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ENHANCEMENT OF GROWTH AND YIELD OF EGGPLANT (*Solanum melongena* L.) BY FOLIAR NUTRITION OF POTASSIUM CITRATE AND IRON-SHELATE IN EARLY SUMMER SEASON.

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ABSTRACT

The field experiments were conducted during the two successive summer seasons of 2002 and 2003 at Kafer EL-wekala , Sherbin, Dakahlia, Egypt, to study the effect of foliar nutrition of potassium citrate and Fe-chelate on growth and yield of eggplant, c.v. Black beauty. The experiment contained 9 treatments, which were the simple combination between 3 levels of potassium citrate (0, 1.5 and 3 g/L) and iron chelate (0, 1 and 2 g/L). The main findings obtained from this investigation showed that dry weight, leaf area, total chlorophyll, average fruit weight and number of fruits per plant as well as total yield per feddan were significantly increased by foliar application of 3 g/L of potassium citrate and 2 g/L of Fe-chelates.

INTRODUCTION

Eggplant (*solanum melongena* L.) is one of the most important summer vegetable crop cultivated in Egypt. It requires warm weather for early planting. Many factors affect eggplant growth and productivity among these factors are the expose of plants during the early stage after transplanting, 1st Feb, to average temperature about 19.1 ^{o}C (day) and 8.0 ^{o}C (night). These unfavourable climate led to internal disturbance in the physiological processes.

Treatments which are capable of inducing durability for low temperature will have beneficial effect. Citrate or citric acid is directly engaged in Krebs cycle, acting as a hydrogen generation for the respiration chain (Strove, 1989). It is important for the production of energy substances and hence activates ions uptake as well as synthesis of various organic compounds. Such benefit gains might enhance plant growth under the unfavourable conditions.

It has been reported that spraying citric acid increases plant height, number of fruiting branches, total chlorophyll and yield of cotton (Ghourab, 2000 and Ghourab and Wahdan, 2000). On the other hand, Achilea (1999) reported that potassium has a benefit effect on tomato fruit size, dry mater, colour, tast and resistance to biotic and abiotic stress. Foliar application of potassium resulted in increase in dry mater and chlorophyll of tomato (Kaya *et al*, 2001). Palaniappam *et al* (1999) reported that 3 sprays of K resulted in the highest number of tomato fruits per plant. Foliar application of Fe resulted in increase in dry matter and chlorophyll content (Kaya, *et al* 1999 and Kay and Higgs, 2001 on tomato. Moreover, Patnaik *et al* (2001) on tomato noticed that foliar sprays of 0.5% $FeSo_4$ at weekly interval resulted in the highest fruit yield with maximum yield responses of 39%. Similar results were reported by Raji *et al,* (2001) on eggplant.

The present investigation was suggested to study the effect of foliar application with potassium citrate and iron-chelate on growth and yield of eggplant.

MATERIALS AND METHODS

Field experiments were conducted during the two seasons of 2002 and 2003 at Kafr EL-Wekala, Sherpin, Dakahlia, Egypt to study the effect of foliar nutrition of potassium citrate and iron-chelate on the growth and productivity of eggplant. The experiment contained 9 treatments , which were the simple combination between 3 levels of potassium citrate (0, 1.5 and 3 g/L) and iron chelate (0 ,1 and 2 g/L). Data of some chemical and mechanical properties of the soil as describted by Chapman and Portt (1961) and Jakson (1965) are shown in Table (1):

Sand %	Silt %	Clay %	E.C	$CaCo_3$ %
24.42	31.41	41.96	3.61	3.5
Available N ppm	Available P ppm	Available K ppm	Available Fe ppm	ph
6.11	7.25	210	13.12	7.82

The experimental design was a split plots with 3 replications, the three levels of potassium citrate were arranged within the main plots , and the Fe-chelates rates were represented as the sup-plots.

