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Effect of spraying of GA₃ and Some Micronutrients on the growth and Mineral content of Cress plant (*Lepidium sativum* L.)

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ABSTRACT

This study is conducted in aspicial farm in Adujail city\Salahaddin Governorate at the season 2015 on the cress plant. Afactorial experiment has conducted with two factors, the first is spraying with GA₃ (G0 without spraying, G1 spraying with 50 mg.L⁻¹, G2 spraying with 100 mg.L⁻¹ of GA₃).the second factor is spraying with Micro Nutrients (T0 without spraying, T1spraying with 50 mg.L⁻¹ of Fe,T2 spraying with 50 mg.L⁻¹ of Mn, T3 spraying with amixture of 50+50 mg.L⁻¹from Fe and Mn). The experiment is designed with (RCBD), the treatments were replicated 4 times and Duncuns Multiple Range Test at the probability 5% is used and the results are as followed:

GA₃ spraying causes asignificant increase in all Vegetative growth characters compared with the others which are not sprayed and also the Macro Nutrients concentration. Micro Nutrients sprays on the Cress plants also causes asignificant increase in most Vegetative characters and Macro and Micro Nutrients content, specially the treatment of Fe and Mn mixture. Interaction between GA₃ and Micronutrient is significant in all the treatment specially the treatment (100 mg.L⁻¹ of GA₃ + amixture of 50+50 mg.L⁻¹ of Fe + Mn) which give ahighest values of Vegetative growth and Macro and Micro Nutrients content .

Introduction

The Medicinal plants consider ahigh economical and medicinal value and they occupy ahigh status in this time in aplant production because of their important in averious life fields[1] and they are amain source for aplant medicinal drugs and araw matter to produce important chemical materials[2]besides that they have no side effects, for their use compared with thos drugs produced chemically as well as their capacity to inhibit amicrobs[3]. A cress plant (*Lepidium sativum* L.) belong to Asteraceae family, it has an important and medicinal benefits and high food important materials it contains many Vitamins (A,B₁, B₂, B₃, B₅, C, E, K, H) and it contains 32 k.callary, 55gm charbohydrats, 4.4 suger, 2.6 broteins, and elements Cu, Fe, Mg, Mn, P, K, Zn and I. for this importance there are different ways to develop its production like aplant growth regulators use as GA₃ and micro Nutrients as Fe and Mn GA₃ organic compound has a direct influence on growth[4] it makes to increase a cell devission and cell enlargement and other vegetative growth

qualities. [5] confirms in a study on amint plant (*Mentha piperita* L.)that GA₃ caused an increase in the vegetative growth, Chlorophyll, Protein and enzymic effectiveness of the plants,the results of [6] come consistent with the predecessor for the increasing of avegetative growth by GA₃ for (*Dainthus caryophyllus* L.) when they use it with the Nutrients and licorise extract .The results of [7] came confirmness the positive role of GA₃to increase the vegetative growth of the Cress plants. [8] confirmed in his Author about the role and importance of the Micro nutrients in energizing and increasing the growth and increasing Nutrients concentration and their contents in the plant tissues. also [9] optained in astudy on the Cress plants that GA₃ helps in seed Germination and increasing of the plant growth, in astudy acted by ([10]on Brassicaceae family they reached that Hormonal effectiveness like Giberillins in Determination and increased the growth of this plant family[11] supported the role of GA₃ to increase the vegetative growth of the Cress plants and their

contents from nutrients. In the study about Rosemary plant (*Rosmarinus officinalis* L.). [12] Used the spraying of sea algae extracts which contained Gibberellins, he reached to apposite results in avegetative growth and nutrients concentration. [6] Make a study on Acress plants, they used GA₃ and reached to effectiveness in paying the vegetative growth and inceasing the Nutrients concentration in the plants compared with those non sprayed plants. the results of [13] on the (*Pimpinella anisum* L.) plants came to emphasize GA₃ effectiveness to increase the vegetative growth and chemical contents of the plants when they sprayed. [8] explained the effect of Micro nutriens, they caused increased the growth and that lead to acopious vegetative growth and also affected Hormonal synthesis which constribted considered bio operation and increased the vegetative which play arole in inceasing avegetative growth and affect the Nutrient concentration positively in the plant. an experiment make it conduct on Rosemary plants [12] confirmed that spraying with sea algae extracts (sea mino and sea force1) which contained anatural hormones like GA₃, he obtained

apositve results in macro and micro nutrients (N, P, K, Fe, Cu, Zn, B) compared with the control plants.

