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IMPROVING OF *Euphorbia milii* PLANT GROWTH BY FOLIAR APPLICATION OF GA_3 AND COMPLETE FERTILIZER

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ABSTRACT: *Euphorbia milii* plants were treated with different concentrations (0, 500 or 1000 mg/l) of GA_3 and/or complete fertilizer (Solufert) at 0, 3 or 6 g/l as foliar application to investigate the impact of these treatments on some plant growth characters viz.; number of branches/plant, main stem length (cm), fresh and dry weights of main stem (g), number of leaves/branch, fresh and dry weights of leaves/plant (g), number of flowers/plant, the tallest root length (cm), number of roots/plant as well as fresh and dry weights of roots/plant (g). Results indicated that spraying plants with the combinations of 6 g/l Solufert + 500 mg/l of GA_3 or 3 g/l Solufert + 1000 mg/l of GA_3 gave the maximum values of most abovementioned growth traits.

Key words: *Euphorbia milii*, gibberellic acid (GA_3), complete fertilizer (Solufert)

INTRODUCTION

Euphorbia milii is belonging to family *Euphorbiaceae*. It has many common names such as; Christ thorn, Christ plant and Crown of thorns. This specie is a flowering succulent plant. It is highly estimated for its elegance inflorescence, extended flowering season and the tolerance to inapplicable conditions (**Jankalski, 2000**). Also, it can grow around the year in dry, temperate and intense sun light radiation locations as pot plant, bedding or garden plants (**Jankalski, 2000**). *Euphorbia milii* is widely used as pot plant for its attractive inflorescences. Moreover, many important medicinal ingredients have been identified in this plant such as; anthraquinones, saponins, cardiac glycosides, and flavonoids (**Ashfaq *et al*., 2022**). The leaves of *E. milii* are used in folk medicine as antiseptic, antibacterial, anticancer, anti-inflammatory and for mild hypersensitive (**Okwu, 2004; Pradyutha *et al*., 2015**).

The gibberellic acid is a tetracyclic diterpenoid compound and a plant growth and development stimulator. GAs promote seed germination, stimulate the conversions from meristem to shoot growth, juvenile to adult leaf stage, vegetative to flowering, regulate sex expression and many other physiological promotion effects (**Pradeepkumar *et al*., 2020**). Also, gibberellic acid is understood to be concerned in stimulating stem elongation, enhancing leaf number and area, shoot weight as well as flower diameter. Moreover, GA_3 retards plant senescence via declining the senescence effect of ethylene (**Singh *et al*., 2019**).

Foliar fertilizer application is an important plant management strategy that helps maximize crop yield and quality. Foliar feeding is used as a method of delivering additional amounts of macro- and micronutrients. Discovered effects of foliar fertilization include increased yield, tolerance to diseases and pests, improved drought resistance, and improved crop quality. Plant response varies with fertilizer type, form, application concentration and frequency, and plant growth stage. Foliar fertilizer application may also be used to help plants overcoming

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transplant shock and other adverse environmental conditions. So that, foliar fertilization is recommended in integrated plant production, since it is more ecologically friendly and may improve productivity and quality of plants (**Haytova, 2013**).

There is growing interest in foliar fertilization because this method of fertilization has many benefits. It responds quickly and effectively to plant feeding requirements, disregarding of soil conditions (**Kerin and Berova, 2003**). Supplemental foliar fertilization during plant growth and development improves nutrient balance, resulting in increased yield and quality (**Kolota and Osinska, 2001**).

Thus, the main goal of this study was to investigate the influence of foliar application of GA_3 and complete fertilizer (Solufert) on *Euphorbia milii* plants growth and development.

MATERIALS AND METHODS

This work was carried out during the two consecutive seasons of 2020 and 2021 under the green-house conditions of Faculty of Agriculture, Zagazig University, Egypt, to study the effect of foliar application of different gibberellic acid (GA_3) concentrations (0, 500or 1000 mg/l) and complete fertilizer (Solufert) levels (0, 3 or 6 g/l) and their combinations on *Euphorbia milii* plants growth characters.