Eggplant (c.v. Black beauty) transplants with 45 day age were transplanted on 1st of February. All agriculture treatments for eggplant were followed according to the instructions laid by Egyptian Ministry of Agriculture.

Sprayes were started after 14 days from transplanting and repeated at 21 days intervals during the growth season. Four plants were chosen at random from every plot at 120 day after transplanting to measure dry weight per plant , leaf area (cm^2) per plant and total chlorophyll (Mackinny 1941). Eggplant fruits were harvested weekly and average fruit weight by gram, average fruits number and total yield as ton per feddan were determined.

All data of the two experiments were statistically analyzed according to Snedecor and Cochran (1968). The treatments means were compared using Duncan's Multiple Range test as published by Duncan (1955).

RESULTS AND DISCUSSION

1- Effect of foliar application of potassium citrate:

Data presented in Table (2) show that foliar application of 3 g/L of potassium citrate resulted in the highest significant increases in both dry weight and leaf area, it is also clear from the same data that the increment of total chlorophyll was not significant at both seasons of this work. The results were in harmony with those of Kaya *et al* (2001) on tomato. Results in Table (3) showed that increasing the concentration of potassium citrate up to 3 g/L resulted in the highest average fruit weight, number of fruits per plant, early yield and total yield per feddan at both seasons of this work. These results are in accordance with those of Achilea (1999) and Palaniappan *et al* (1999) all work on tomato.

Table 2. Effect of foliar application of potassium citrate on dry weight, leaf area and total chlorophyll of eggplant during 2002 and 2003 seasons.

Season	2002			2003		
treatment	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll I mg/100 g	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll mg/100 g
P. c. 0 g/L	242.2 C	1525 B	163.7 A	196.3 B	1481 C	167.7 A
P. c 1.5 g/L	250.5 B	1611 A	168.5 A	218.9 A	1538 Ab	170.0 A
P. c. 3 g/L	280.8 A	1641 A	172.4 A	219.3 A	1579 A	170.1 A

P. c.= Potassium citrate

Table 3. Effect of foliar application of potassium citrate on average fruit weight, number of fruits per plant and total yield of eggplant during 2002 and 2003 seasons.

Season	2002				2003			
treatment	Average fruit weight (g)	Number of fruits per plant	Early yield per fed.	Total yield ton per fed.	Average fruit weight (g)	Number of fruits per plant	Early yield per fed.	Total yield ton per fed.
P. c. 0 g/L	217.5 C	16.0 C	2.3 C	16.4 C	192.4 C	13.5 C	2.1 C	13.8 C
P. c 1.5 g/L	223.7 B	18.0 B	2.8 B	17.4 B	210.7 B	15. 8 B	2.4 B	15.8 B
P. c. 3 g/L	236.9 A	19.2 A	3.1 A	18.6 A	224.9 A	18.1 A	2.9 A	17.6 A

P. c.= potassium citrate

The stimulatory effect of such treatments may be due to the enhancing effect of potassium on photo synthesis via increasing leaf area and hence Co^2 assimilation (Gardener *et al,* 1985),potassium, also is directly involved in the process of phloem loading as a counter ion to H^+ release (Komor *et al,* 1980). The effect of potassium on fruit weight and yield might be due to the effect of potassium on mobilization and accumulation of stored substances. It is also clear that citrate enhances respiration process via enhancing Krebs cycle which believed to enhance ATP synthesis (Stroev, 1989). As ATP is required for the activity of the cell membrane pump system (H+-ATP–ase) their by the cell regulate their ions concentration and absorbtion (Palta, 1990), such benefit gains might enhance plant growth and yield.