Materials and Methods

A farm experiment was conducted on the Cress plants in aspicial farm in Adujail city / salahaddin governorate at the season 2015 as Afactorial experiment with two factors (GA₃ which used in three levels G0 without spraying, G1 spraying with 50 mg.L⁻¹, G2 spraying with 100mg.L⁻¹) the second factor was aspraying with Micro nutrients T with four treatments (To without spraying, T1 spraying with 50 mg.L⁻¹ from Fe, T2 spraying with 50 mg.L⁻¹ from Mn, T3 spraying with amixture of 50+50 mg.L⁻¹ from Fe and Mn) we have got 12 treatments designed with in (RCBD) designe, the treatment replicated four times, the seeds were planted in ashingles in the distanses (1.5 x2meter). the means comparted under Duncuns Multiple Range Test at the probability %5 [14]. The spraying operations were done after the plant reached the high of 10 cm, the spraying repeat again after two weeks from the first spraying using (FeSO₄.6H₂O and MnSO₄.6H₂O) Respectively. the Qualities measured were as follows:

1-Plant hights: they measured by the ruler from soil surfac till the the hilhest optimum of the plant for five plants took their average.

2-Leavs No.plant⁻¹: they calculate leaves No. for five plants took their average.

3-Shoot No.plant⁻¹: they measured for five plants got their average.

4-Leaf area (cm)²: we did these calculation by using the weighting method according to [15]. The leaves

were weighted and photographted their shaps and sizes on A₄ paper and then leaf area calculated according

To this equation :

$$\text{Leaf area (cm}^2\text{)} = \frac{\text{Paper shap weight} * \text{photographed paper area}}{\text{Photographed paper weight}}$$

For five leaves got their average

5- Dry weight (gm): five leave were token and dried in the Oven on (65-70 c⁰) for (48-72 h) until weight stability, then they weighted dried [16].

6-Chlorophyll Determined (Spad units): Total chlorophyll was Appreciated by hand chlorophyll meter model SPAD -502.

7-Nutrient concentration: one sample from each treatment was token and cleaned well and dried well in the oven at (65-70 c⁰ for 48-72 h until weigh stability) then they crushed well. We got 0.4 gm from each sample and putted in avolumetric bottles and digeted (wet digestion in the hood) by using amixture of 2+2 ml from sulpharic and perchloric concentric acids on ahigh heat until they became clear, they putted in volumetric flasks with acapacity of 100 ml and complete the volume to asignal by adistil water and then the Nutrients determined:

a-Nitrogen (N%) :using Micro Kjeldahl system according to the method of [17] and [18].

b-Phosphorous (p%): it detirmends using the chromatic method by aspectrophotometer according to the method of [19].

c-Potasium (k%): using Aflam photometer according to [16]

d-Calcium (Ca%) and Magnesium (Mg%) and Micro nutrients (Fe, Mn, Cu, Zn, I mg.L⁻¹) using Atomic absorption spectrophotometer according to [20].

Results and Discusion

1-Effect of GA₃ and Fe and Mn and their Interaction on the Vegetativ growth of the cress plants.

Table (1) illustrated that spraying Cress plants with GA₃ caused a significant increase in all vegetative growth qualities, the plants sprayed with 100 mg.L⁻¹ gave ahighest values in plant high (17.28 cm), shoot No. plant⁻¹ (5.942), leaves No. plant⁻¹ (16.94), leaf area (3.551cm²), Dry weight (2.828gm) and chlorophyll (32.13 spad) while non sprayed plants gave the lowest values in all these qualities.

The same table shows as well plants sprayed with Fe and Mn have given asignificant positive results in all vegetative qualities, the plants sprayed with amixture of (50+50 mg.L⁻¹ of Fe+Mn) marked with ahighest plant high (17.84 cm), shoot No.plant⁻¹ (6.208), leaves No.plant⁻¹ (17.12), leaf area (3.455 cm²), Dry wieght (2.975 gm) and Chlorophyll (32.84 SPAD)

compared with other treatment and with plants non sprayed with Micro Nutrients which gave alowest values.

