



## Influence of Some Micro and Macro -Nutrients on Growth, and Chemical Constituents of Croton (*Codiaeum Variegatum*) L Plants.

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### Abstract

A pot croton (*Codiaeum variegatum*) experimental study was conducted at the Floriculture Nursery of the Hort. Dept. , Faculty of Agriculture ,Moshtohor, Benha University , during 2022 and 2023 seasons to evaluate the effect of some micro and macro-nutrients foliar spray treatments i.e. the combination of Ca +Mg at 50, 100 and 150 ppm, treatments beside the combination of micro-nutrients i.e. Fe +Mn +Zn at 50, 100 and 150ppm a on vegetative growth root parameters and chemical constituents of croton (*Codiaeum variegatum*) plants. Results showed that different applied treatments of some nutrients treatments led to significant increase of the studied mention afore. However, the highest values in this concern, were recorded by Ca+Mg at 50 ppm sprayed plants, followed in descendingly by (Fe +Mn +Zn) at 100 ppm . Consequently, it is preferable to spray croton plants with Ca+Mg at 50 ppm or 100 ppm Fe +Mn +Zn to enhance the growth, roots and some chemical constituents of this plant.

**Key words:** *Codiaeum variegatum*, Micro and Macro -nutrients, growth and chemical compositions

### Introduction

Croton (*Codiaeum variegatum* ) belongs to is one of the beautiful indoor and outdoor plants need extensive agriculture development. It is colourful, glossy foliage and variation of leaf types are one of the most popular plants in Egypt. It is a native to the tropics from Java to Australia and South Sea Islands. However, the agricultural strategy of Egypt gives much interest to ornamental plants production for local and Exportation Also, croton is a valuable and eye-catching ornamental plant with many uses in landscaping and interior decoration. It plays a role in air purification and is very important in the indoor ornamental plant trade, as it is considered an important potted plant due to the beauty of its leaves and its adaptability, making it an important choice for adding colour and attracting visual interest in different places and environments (Bakheet et al. 2018). The Chemical fertilizers greatly affect the growth and productivity of plants in general, especially ornamental plants. Mineral fertilization plays a major and important role in improving and increasing growth within the plant, especially when using optimal rates. Many studies conducted by researchers have shown positive effects of chemical fertilizers on the growth and productivity of different plants (El-Naggar et al., 2016). Calcium and magnesium are two cation mineral nutrients that have

either structural physiological or biochemical functions in growth and stress tolerance in plants walls, stabilization of cell membranes and aintenance of cell turgor. Ca plays several roles in plants, including structural functions in cell pressure, as well as acting as a counter-ion for inorganic and organic anions in vacuoles and as a cytoplasmic second messenger. **Abou-Shleell, (2017)** stated that the foliar application with (Ca, Mg and Fe in the chelate at 500 ppm led to a significant increase in vegetative growth and chemical composition of on *Moringa olifera*. Micronutrients are important to plant growth, their concentrations in plant tissues are only a small proportion of the concentrations of macronutrients. Micronutrients play many complex roles in plant nutrition, but most of them are used in the functioning of a number of enzyme systems . In this respect (**Ghatas and Mohamed ,2018**) on *Cymbopogon citruts L.*plants , they mentioned that foliar application of (Ca, Mg and Fe in chelated) form at 500 ppm significantly increased all the studied vegetative growth parameters and chemical composition of the plants. Thereupon, this study was conducted to evaluate the effect of spraying with microelements such as iron, zinc and manganese and macroelements such as calcium and magnesium on vegetative, root growth and chemical compositions of *Codiaeum variegatum L.* plant

## Materials and Methods

A pot experimental study was conducted at the Floriculture Nursery of the Horticulture Department, Faculty of Agriculture, Moshtohor, Benha University, during 2022 and 2023 seasons to study the effect of some macro and micro elements on vegetative root growth and chemical compositions of *croton* plant

### Plant Material:

Uniform of croton (*Codiaeum variegatum*) rooted cuttings having From 1-4 branches, 29-50 cm in length of the plant, 18-50 in number of leaves on

it, and 0.2 -0.6 in stem diameter above a height of 10 cm were selected for achieving this study . The plants were obtained from Floriculture Nursery of the Hort. Dept., ac. of Agric., Benha Univ. and were reported in plastic pots of 20 cm diameter (one plant / pot), filled with a mixture of 1 clay: 1 sand :1 peat moss (v:v:v). The chemical characteristics of the planting medium were shown in Table (1). Chemical analysis was determined according to Black et al. (1982). and placed in a partial shade (14000-16000 lux) under the house condition on 9 April, for the two seasons of this study.