The experiment included nine treatments, which were the combinations between three GA_3 concentrations and three complete fertilizer (Solufert) concentrations. This experiment was designed as factorial experiment between the above mentioned GA_3 concentrations and complete fertilizer (Solufert) levels in a complete randomized block design with three replicates, each replicate contained five pots and each pot contained one plant.

Rooted cuttings of *Euphorbia milii* with three years old were used as plant material for this study. Each plant was cultivated in 20 cm diameter pot contained sand + peat moss (1:1, v/v) medium on 15th June at both experimental seasons. Pots were maintained in the green-house conditions with air temperature ranged from 25 to 30^{o}C, relative humidity between 70 to 85%. Throughout the experimental period during both seasons, pots were irrigated whenever needed.

Complete fertilizer (Solufert) was dissolved in water at two concentrations (3 and 6 g/l) and plants were sprayed three times with this solution or water (control) at two weeks interval starting from 15th of July. Solufert is containing; 20% N, 20% P_2O_5, 20% K_2O and 6% SO^4.

Plants were foliar sprayed with aqueous solution of GA_3 at 0, 500 or 1000 mg/l three times starting on 15th of July with two weeks interval.

On 15th September the following data were recorded; number of branches/plant, main stem length (cm), fresh and dry weights of main stem (g), number of leaves/branch, fresh and dry weights of leaves/plant (g), number of flowers/ plant, the tallest root length (cm), number of roots/plant as well as fresh and dry weights of roots/plant (g).

The obtained data were statistically analyzed with analysis of variance (ANOVA) procedure using the MSTAT-C Statistical Software Package (**Michigan State University, 1983**). Differences between means were compared by using Duncan multiple range test (**Gomez and Gomez, 1984**).

RESULTS

Data in Table 1 indicate that increasing of Solufert level was concomitant with enhancing in number of branches/plant during both seasons. The maximum mean numbers of branches/ plant (10.4 and 10.0) were recorded with the highest Solufert level (6 g/l) during both seasons, respectively. Concerning the effect of GA_3 concentration, it was observed that both tested concentrations were more effective than control treatment in improving the number of branches/ plant. In this regard low level (500 mg/l) of GA_3 was more pronounced than the higher one. The combination treatment of 6 g/l Solufert + 500 mg/l of GA_3 gained the ultimate values (12.6 and 12.2) during both tested seasons.

Solufert level almost had no (in the first season) or little (in the second season) effect on main stem length. Low and high levels slightly enhanced this parameter compared to control treatment without significant difference between both levels (Table 2). Spraying plants with GA_3

Table 1. Effect of complete fertilizer (Solofert) and GA_3 concentration on number of branches/ plant of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA3 Conc. (mg/l)			Mean	GA3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	5.0 d	7.6 c	9.6 bc	7.4 B	5.0 f	7.0 de	9.6 c	7.2 B
3.0	4.6 d	12.3 a	8.0 c	8.3 B	4.2 f	11.3 b	7.8 d	7.7 B
6.0	7.6 c	12.6 a	11.0 ab	10.4 A	6.6 e	12.2 a	11.4 b	10.0 A
Mean	5.7 C	10.8 A	9.5 B		5.2 C	10.1 A	9.6 B	

Table 2. Effect of complete fertilizer (Solofert) and GA_3 concentration on main stem length (cm) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA3 Conc. (mg/l)			Mean	GA3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	12.6 b	22.3 a	23.0 a	19.3 A	13.6 e	21.0 c	23.3 ab	19.3 B
3.0	16.6 b	21.8 a	24.6 a	21.0 A	16.8 d	22.8 bc	23.6 ab	21.0 A
6.0	15.6 b	23.0 a	25.3 a	21.3 A	15.5 de	24.0 ab	25.0 a	21.5 A
Mean	14.9 B	22.3 A	24.3 A		15.3 C	22.6 B	24.0 A	

especially at high concentration significantly stimulate stem elongation. The tallest main stems (24.3 and 24.0 cm) were determined with high GA_3 during both seasons, respectively. Among different combined treatments the treatment of 6 g/l Solufert + 1000 mg/l of GA_3 attained the maximum main stem lengths (25.3 and 25.0 cm) during both seasons, respectively. However there were no significant differences between this treatment and some other combined treatments.