Table (1) Effect of GA₃ and Fe and Mn and their Interaction on Avegetative growth characters of Acress plant

Characters Treatments	Plant hight (cm)	Shoot No.plant ⁻¹	Leaves No.plant ⁻¹	Leaf area (cm) ²	Dry weight (gm)	Total chlorophyll SPAD UNITS
GO	15.18b	4.746b	13.20c	2.625b	2.473c	28.36c
G1	16.36ab	5.578a	15.45b	2.929b	2.615b	30.07b
G2	17.28a	5.942a	16.94a	3.551a	2.28a	32.13a
T0	14.34c	2.254c	12.83c	2.453c	2.222d	26.29c
T1	16.13b	5.321b	14.98b	29.28b	2.563c	30.05c
T2	16.79b	5.904a	15.85b	3.303a	27.95b	31.57ab
T3	17.84a	6.208a	17.12a	3.455a	2.975a	32.84a
G0T0	13.26i	3.737i	11.20i	2.100f	2.092g	22.24j
G0T1	14.68h	4.470h	12.56i	2.530e	2.300f	28.81h
G0T2	15.74f	5.212f	13.35g	2.920cd	2.660cd	30.16f
G0T3	16.85d	5.563e	15.68e	2.950cd	2.842bc	32.26c
G1T0	14.32h	4.275h	13.10h	2.397ef	2.185g	27.40i
G1T1	16.40e	5.750e	15.57e	2.718d	2.590e	30.17f
G1T2	16.92d	6.000d	16.30d	3.100c	2.750cd	31.07e
G1T3	17.81b	6.287c	16.82c	3.500b	29.35b	31.66d
G2T0	15.24g	4.750g	14.20f	2.862d	2.390f	29.23g
G2T1	17.30c	5.742e	16.82c	3.538b	2.800bc	31.17e
G2T2	17.71b	6.500b	17.90b	3.387b	2.975b	33.50b
G2T3	18.85a	6.775a	18.85a	3.915a	3.150a	34.62a

*The same letters in same column refer no significant deference in front

Table (1) illustrated also that Interaction between GA₃ and Micro Nutrients was significant, all treatments marked as significant positive results compared with control treatment, the plants in the treatment (G2T3) which sprayed within (100mg.L⁻¹ and a mixture of 50+50 Fe +Mn) gave a highest values in plant height (18.85cm), shoot No.plant⁻¹(6.775), leaves No.plant⁻¹(18.85), leaf area (3.915 cm²) Dry weight (3.150 gm) and Chlorophyll (34.62 spad) compared with control treatment which gave lowest values in plant height (13.46 cm), shoot No. plant⁻¹(3.737), leaves No.plant⁻¹(11.20cm²), leaf area (2.10 cm²), Dry weight (2.092 gm) and Chlorophyll (22.24 spad).

The increase in avegetative growth may be attributed to a main role of GA₃ for growth and cell division and then increased cell dilation and this gives an indication to increase the vegetative growth [21], and may be GA₃ increased shoot growth by increasing cell division of meristematic cells in an apical meristem [22], or may be GA₃ contributes in a main role for alateral growth by its contribution with the other hormones like auxine, cytokinins, and help in alateral buds growth and that positively affected to increase branches numbers [23], as well as the cooperation between GA₃ and indogenous Auxins which act on the Enzymes act on cell wall components and cellulose matter (cellulase enzyme) caused to increase cell wall softness and subsequently stretches it and increases its sizes and final plant height (24), Chlorophyll increase may be returned to discourage the decay of stains because of GA₃

treatment [25], and may be Hormones can stimulate the biosynthesis the Chlorophyll stain [26]. these results went with [27] results about the role of Mn in increasing the growth and it agrees with [28] results on the effect of Fe on Chamomile plants and with [29] the effect of GA₃ on Mint plants.

2- Effect of GA₃ and Fe and Mn and their Interaction on the Chemical component of Cress plants.

Table (2) Illustrates that spraying Cress plants with GA₃ caused a significant increase in Macro nutrients concentration compared with non sprayed plants, A plants sprayed with 100mg.L⁻¹ from GA₃ Distinguished with a highest concentration of these nutrients.

The same table shows that spraying of the plants with a micro nutrients have given a positive significant results in Macro nutrients compared with those non sprayed, the treatment used the mixture of Fe and Mn marked the highest values of macro nutrients concentration. Table (2) shows as well the Interaction between GA₃ and Micro nutrients was significant, the plants sprayed with (100 mg.L⁻¹ and Fe +Mn mixture) gave a highest nitrogen concentration (2.33%), phosphorous concentration (0.368%), potassium concentration (2.56%), calcium concentration (2.33%) and Magnesium concentration (0.427%) compared with other treatments and control treatment which gave lowest values in all these macro nutrients, N(1.72%), P(0.284%), K(2.02%), Ca(1.76%) and Mg (0.253%).

Table 2: Effect of GA₃ and Fe and Mn and their Interaction on the concentration of amacro nutrients of across plant.

