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INTERACTION OF AUXIN AND ZINC TREATMENTS ON THE GROWTH OF *CITRUS SINENSIS L.* PLANTS.

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ABSTRACT: There is a considerable work on the relationship between zinc and auxins on plant growth. An obvious icrease in citrus plants hight and dry weight was found by adding zinc to the medium of planting. Moreover, the same trend was true with adding auxins as foliar spray treatment. Meantime, combining zinc treatments with auxin was more effective than either zinc or auxin alone in increasing plant hight and dry weight. Concerning zinc uptake it was found that it was increased by the application of both zinc and auxins at their modrate concentration than the values produced by separate treatments. About zinc translocation it was evident that it was decreased by zinc treatments while, it was increased by auxin treatments. Also, it was quite apparent that the application of auxin as foliar spray in combination with different levels of zinc increased its translocation in citrus plants. The effect was more pronounced by 10 mg/l zinc combined by 5 mg/l auxin This indicates that the action of auxin was more effective when applied with zinc This means that the presence of auxin helped zinc to translocate to upper parts of the plant It was obvious that there was an interaction between zinc and auxin on the plant growth which may help the plant to be more productive .

INTRODUCTION

Zinc is known to be essential for normal plant growth. A considerable work has been done on the relationship and interaction between zinc and auxin. Zinc appears to be essential for auxin formation. The usual symptoms of zinc deficiency are primarlily a general failure of elongation. Skoog (1940) considered this lack of growth to be associated with a low auxin content.Supply deficient plants with zinc restored the auxin supply.

Likewise, the addition of auxin or tryptophan relieved the deficiency symptoms (Tsui, 1948). Zinc fertilization at 9 and 12 ppm delayed the senescence of wheat through an increase in the level of indole-3-acetic acid (IAA), chloropgyll content, and net assimilation rate in leaves and increased the total dry matter content. At 15 ppm level of zinc a decrease in these attributes was noted. This was apparently due to the beging of toxicity of this element at this level (Hemantaranjan and Grag , 1984). Meantime, El-Sayed *et al.*, (1985) found that total yeild of onion was increased with the foliar application of IAA at 100 - 200 ppm. The maximum amount of onion yeild was obtained when plants sprayed with 0.05 % concentration of $ZnSO_4$. Moreover, spraying onion plants with IAA at 100 or 200 ppm and 0.05 % $ZnSO_4$ solution gave the highest yeild .

Zinc in plants is mainly involved in enzymatic reactions. One of the most important functions of zinc is its effect on the synthesis of tryptophan (Tsui,1948). As tryptophan is also a precursor of indole acetic acid, the formation of this growth substance is also indirectly affected by zinc. Tsui (1948) observed low rates of stem elongation, low auxin activities and low tryptophan content in zinc deficient tomato plants. He added that zinc is required directly for the synthesis of tryptophan and indirectly for the synthesis of auxin .

Concentration of zinc in the plant leaves are widely variable depending on species, variety, and growing conditions. Usually, levels of zinc in plants range from around 10 to 100 ppm. Zinc concentration are normally highest in the very young plants and decrease with age due both to dilution and eventually to translocation to seed (Broam et al.,1963).

The present investigation was undertaken to study the effect of the interaction of both auxin and zinc on the growth of citrus plants .

MATERIALS and METHODS

A pot experiment was carried out in 2 kg. containing pots cultivated with one year old citrus plants as indicator (*Citrus sinensis L.*) and they were placed for experiment for 8 weeks. Pots were regularly irrigated to field capacity on weight basis with 0.25 strength Hogland nutrient solution

Treatments:

1. Pots were grouped into 4 sets for the three treatments of zinc which were 0,5,10, 20 mg/l. Zinc was added to the base nutrient Hogland solution as $ZnSO_4$.
2. Every set was further categorized into 4 subsets for auxin treatments Auxins used were indole acetic acid (IAA) and indole butyric acid (IBA) at concentrations 0, 5, 10 mg/l each. Auxins were applied to plants as foliar spray. There was three replicates for each treatment. After 8 weeks, tested plants were cut to shoot and root systems and were weighted freshly. Then plant samples were oven dried at 70°C for 72 hrs. and their dry weight was recorded.

