Effect of Ethephone, Zinc and Boron on growth and Yield of Cucumber (Cucumis Melo var. Flexuosus) Cultivated in Plastic Houses and The Economic Feasibility From That

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Abstract

A field experiment was carried out in one of the plastic houses belonging to the College of Agriculture, Al-Qasim green University to studying the possibility of cultivating cucumis melo var. flexuosus inside greenhouses to improve growth and yield using microelements and ethephon. Microelements (Zn + B) at a concentration of 250 mg/L and the growth regulator Elathyphon at a concentration of (2.5, 1.5, 0) ml/L were used as a spray on the shoots. A factorial experiment was applied with the split plot system and randomized complete block design (RCBD) according to the least significant difference (L.S.D) test under the significance level of 0.05. The results were as follows: The interaction between (Zn + B) had a positive and significant effect on indicators such as leaf area 206.88 dm², number of female flowers 22.33 flower⁻¹, and the total yield 4327 kg, the percentage of nitrogen, phosphorous and potassium in the leaves was 0.6733, 2.691, 2.927, and the percentage of zinc and boron in the leaves was 19.626, 14.282. The yield of one plant and the weight of the fruit 2575.5 g, 121.44 g, respectively. As for the interaction between Zn + B + 1.5, a significant effect on leaf area trait 239.91 Number of female flowers 26.33 flower⁻¹, Total yield 5494 kg The percentage of PK in leaves 0.7233, 3.080 and the percentage of boron in leaves 14.560 while the yield of one plant 3270.4 g

Keywords: Cucumber, Ethephon, Zinc, Boron, Greenhouses.

1. Introduction

Cucumber Cucumis melo var. flexuosus belongs to the Cucurbitaceous family. Most cucumbers are dioecious and monococious, meaning that the plant bears male and female flowers separately on the same plant. The predominant pollination is cross-pollination by insects. The chromosome number of cucumber is (2n=14) Cucumber are grown in Iraq in two lugs in open fields (spring and autumn), The area planted with the cucumber crop in Iraq for the year 2018 reached (55134 dunums) and production amounted to (138.353 tons), while the area planted with summer cucumbers reached (17.008 dunums) and production It reached (34.788 tons) [1]. In view of the increased demand for the cucumber crop in all seasons, which called for finding alternative solutions, including the cultivation of distinct local varieties in abundant production inside greenhouses, and because the sexual behavior of the varieties spread in local agriculture is characterized by the late appearance of feminine flowers as a result of the high rate of gibberellin / ethylene in plant tissues. This is in agreement with the results of the studies conducted by [2], that the high rate of ethylene inside plant tissues on the rate of Gibberellins works to change the sex ratio in favor of female flowers: The number of female flowers in a cucumber plant is one of the determinants of production, as the sexual expression of cucumber is infected by the endogenous level of growth hormones and can be stimulated by external application or foliar spraying with growth regulators [3,4].

Based on this importance, we conducted this research to study the effect of spraying cucumber plant with ethephon solution on changing the sex ratio and raising the level of ethylene to accelerate the emergence of female flowers and increase their number. [5], found that ethephon at a concentration of 250 and 350 mg/ l³ stimulates female flowering in cucumbers, especially when spraying the second and third leaves, as well as spraying the plant with microelements, Zinc where play an important role in the production and formation of pollen and has a role in the work of the enzymes [6].

Zinc is one of the most important eight micro-elements in plant nutrition, as it plays an important role in plant building and growth through its participation in the formation of many enzymes and protein substances. It participates in the processes of carbohydrate metabolism through its direct effect on the efficiency of photosynthesis. The net product of photosynthesis
decreased by 50-70% depending on the type of plant and the degree of scarcity of the element, and this effect may be due to a decrease in the efficiency of enzyme performance (Carbonic anhydrase), because zinc is included in the synthesis of this enzyme. Zinc is a component of the amino acid tryptophan which is the basic building block for auxin and vitamin A and many important enzymes in plant growth and that zinc deficiency leads to yellowing of modern leaves and lack of development and has an important role in plant productivity quantitatively and qualitatively through its influence in the process of carbon metabolism, nitrogen fixation, respiration and other metabolic processes. [7], Boron has an important role in the life of plants, as it is necessary for the formation of hormones in plants, in addition to its role in the process of pollination and the formation of fruits. It also controls the rate of water entry into the plant and the absorption of water from the soil [8], also works on Facilitating the movement of photosynthetic products from the leaves to the active areas of the plant.