2- Effect of foliar application of Fe-chelates:

The data reported in Table (4) showed significant differences in the response spraying Fe-shelates applications. Using 1 g/L or 2 g/L gave rise to highest increase in dry weight and leaf area per plant during the first season. The same data reveal that highest significant values of total chlorophyll resulted from foliar spraying of 2 g/L of Fe-chelates in both seasons. Similar results were reported by Kaya *et al.*, 1999, Kaya *et a*/ 2001 and Higgs, 2001 all work on tomato. It is obvious from data in Table (5) that significant differences were noticed between all used foliar sprays, Fe-chelates at higher rat (2 g/L) increased average fruit weight, number of fruit per plant and total

yield feddan. These results are in a good a agreement with those of Patnaik *et al* (2001) on tomato and Raji *et al* (2001) on eggplant.

The stimulatory effect of Fe-chelates on Chlorophyll components may be expected since Fe is a main component of privet importance in enhancing photosynthesis and hence Co_2 assimilate such benefit gains might enhance plan growth and productivity of eggplant.

Table 4. Effect of foliar application of Fe-chelates on dry weight, leaf area and total chlorophyll of eggplant during 2002 and 2003 seasons.

Season	2002			2003		
treatment	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll mg/100 g	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll mg/100 g
Fe 0 g/L	247.1B	1558 B	154.8 C	211.4 A	1471 B	161.2 C
Fe 1.5 g/L	262.2 A	1591 A	160.4 B	212.4 A	1561 A	167.3 B
Fe 2 g/L	264.1 A	1628 A	189.5 A	212.7 A	1566 A	180.0 A

Table 5. Effect of foliar application of Fe-chelates on average fruit weight, number of fruits per plant and total yield of eggplant during 2002 and 2003 seasons.

Season	2002				2003			
treatment	Average fruit weight (g)	Number of fruits per plant	Early yield ton per fed.	Total yield ton per fed.	Average fruit weight (g)	Number of fruits per plant	Early yield ton per fed.	Total yield ton per fed.
P. c. 0 g/L	223.7 B	17.5 A	2.3 C	15.2 C	207.9 C	14.4 B	2.3 C	14.8 C
P. c 1 g/L	220.3 B	17.7 A	2.8 B	17.7 B	209.3 B	16.5 A	2.4 B	15.5 B
P. c. 2 g/L	233.9 A	18.0 A	2.1 A	19.5 A	210.9 A	16.5 A	3.7 A	16.9 A

2- Effect of interaction between potassium citrates and Fe-chelate:

Table (6) presents the dry weight, leaf area and total chlorophyll as influenced by interaction between potassium citrate and Fe-shelates as a foliar application treatments. The obtained data showed that all treatments had a significant response to the interaction treatments. Dry weight and leaf area were statistically affected by foliar application of 3 g/L potassium citrate +1 g/L Fe-shelates and 3 g/L potassium citrate + 2 g/L Fe-chelates at both season of this work. The same data were reported as a result of foliar application of potassium citrate at 3 g/L + Fe-chelates at 2 g/L. Data given in Table (7) reveal that average fruit weight, number of fruits per plant and total yield as well as early yield per fed. of eggplant were significantly influenced by the foliar application of potassium citrate at 3 g/L + Fe-chelates at 2 g/L.

Table 6. Effect of interaction between potassium citrate and Fe-chelates on dry weight, leaf area and total chlorophyll of eggplant during 2002 and 2003 seasons.

Season	2002			2003		
Treatment	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll mg/100 g	Dry weight g/plant	Leaf area (cm^2)	Total chlorophyll mg/100 g
P. c. 0 g/L+ Fe 0 g/L	232.1 E	1482 C	150.2 D	195.3 C	1421 C	163.0 C
P. c. 0 g/L+ Fe 1g/L	245.3 C	1523 C	159.7 CD	197.3 C	1520 B	166.3 B
P. c. 0 g/L+ Fe 2 g/L	249.1 CD	1571 BC	181.3 B	202.3 C	1503 B	173.8 B
P. c 1.5 g/L+ Fe 0 g/L	237.2 DE	1592 B	159.9 CD	220.1 A	1481 B	161.4 C
P. c 1.5 g/L+ Fe 1g/L	252.4 C	1599 B	158.3 CD	223.1 A	1531 B	164.4 C
P. c 1.5 g/L+ Fe 2 g/L	261.9 BC	1642 A	187.4 B	213.5 B	1602 A	184.3 A
P. c. 3 g/L+ Fe 0 g/L	271.1 B	1601 B	154.2 D	218.8 AB	1511 B	159.3 C
P. c. 3 g/L+ Fe 1g/L	288.9 A	1650 AB	163.2 C	216.8 AB	1633 A	171.3 BC
P. c. 3 g/L+ Fe 2 g/L	281.3 A	1671 A	199.8 A	222.3 AB	1592 A	181.9 AB