Plant samples were analyzed for Zn determination by atomic absorption spectrophotometer (Philips Pu 9100) according to the method described by Chapman and Pratt (1961).

Zinc uptake was calculated according to the equation:

Zn uptake = Zn content x D. Wt.

Zinc translocation was calculated by the equation:

$$\text{Translocation } \% = \frac{\text{Shoot uptake}}{\text{whole plant uptake}} \times 100$$

RSULTS and DISCUSSIONS

Effect of different treatments of auxins and zinc on the growth of citrus plants:

Fig. (1) shows the effect of auxins and zinc treatments on the growth of citrus plants as measured by plant hight and dry matter yield for the plant. Results showed clearly that separete zinc treatments caused an obvious increase on the plant hight. Increasing the concentration of zinc from 0 to 20 mg/l lead to a gradual increase in the plant hight. The same trend was true with the used auxins added to the plant. Moreover, combining zinc treatments with auxin ones (IAA and IBA) was more effective than either zinc or auxins treatments alone in increasing plant hight. Also, the results

indicated that the useful effect of auxins was found by combining 5 mg/l with 10 mg/l of zinc, where the plant hight reached 19.9 cm and 21.7 cm respectively, Meantime, 20 mg/l treatment of zinc was less effective than other cocentrations of zinc (5 and 10 mg/l). Treatment of combinations of zinc and IBA was relatively quite effective at the first concentration of zinc (5 mg/l), while, the other two combinations (10 and 20 mg/l) of zinc and IBA were not effective as the first one. Also, results showed clearly that combining zinc concentrations with 5 mg/l of IBA was better than the other treatments of IBA (10 mg/l).

Results illustrated in Fig. (1) clearly indicated that the addition of different rates of IAA and zinc added alone or in combinations caused a marked effect on the dry matter yeild of citrus plants. Also, it was evident that the addition of IAA within the range of 0 to 10 mg/l tended to increase the dry matter yeild of shoot, root, and the whole plant. The percentage increase due to the addition of 10 mg/l IAA reached to 72 %, 118 %, and 85 % for shoot, root, and the whole plant respectively. Similar trend was detected when zinc was added alone at 20 mg/l. The corresponding values of the dry matter yeild of shoot, root, and the whole plant at 20 mg/l of zinc were 46 %, 118 %, and 66 % respectively. The highest value of dry weight was given by the addition of 5 mg/l IAA combined with 10 mg/l zinc, then it decreased with the higher rate of IAA .

The above mentioned results showed that the application of IAA at 5 mg/l seemed to be favorable for the activation of growth while, the 10 mg/l of IAA was accompanied by a marked reduction in dry matter yeild. Moreover, the application of IAA at 5 mg/l plus 10 mg/l of zinc showed the most favorable growth of citrus plants. Meantime, the marked decrease in dry matter yeild due to the high rate of auxin and zinc (10 mg/l IAA plus 20 mg/l zinc) may be attributed to the superoptimal concentration of zinc or its toxicity at this level. These results are in agreement with those obtained by Hemantaranjan and Grag (1984) on their work on wheat plants and El-Sayed *et al.*, (1985) on onion plants.