**Table 1.** Chemical analysis of the planting medium

Parameters	Unit	Seasons	
		2022	2023
CaCO <sub>3</sub>	%	1.08	1.02
Organic matter	%	1.80	1.74
Available nitrogen	%	0.94	0.86
Available phosphorus	%	0.52	0.60
Available potassium	%	0.84	0.79
E.C	ds/m	1.22	1.30
pH	-log [H <sup>+</sup> ]	6.72	6.74

### Experimental layout and procedure

The layout of the experiment was a simple randomized block design included seven treatments with three replicates, each replicate contained 5 pots the treatment contained 15 plants . Also The experimental treatments were started in the two seasons after one month from beginning the planting time at 1<sup>st</sup> March, in both seasons. the treatments which represented and all combinations between foliar application micro-nutrients Fe, Mn and Zn was applied as foliar spray in the form of EDTA (13%) : Fe +Mn+Zn at 50,100 and150 ppm. Also, macro elements Ca and Mg were applied as foliar spray in chelated form Ca +Mg at 50,100 and 150 ppm. In addition to the control plants which sprayed with tap water. A surfactant (Tween 20) at a concentration of 0.01% was added to all sprayed solutions including the control. Treated plants were foliar sprayed three times a year at 30 days intervals,. The first spray was applied, on 1<sup>st</sup> April in the two seasons. Treated plants were sprayed till run off, whereas control plants were sprayed with tap water. Common agricultural practices (irrigation, fertilization, manual weed control, ... etc.) were carried out when needed.

### Data Recorded:

On 30<sup>th</sup> December in the two seasons, the experiment was finished and data recorded were:

#### 1. Vegetative growth parameters:

1. Plant height (cm).
2. - Stem diameter (cm).
3. Number of shoots/ plant.
4. Number of branches/plant.

5. Fresh weight of vegetative growth /plant (g).

6. Dry weight of vegetative growth /plant(g).

#### 2. Rooting growth parameters :

1. Roots volume (cm<sup>3</sup>).
2. Fresh weight of rooting growth (g).
3. Dry weight of rooting growth (g).

#### 3. Chemical composition determination:

Total nitrogen,total phosphorus, potassium % were determined in dried leaves according the methods described by **Horneck and Miller (1998)**, **Hucker and Catroux (1980)** and **Horneck and Hanson (1998)**, respectively.

Total chlorophylls content as (mg/100 g F.W.), was determined in fresh leaves according to **A.O.A.C. (2005)**.

### Statistical analysis:

All obtained data in both seasons of study were subjected to analysis of variance as factorial experiments in a complete randomized block design. L.S.D. method was used to differentiate between means according to **Snedecor and Cochran (1989)**.

## Results and Discussion

### Effect of some micro and macro-elements as foliar spray treatments on vegetative growth parameters of the croton plant during 2022 and 2023 seasons

Tables (2,3 and 4) declares that all studied vegetative growth i.e. ( plant height , stem diameter, No. shoots/ plant, No. of branches / plant, fresh

weight/leaves and dry weight/leaves were resulted a highly significant increments by used all macro- and microelements treatments of croton (*Codiaeum variegatum*) L especially Ca+Mg at 50 ppm in both seasons. (Fe +Mn +Zn) at 100 ppm gave the second values of parameters mention afore in this concern. On the reverse, control (tap water ) gave the lowest values of these parameters regarding in both seasons. Furthermore, the rest treatments came in-between the mentioned above treatments in the two seasons. The abovementioned results of mineral and micro-nutrients are nearly similar to those obtained by, **Amuamuha et al., (2012)** on marigold plant **Khalid**