Characters Treatments	N%	P%	K%	Ca%	Mg%
G0	1.96b	0.303b	2.29c	1.98c	0.286b
G1	2.20a	0.336a	2.45b	2.09b	0.364a
G2	2.31a	0.346a	2.59a	2.18a	0.369a
T0	1.88c	0.293b	2.19d	1.87d	0.279d
T1	2.13b	0.329ab	2.40c	2.05c	0.313c
T2	2.28b	0.336a	2.53b	2.17b	0.364b
T3	2.42a	0.356a	2.92a	2.24a	0.378a
G0T0	1.72h	0.284e	2.02i	1.76h	0.253k
G0T1	1.89gh	0.296de	1.94g	1.94g	0.286i
G0T2	2.03ef	0.293de	2.10ef	2.10ef	0.296h
G0T3	2.22d	0.342c	2.14de	2.14de	0.310f
G1T0	1.91fg	0.295de	1.91g	1.91g	0.281j
G1T1	2.18de	0.340c	2.05fg	2.05fg	0.312e
G1T2	2.31c	0.352b	2.16d	2.16d	0.390c
G1T3	2.42d	0.359b	2.25c	2.25c	0.402b
G2T0	1.97fg	0.301d	1.96g	1.94g	0.303g
G2T1	2.27d	0.351b	2.17d	2.17d	0.342d
G1T2	2.45b	0.365a	2.27b	2.27b	0.408a
G2T3	2.58a	0.368a	2.33a	2.33a	0.427a

*The same letter in same column refer no significant differents

Table (3) shows the effect of GA₃ and Micro nutrients and their Interaction on micro nutriens concentration where the table shows that spraying with GA₃ droved to asignificant positive deffirents in Micro nutrient concentration except anigative effect in Cu concentration in the plant, spraying with 100 mg.L⁻¹ of GA₃ gave ahighest concentration of Fe, Mn , Zn, and I, and alowest concentration of Cu , compared with those non sprayed plants. Tabe (3)also shows

that spraying the Micro nutrients (Fe and Mn) each one single or their mixture drov to asignificant increace in micro nutrient concentration in plants compared with non

sprayed plants except Mn concentration wher Mn spraying decreased its concentration wher Fe spraying gave ahighest Mn concentration in the plants.

Table 3: Effect GA₃ and Fe and Mn and their Interaction on the concentration of Micro nutrients of Across plant.

Characters Treatments	Fe mg.L ⁻¹	Mn mg.L ⁻¹	Cu mg.L ⁻¹	Zn mg.L ⁻¹	I mg.L ⁻¹
G0	77.36b	73.65b	12.50a	18.21b	0.191c
G1	80.04ab	78.02a	11.06b	19.58ab	0.215b
G2	81.78a	80.08a	10.11c	20.16a	0.253a
T0	71.44c	71.44d	9.51c	15.90c	0.173c
T1	76.48b	83.23a	11.34b	19.65b	0.205b
T2	84.89a	75.94c	12.19a	20.67ab	0.244a
T3	83.13a	78.38b	11.61ab	21.05a	0.255a
G0T0	71.08j	69.40j	10.25f	14.62j	0.155k
G0T1	75.25i	78.22e	11.82d	18.25f	0.170j
G0T2	80.52e	71.47i	13.72b	19.35e	0.212g
G0T3	82.60d	75.50g	14.23a	20.62c	0.227f
G1T0	75.60h	71.40i	9.48g	16.27h	0.180i
G1T1	75.82h	84.80b	11.63d	19.85d	0.211g
G1T2	85.35b	76.90i	12.77c	21.12ab	0.230e
G1T3	83.40c	78.97e	10.35ef	20.42c	0.240c
G2T0	76.55g	73.52h	9.51g	19.24g	0.158h
G2T1	78.37f	86.67a	10.57e	20.42b	0.235d
G2T2	88.80a	79.45d	10.10f	21.02b	0.292b
G2T3	83.40c	80.67a	10.26f	21.42a	0.301a

*The same letter in the same column refer no significant deffirents

Previous table shows that interaction between GA₃ and Fe and Mn was significant, all treatments were distinguished with significant increases, the plants sprayed with (100 mg.L⁻¹ +50+50 mg.L⁻¹ Fe+Mn) distinguished with a highest concentration of Mn (80.67mg.L⁻¹), Zn (21.42 mg.L⁻¹), I (0.301 mg.L⁻¹) compared with lowest values of these nutrients in control plants which gave (69.40, 14.62, 0.155 mg.L⁻¹) for these Micro nutrients subsequently, whereas the plants sprayed with (100 mg.L⁻¹ of GA₃ + 50 mg.L⁻¹ of Mn) gave a highest concentration of Fe (88.80 mg.L⁻¹) compared with (71.08 mg.L⁻¹) in the control plants. Also the plants sprayed with (50+50mg.L⁻¹ from Fe and Mn without GA₃) gave a highest concentration of Cu (14.23mg.L⁻¹) compared with (10.10 mg.L⁻¹) in plants sprayed with (100 mg.L⁻¹ GA₃ + 50 mg.L⁻¹ Mn).