As shown in Tables 3 and 4, fresh and dry weights of main stem were gradually elevated with increasing either Solufert or GA_3 concentration. Moreover, the heaviest fresh (178.2 and 182.7 g) and dry (13.26 and 13.76 g) weights of main stem were obtained by spraying plants with 6 g/l Solufert + 1000 mg/l of GA_3 during both seasons, respectively.

Tabulated data in Table 5 show that number of leaves/branch was slightly increased with enhancing Solufert level but recorded increments did not reach significant level. Also, GA_3 concentration had no significant influence on this parameter. In most cases there were no significant differences among different tested combined treatments in this regard.

As seen in Table 6, fresh weight of leaves/ plant was augmented by spraying plants with Solufert. Higher level of fertilizer was more efficient than low one during first season while there was no significant difference between both levels during second season. As GA_3 concentration increased, fresh weight of leaves/plant was enhanced in both seasons. The maximum fresh weights of leaves/plant were observed when plants were sprayed with 500 mg/l GA_3 + 3 g/l Solufert or 1000 mg/l GA_3 + 6 g/l Solufert.

Dry weight of leaves/plant was amplified as plants were sprayed with either Solufert or GA_3 without significant difference between high and low concentrations of each compound (Table 7). The best combined treatment for improving this character was 500 mg/l GA_3 + 3 g/l Solufert since this treatment recorded the maximum values (2.14 and 2.42 g) of this parameter.

Table 3. Effect of complete fertilizer (Solofert) and GA_3 concentration on fresh weight of main stem (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	34.5 gh	61.2 f	83.7 e	59.8 C	37.5 gh	61.7 f	85.2 e	61.5 C
3.0	29.5 h	96.7 d	122.5 b	82.9 B	34.5 h	98.2 d	143.5 b	92.0 B
6.0	39.7 g	108.0 c	178.2 a	108.6 A	41.2 g	108.0 c	182.7 a	110.6 A
Mean	34.5 C	88.6 B	128.1 A		37.7 C	89.3 B	137.1 A	

Table 4. Effect of complete fertilizer (Solofert) and GA_3 concentration on dry weight of main stem (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	3.50 f	5.26 e	7.50 cd	5.42 C	4.50 g	5.76 f	8.50 d	6.25 C
3.0	3.50 f	8.00 c	10.26 b	7.25 B	4.50 g	10.00 c	10.76 b	8.42 B
6.0	4.00 f	7.00 d	13.26 a	8.08 A	6.00 f	7.00 e	13.76 a	8.92 A
Mean	3.66 C	6.75 B	10.34A		5.00 C	7.58 B	11.01A	

Table 5. Effect of complete fertilizer (Solofert) and GA_3 concentration on number of leaves/ branch of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	6.6 a	6.8 a	5.6 a	6.3 B	6.6 ab	6.7 ab	7.8 ab	6.3 A
3.0	9.7 a	6.2 a	7.5 a	7.8 AB	8.4 ab	5.9 b	7.4 ab	7.2 A
6.0	8.5 a	8.6 a	9.6 a	8.9 A	7.8 ab	6.2 b	9.4 a	7.8 A
Mean	8.3 A	7.2 A	7.6 A		7.6 A	6.2 A	7.5 A	

Table 6. Effect of complete fertilizer (Solofert) and GA_3 concentration on fresh weight of leaves/ plant (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	2.26 e	8.76 c	11.00 b	7.34 C	2.76 g	12.26 cd	13.00 bc	9.34 B
3.0	3.00 e	13.76 a	10.50 b	9.08 B	5.00 f	15.26 a	13.50 b	11.25 A
6.0	4.76 d	11.26 b	14.26 a	10.10 A	6.26 e	11.76 d	14.76 a	10.93 A
Mean	3.34 C	11.26 B	11.92 A		4.67 C	13.10 B	13.75 A	