**(2012)** on anise plant, **Amran (2013)** on *Pelargonium graveolens* ,**Youssef (2014)** on *Echinacea purpurea*, **Yadegari (2015)** on borago, thyme and marigold , **Ghatas and Abdallah (2016)** on *Echinacea purpurea*, plant. ,**Abou-Shleel (2017)** on *Moringa olifera*. **Ghatas and Mohamed (2018)** of *Cymbopogon citruts* L. plant, **Shyala et al, (2019)** on *Tagetes erecta* L. , **Farruggia et al ( 2023)** on Oregano and **Soliman et al., (2023)** they observed that spraying *Cuminum cyminum* L. with chelated - zinc at 200 ppm and glycine at 400 ppm with wide planting lines significantly increased the vegetative growth

**Table 2.** Effect of some micro and macro-elements as foliar spray treatments on plant height and stem diameter parameters of the croton plant during 2022 and 2023 seasons

Treatments	Parameters			
	Plant height (cm)		Stem diameter (cm)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	38.00	35.00	0.37	0.37
Fe+ Zn+ Mn at 50 ppm	43.00	46.30	0.48	0.57
Fe+ Zn+ Mn at 100 ppm	52.00	56.00	0.70	0.77
Fe+ Zn+ Mn at 150 ppm	45.67	50.70	0.60	0.63
Ca+ Mg at 50 ppm	53.00	55.00	0.67	0.80
Ca+ Mg at 100 ppm	43.30	47.30	0.47	0.57
Ca+ Mg at 150 ppm	47.00	47.00	0.53	0.60
L.S.D. at 5 %	<b>3.99</b>	<b>4.76</b>	<b>0.11</b>	<b>0.10</b>

**Table 3.** Effect of some micro and macro-elements as foliar spray treatments on number of shoots /plant and number of branches /plant of the croton plant during 2022 and 2023 seasons

Treatments	Parameters			
	No. shoots/ plant		No. branches / plant	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	22.70	27.0	2.33	2.30
Fe+ Zn+ Mn at 50 ppm	22.30	24.3	2.00	2.70
Fe+ Zn+ Mn at 100 ppm	32.30	34.7	3.30	3.70
Fe+ Zn+ Mn at 150 ppm	23.70	27.7	2.30	3.00
Ca+ Mg at 50 ppm	30.03	36.3	3.30	4.00
Ca+ Mg at 100 ppm	25.00	29.7	2.30	2.30
Ca+ Mg at 150 ppm	25.30	31.3	2.00	2.30
L.S.D. at 5 %	<b>4.83</b>	<b>3.67</b>	<b>0.84</b>	<b>0.84</b>

**Table 4.** Effect of some micro and macro-elements as foliar spray treatments on Fresh weight of leaves (g) /plant and dry weight of leaves (g) /plant of the croton plant during 2022 and 2023 seasons

Treatments	Parameters			
	Fresh weight/leaves (g)		Dry weight/leaves (g)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	36.00	41.70	23.00	25.00
Fe+ Zn+ Mn at 50 ppm	44.00	60.00	23.30	33.30
Fe+ Zn+ Mn at 100 ppm	58.00	65.30	34.70	53.30
Fe+ Zn+ Mn at 150 ppm	42.30	42.00	23.00	45.00
Ca+ Mg at 50 ppm	91.70	98.70	40.70	52.70
Ca+ Mg at 100 ppm	57.00	73.30	33.30	39.70

Ca+ Mg at 150 ppm	53.70	48.30	33.00	37.30
L.S.D. at 5 %	4.25	4.02	3.29	4.57

#### Root parameters:

Data in Table 5. Demonstrated that all different nutrients treatments succeeded in increasing roots parameters i.e. (Volume of roots, fresh weight/roots and dry weight/roots ) on croton plant in both seasons. However, Ca+ Mg treatments statistically increased this parameter, with superiority for the medium concentration (50 ppm) in the two seasons. Moreover, Fe +Mn +Zn at 100 ppm treatment gave the second values in this concern,

followed by (Ca +Mg at 150 ppm treatment in most cases in both seasons. Regardless, the control treatment achieved the lowest values of these studied parameter rank in the first and second seasons. The abovementioned results of mineral and micro nutrients of root parameters are nearly similar to those obtained by, **Sakr *et al.*, (2010)** on *Magnolia grandiflora L.* and **El-Khateeb *et al.*, (2023)** obtained That the heaviest roots and root number were with Zn and Mn on *Schefflera cv. Gold Capella*.

