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EFFECT OF SOME GROWTH SUBSTANCES AND CHEMICAL FERTILIZATION ON VEGETATIVE GROWTH AND CHEMICAL COMPOSITION OF *MATTHIOLA INCANA* PLANT

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ABSTRACT: A field experiment was carried out during two successive seasons of 2018/2019 and 2019/2020 in Floriculture farm of Horticulture Department, Faculty of Agriculture, Benha University to study the effects of spraying some growth substances of kinetin, Salicylic acid, Calcium Thiosulfate and potassium Silicate as well as, chemical fertilization (N.P.K) on vegetative growth and chemical composition of *Matthiola incana* plants to increase and improve the quality of this plant to bed gardens ornamentation. Obtained results showed that the tallest plants and the thickest plant stem were recorded by 100 ppm kinetin combined with NPK fertilization at the high level treatment in both seasons. The heaviest fresh and dry weights of leaves/ plant were recorded by 100 ppm kinetin-sprayed plants enriched with NPK fertilization at the high in both seasons. The highest number of branches and leaves / plant were recorded by 100 ppm kinetin-sprayed plants combined with NPK fertilization at the high level in both seasons. The highest leaf N and total carbohydrates content were recorded by 100 ppm kinetin-sprayed plants provided with NPK fertilization at the high level, whereas the richest leaf P content was registered by 200 ppm salicylic-sprayed plants combined with NPK fertilization at the high level. While, the greatest leaf K content was scored by 6 cm potassium silicate-sprayed plants supplemented with NPK fertilization at the high level in both seasons. Conclusively, spraying *Matthiola incann* plants with kinetin at 100 ppm and fertilized them with chemical fertilizer at 100N: 200P; 200K kg/fed. produced the best vegetative growth and quality of this plant.

Key words: *Matthiola incana*, growth substances, chemical fertilization, growth and chemical constituents.

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INTRODUCTION

Matthiola is a genus of family Brassicaceae **(**Crucifera**)**.The Brassicaceae consists of 13-19 tribes, 350 genera and about 3500 species in the world (Onyilagho et al., 2003). The common name "stock" usually refers to the species *M. incana* L. and it may be applied to the whole genus. It is a common garden flower, available in a variety of colors. The beauty of the flower and pleasant sweet smell makes the stock an odd member of its family. Seeds are rich in oils and up to 65% of the oil consists of Omega-3-linolenic acid; one of the fatty acids essential to good health (Heuer *et al.,* 2005). *Matthiola incana* L. is mostly used as an winter annual plant cultivated in pots or for fresh cut. This species is native to the Mediterranean Region and the Canary Islands, from Spain to Turkey and in the south to Egypt. It produces spikes of double and single flowers in shades of rose, purple, pink and white, fruits of the size from 4 to 16 cm, erect to somewhat spreading, compressed without glands; stigma without conspicuous horns (Gullen *et al.,* 1995). The double flowering varieties are used for decoration, for the beauty of their flowers and their pleasant aroma (EL- Quesni *et al,.* 2012). It is mainly used for planting in flowerbeds in different types of gardens, and has become an economically important floral crop (Hisamatsu *et al.*, 2000). Cytokinins are important plant hormones that regulate nacreous processes of plant growth and development. kinetin (kin) delayed senescence by its effect on ethylene synthesis processes in the tissue of flowers and decreases the ethylene production within the carnation flowers (Bosse and Van Staden, 1989) and decreasing of protein hydrolytic enzymes activity lipooxygenase (Leshem *et al.,* 1979). In this concern, El-Kinany *et al.,* (2019) revealed that *Gaillardia pulchella* var. pulchella had the highest vegetative and flowering growth parameters when spraying gaillardia plants with kinetin compared to the control treatment.

Salicylic acid (SA), an endogenous plant growth regulator, has been found to generate a wide range of metabolic and physiological responses in plants thereby affecting their growth and development. SA as a natural and safe phenolic compound exhibits a high potential in controlling post-harvest losses of horticultural crops. Salicylic acid as a plant growth regulators play an important role in plant growth and its role in the extension the vase life of cut flowers was approved. These compounds delay cell division and growth in the beneath apex, but they do not have any effect on meristem (Hedayat,2001).