The study aims at demonstrating the possibility of cultivating cucumber in protected conditions and the economic feasibility of its cultivation, as well as the role of ethephon and microelements (zinc, boron) in encouraging and improving flowering and increasing fertility.

2. Materials and Methods

A field experiment was conducted in one of the plastic houses of the College of Agriculture, AL-Qasim Green University on 10/1/2020. The 180 m² (36 x 5) house has been tilled and leveled. Soil was prepared for planting by adding organic matter (cow and sheep manure) and compound fertilizer (DAP) at a ratio of (46-18) (N-P2O5) at a rate of 200 kg/ha³ at once and adding urea fertilizer (46% N) at a rate of 100 kg H and sulfate Potassium (41.5% K) at 100 kg h⁻¹ in two batches each. A factorial experiment was carried out using Randomized complete block Design (RCBD) with three replications. The experiment included two factors: the first factor, the microelements (Zn, B, Zn+B) at a concentration of 250 mg/L⁻¹ in the main plots. The spraying was done at the beginning of flowering and the second spray 25 days after the first spray. The second, ethephon, was sprayed with several concentrations (0, 1.5, 2.5) ml/L⁻¹ in the Sup plot in two sprays at the stage of 3-6 true leaves.

The results were analyzed according to the LSD test under probability0.05. The following indicators were measured:
- Leaf area : number of female flowers, Total yield
- percentage of N : According to the method mentioned by [9], the total nitrogen was calculated from the following equation:
  \[ \text{P} \times \text{percentage of phosphorous was estimated according to the method of [10].} \]
- percentage of K: The percentage of potassium in the leaves was estimated as reported in [11], using a flame photometer.
- percentage of Zn: Zinc was measured using an atomic absorption spectrophotometer, according to [12].
- percentage of B: Boron was estimated according to the method proposed by [13].

fruit weight rate=Total experimental unit yield /number of fruits in the experimental unit

One plant Yield (g) = number of fruits x weight of one fruit

Total yield: The total yield from the first fairy to the last fairy was collected for each experimental unit (1.56) and the total yield of the regular plastic house, which had an area of 504m² (56X9) and contained 1680 plants, was calculated. The yield of one plant (g) * 1680 The number of plants in the plastic house 504m²

3. Results and Discussion

The leaf area is an important characteristic that expresses the ability of a plant to grow and develop. The results of the table (1) indicate that there are significant differences when treating spraying with microelements, as it was found that spraying with (Zn+B) gave the highest rate of leaf area character with an increase of 63% compared to the control treatment, the reason is attributed to the role of zinc in the formation of the amino acid tryptophan, of which the hormone (IAA)is necessary in the process of cell division and elongation. The reason for increasing the leaf area by using boron may be due to an increase in the efficiency of roots and root hairs on transport and thus increase the growth rates and the absorption of solar radiation by the leaves and increase the efficiency of photosynthesis and the vitality of the plant, one of the most important manifestations of which is the increase in the leaf area This agrees with what is found [14-16], who stated that boron spraying on the shoot of squash plant led to a significant increase in vegetative growth measurements compared to the control treatment. The reason for the superiority of the spray treatment with ethephon at a concentration of 1.5 ml/L⁻¹, which recorded the highest rate and an increase of 7.21% attributed to the role of ethephon in reorganizing plant growth and development by reducing apical dominance and lowering plant height and directing growth factors towards activating cell division and increasing the necessary physiological activities responsible for increasing vegetative growth such as the number of leaves per plant and the area of one leaf and as a result increasing the leaf area as a result of impeding the growth of the growing top of the stalk [18]. This result agreed with the results obtained by [19], which indicated that there was a significant effect of ethephon spray concentrations on the leaf area of soybean. The same table indicated ethephon the reason for reducing leaf area at concentration 2.5 ml/L⁻¹ results from its effect in reducing the volume of cells and reducing the
intercellular spaces of the intermediate tissue cells, especially at high concentrations of it, and thus the leaf becomes shorter and thicker and its area decreases, while the low and moderate concentrations lead to an increase in the leaf area as a result of encouraging growth, as indicated by most Researchers in this field, including [20].

It was also found that spraying with zinc and boron table 1 led to a significant increase in the average number of female flowers, with an increase in28%, as zinc has an important role in increasing the number of flowers in the plant by stimulating the formation of pollen grains (2) Zinc affects the rate of the contract by encouraging the manufacture ofAA Auxin stimulates the formation of flowers in plants with a long day, if sufficient light period is given [21]. Which makes the end result is an increase in the number of fruits and the yield this is consistent with what he mentioned [22]. Boron also has an important role in fertilization processes, as it is necessary for the germination and growth of pollen grains in the tissues of the stigma and flower.