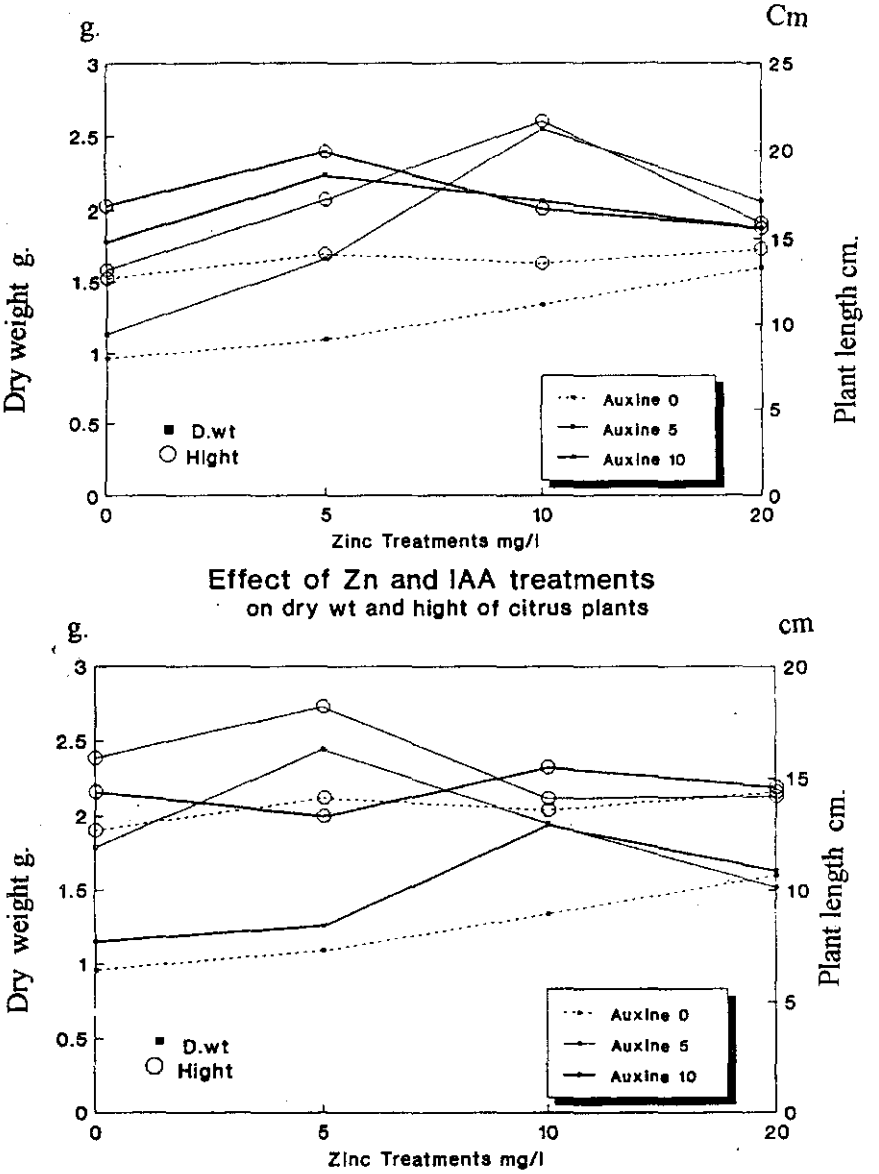

Fig. (1): Effect of IAA, IBA and Zn treatments on dry wt. and hight of citrus plants.

Effect of different treatments of auxin and zinc on zinc content in shoot and root of citrus plants:

Fig. (2) illustrates the zinc content in shoot and root of citrus plants as affected by different treatments of auxin and zinc. The figure shows that zinc content was higher in the shoot of citrus plants than that of root in treatments used. Also, the combined treatments showed higher content of zinc than the single ones. Moreover, there was no obvious differences in zinc content in shoot and root between the two auxins used (IAA and IBA) . Meanwhile, IAA treatment resulted in the highest content of zinc in the root of citrus plant while, IBA showed its highest effecton zinc content in the shoot at 5 mg/l and 10 mg/l of zinc treatment .