**Table 5.** Effect of some micro and macro-elements as foliar spray treatments on roots volume (cm<sup>3</sup>), fresh weight of roots (g) /plant and dry weight of roots (g) /plant of the croton plant during 2022 and 2023 seasons

Treatments	Root parameters					
	Roots volume (cm <sup>3</sup> )		Fresh weight of roots/plant (g)		Dry weight of roots/plant (g)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	13.3	13.3	15.0	18.0	11.3	8.0
Fe+ Zn+ Mn at 50 ppm	15.7	21.0	15.0	21.0	10.0	11.0
Fe+ Zn+ Mn at 100 ppm	30.3	35.0	20.3	33.0	13.7	19.0
Fe+ Zn+ Mn at 150 ppm	15.7	22.3	15.0	17.0	10.7	11.7
Ca+ Mg at 50 ppm	31.0	35.3	25.0	36.7	17.0	21.7
Ca+ Mg at 100 ppm	15.0	17.7	15.0	20.0	12.0	17.7
Ca+ Mg at 150 ppm	21.0	25.0	15.0	17.7	10.33	11.7
L.S.D. at 5 %	9.5	8.1	2.40	3.2	2.8	2.8

#### Chemical composition:

Tables (6, 7 and 8) reveal that all micro- and macro-elements statistically increased leaf Ch. a, b and carotenoids, nitrogen, phosphorus, potassium and total carbohydrate% N of croton plant when compared to control in the two seasons. Hence, Ca+Mg at 50 ppm sprayed plants gave the highest values in this concern, followed in descendingly by (Fe +Mn +Zn) at 100 ppm in both seasons. On the contrary, the lowest values of these parameters were recorded by control in both seasons. The aforementioned obtained results of mineral and

micro-nutrients are in conformity with those obtained by **Youssef (2014)** on *Echinacea purpurea.*, **Ghata and Abdallah (2016)** on *Echinacea purpurea*, **Abou-Shleell (2017)** on *Moringa olifera*, **Ghata and Mohamed (2018)** on *Cymbopogon citrus L.* **Mehmood *et al* (2021)** on sunflower hybrids, **El-Khateeb *et al.* (2023)** on *Schefflera cv. Gold* . **Ahmed *et al.*(2023)** on *solidago virgaurea L.*, plant and **Soliman *et al.* (2023)** observed that spraying *Cuminum cyminum L.* with chelated -zinc at 200 ppm and glycine at 400 ppm with wide planting lines significantly increased biochemical constituents

**Table 6.** Effect of some micro and macro-elements as foliar spray treatments on chlorophyll a, b and carotenoids contents (mg/g F.W.) of the croton plant during 2022 and 2023 seasons

Treatments	Pigments content					
	Chlorophyll a (mg/g F.W.)		Chlorophyll b(mg/g F.W.)		Carotenoids (mg/g F.W.)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	0.80	0.90	0.31	0.37	0.28	0.29
Fe+ Zn+ Mn at 50 ppm	0.86	0.91	0.34	0.37	0.22	0.23
Fe+ Zn+ Mn at 100 ppm	1.03	1.08	0.35	0.38	0.33	0.34
Fe+ Zn+ Mn at 150 ppm	0.90	1.05	0.32	0.36	0.21	0.22
Ca+ Mg at 50 ppm	1.18	1.26	0.48	0.50	0.30	0.31

Ca+ Mg at 100 ppm	0.88	0.91	0.32	0.34	0.24	0.25
Ca+ Mg at 150 ppm	1.07	1.09	0.30	0.30	0.25	0.26
L.S.D. at 5 %	<b>0.18</b>	<b>0.20</b>	<b>0.10</b>	<b>0.10</b>	<b>0.04</b>	<b>0.06</b>