Table 7. Effect of complete fertilizer (Solofert) and GA_3 concentration on dry weight of leaves / plant (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	0.48 e	1.00 d	1.14 cd	0.87 B	0.50 d	1.40 b	1.42 c	1.10 B
3.0	0.50 e	2.14 a	1.40 bc	1.34 A	0.51 d	2.42 a	2.14 ab	1.69 A
6.0	0.52 e	1.52 b	1.64 b	1.22 A	0.53 d	1.75 c	1.97 b	1.41 A
Mean	0.50 B	1.55 A	1.39 A		0.51 B	1.85 A	1.84 A	

Data in Table 8 illustrated that number of flowers/plant was raised by treating pants with low level of Solufert, while high level decreased this parameter. On the other side, this trait was gradually improved by elevating GA_3 concentration and reached its maximum values (5.88 and 6.01) when plants were sprayed with high GA_3 concentration (1000 mg/l). Among different tested interaction treatments, the treatment of 3 g/l Solufert + 1000 mg/l of GA_3 proved to be the most effective treatment in this regard.

The tallest root length was significantly enhanced by spraying plants with low level of Solufert, while high level significantly suppressed this character (Table 9). Concerning the effect of GA_3 on this trait it was found that as GA_3 concentration raised the length of tallest root was improved since the tallest root (42.1 and 42.3 cm) during both seasons, respectively. The most suitable combined treatment for stimulating root elongation were of 3 g/l Solufert + 1000 mg/l of GA_3 in the first season and the same treatment or 3 g/l Solufert + 500 mg/l of GA_3 treatment in the second season.

Spraying plants with Solufert at low level promoted initiation of more roots on plant, however high level of this fertilizer had suppression effect on new root initiation (Table 10). Similar effect was discovered for GA_3 since low concentration was more efficient than higher one in this respect. During both seasons the combined treatment of 3 g/l Solufert + 500 mg/l of GA_3 treatment proved to be the best treatment for stimulating root initiation on plants.

Data in Table 11 illustrate that fresh weight of roots/plant was significantly augmented by spraying plants with Solufert without significant difference between both levels in this concern. The same Table shows that this character was gradually raised as GA_3 concentration elevated. Data of both seasons clearly demonstrate that the combined treatment of 3 g/l Solufert + 1000 mg/l of GA_3 was the best treatment in this connection however, there was no significant difference between this treatment and the treatment of 6 g/l Solufert + 1000 mg/l of GA_3 during second season.

As either Solufert or GA_3 concentration increased, the dry weight of roots/plant was improved (Table 12). The heaviest dry weights of roots/plant (8.50 and 9.50 g) were gained when plants were sprayed with 3 g/l Solufert + 1000 mg/l of GA_3 during both seasons. It is worth to mention that there was no significant difference between this treatment and the treatment of 6 g/l Solufert + 1000 mg/l of GA_3 during second season.

Among different determined growth characters, number of branches/plant, shoot length and number of flowers/plant seem to be the most important decorative characteristics for this plant. According to the abovementioned characters evaluation, the most suitable treatments for improving these characters are the combinations of 6 g/l Solufert + 500 mg/l of GA_3 or 3 g/l Solufert + 1000 mg/l of GA_3.