Calcium (Ca) is thought to function as a secondary messenger in the transmission and transduction of several environmental signals acting as intracellular metabolic agent (Harper *et al.,* 2004). Due to its high affinity to calmodulin and other calcium-binding-proteins**,** this nutrient might directly control several physiological processes (Hepler and Wayne 1985). Calcium is one of the main macro essential nutrients for plant growth. In addition for being essential in building cell walls of the plant, it plays an important role in enabling the plant to tolerate saline conditions. Calcium is an immobile mineral, lack of calcium occurs at ending points and growing branch heads of the plant. This can cause delay in blooming of the plant, or can occur in the same time as natal growth. In this concern, Mohammed and Abood (2020) indicated that sprayed *Gerbera jamesonii* with Calcium nitrate (500 mg L^{-1}) and salicylic acid (75 mg L-1). increased the number of leaves, leaf area, total chlorophyll, wet and dry weight of leaf, early flowering, number inflorescences, Peduncle diameter and vase life.

Silicon, a chemical element commonly occurring in nature, has a positive effect on plant development and resistance. Its properties include the beneficial effect on the ionic balance in plants, reducing toxic effects of manganese and iron excessive amounts, as well as reinforcement of cell walls

Silicon is an essential element, necessary for plants to complete their life cycle, or optional to the plant's life cycle. Incorporating silicon into a nutrition program can improve drought, tolerance, strength, disease resistance and postharvest keeping quality for many crops *(Marschner et al,. 1997).* In this respect, Attia and Elbohy (2019) indicated that spraying marigold plants (*Calendula officinalis* L) with potassium silicate at $8cm^3/l$ significantly increased plant height, no. of branches, fresh weight of herb (g)/plant and dry weight of herb (g)/plant, number of flowers/plant and leaf chemical composition as compared to control treatment. Plant nutrition is one of the most principal factors that influence positively plant growth (Sharma and Kumar, 2012). Superior quality flower production requires strong consideration for nutrients uptake. Management of inorganic nutrition is a critical factor in defining the ornamental value of the plants. Increased flower production, flower quality and fineness in the form of plant are the most important objectives to achieve in bedding and cut-flower production. Flower quality is a function of nutrient level (Boodley, 1975). Appropriate combination of fertilizers has a positive impact on quality flower production and long-lasting flowering period. Nitrogen, phosphorous and potassium are the most valuable essential nutrients, for enhancing quality and higher flower production of ornamentals (Kashif, 2001). In this concern, Abou El-Ghait *et al.,* (2020) on *Jasminum sambac* plants revealed that NPK chemical fertilization at 6 g / pot increased plant height , branches number / plant, fresh and dry weights of leaves / plant, number of flowers/plant and leaf chemical composition as compared with un-fertilized plant.

Therefore, this investigation was established to study the effect of some growth substances and chemical fertilization on vegetative growth and chemical composition of *Matthiola incana* plant.

MATERIALS AND METHODS

This trail was conducted to study the effects of spraying some growth substances of kinetin, Salicylic acid, Calcium Thiosulfate and potassium Silicate as well as, chemical fertilization (N.P.K) on vegetative growth and chemical composition of *Matthiola incana* plants to enhance the vegetative growth and chemical composition of this plant. To achieve the mentioned investigation, a field experiment was carried out during two successive seasons of 2018/2019 and 2019/2020 in Floriculture farm of Horticulture Department, Faculty of Agriculture, Benha University.

Plant materials:

The variety which has been cultivated in the experiment of *Matthiola incana* plants is cv. 'Katz white'. The country of seed origin is USA. The weight of 1000 seed is 1.5 g. The germination percentage of seeds is 93%. Seed purity percentage is 99%. In 20th September of both seasons, seeds were sown in a prepared growing medium composed of peat moss: perlite (1:1 by volume) for 40 days in plastic trays .the plastic trays were placed inside plastic greenhouse for 30 days then they transferred inside the lath house for ten days and the seedling were sprayed with NPK (20:20:20) at ٢ cm/L for three times a week. When the seedlings were reached (15-18) cm in height, (10-12) g in weight with 6-8 leaves were transplanted to the field.

Experimental procedures:

On 1st November of 2018 and 2019 (for the first and second seasons), the well seedlings of *Matthiola incana* cv. 'Katz white' were planted in the soil. The soil was plowed then sand was added at 4m^3 /108 m^2 to the soil and Calcium superphosphate was added before planting during soil preparation. The field was divided into plots and the experimental plot unit area (1m^2) was contained 6 plants in two rows each row contain 3 plants. The plant spacing 25 cm^2 between plants, 50 cm^2 between rows inside each plot. The plants were planted in sufficient irrigated soil which was irrigated at weekly intervals to maintain soil moisture at 65-70% of field capacity by flood irrigation system. The textural class of the used soil was clay loam with EC at 0.82 and 0.79 dS.m^{-1} and Ph at 7.46 and 7.78, in the first and second seasons respectively.