**Table 7.** Effect of some micro and macro-elements as foliar spray treatments on total carbohydrates and total nitrogen percentages of the croton plant during 2022 and 2023 seasons

Treatments	Parameters			
	Total carbohydrates (%)		Total nitrogen (%)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	17.3	18.7	1.82	1.83
Fe+ Zn+ Mn at 50 ppm	18.0	19.0	2.57	2.77
Fe+ Zn+ Mn at 100 ppm	24.0	26.3	3.01	3.07
Fe+ Zn+ Mn at 150 ppm	18.3	20.7	2.12	2.33
Ca+ Mg at 50 ppm	24.0	26.0	3.13	3.23
Ca+ Mg at 100 ppm	17.7	18.0	2.19	2.23
Ca+ Mg at 150 ppm	19.7	21.0	2.16	2.22
L.S.D. at 5 %	<b>2.87</b>	<b>3.38</b>	<b>0.26</b>	<b>0.23</b>

**Table 8.** Effect of some micro and macro-elements as foliar spray treatments on total phosphorus and potassium percentages of the croton plant during 2022 and 2023 seasons

Treatments	Parameters			
	Total phosphorus (%)		Potassium (%)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
Control (tap water)	0.22	0.23	1.94	1.96
Fe+ Zn+ Mn at 50 ppm	0.34	0.38	1.71	1.76
Fe+ Zn+ Mn at 100 ppm	0.31	0.32	2.07	2.09
Fe+ Zn+ Mn at 150 ppm	0.25	0.27	1.69	1.77
Ca+ Mg at 50 ppm	0.31	0.33	2.11	2.20
Ca+ Mg at 100 ppm	0.24	0.25	1.82	1.85
Ca+ Mg at 150 ppm	0.25	0.25	1.92	1.95
L.S.D. at 5 %	<b>0.11</b>	<b>0.11</b>	<b>0.29</b>	<b>0.75</b>

## Conclusion

Conclusively, It is clear from the previous results obtained that it is better to spray croton plants with calcium and magnesium treatment at a concentration of 50 ppm to enhance the growth, productivity and quality of croton plant.

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تأثير استخدام معاملات الرش ببعض العناصر الكبرى والصغرى علي النمو والمحتوي الكيماوي لنبات الكروتون  
 اجريت تجربة اصص بمشتمل الزينة بقسم البساتين - كلية الزراعة بمشتمل جامعة بنها خلال موسمي 2022 و2023 لدراسة تأثير استخدام الرش  
 بالعناصر الكبرى والصغرى علي النمو والمحتوي الكيماوي لنبات الكروتون . أظهرت النتائج المتحصل عليها أن جميع معاملات الرش بالعناصر  
 الصغرى والكبرى أدت إلى زيادة معنوية في جميع الصفات المختلفة للنمو والقراءات الجذرية والمحتوي الكيماوي (المحتوى من الكلوروفيل ،  
 النسب المئوية للكربوهيدرات الكلية والنيتروجين الكلي والفسفور الكلي والبوتاسيوم) تحت الدراسة. وقد وجد ان افضل النتائج التي تم الحصول  
 عليها للصفات تحت الدراسة نتجت من استخدام المعاملة المكونة من الكالسيوم+الماغنسيوم بتركيز 50 جزء في المليون ، تبعث بمعاملة الرش  
 باستخدام الحديد+الزنك+المنجنيز بتركيز 100 جزء في المليون مقارنة بمعاملة الكنترول باستخدام الرش بماء الصنبور في كلا الموسمين . ويتضح  
 من النتائج السابقة المتحصل عليها أنه من الأفضل رش نباتات الكروتون بمعاملة الكالسيوم والمغنيسيوم بتركيز 50 جزء في المليون لتعزيز نمو  
 وإنتاجية ونوعية هذا النبات .  
 الكلمات الافتتاحية : نبات الكروتون, العناصر الكبرى, العناصر الصغرى, النمو والمحتوي الكيماوي