The reason for the superiority of spraying with boron in increasing the measurements of flower growth is due to the role of boron in the germination and growth of the pollen tube of pollen grains and increasing and improving the rate of fertilization, which leads to an increase in the number of female flowers and an improvement in the rate of knots. It also increases the chances of the plant to produce flowers and fruits, and the treatment of spraying with ethephon was Also superior at a concentration of 1.5 ml /L which led to a significant increase in the number of female flowers, and because the determination of the sex of flowers depends on the level of gibberellin and ethylene in plant tissues, the high rate of ethylene worked to change the sex ratio in favor of female flowers and increase their number [23], and it may be attributed The activating role of ethephon to ethylene gas CH2 = CH2, which is released when decomposing and in turn affects the flowering sex of cucumber and other cucurbits such as pumpkin [24], in addition to activating the formation of a group of enzymes in tissues treated with ethylene Cellulose Peroxidase, Cataloës, a -amylase, protease and the formation of RNA responsible for protein synthesis [25].

Heating operators in the 1860s noticed that ethylene enters as an active agent in smoke that causes an increase in female flowering in squash. The Russian workers also found that the best time for smoking is in the first three leaf stage, as it works to reverse the sex of the flowers, which is consistent with [26], where plants treated with ethephon produced female flowers only on cucumber plant as these results agree with [27] and with [28], who noticed that spraying the shoot of zucchini in the early stages of growth (from the first leaf to the fifth leaf) at a concentration of 500-100 mg L-1 of ethephon solution led to a decrease in the sexual ratio and an increase in the number of female flowers. We also note that there is a significant effect of the percentage of N,P and K In Leaves and an increase 29%, 27% And 48% straight that the increase happening the percentage of nitrogen, phosphorous and potassium in the leaves may return To the role of zinc and boron in the absorption of NP+K Which was added to the soil in the form of (DAP + potassium sulfate) where the elements contributed in appropriate quantities near the root area contributed to increasing the efficiency of the roots for absorption and transfer to the vegetative system and its accumulation inside the plant, which and due to increase its concentration in the leaves (10) to provide nitrogen and phosphorous Ready-made in the soil as a result of increased levels of mineral fertilizer contributed to increased absorption NS By the roots and which is reflected In turn, it increases its concentration in the plant, so Phosphorous strengthens and increases the activity of the root system of the plant, which may work to increase absorption Nutrients from the plant, including phosphorous, nitrogen and potassium) [29]. Potassium plays an important role in regulating the water effort of the cell and opening and closing the stomata, which facilitates the absorption and transfer of water and nutrients from the soil to the plant. [30],the proportion of zinc and boron in cucumber leaves in the conditions of foliar fertilization with the two components increased significantly and with an increased percentage38% and11.9% respectively compared to the control treatment, and this confirms the view that fertilization with both zinc andboron combined or separately leads to an increase in the content of the leaves and other parts of the plant from the two elements. There was a noticeable increase in the boron content of the leaves. The reason for this may be that boron increases the readiness of the zinc element in addition to many other elements. Several studies also confirmed that fertilizing with boron led to an increase in the availability of most of the mineral elements and an increase in the plant’s ability to absorb as well as the state of zinc, where fertilization with it led to an increase in the boron content of the plant parts [31] and [32], the increase in growth indicators. The vegetative area, especially the leaf area, which increases carbon metabolism and the production of complex compounds such as carbohydrates, soluble amino acids and organic acids that are transmitted to the fruits, where boron plays an important role in transporting carbohydrates and manufactured materials in the leaves and accelerating their transmission and accumulation in the fruits [33]. Which leads to an increase in its weight, and the increase in the number of female flowers increases the yield of one plant and then an increase in the total yield.

Table(2) shows the effect of the interaction between the micro-elements and ethephon sprays, which is due to the effect of zinc, boron and ethephon jointly with each other in the superiority of the leaf area with an increase of 89% and the number of female flowers by an increase of 97% and an increase in N,P,K,Zn,B in Leaves: 159%, 68% 18.5%, 59, 101 %, respectively, as well as a significant increase in one plant yield 162% . The percentage increase in the weight of one fruit 18.6%.
Table 1. Effect of ethephon, zinc and boron on the growth and yield of cucumber plant on some chemical and qualitative indicators