That increasing a macro and micro nutrients may be attributed to Fe role in nuclear acids and chloroplasts which lead to increase chlorophyll content and chloroplast protein which increase photosynthesis operation efficiency, that's caused increase the growth and cell breadth rates and increased cell numbers, which increased the demand of nutrients absorption to keep up the growth increase to bring the balance inside the plant [29 and 30]. Also that addition of Fe and Mn may be increase the vegetative growth qualities (table 1), which drove to this increase because of the effectiveness of photosynthesis and plant need to more concentration of nutrients and cause increase of their concentration inside the plants [31], increase in Fe and Mn concentration may be attribute to take it from spraying solution directly when it was sprayed on the plants and absorbed across the stomata [32]. As Fe was entered in

Cytochromes and ferredoxin installation so its effective in increase photosynthesis operation effectiveness and therefore the product food [33], also that Mn role in splitting H₂O molecule and releasing electrons and H⁺ ions and therefore contributing in reducing NADP to NADPH which contributed in reducing CO₂ in Calvin Cycle producing Glucose [34]. Nutrients concentration rising may be due to the role of GA₃ in improvement the vegetative growth (table 1) and what the increase in growth requires nutrients absorption so their concentration were increased (16), and the reason of this increase may be due to role of GA₃ in energizing cell division and elongation and later stimulates RNA and increased the Bio operations inside the cells as a transmission of nutrients to root system so increased their concentration (35). The reason may be due to the relationship between Fe and many nutrients like Mg which increased its concentration inside the plant (table 2) and their shared relationship, Fe enters in installation of porphyrin and cytochromes and Fe centered in high rates in chloroplasts which gives a high important for this nutrient in increase photosynthesis operation effectiveness (36), GA₃ may be play important role in physiological

operations inside the plant and what it needs from mineral elements to construct amino acids which drives to increase nutrients absorption and increased the concentration (37). These results were agreed with (38) about effect of Mn on Indian mustard plant, and with (39) about Fe role in increase Fe concentration in cytoplasm and chloroplast, and with (40) about the effect of Mn with other heavy metals on the Indian mustard plant.

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تأثير الرش بحامض الجبرلين وبعض العناصر الصغرى في النمو والمحتوى المعدني لنبات الرشاد (*Lepidium sativum* L.)

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الملخص

اجريت الدراسة في احدى المزارع الخاصة بقضاء الدجيل/ محافظة صلاح الدين على نباتات الرشاد للموسم الزراعي 2015 كتجربة عاملية ذات عاملين متداخلين العامل الاول الرش بحامض الجبرلين بثلاث مستويات (G0 بدون رش و G1 الرش بـ 50 ملغم.لتر⁻¹ ، G2 الرش بـ 100 ملغم.لتر⁻¹) والعامل الثاني الرش بالعناصر الصغرى بأربعة معاملات (T0 بدون رش T1 , الرش بـ 50 ملغم.لتر⁻¹ من الحديد , T2 الرش بـ 50 ملغم.لتر⁻¹ من المنغنيز T3, الرش بـ 50+50 ملغم.لتر⁻¹ من خليط الحديد والمنغنيز) وكررت المعاملات اربعة مرات وصممت التجربة بتصميم القطاعات العشوائية الكاملة وقورنت المتوسطات بموجب اختبار دنكن متعدد الحدود عند مستوى احتمال 5%. وظهرت النتائج التالية:-
سبب الرش بحامض الجبرلين زيادات معنوية في صفات النمو الخضري والعناصر الكبرى والصغرى وقد تميزت المعاملة 100 ملغم.لتر⁻¹ بأعلى القيم مقارنة ببقية المعاملات , كما سبب الرش بالعناصر الصغرى زيادات معنوية في صفات النمو الخضري والعناصر الكبرى واغلب العناصر الصغرى مقارنة بعدم رشها على النباتات وقد تميزت معاملة الرش بـ 50 ملغم.لتر⁻¹ من الحديد والمنغنيز بأعلى القيم لأغلب هذه الصفات المدروسة. التداخل ما بين حامض الجبرلين والعناصر الصغرى كان معنوي التأثير تميزت فيه المعاملات بزيادات معنوية مقارنة بمعاملة المقارنة وقد تميزت معاملة الرش بـ 100 ملغم.لتر⁻¹ من الجبرلين + خليط الحديد والمنغنيز (50+50 ملغم.لتر⁻¹) بأعلى القيم لأغلب هذه الصفات.