Effect of concentration and date of spraying with trace elements on growth and yield of cotton plant (Gossypium hirsutum L.)

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Abstract

This study was conducted in the fields of the Cotton Research Unit / Technical Agricultural College / Mosul, to study the effect of three concentrations of the trace element composition (0, 1.25, 2.5) ml / liter and three spraying dates (the vegetative growth stage, the flowering stage and the boll formation stage) on qualitative and quantitative characteristics of vegetative growth and yield of Lashata cultivar cotton plant. The seeds were sown at 15/4/2018 in mixed soil by adopting the design of complete random design. RCBD with three replicates and one experimental unit contained ten homogeneous plants. The results were analyzed and tested according to the Duncan polynomial test under the level of error probability of 5%. The results of this study showed a significant effect of the trace elements in most of the studied characteristics. Especially when adopting the spraying date in the vegetative growth stage as the vegetative growth characteristics increased (plant height, number of nodes until the first fruit branch, number of vegetative branches, number of fruiting branches) and quantity yield characteristics (number of bolls, weight of the existing boll, seed index, cotton yield Cast iron) and qualitative yield characteristics (staple index, percentage of hair, earliness percentage) and the interaction coefficients between spray concentrations and dates compared to control treatment.

Key words: cotton, lashata, trace elements, bolls, spray time.

1. Introduction

Cotton is an important industrial crop to achieve two goals, the first for fiber and its use in the textile industries, and the second goal is to obtain seeds for the oil industry, in addition to using the waste products as animal fodder in Iraq, and the production rate of this crop is lower than in the agricultural developed countries and in all regions of the production of this crop in the world. Inadequate processing of the necessary nutrients and in the inappropriate growth stages due to the limitation or lack of production of this crop, and the addition of the elements in less than the appropriate and unbalanced dose was the reason for limiting or deficiency in the complete production of the soil, so the good management of the nutrients and their preparation for the plant is considered necessary. To reach agriculture and production depending on the available natural resources [1], and that adding two or three elements necessary for plant growth (nitrogen or phosphorous with or without potassium) will not be sufficient to obtain energy or the real production of different crops. Nutrients cause a decrease in yield and quality and make the plant more sensitive to many fungal and bacterial diseases. For the correct and adequate management of nutrients is one of the important factors in obtaining a good yield of crops, an estimate of (30-50%) of the yield is due to the additives of fertilizers and nutrients [2]. In all parts of the world, the lack of nitrogen and phosphorus is known for the cotton crop in Iraq, and the use and addition of potassium in the lands where the readiness of this element is less helped in overcoming the cases of plant stress and had an important effect in increasing the yield of seeds and fibers. The lack of trace elements distributed in different regions of the world causes a decrease in the yield and quality of the cotton yield, and the use of trace elements with nitrogen, phosphorus and potassium) increased the cotton response to fertilization processes [3,4], stated that the addition of trace elements in the form of a mixture of chelated or non-clutch increased the biological yield, the yield of seeds and fibers in comparison with the addition of individual trace elements. Determining the appropriate or critical stage for adding nutrients is an important factor that determines the efficiency of Nutrient use. Whereas, [5] stated that controlling the timing of nitrogen addition can improve and regulate early...
vegetative growth and the formation of yield vocabulary, [2,6], found that the flowering phase is the most appropriate phase to add the microelements to the cotton plant with another spray in the vegetative growth phase. There are a number of foliar fertilizer formulations on the market, and in this research a formula (biomeen 235-l) was used, as it was added to the shoots of cotton plants in different growth stages.[7], found that soaking the seeds of peas before planting with a solution of molybdenum at a concentration of 10 mg / liter and spraying the plants with a solution of boron at a concentration of 50 mg / liter as trace elements gave the highest seed yield and the best protein ratio, and he attributed this to the role of boron in the protein formation process through its importance in Atmospheric nitrogen fixation is vital, as is its role in the formation of DNA . [8], also found that the increase in the levels of fertilizer in concentrations (0, 2.5, 5 and 7.5) kg per hectare of zinc led to a significant increase in some components of the yield and grain yield of maize, and attributed that to the role and effect of zinc in raising and increasing the efficiency of The process of photosynthesis and the speed of transmission of its products inside the plant. The research aims to determine the best suitable dose and the best suitable growth stage to add the microelements and to determine the overlap between doses and dates and their effect on the vegetative growth, yield and quality of the cotton crop.