Treatments:

This study involved two factors as follows: The first one dealing with some growth substances treatments, while the second one dealing with some chemical fertilization (N.P.K.) treatments.

The first factor: plant growth substances:

Kinetin at two concentrations (25 and 50 mg/L), Salicylic acid at two concentrations, (100 and 200 mg/L), Calcium thiosulfate at two concentrations, (2 and 3 cm/L) and Potassium silicate at two concentrations, (4 and 6 cm/L), besides control (tape water). Application of Kinetin, Salicylic acid, Calcium thiosulfate and Potassium silicate were carried out as foliar spray for six times. The first spray was done after 40 days from transplanting seedlings to the soil and the plants were sprayed at weekly intervals after the first spray.

Untreated plants (control) were sprayed with distilled water only. Spraying was done in the first hours of the day before the sunrise. The dorsal sprinkler (20 liter capacity) was used to spray the plants.

The second factor: Chemical fertilization (N.P.K):

Nitrogen treatment used as Ammonium nitrate (33%) at four levels (zero is considered as control, 50, 75 and 100 kg/fed.). phosphorous treatment used as Calcium superphosphate (46 %). Potassium treatment used as Potassium sulfate (48%) at four levels (zero is considered as control, 100, 150 and 200 kg/fed.).

Plants were fertilized by 50 kg/fed. N + 100 kg/fed. P + 100 kg/fed.K for the first treatment. The second treatment was 75 kg/fed. N + 150 kg/fed.P + 150 kg/fed.K. The third treatment was 100 kg/fed.N + 200 kg/fed.P + 200 kg/fed.K.

Calcium superphosphate was added before planting during soil preparation. Ammonium nitrate and Potassium sulfate fertilizers were added as soil drench to the soil for six times. The first addition of Ammonium nitrate was done after 7 days from transplanting the seedlings to the soil and then the five additions doses were done at weekly intervals till the sixth addition. The first addition of Potassium sulfate was done after 21 days from transplanting seedlings to the field and the second addition was given 21 days after the first addition while the third addition was given 7 days after the second addition, while the fourth, fifth and sixth additions were done at weekly intervals using Tween 20 as a sticking agent at the rate of 0.1 cm/L for all treatments.

Layout of the Experiment:

The design of this experiment was factorial experiments in a complete randomize block design with 36 treatments represented the combinations between nine some growth substances and chemical fertilization at four rates (9 growth substances treatments x 4 chemical fertilization levels) replicated three times (each replicate consisted of five beds, with six plants/bed). Common agricultural practices (irrigation, manual weed control … etc.) were carried out when needed.

Data recorded:

At the end of those experiments on 1st of March for both seasons (after 155 - 160 days from planting the seeds), three plants were randomly chosen at 70% flowering from each plot during both seasons and the following data were recorded:

Vegetative growth parameters:

Plant height (cm), Stem diameter (cm), number of branches per plant, number of leaves per plant, fresh weight of leaves per plant (g) and dry weight of leaves per plant (g).

Chemical composition determinations:

Samples of leaves from the vegetative growth were taken after two weeks from the last treatment application for all experiments. The samples were collected and sent directly to the laboratory. All samples were warped with a damp cloth, and then rinsed with distilled water to remove any residues.

The leaf parts were then oven dried at 70^0 C till a constant weight. Dry matter was determined and 2.0 g of dry matter was taken for determination of N-P-K and total carbohydrates contents.

1. Total nitrogen:

Total nitrogen was measured in sample solutions by using the modified micro-kjeldahl method as described by Pregl (1945).

2. Phosphorus content:

Phosphorus was determined colourimetrically by spectronic (20) spectrophotometer using the method described by Trouge and Meyer (1939).

3. Potassium content:

Potassium content was measured by flame photometer according to Brown and Lilland (1946).

4. Total carbohydrates content:

Total carbohydrates content was determined in dry powder material according to Herbert *et al.*, (1971).

