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Effect of spraying of GA_3 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 GA_3 (G0 without spraying, G1 spraying with 50 $mg.L^{-1}$, G2 spraying with 100 $mg.L^{-1}$of GA_3).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 $mg.L^{-1}$from 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 fellowed:
GA_3 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 sprayes 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 GA_3 and Micronutrient is significant in all the treatment specially the treatment (100 $mg.L^{-1}$ of GA_3 + 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,B_1, B_2, B_3, B_5, 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 GA_3 and micro Nutrients as Fe and Mn GA_3 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 GA_3 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 GA_3 for (*Dainthus caryophyllus* L.) when they use it with the Nutrients and licorise extract .The results of [7] came confirmness the positive role of $GA_3$to 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 tisues. also [9] optained in astudy on the Cress plants that GA_3 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 GA_3 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 Giberillins, he reached to appositive results in avegetative growth and nutrients concentration.[6] Make astudy on Acress plants ,they used $GA_3$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 GA_3 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 hormons like GA_3 ,he optained

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

Materials and Methods

Afarm 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 (GA_3which used in three levels G0 without spraying, G1 spraying with 50 $mg.L^{-1,}$, G2spraying with 100$mg.L^{-1}$) 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, T3spraying 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 ($FeS0_4.6H_2o$ and $MnS0_4.6H_20$) 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 A_4 paper and then leaf area calculated according

To this equation :

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

For five leaves got their average

5- Dry weight (gm): five leave were token and dried in the Oven on (65-70 c^0) 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 $c^0$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 perichloric 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 GA_3 and Fe and Mn and their Interaction on the Vegetativ growth of the cress plants.

Table (1) illustrated that spraying Cress plants with GA_3caused a significant increase in all vegetative growth qualities, the plants sprayed with 100 $mg.L^{-1}$ gave ahighest values in plant hight (17.28 cm) ,shoot No. $plant^{-1}$ (5.942), leaves No. $plant^{-1}$ (16.94), leaf area (3.551cm^2), 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 cm^2), 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 GA_3 and Fe and Mn and their Interaction on Avegetative growth characters of Acress plant

Characters / Treatments	Plant hight (cm)	Shoot N0.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 infront

Tabe (1) illustrated also that Interaction between GA_3 and Micro Nutrients was significant, all treatments marked asignificant positive results compared with control treatment, the plants in the treatment (G2T3) which sprayed within (100mg.L^{-1} and amixture of 50+50 Fe +Mn) gave ahighest values in plant hight (18.85cm),shoot No.plant^{-1}(6.775), leaves No.plant^{-1}(18.85),leaf area (3.915 cm^2) Dry weight (3.150 gm)and Chlorophyll (34.62 spad) compared with control treatment which gave alowest values in plant hight (13.46 cm), shoot No. plant $^{-1}$(3.737), leaves No.plant^{-1}(11.20cm^2), leaf area (2.10 cm^2), Dry weight (2.092 gm) and Chlorophyll(22.24 spad).

The increase in avegetative growth may be attributed to amain role of GA_3 for growth and cell devision and then increased cell dilation and this gives an indication to increase the vegetative growth [21], and may be GA_3 increased shoot growth by increasing cell devision of Ameristimatic cells in an apical meristem[22], or may be GA_3 contributs in amain role for alateral growth by its contribution with the other hormons like auxine, cytokinins, and help in alateral buds growth and that positively afected to increase branches numbers[23], as well as the cooperation between GA_3 and indoginous Auxins which act on the Enzymes act on cell wall components and cellulose matter (cellulase enzyme) caused to increase cell wall softness and subsequently stretchs it and increases its sizes and final plant hight (24), Chlorophyll increase may be returne to discourage the decay of stains because of GA_3 treatment [25], and may be Hormons 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 GA_3 on Mint plants.

2- Effect of GA_3 and Fe and Mn and their Interaction on the Chemical component of Cress plants.

Table (2) Illustrates that spraying Cress plants with GA_3 caused asignificant inreases in Macro nutrients concentration compared with non sprayed plants, Aplants sprayed with 100mg.L^{-1} from GA_3 Distinguished with ahighest concentration of these nutrients.