2. Materials and working methods

The research was carried out in the fields of the Cotton Research Unit at the Technical Agricultural College / Mosul during the spring season of 2018 to study the effect of spraying with a commercially named trace element composition (biomeen 235-l), which consists of the following: -

- Fe 1.2% - Mn 1.8% - Zn 3.0% - Mg 0.5% - Cu 0.5% - b 0.25% - Mo 0.025% - Co 0.00025%.

With three concentrations (0, 1.25, 2.5 ml / liter) and three dates in the vegetative growth stage, flowering stage, the boll formation stage, the overlap between the doses and the dates and the effect of this on the vegetative growth and yield and the quality of the cotton yield of the Lashata variety. With a length of (3 m) and the distance between the beds was (90 cm), so that the experimental unit included two beds, the cotton seeds were planted on 15/4/2018 and the distance between one holes was (25 cm) and on one side of the bed, samples were taken from the field soil to study the physical and chemical characteristics Before planting (Table 1), phosphate fertilizer was added in the form of triple superphosphate at a rate of (60 kg / ha) when preparing the land for cultivation. As for nitrogen fertilizer (urea), it was added at a rate of (200 kg / h) in two equal batches, the first after a month of germination and the second in the stage of formation. The flowering buds were then carried out with the spraying treatments with the mixture of micro-elements on the shoots until complete wetness with the addition of an adhesive diffuser to the spray solution, which is tween20, where the spraying took place at the three times mentioned above as mentioned by [9], at the end of the season.

The following traits were studied on ten plants in the medium of the experimental unit:

- Plant height (cm) from the soil surface to the end of the growing apex
- number of nodes until the first fruiting branch
- number of vegetative branches
- number of fruiting branches
- number of open bolls per plant
- weight of one boll (g),
- seed index,
- weight of 100 seeds / g,
- Total yield of cotton (kg / ha),
- staple index, which is the weight of hair in 100 seeds,(Lint index)
hair percentage% and early percentage%, estimated according to the following equations as explained by [10]:

\[
\text{Staple guide} = \frac{(\text{sample per hair weight} \times \text{seed guide})}{(\text{sample per seed weight})}
\]

\[
\text{Hair Ratio\%} = \frac{\text{(Ten Output Weight)}}{\text{(Cast Cotton Sample Weight)}} \times 100
\]

The cotton in the first fairy

\[
\text{Earliness percentage} = \frac{\text{Total cotton yield}}{- \times 100}
\]

The data were analyzed statistically according to the Randomized Complete Block Design and compare the averages and test the coefficients according to the Duncan polynomial test at a probability level of 5% as explained by [11].

| Table 1. some chemical and physical Characteristics of the soil. |
|---------------------------------------------------------------|
| **Type of analysis** | **Value** | **Measurement unit** |
|----------------------|-----------|---------------------|
| Electrical conductivity (1:1) | 0.49 | Dc Siemens⁻¹       |
| PH (1:1) | 7.3 | -                  |
| Positive exchange capacity | 18.2 | Cents. Kg⁻¹        |
| Organic matter | 16.4 | g. Kg⁻¹           |
| Calcium carbonate | 248 | g. Kg⁻¹           |
| Ready nitrogen | 22 | mg. Kg⁻¹         |
| Ready phosphorus | 11 | mg. Kg⁻¹         |
| Ready potassium | 178 | mg. Kg⁻¹          |
| Sand | 220 | g. Kg⁻¹          |
| Clay | 450 | g. Kg⁻¹          |
| Silt | 230 | g. Kg⁻¹          |
| Bulk density | 1.32 | g. cm³          |
| Field capacity | 26 | %                 |

3. Results and discussion

3.1. The effect of concentration and the date of spraying with trace elements on the vegetative growth characteristics of the cotton plant