P. c.= potassium citrate AB Fe = Fe-chelates

Table 7. Effect of interaction between potassium citrate and Fe-chelates on average fruit weight, number of fruits per plant and total yield of eggplant during 2002 and 2003 seasons.

Season	2002				2003			
Treatment	Average fruit weight (g)	Number of fruits per plant	Early yield ton per fed.	Total yield ton per fed.	Average fruit weight (g)	Number of fruits per plant	Early yield ton per fed.	Total yield ton per fed.
P. c. 0 g/L+ Fe 0 g/L	211.7 D	16.03 D	2.09 I	14.92 E	189.1 C	13.01 F	2.11 G	13.37 E
P. c. 0 g/L+ Fe 1g/L	215.3 D	15.92 D	2.32 H	16.32 D	194.2 C	13.21 EF	1.99 H	13.81 E
P. c. 0 g/L+ Fe 2 g/L	225.4 B	16.01D	2.54 E	17.82 C	193.9 C	14.32 D	2.18 F	14.32 D
P. c 1.5 g/L+ Fe 0 g/L	221.3 CD	17.32 C	3.35 G	15.47 D	212.4 B	14.21 D	2.27 E	14.22 D
P. c 1.5 g/L+ Fe 1g/L	214.5 D	18.21 B	2.75 D	17.42 CD	208.3 B	17.01 B	2.39 D	15.73 C
P. c 1.5 g/L+ Fe 2 g/L	235.2 A	18.32 B	3.15 C	19.43 B	211.4 B	16.13 BC	2.63 C	17.43 B
P. c. 3 g/L+ Fe 0 g/L	238.2 AB	19.03 AB	2.47 F	15.13 E	222.1 A	15.82 C	2.63 C	16.71 BC
P. c. 3 g/L+ Fe 1g/L	231.2 B	18.84 AB	3.23 B	19.32 B	225.4 A	19.17 A	2.75 B	16.99 B
P. c. 3 g/L+ Fe 2 g/L	241.2 A	19.71 A	3.64 A	21.25 A	227.3 A	19.1 8A	3.22 A	18.99 A

P. c.= Potassium citrate Fe = Fe-chelates

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تحسين النمو ومحصول الباذنجان بالرش الورقى بستـــرات البوتاســـيوم و الحديد المخلبى خلال العروة الصيفية المبكرة.

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أجّريت تجربتان حقليتان خلال الموسم الصيفى لعام ٢٠٠٢ , ٢٠٠٣ فى كفر الوكالة ، مركز شربين ، دقهلية لدراسة تأثير الرش الورقى بسترات البوتاسيوم و الحديد على النمو و المحصول فى نبات الباذنجان صنف بلاك بيوتى و قد اشتملت التجربة على ٩ معاملات نتجت عن التفاعل بين ثلاث مستويات من سترات البوتاسيوم (صفر ، ١,٥ ، ٣ جم /لتر) وثلاث مستويات من الحديد المخلبى (صفر، ١، ٢ جم /لتر) وقد أدى الرش بمعدل ٣ جم سترات بوتاسيوم و ٢ جم حديد مخلبى الى الحصول على أعلى زيادة معنوية فى الوزن الجاف للنبات و المساحة الورقية و الكلورفيل الكلى و متوسط وزن الثمرة و عدد الثمار للبنات و كذلك المحصول الكلى للفدان.