DISCUSSION

Effect of Foliar Spraying with Complete Fertilizer on Growth

Consulting the above-mentioned results concerning the effects of foliar spray with complete fertilizer (Solufert), it is clear that spraying

Table 8. Effect of complete fertilizer (Solofert) and GA_3 concentration on number of flowers/ plant of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	3.33 c	4.00 bc	5.66 b	4.33 B	1.33 c	6.00 b	6.36 b	3.56 B
3.0	4.66 bc	5.66 b	9.00 a	6.44 A	4.67 bc	6.67 b	8.00 a	6.44 A
6.0	3.33 c	3.00 c	3.00 c	3.11 C	5.00 b	4.00 bc	5.66 b	4.88 B
Mean	3.77 B	4.22 B	5.88 A		3.66 B	5.55 A	6.67 A	

Table 9. Effect of fertilizer and GA_3 concentration on the tallest root length (cm) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (mg/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	23.1 fg	34.3 d	40.3 c	32.6 B	23.2 d	38.3 b	40.5 b	34.0 B
3.0	26.3 e	49.1 a	45.6 b	40.3 A	26.3 c	45.2 a	45.7 a	39.0 A
6.0	25.0 ef	21.8 g	40.5 c	29.1 C	22.6 d	19.6 e	40.7 b	27.6 C
Mean	24.8 C	35.1 B	42.1 A		24.0 C	34.4 B	42.3 A	

Table 10. Effect of complete fertilizer (Solofert) and GA_3 concentration on number of roots/ plant of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	59.3 bc	56.3bc	56.3 bc	57.3 A	59.3 b	56.3 bc	56.3 bc	57.3 B
3.0	46.0 bcd	85.3 a	44.6 cd	65.1 A	46.0 cd	85.3 a	64.0 b	65.1 A
6.0	35.3 d	44.6 cd	53.0 bcd	44.3 B	35.3 d	58.1 bc	53.0 bc	48.8 C
Mean	46.8 B	62.1 A	57.7 A		46.8 C	66.5 A	57.7 B	

Table 11. Effect of complete fertilizer (Solofert) and GA_3 concentration on fresh weight of roots/ plant (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	7.2 g	24.5 d	25.5 d	19.0 B	7.7 g	27.5 de	26.5 e	20.5 B
3.0	19.0 e	30.7 c	49.7 a	33.1 A	31.0 cd	34.2 c	51.2 a	38.8 A
6.0	11.2 f	38.7 b	41.7 b	30.5 A	14.7 f	43.2 b	54.2 a	37.4 A
Mean	12.4 C	31.3 B	38.9 A		17.8 C	35.0 B	44.0 A	

Table 12. Effect of complete fertilizer (Solofert) and GA_3 concentration on dry weight of roots/ plant (g) of *Euphorbia milii* after eight weeks during both seasons

Solofert Conc. (g/l)	First season				Second season			
	GA_3 Conc. (mg/l)			Mean	GA_3 Conc. (mg/l)			Mean
	0.0	500	1000		0.0	500	1000	
0.0	1.14 g	4.00 e	4.64 d	3.26 C	1.42 g	4.00 e	5.90 c	3.77 C
3.0	1.64 fg	4.26 de	8.50 a	4.80 B	1.90 fg	4.76 d	9.50 a	5.38 B
6.0	2.14 f	7.26 b	6.64 c	5.35 A	2.42 f	7.76 b	8.90 a	6.36 A
Mean	1.64 C	5.17 B	6.59 A		1.91 C	5.51 B	8.10 A	

plants with this fertilizer had a positive influence on most determined vegetative and flowering growth parameters. Our results substantiate with earlier findings in sunflower (**El-Kady *et al*., 2010**), Eucalyptus (**Dahmardeh *et al*., 2011**), anise, coriander and sweet fennel (**Khalid, 2012**), fenugreek (**Gendy *et al*., 2015**), barley (**Ahmed *et al*., 2017**), sunflower (**Kaleri *et al*., 2019**), pomegranate (**Al-Sereh *et al*., 2020**) and cucumber (**Toman *et al*., 2020**). This promoting effect of foliar application of complete fertilizer on plant growth and development may attributed to the several advantages of foliar application of fertilizers such as; 1) It can be used throughout the growing season, allowing you to spray nutrient solutions in small volumes and compositions that meet the specific needs of your plants at different stages of development. 2). It may promote rapid absorption of nutrients and avoid the occurrence of soil interactions that may restrict root uptake because of immobilizing nutrients in the soil. 3) Foliar fertilization stimulates the ability of the root system to uptake nutrient elements from the soil (**Haytova, 2013**). Also, the betterment influence of foliar application of fertilizer on plant growth may be because of the development of root system, fast uptake of nutrient elements via plant leaves, activation of many digestive enzymes associated with chemical processes and various physical methods (**Adam and Lwona, 2018**). Moreover, the promotion of vegetative growth traits as a result of complete fertilizer application may be resulted from the improvement in nutritional status of plant which positively reflected on plant growth and development (**Maksoud, 2000 and Kassem and Marzouk, 2002**).