Statistical analysis:

All data obtained during both seasons of studies were subjected to analysis of variance as a factorial experiments in R.C.B.D. LSD method was used to difference means according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Vegetative growth parameters:

1. Plant height:

Table (1) shows that all tested sprays of growth substances succeeded in increasing plant height of *Matthiola incana* plants as compared with un-sprayed plants in both seasons. In this respect, 100ppm kinetin-sprayed plants gave the highest values in this concern, followed by the kinetin at 50 ppm in both seasons. On the other hand, there was a positive correlation between the plant height values and fertilization levels, so the values of plant height increased as the level of fertilization increased until reach to the maximum increasing at the high level (100N:200P:200K / fed.).This trend was true in both seasons.

Moreover, data in Table (1) indicate that all the interactions between growth substances and chemical fertilization levels statistically increased plant height of *Matthiola* plants as compared with untreated plants in both seasons. In this concern, the tallest plants (129.0 and 130.0 cm) were recorded by 100 ppm kinetin combined with NPK fertilization at the high level treatment in the first and second seasons, respectively.

2. Stem diameter (cm):

Data presented in Table (2) declare that stem diameter increased due to using all tested growth substances treatments as compared with control plants in both seasons. Consequently 100 ppm kinetin -sprayed plants recorded the highest values of this parameter in both seasons. Paralley, stem diameter increased with all tested levels of NPK fertilization, especially the high level in both seasons.

In general, all interaction between growth substances and NPK fertilization treatments succeeded in increasing the diameter of Matthiola stem as compared with control in the two seasons. In this regard, the highest values of stem diameter (1.30 and 1.33 cm) were scored by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level in the first and second seasons, respectively.

3. Number of branches and leaves/plant:

Tables (3 and 4) declare that all tested growth substances and NPK fertilization treatments as well as their interactions increased the number of branches and leaves/plant in both seasons. In this concern , the increment in branches and leaves number were in parallel to applied concentration of kinetin and fertilization levels, so the highest concentration of kinetin or the highest level of fertilization significantly scored the highest number of branches and leaves / plant when compared with control in both seasons. Generally, the highest number of branches/plant (4.00and 4.00) and leaves/plant (129.32 and 128.00) were recorded by 100 ppm kinetin-sprayed plants combined with NPK fertilization at the high level in the first and second seasons, respectively.

4. Fresh and dry weights of leaves (g):

Tables (5 and 6) show that all tested sprays of growth substances succeeded in increasing the fresh and dry weights of *Matthiola inccan* plants as compared with un-sprayed plants in both seasons. In this respect, 100ppm kinetin-sprayed plants gave the highest values in this concern, followed by the kinetin at 50 ppm in both seasons.

It was interest to notice that there was a positive relationship between the fresh and dry weights of leaves/plant and chemical fertilization treatments. Hence, as the level of chemical fertilization increased the fresh