Effect of different treatments of auxins and zinc on the uptake of zinc and its translocation in citrus plants:

Results showed in Fig.(3) revealed that zinc uptake was increased by the application of either IAA or zinc. The relative increase due to auxin application within the range of 0 to 10 mg/l were 21.220 mg/l, 20.820 mg/l, and 39.607 mg/l repectively. The corresponding values due to the addition of zinc at rates of 0, 5, 10, and 20 mg/l were 21.220 mg/l, 24.680mg/l, 26.366 mg/l, and 35.434 mg/l respectively. Results also, indicated that the values of zinc uptake due to the application of both IAA and zinc were more than those obtained by their separate treatments. The highest results obtained at the rate of 10 mg/l zinc combined by 5 mg/l auxin which means that this was the best ratio of auxin and zinc. The reduction in zinc uptake caused by the higher rates of IAA and zinc applied together could be attributed to a state of imbalance between auxin and zinc or to the adverse effect of high levels of them on zinc uptake in citrus plants.

Two factors control zinc uptake, a concentration factor which represents the concentration of zinc in the soil solution and a capacity factor which represent the soil ability to replenish zinc in the soil solution (Bauer and Lindsay, 1965). Most workers agree that zinc absorption is largely an active process (Ambler et al., 1970).

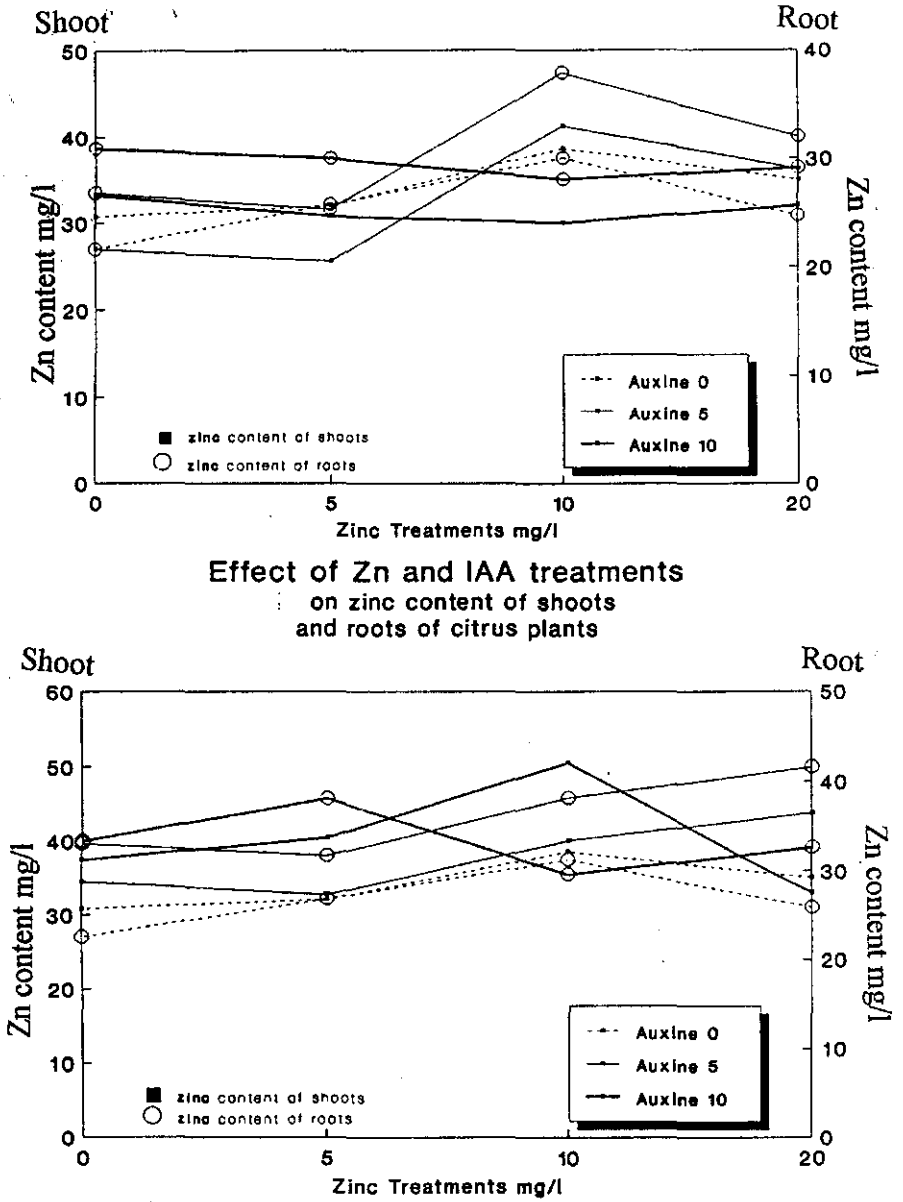

Fig. (2): Effect of IAA, IBA, and Zn treatments on zinc content of shoot and root of citrus plants.

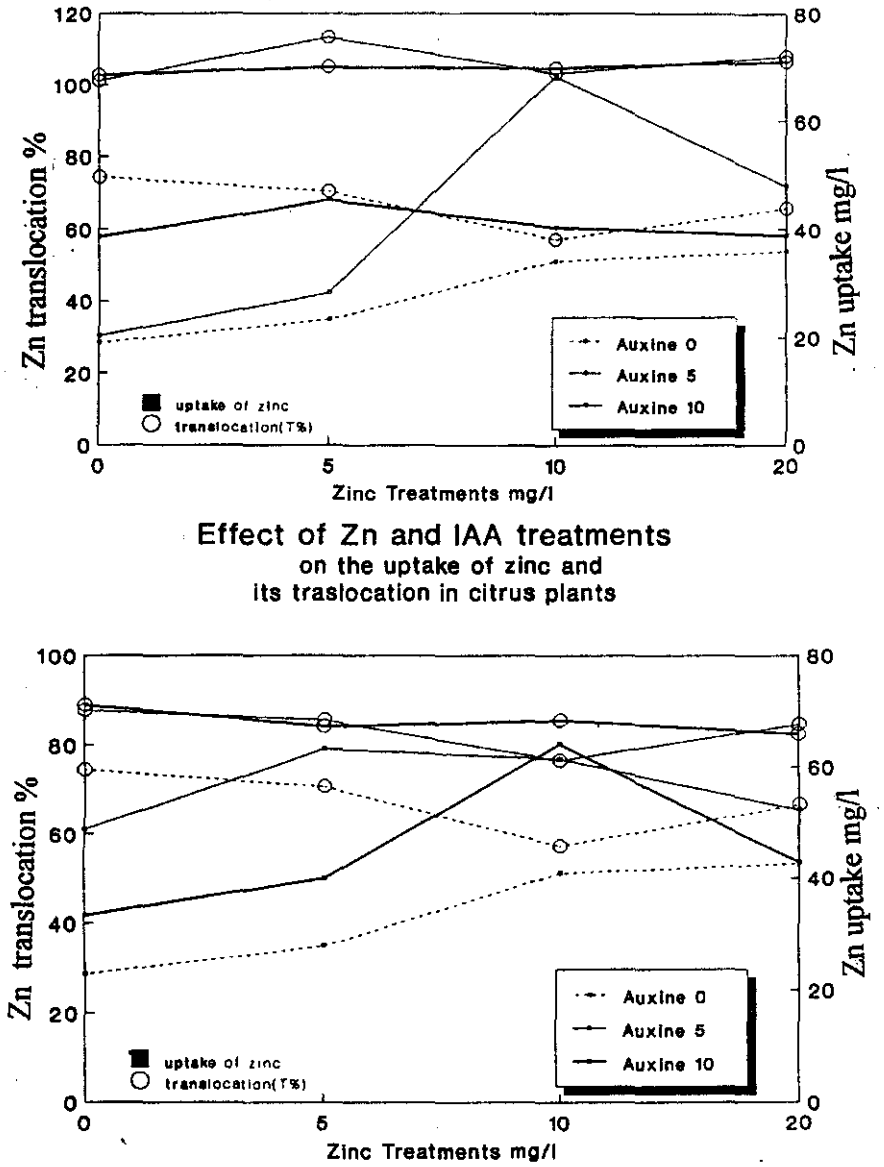

Fig. (3): Effect of IAA, IBA, and zinc treatments on the uptake and translocation of zinc in citrus plants.