Effect of Foliar Spraying with GA_3 on Growth

On perusal of the abovementioned results regarding the impact of GA_3 on some growth parameters clearly demonstrate that GA_3 had a stimulatory effect on most investigated growth traits. This stimulatory influence are earlier supported by many investigators findings such as: **Singh *et al*. (2019)** on gladiolus, **Cornea-Cipcigan *et al*. (2020)** on *Cyclamen* Species, **Ghani *et al*. (2021)** on carrot, by **Leilah and Khan (2021)** on sugar beet, **Othman *et al*. (2021)** on gerbera and lily, Rajashree and **Deepanshu (2022)** on bitter gourd and **Ogugua *et al*. (2022)** on tomato. This may be attribute to the fact that gibberellic acid serves to stimulate the production of mRNA molecules in the cell, and the mRNA created in this form codes for hydrolytic enzymes, thus increasing the chances of rapid growth (**Richards *et al*., 2022**). Also, gibberellic acid enhances plant growth and nutritional potential by stimulating sucrose phosphate synthase and fructose 1,6-biphosphatase and improving phloem loading (**Iqbal *et al*., 2011**). In addition to its impact on promotion stem elongation, overcomes seed and bud dormancy (**Mbaveng *et al*., 2014**). Moreover, it is well known that gibberellic acid causes the transition from meristem to shoot growth, from immature to mature leaves, and from vegetative to flowering stage (**Gupta and Chakrabarty, 2013**).

Effect of Foliar Spraying with Complete Fertilizer and GA_3 on Growth

The synergistic effect between GA_3 and foliar application of complete fertilizer (Solufert) on enhancing growth trait values which demonstrated in this study was previously proved on some plant species such as; gladiolus (Ghatas, 2016), marigold (**Tiwari *et al*., 2018**), plum (**Ali *et al*., 2019**), cucumber **(Toman *et al*., 2020)**, *Platycladus orientalis* (**Assaf and Muhamed, 2023**), grape (**Alimam and Saadon, 2024**). Unfortunately, there was no interpretation for this synergistic effect in the literature, but our explanation is that feeding plants with complete fertilizer which improve nutrition status of plants may support GA_3 physiological roles such as; cell division and elongation, cell enlargement and protein synthesis.

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تحســــــين نمـــــو نبـــــات شـــــــوكة المســـيح بالـــرش الورقي بحمض الجبريلليك وسماد كامل

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عوملت نباتات شوكة المسيح بتركيزات مختلفة من حمض الجبريلليك (صفر، 500 أو 1000 مللجم/لتر) و/أو سماد كامل (سولوفيرت) بمستويات (صفر، 3 أو 6 جم/لتر) كاضافة ورقية للتعرف على تأثير تلك المعاملات على بعض صفات النمو الخضري وهي: عدد الأفرع/نبات، طول الساق الرئيسي (سم)، الوزن الطازج والجاف للاوراق/نبات (جم)، عدد الأزهار/نبات، طول أطول جذر (سم)، عدد الجذور/نبات وكذلك الوزن الطازج والجاف للجذور/نبات (جم). وقد أشارت النتائج الى أن رش النباتات بتوليفات 6 جم/لتر سولوفيرت + 500 مللجم/لتر حمض جبريلليك أو 3 جم/لتر سولوفيرت + 1000 مللجم/لتر حمض جبريلليك أعطى أقصى القيم لمعظم صفات النمو السابق الإشارة إليها.

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