It is noted from Table (2) that there was a gradual increase in all the vegetative growth characteristics of the cotton plant with an increase in the concentration of trace elements and that the foliar fertilization with the composition of the trace elements at a concentration (2.5 ml / liter) led to a significant increase in all the studied vegetative growth characteristics of the cotton plant variety Lashata, the rate of plant rise increased by 29%, the number of nodes until the first fruiting branch by 52%, the number of vegetative branches by 22%, and the number of fruiting branches by 61% compared to the control treatment, as for the effect of the date of spraying the date of the first spraying (the vegetative growth phase was significantly differentiated in the
characteristic of plant height and the number of fruiting branches, and it was not significant in the characteristic of the number of nodes and the number of vegetative branches on the second date (flowering phase), and it was significantly superior to the third date, the stage of formation of bolls for all traits. As for the second date (flowering stage), it was significantly superior to the third date, the stage of formation of bolls for all traits. As for the second date (flowering stage), it was significantly superior to the date of formation of the boll and the number of fruiting branches, and the insignificant characteristic, the number of nodes and the number of vegetative branches, and the positive effect of spraying treatments with micro-elements may explain the decrease in the soil content of these elements due to the expansion in the use of fertilizers and for long periods, which led to the depletion of the trace elements and to an imbalance in the nutritional balance and this affects the growth of the plant by influencing the processes of absorption and transportation, as well as that in soils that tend to alkaline such as Iraq, the readiness of all the trace elements (except for the element molybdenum) due to the nature of the reaction resulting from the presence of calcium carbonate and the conversion of these elements into low-soluble compounds. As for the effect of intervention coefficients, it is noted from the same table that the best interaction between the concentration and the date of spraying in the characteristics of plant height and the number of nodes until the first fruiting branch and the number of vegetative branches and the number of fruiting branches was the result of spraying with a concentration of 2.5 ml of micro-elements / liter in the stage of vegetative growth, reaching 131.2 cm and 45, 8.3 and 19.1 for the four aforementioned traits respectively, which all differed significantly from the control treatment and this is consistent with what each of the following found:[3-7].

Table 2. Effect of concentration and time of micronutrients spraying on some vegetative growth characteristics of cotton plant (Gossypium hirsutum L.) Lashata variety(*)

| Micronutrients concentration Solu | Plant height (cm) | No. of nodes | No. of vegetative branches | No. of fruiting branches |
|---------------------------------|------------------|-------------|---------------------------|-------------------------|
| Spray | | | | | |
| V | B | V | B | V | B | V | B |
| 0 | 120.8 | 91.2 | 82.6 | 98.6 | 3.5 | 3.2 | 3.2 | 3.3 | 6.6 | 5.5 | 5.1 | 5.4 | 11.1 | 10.5 | 9.1 | 10.0 |
| 1.25 | 134.3 | 122.8 | 101.1 | 119.49 | 4.3 | 3.7 | 3.3 | 3.4 | 7.8 | 7.1 | 5.8 | 6.4 | 18.6 | 15.1 | 11.8 | 15.0 |
| 2.50 | 138.5 | 126.6 | 112.5 | 125.59 | 4.5 | 4.1 | 3.4 | 4.0 | 8.3 | 7.5 | 6.2 | 7.3 | 19.1 | 17.5 | 12.6 | 16.0 |
| Mean | 131.2 | 113.98.7 | 3.7 | 3.7 | 3.3 | 7.6 | 6.7 | 5.7 | 16.3 | 14.4 | 11.2 |

(*) Number that share the same alphabet, for every factor or interaction, there are no significant differences between them, according to the Duncan multiple tests, under 5% probability level.
3.2. The effect of concentration and the time of spraying with trace elements on the yield characteristics of the cotton plant

It is noticed from Table (3) that there is a significant increase in the studied yield characteristics of the cotton plant, Lashata cultivar, as a result of spraying with trace elements, with a positive relationship between the concentration used of the trace elements and the increase in the yield characteristics and the most influential concentrations in the number of bolls, boll weight and seed index. The cotton blossom yield was using a concentration of 2.5 ml/liter, which led to an increase of its percentage and 69% for the aforementioned traits, 33%, 79%, and 71% respectively, compared with the control treatment, and there was a significant superiority of the concentration of 2.5 ml/liter over the concentration of 1.5 ml/liter and the comparison treatment, as well as the significant superiority of the concentration of 1.5 liters over the comparison treatment for all the yield characteristics. The studied study, except for the seed index characteristic, where there was no significant difference between the concentrations of 1.5 ml/liter and the comparison treatment. The first date (the vegetative growth stage) may be superior to the flowering stage and the formation of the boll significantly more than the characteristic of the number of bolls and the cotton yield. As for the weight of the boll and the seed index, the first date was significantly superior to the date of formation of the boll, and there was no difference between the date of flowering and the date of formation of the boll, and the date of the vegetative growth was the most influential in increasing the four yield characteristics, as the number of bolls reached 29.1, the weight of the nut is 6 g and the seed index 4.3. The cotton blossom yield is 913.7 kg/ha. The increase in the yield characteristics of the cotton plant as a result of spraying with trace elements may be explained by the lack of interest in adding micro-elements with the expansion of the use of phosphate and nitrogen fertilizers, and this leads to an imbalance of nutritional balance, which affects the growth of the plant and this is consistent with what the [12], found that adding the elements Zn and B to the shoots of the cotton plant alone or together led to a significant increase in the cotton yield compared to the comparison treatment, and it may be attributed to the increase in the number of open bolls and the weight of one nut and because of the increase in the number of times sprayed the micronutrients (three times) Zn and B on cotton plants, [2,8].