Concerning the translocation of zinc in citrus plants as influenced by the various level of zinc and auxin treatments Fig (3) results indicated that adding zinc to the soil at range of 0 to 20 mg/l decreased zinc translocation. Such values reached % 67.390 at 20 mg/l treatment of zinc. On the contrary application of auxin up to 5 mg/l increased zinc translocation, then it decreased with higher concentrations of auxin treatment. This means that, the high rate of auxin was associated by a marked reduction in zinc translocation. Meantime, it was quite apparent that the application of auxin as foliar spray in combination with different levels of zinc increased its translocation in citrus plants. The most pronounced effect was obtained at 10 mg/l zinc combined with 5 mg/l auxin. This indicates that the action of auxin was more effective when applied with zinc. Consequently, the combined application of auxin and zinc made it more readly mobile in citrus plants. That was because the presence of auxin helped zinc to translocate to upper parts of the plant. It was stated earlier that zinc has an intermediate mobility in the plant compared to some of the other elements. In fact roots may show luxury accumulation of zinc under conditions of high zinc availability even though translocation occurs from the roots to the leaves (Boawn et al., 1957).

It can be concluded from the above mentioned data that there is an interaction between zinc and auxin during the plant growth. This may obtain plants more reproductive. Salam and Kenefick (1970) observed from their experiment with corn that plants grown without zinc retarded in growth and developed foliar deficincy symptoms. They added that abnormal characteristics were eleminated by adding zinc or tryptophan to the nutrient medium. Also, from the results obtained by Tsui (1948) on the role of zinc on auxin synthesis in tomato plants, he concluded that zinc is required directly for the synthesis of tryptophan and indirectly for the synthesis of auxin.

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علاقة المعاملة بالأوكسجين والزنك فى تأثيرهم على نمو نباتات *Citrus sinensis* الـ

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هناك علاقة ثابتة بين كل من الاوكسين والزنك فى تأثيرهم على نمو النبات . فقد وجدت زيادة واضحة على الطول والوزن الجاف لنبات الموالح المستخدم فى التجربة باضافة الزنك على البيئة المنزرع بها . كما لوحظت نفس الزيادة فى الطول والوزن الجاف بالمعاملة بالاوكسينات كرش على المجموع الخضرى . بالاضافه الى ذلك فقد ثبت ان المعاملة المزدوجة بكل من الاوكسين والزنك كانت أكثر فاعلية عن استعمال كل منهما منفردا على الطول والوزن الجاف للنبات . كذلك فقد وجدت زيادة واضحة فى امتصاص الزنك بالمعاملة المزدوجة بكل من الاوكسين والزنك بتركيزاتهم المتوسطة اكثر من القيم المتحصل عليها بالمعاملة المنفردة بكل منهما . اما بالنسبة لانتقال الزنك داخل النبات فقد ثبت انها تناقصت بالمعاملة بالزنك فقط بينما زاد الانتقال بالمعاملة بالاوكسين منفردا . وكان من الواضح ان اضافة الاوكسين كرش على المجموع الخضرى بالاضافة لمعاملات الزنك المختلفة قد زاد من انتقال الزنك فى النبات وكان التأثير اوضح بالمعاملة بالزنك على ١٠ ملجم/لتر بالاضافة لمعاملة بـ ٥ ملجم/لتر للاوكسين . وهذا يبين ان الاوكسين كان اكثر فاعلية عند وجود معاملة الزنك. مما يظهر ان وجود الاوكسين قد ساعد الزنك على الانتقال داخل النبات . وهذا يوضح ان هناك علاقة بين الاوكسين والزنك فى تأثيرهم على نمو النبات مما يساعد فى الحصول على نباتات أكثر انتاجية . وهذه العلاقة يعتقد انها تأتى من ان الزنك يشجع بناء الاوكسين .