| Fruit weight(g) | One plant yield(g) | B%  | Zn%  | K%   | P%   | N%   | plastic house product 504 m² | Number of flowers female | Leaf area Ds.m² | Transactions |
|-----------------|-------------------|-----|------|------|------|------|-------------------------------|--------------------------|--------------|-------------|
| 110.11          | 1526.8            | 12.763 | 14.172 | 1.967 | 0.5278 | 2.079 | 2565                          | 17.11              | 126.26      | Control     |
| 112.65          | 2089.9            | 13.269 | 18.628 | 2.524 | 0.5178 | 2.250 | 3511                          | 20.00              | 152.41      | Zn          |
| 109.00          | 1583.8            | 13.558 | 15.614 | 2.664 | 0.5789 | 2.026 | 2661                          | 17.22              | 166.89      | B           |
| 121.44          | 2575.5            | 14.282 | 19.626 | 2.927 | 0.6733 | 2.691 | 4327                          | 22.00              | 206.88      | Zn+B        |
| 1.834           | 67.11             | 0.1557 | 0.5284 | 0.0480 | 0.02206 | 0.1086 | 112.7                          | 1.581              | 4.746       | LSD 0.05    |

Table 2. Effect of interaction between ethephon, zinc and boron on the growth and yield of cucumber plant on some chemical and qualitative indicators.

| Fruit weight(g) | One plant yield(g) | B%  | Zn%  | K%   | P%   | N%   | plastic house product 504 m² | Number of flowers female | Leaf area Ds.m² | Transactions |
|-----------------|-------------------|-----|------|------|------|------|-------------------------------|--------------------------|--------------|-------------|
| 105.67          | 1244.8            | 12.533 | 12.757 | 1.187 | 0.4533 | 1.530 | 2091                          | 13.33              | 126.86      | Control x 0 |
| 107.67          | 1666.4            | 13.367 | 13.853 | 2.510 | 0.5400 | 2.190 | 2800                          | 22.00              | 134.64      | Control x 1.5 |
| 117.00          | 1669.0            | 12.390 | 15.907 | 2.203 | 0.5900 | 2.517 | 2804                          | 16.00              | 117.27      | Control x 2.5 |
| 93.94           | 1643.3            | 12.183 | 15.473 | 2.570 | 0.4667 | 2.500 | 2761                          | 19.00              | 157.22      | Zn x 0      |
| 113.00          | 2200.9            | 12.770 | 21.557 | 2.633 | 0.5267 | 1.490 | 3698                          | 21.00              | 162.84      | Zn x 1.5    |
| 131.00          | 2425.6            | 14.853 | 18.853 | 2.370 | 0.5600 | 2.760 | 4075                          | 20.00              | 137.18      | Zn x 2.5    |
| 106.33          | 1327.9            | 14.857 | 15.553 | 2.477 | 0.5567 | 2.743 | 2231                          | 14.00              | 174.27      | B x 0       |
| 115.33          | 2009.1            | 12.393 | 17.710 | 2.770 | 0.6200 | 1.773 | 3375                          | 21.67              | 185.62      | B x 1.5     |
| 105.33          | 1414.3            | 13.423 | 13.580 | 2.747 | 0.5600 | 1.560 | 2376                          | 16.00              | 140.77      | B x 2.5     |
| 117.33          | 2402.7            | 14.207 | 20.877 | 2.923 | 0.6733 | 2.467 | 4037                          | 22.67              | 215.99      | Zn + B x 0  |
| 121.67          | 3270.4            | 14.560 | 18.557 | 3.080 | 0.7233 | 2.523 | 5494                          | 26.33              | 239.91      | Zn + B x 1.5 |
| 125.33          | 2053.5            | 14.080 | 19.443 | 2.777 | 0.6233 | 3.083 | 3450                          | 17.00              | 164.74      | Zn + B x 2.5 |
| 3.840           | 90.96             | 0.2243 | 16.165 | 0.1505 | 0.03478 | 0.1561 | 152.8                          | 1.920              | 8.195       | LSD 0.05    |

Conclusion

1. The experiment showed the possibility of cultivating the cucumber in protected conditions in a commercial manner because of its economic due to the high prices and consumer desire and the production of its seeds locally compared to the ordinary cucumber.
2. The superiority of the combination (Zn + B) in most of the studied indicators, as it gave the highest yield as well as other indicators.
3. Increasing the concentration of ethephon had a negative role in many of the studied indicators.
4. Ethephon spray at a concentration of 1.5 ml/L⁻¹, the reason for the increase in female flowers and thus the increase in the yield, as it exceeded in most of the studied indicators.
5. Boron had no role in increasing the number of female flowers, but it improved the rate of the contract.

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