| Micronutrients concentration Solu- | Total number of bolls | Weigh of boll (gm) | Weight 100 seeds (seed index) | Cotton yield (Kg/ha) |
|-----------------------------------|----------------------|-------------------|---------------------------|---------------------|
| tion ml/l | Spraying time (growth stage) | | | |
| Veg | B | V | B | B | B |
| Et | Fl | ol | et | Fl | ol | Fl | ol |
| At | o | Fo | M | at | o | Fo | M |
| Ve | w | r | a | Ve | w | r | a |
| Gr | in | m | n | Gr | in | m | n |
| O | g | at | n | O | g | at | n |
| Wt | io | wt | n | Wt | io | wt | n |
| H | n | H | n | H | n | H | n |
| 0 | 20.7 | d | 15.8 | h | 14.4 | 0 | c | 17. | 4.2 | de | 3.8 | ef | 3.3 | f | 3.4 | c | 3.6 | ef | 3.3 | f | 3.3 | b | f |
| 1.25 | 31.1 | b | 22.6 | d | 17.3 | fg | 23. b | 6.3 | b | 5.5 | cd | 4.5 | de | 5.4 | b | 4.5 | ab | 4.3 | b | 3.5 | ef | 4.1 | ab | b |

Table 3. Effect of concentration and time of micronutrients spraying on some yield characteristics of cotton plant (Gossypium hirsutum L.) Lashata variety
3.3. The effect of concentration and the timing of spraying with trace elements on some specific characteristics of the cotton plant:

It is noted from the results of Table (4) a significant superiority of the concentration of 2.5 ml / liter and the comparison treatment and the three dates for the three qualitative characteristics studied, which is the staple guide, the percentage of hair and the percentage of precocity. Bolls are significant for the trait of staple guide, as well as for the quality of the percentage of hair and the percentage of early as well as the significant superiority of flowering time over the date of formation of the boll for the three traits. For concentrations of 2.5 ml / liter in the stage of vegetative growth and the lowest coefficients for the concentration was zero (the comparison treatment) in the stage of bolls formation, as well as the case for the two characteristics of hair percentage and percentage of early precipitating table (4) These results are in agreement with what was mentioned by [13], of spraying plants The cotton of the Ashore variety with foliar fertilizer (Al-Nahrain), which contains two and three sprays of trace elements, led to a significant superiority in the yield of cotton hair and the number of crumbled bolls, the early coefficient and the qualitative characteristics of cotton. He explained that the need for cotton is not only in the major elements, but also in the smaller elements, and that the trace elements are not present in the solid (mineral) fertilizers that are currently available commercially. Cotton plant Lashata variety positively affected the studied traits, such as seed index character, number of fruiting branches, number of open bolls / per plant when spraying with a concentration of 1.5 kg boron / ha, and the result was the highest values in these characteristics, and the same direction was found [14], that the spraying of boron at a concentration of 2.0 kg / ha led to positive results in all traits, especially in the yield of cotton blossom.

Conclusions and Recommendation

It is concluded from this study that the spraying with the composition of the micro-elements improved the vegetative growth and yield characteristics and the yield quality of the Lashata cotton plant, and that the increase was positively correlated with the increased concentration used, especially when spraying in the vegetative growth stage. Accordingly, it can be recommended to conduct more foliar fertilization experiments with trace elements and various formulations for the purpose of improving growth, increasing the cotton yield, the area unit, and improving the quality.

Table 4. Effect of concentration and time of micronutrients spraying on some yield quality characteristics of cotton plant.