The same tabe shows that spraying of the plants with Amicro nutrients have given apositiv 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 GA_3 and Micro nutrients was significant ,the plants sprayed with (100 mg.L^{-1} and Fe +Mn mixture) gave ahighest nitrogen concentration (2.33%), phosphorous concentration (0.368%), potassium concentration (2.56%), calcium concentration (2.33%) and Magnesium concentration (0.427%) compared with 0ther treatments and control treatment which gave alowest 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 GA_3 and Fe and Mn and their Interaction on the concentration of amacro nutrients of acress 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 GA_3 and Micro nutrients and their Interaction on micro nutriens concentration where the table shows that spraying with GA_3 droved to asignicant positive deffirents in Micro nutrient concentration except anigative effect in Cu concentration in the plant,spraying with 100 $mg.L^{-1}$ of GA_3 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 GA_3 and Fe and Mn and their Interaction on the concentration of Micro nutrients of Acress 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 GA_3 and Fe and Mn was significant ,all treatments were distinguished with asignificant increases, the plants sprayed with (100 $mg.L^{-1}$ +50+50 $mg.L^{-1}$ Fe+Mn) distinguished with ahighest concentration of Mn (80.67$mg.L^{-1}$),Zn (21.42 $mg.L^{-1}$),I (0.301 $mg.L^{-1}$) compared with alowest values of these nutrients in acontrol 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 GA_3 + 50 $mg.L^{-1}$ of Mn) gave ahighest 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+50$mg.L^{-1}$ from Fe and Mn withoutGA_3) gave ahighest concentration of Cu (14.23$mg.L^{-1}$) compared with (10.10 $mg.L^{-1}$) in aplants sprayed with (100 $mg.L^{-1}$ GA_3 + 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 aphotosynthesis 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 drov to this increas 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 absorpted across the stomatas[32]. As Fe was entered in Cytochromes and feridoxin installation so its effective in increase photosynthesis operation effectivity and therefore the product food [33],also that Mn role in splitting H_2o molucle and releasing electrons and H^+ Ions and therefore constribting in reducing NADP to NADPH which constribted in reducing CO_2 in Calvin Cycle producing Glucose [34]. Nutrients concentration rising may be due to the role of GA_3 in improvement the vegetative growth (tabe 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 arol of GA_3 in energizing cell division and elongation and later stimulates RNA and increased the Bio operations inside the cells as atransmission of nutrients to Aroot 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 inters in installation of porphyrin and cytochromes and Fe centeric in ahigh rates in chloroplasts which gives ahigh important for this nutrient in increase photosynthesis operation effectiveness (36),GA_3 may be play important role in physiological.

operations inside the plant and what it needs from amineral elements to construct amino acids which drives to increase nutrients absorption and increased the concentration (37). These results were agreeded with (38) about effect of Mn on indian mustard plant, and with (39) about Fe role in increase Fe concentration in cytoplasme 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 الخاصه 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 ب50 ملغم.لتر$^{-1}$ ، G2 الرش ب 100ملغم.لتر$^{-1}$) والعامل الثاني الرش بالعناصر الصغرى بأربعة معاملات (T0بدون رش, T1 الرش ب50 ملغم.لتر$^{-1}$ من الحديد، T2الرش ب 50ملغم.لتر$^{-1}$ من المنغنيز T3,الرش ب50+50 ملغم.لتر$^{-1}$ من خليط الحديد والمنغنيز) وكررت المعاملات اربعه مرات وصممت التجربة بتصميم القطاعات العشوائية الكاملة وقورنت المتوسطات بموجب اختبار دنكن متعدد الحدود عند مستوى احتمال 5%.واظهرت النتائج التالية:- سبب الرش بحامض الجبرلين زيادات معنوية في صفات النمو الخضري والعناصر الكبرى والصغرى وقد تميزت المعاملة 100ملغم.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 بخليط الحديد والمنغنيز بأعلى القيم لأغلب هذه الصفات المدروسة. التداخل ما بين حامض الجبرلين والعناصر الصغرى كان معنوي التأثير تميزت فيه المعاملات بزيادات معنويه مقارنة بمعاملة المقارنة وقد تميزت معاملة الرش ب 100 ملغم.لتر$^{-1}$من الجبرلين + خليط الحديد والمنغنيز (50+50 ملغم.لتر$^{-1}$) بأعلى القيم لأغلب هذه الصفات.