in the efficiency of photosynthesis and its outputs, which contributed to an increase in the dry weight of the plant, this result agrees with the results obtained by **Devi *et al.* (2011); Al-Darraji & Al-Jumaily (2020)** who indicated a significant effect of ethrel concentrations on the dry weight of the soybean plants. The concentrations of boron were significantly affected on the dry weight of the plant, as the concentration of 150 mg.L^{-1} gave the higher average, amounted to 246.45 g with an increase rate of 18.85% compared to the control treatment, which gave the lower average, which was 207.37. The increase in the dry weight of the plant when spraying with boron 150 mg.L^{-1} may be due to the superiority of concentration in the characteristics of the number of branches and leaf area (Table, 2 and 3), which is reflected in the increase in the products of photosynthesis that are deposited in the form of a dry substance in the plant, these results are consistent with the findings of **Al-Dulaimi & Al-Mohammadi (2014); Timotiwu**

***et al*. (2018)** that there was a significant effect of boron spraying on the dry weight of the soybean plants. The interaction effect between the concentrations of boron and growth regulators was significant in the dry plant weight. The sprayed plants with boron at a concentration of 150 mg.L^{-1} with ethrel of 200 mg.L^{-1} achieved the higher interaction value, reached 265.24 g compared to the control treatment, which gave the lower value for this trait, amounted to 207.37 g. It is clear from this combination of the spraying with boron at a concentration of 150 mg.L^{-1} with ethrel at a concentration of 200 mg.L^{-1} led to a better redistribution of the dry matter for the growth of branches and leaf area, as well as an increase in yield components, which led to an increase in the dry matter in the plant.

Table (5): Effect of spraying boron and some growth regulators on plant dry weight (g).

Boron concentrations (B) (mg.L^{-1})	Growth regulators (Gr) mg.L^{-1}			(B) Mean
	Kinetin 100	Ethrel 200	Kinetin + Ethrel 100 200	
75	221.51	231.18	230.76	227.82
150	236.75	265.24	237.35	246.45
225	120.75	123.50	122.25	122.17
Gr mean	193.00	206.64	196.79	
Control mean	**207.37**			
LSD 0.05 interaction	**7.39**			
LSD 0.05 GR	**4.27**			
LSD 0.05 boron	**9.16**			

Total seed yield (ton.ha^{-1})

The seed yield represents the total of several components, namely the number of pods in the plant, the number of seeds in the pod, and the weight of the seed, and these components are the final outcome of the biochemical activities that occur inside the plant during its life cycle. The results of (Table 6) showed that a significant difference between the concentrations of growth regulators in the average of the total seed yield, as the spraying with ethrel at a concentration of 200 mg.L^{-1} gave the higher average for the trait amounting to 2.715 tons.ha^{-1} with an increase of 8.77%, compared to (the kinetin at a concentration of 100 mg.L^{-1} + ethrel at a concentration of 200 mg.L^{-1}) which gave the lower average, amounted to 2.496 tons.ha^{-1}. The superiority of the sprayed plants with ethrel at a concentration of 200 mg.L^{-1} in the total seed yield, may be attributed to their superiority in the number of branches per plant, leaf area and plant dry weight (Table 2, 3 and 5), this result agrees with the results obtained by **Devi *et al*. (2011); Sahane *et al*. (2015b); Bramhankar *et al.* (2018); Al Daraji (2019)** they indicated a significant effect of ethrel concentrations on the soybean seed yield. As for the effect of boron on seed yield, the results showed that there were significant differences between the concentrations of the sprayed boron in this trait, as the sprayed plants with a concentration of 150 mg.L^{-1} gave the higher average, reached 3.071 kg.h^{-1} and did not differ significantly from the treatment of the spraying with boron at a concentration of 75 mg.L^{-1}, amounted to 2.978 tons. h^{-1} with an increase of 76.59% and 71.24% for the two treatments, respectively compared to the spraying with boron at a concentration of 225 mg.L^{-1}, which gave the lower average, amounted to 1.739 tons.h^{-1}, as the plants leaves that sprayed under this concentration were burned at the beginning of the spraying phase. The increase in the seed yield is due to the superiority of the same treatment 150 mg.L^{-1} in the number of branches per plant (Table 2) and leaf area (Table 3), these results are in agreement with the findings of **Devi *et al* (2012); Singh *et al* (2018); Al-Nuaimi & Al-Jumaily (2020)** they indicated a significant difference between boron levels in the seed yield per unit area in the soybean plant as for the interaction between boron and growth regulators, it had no significant effect on this characteristic.

Table (6): Effect of spraying boron and some growth regulators on total seed yield (tons. h^{-1}) .

Boron concentrations (B) (mg.L^{-1})	**Growth regulators (Gr) mg.L^{-1}**			**(B) Mean**
	Kinetin 100	**Ethrel 200**	**Kinetin + Ethrel 100 200**	
75	3.031	3.112	2.791	2.978
150	2.986	3.236	2.989	3.071
225	1.711	1.796	1.708	1.739
Gr mean	2.576	2.715	2.496	
Control mean	**2.596**			
LSD 0.05 interaction	**NS**			
LSD 0.05 GR	**0.10**			
LSD 0.05 boron	**0.17**			

CONCLUSIONS

1. Ethrel had a role in regulating plant growth by reducing plant height and increasing the number of branches in the plan and increasing the percentage of fertility and reducing the drop of flowers, which results in an increase in the seed yield.
2. Boron performed clear physiological functions in increasing the fertilized flowers and then increasing the number of pods in plant that reflected on the seed yield.
3. Spraying ethrel at a concentration of 200 mg.L^{-1} and 150 mg.L^{-1} of boron led to an increase in growth factors Positively associated with an increase in yield and its components.
4. Spray ethrel concentration 200 mg.L^{-1} to give it the highest seed yield and protein content in the seeds.

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