| Micronutrients concentration Solution ml/l | Lint index | Yield quality Characteristic | Percentage of hair % | Percentage of earliness % | Spraying time (growth stage) |
|------------------------------------------|------------|------------------------------|----------------------|---------------------------|---------------------------|
| 2.50                                     | 35.5 a     |                              | 26.7 c               | 18.8 f                    | 27.0 a                    |
| Mean                                     | 29.1 a     |                              | 21.7 b               | 16.8 c                    | 6.0 a                     |
| (*) Number that share the same alphabet, for every factor or interaction, there are no significant differences between them, according to the Duncan multiple tests under 5% probability level. |
### Table

| Treatment | Vegetative Growth Mean | Flowering Mean | Boll Formation Mean | Vegetative Growth Mean | Flowering Mean | Boll Formation Mean | Vegetative Growth Mean | Flowering Mean | Boll Formation Mean |
|-----------|------------------------|----------------|--------------------|------------------------|----------------|--------------------|------------------------|----------------|--------------------|
| 0         | 38.4 c                 | 35.9 d         | 32.2 e             | 35.5 c                 | 37.2 c         | 34.6 a             | 29.6 e                 | 33.8 b         | 36.8 de             |
| 1.25      | 40.9 b                 | 38.1 c         | 35.6 d             | 38.2 b                 | 39.2 ab        | 36.7 c             | 32.1 a                 | 37.0 b         | 39.2 de             |
| 2.50      | 42.8 a                 | 40.6 b         | 37.4 cd            | 40.3 a                 | 40.1 a         | 38.7 b             | 35.2 a                 | 38.0 a         | 40.1 a              |
| Mean      | 40.7 a                 | 38.2 b         | 35.1 c             | 38.8 a                 | 36.7 a         | 32.3 e             | 38.7 a                 | 35.7 a         | 33.4 b              |

(*) Number that share the same alphabet, for every factor or interaction, there are no significant differences between them, according to the Duncan multiple tests, under 5% probability level

### References

[1] Ahmad N., and I. Muhammed, 2008. Fertilizers plant nutrient management and self-reliance in Agriculture. The pakistan development review 37: 217-233
[2] Stewart, W.M.D., W.D. Dobb, A.E. Johnston and T.J. Smith. 2005: The contribution of commercial fertilizer nutrients to food production. Agron. Jour. 97: pp. 1-6.
[3] Badaruddin, M., M.p. Reynolds and O.A. Ageeb. 2001: wheat management in warm environments: effect of organic and inorganic fertilizers, irrigation frequency and mulching. Agron. J. 91: 975-981
[4] Modaish, A.S., 2007. Foliage application of chelated and non-chelated metal for supplying micronutrients to wheat grown in calcareous soil. Agric.: 237-245
[5] Warner, R., C.R. Crozier and R.W. Heiniger. 2001: Optimizing nitrogen application timing in no till soft red winter wheat. Agron. J. 93: 435-442.
[6] Negm, A.Y. and F.A. Zahran. 2001: optimizing time of micronutrient application to wheat plants grown on sandy soils. Egyptian Jour. Agric. Res. 79: 812-823
[7] Hadhili, Kazem Hasan and Fatima Fajr Al-Jubouri 2015 The effect of molybdenum and boron on the yield of barbili and its components Al-Qadisiyah Journal for Agricultural Sciences, 5(2), 87-95.
[8] Issa, Saeed Salman 2013 The response of three varieties of yellow corn to zinc addition in Babil Governorate. Al-Qadisiyah Journal for Agricultural Sciences, 3(1), 54-61.
[9] Arshad, M., M.A. Gill, T. Aziz, M. Rahmatallah and I. Ahmad. 2004. Growth response of cotton cultivars to zinc deficiency stress in cheaters buffered nutrient solution. Pakistan Jour. of Botany No. 36 (2): 273-380.
[10] Al-Bayati H. M. H. 1982: A study of the genetic behavior of some physiological traits in crossbreeds between five varieties of cotton and their relationship to yield, a master's thesis, Breeding crops. College of Agriculture and Forestry, University of Mosul, Iraq.
[11] Dawood K. M., Z. Abdel-Elyas. 1990: Statistical Methods for Agricultural Research, Directorate of Dar Al-Kutub for Printing and Publishing, University of Mosul, Iraq.
[12] AL-Naqeeb, M. A., I.H.H. Al-hilify., W.F. Humood and H.M.A.L. Abodi. 2010. Effect of zinc and Boron on Growth and Yield of Cotton.The Iraqi Jour. Of Agri. Sciences, 41 (6): 11-20.
[13] Mohammed, M.A. (2020). Structural, Optical, Electrical and Gas Sensor Properties of ZrO2 Thin Films prepared by Sol-Gel Technique. Neuroquantology, 18(3), 22-27. doi: 10.14704/nq.2020.18.3.nq20146
[14] Soomro, A.W., A.R. Soomro, A.B. Leghari, M.S. Chang, A.H. Soomro, and G.H. Tunio. 2000b. Effect of Boron and Zinc micronutrients on seed cotton yield and its components. Pakistan J. of Biological Sci. 3: 12: 2008-2009.