Table 1. Effect of some growth substances and chemical fertilization on plant height of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	79.33	85.33	88.33	93.66	86.66	80.33	85.66	88.66	91.00	86.41
Pot. Silic. 4 cm^3/l	85.66	86.66	95.66	100.00	91.99	83.00	87.66	99.33	98.66	92.16
Pot. Silic. 6 cm^3/l	89.33	91.00	96.66	104.66	95.41	87.66	92.00	98.66	104.66	95.74
Calcium 2 cm^3/l	86.66	96.66	101.00	111.66	98.99	84.66	94.66	101.33	110.33	97.74
Calcium 3 cm^3/l	93.66	101.33	105.33	114.00	103.99	94.66	100.00	104.00	114.66	103.33
Sal. acid 100 ppm	82.66	93.00	94.66	109.66	94.99	84.00	96.33	97.66	110.00	96.99
Sal. acid 200 ppm	84.33	95.66	110.33	119.33	102.41	86.33	100.00	106.33	121.00	101.91
Kinetin 50 ppm	86.00	100.66	112.66	122.66	105.49	87.00	101.00	111.33	123.00	105.58
Kinetin 100 ppm	91.66	106.33	121.66	129.00	112.16	93.66	109.00	122.00	130.00	112.16
Mean	84.44	86.587	102.92	111.62		86.81	96.25	103.25	111.47	
LSD at 0.05	A= 8.23		B= 12.34	A×B= 24.69		A= 7.14		B= 10.70	A×B= 21.4	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 2. Effect of some growth substances and chemical fertilization on stem diameter of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	0.56	0.73	0.90	0.96	0.78	0.56	0.70	0.86	0.93	0.76
Pot. Silic. 4 cm^3/l	0.63	0.83	0.93	1.06	0.86	0.60	0.80	0.83	1.00	0.80
Pot. Silic. 6 cm^3/l	0.73	0.90	1.03	1.20	0.96	0.60	0.86	0.96	1.22	0.91
Calcium 2 cm^3/l	0.80	0.90	1.00	1.06	0.94	0.76	0.83	1.00	1.06	0.91
Calcium 3 cm^3/l	0.83	1.00	1.10	1.16	1.02	0.80	0.93	1.06	1.13	0.98
Sal. acid 100 ppm	0.96	1.00	1.03	1.06	1.00	0.96	1.00	1.03	1.06	1.01
Sal. acid 200 ppm	1.00	1.02	1.13	1.16	1.07	1.00	1.03	1.09	1.16	1.07
Kinetin 50 ppm	1.13	1.16	1.20	1.23	1.18	1.13	1.16	1.19	1.23	1.17
Kinetin 100 ppm	1.20	1.26	1.29	1.30	1.26	1.16	1.20	1.23	1.33	1.23
Mean	0.87	0.97	1.06	1.13		0.84	0.94	1.02	1.12	
LSD at 0.05	A= 0.09		B= 0.14	A×B= 0.28		A= 0.07		B= 0.11	A×B= 0.22	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 3. Effect of some growth substances and chemical fertilization on No. of branches / plant of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	2.00	2.11	2.33	2.66	2.27	2.00	2.33	2.33	2.66	2.41
Pot. Silic. 4 cm^3/l	2. 00	2.33	2.66	3.00	2.49	2.33	2.33	2.66	3.00	2.83
Pot. Silic. 6 cm^3/l	2. 33	3.00	3.00	3.33	2.91	2.66	3.00	3.00	3.33	3.08
Calcium 2 cm^3/l	2.00	2.66	2.33	2.66	2.41	2.33	2.33	2.66	3.66	2.57
Calcium 3 cm^3/l	2.66	2.66	3.00	3.66	2.99	2.66	2.66	3.00	3.66	2.74
Sal. acid 100 ppm	2.33	2.33	2.66	3.00	2.58	2.00	2.33	2.33	2.66	2.41
Sal. acid 200 ppm	2.33	2.66	2.66	3.33	2.74	2.33	2.66	2.66	3.00	2.66
Kinetin 50 ppm	2.66	3.00	3.33	3.66	3.16	2.66	3.00	3.33	3.66	3.16
Kinetin 100 ppm	3.00	3.33	3.66	4.00	3.49	3.00	3.33	3.66	4.00	3.49
Mean	2.36	2.67	2.84	3.25		2.44	2.66	2.84	3.29	
LSD at 0.05	A=0.12		B=0.18	A×B= 0.36		A= 0.13		B= 0.20	A×B= 0.40	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 4. Effect of some growth substances and chemical fertilization on No. of leaves / plant of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	51.32	55.55	62.11	71.82	60.20	51.32	61.34	62.11	82.46	64.30
Pot. Silic. 4 cm^3/l	56.00	66.77	79.80	91.98	73.63	66.00	69.10	79.80	91.98	76.72
Pot. Silic. 6 cm^3/l	68.33	88.98	91.98	103.23	88.13	76.23	90.99	93.00	104.32	91.13
Calcium 2 cm^3/l	52.66	72.69	66.77	80.67	68.19	62.11	65.24	78.89	109.80	79.01
Calcium 3 cm^3/l	73.57	76.23	87.99	109.80	86.89	75.35	77.14	90.00	111.00	88.37
Sal. acid 100 ppm	59.78	60.58	70.03	84.00	68.59	54.66	64.44	65.24	75.35	64.92
Sal. acid 200 ppm	71.82	73.57	76.23	98.76	80.09	66.77	77.14	77.72	88.98	77.65
Kinetin 50 ppm	85.98	96.57	102.09	114.66	99.82	78.89	90.00	100.99	113.46	95.83
Kinetin 100 ppm	73.16	104.32	115.87	129.32	105.66	91.98	103.23	114.66	128.00	109.46
Mean	65.84	77.25	83.65	98.24		69.25	77.62	84.71	100.59	
LSD at 0.05	A= 8.14		B=12.2	A×B= 24.4		A= 7.31		B= 11.0	A×B= 22	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 5. Effect of some growth substances and chemical fertilization on fresh weight of leaves/plant of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	45.08	67.47	101.63	127.38	85.39	39.34	70.62	105.80	126.58	85.58
Pot. Silic. 4 cm^3/l	80.24	102.19	154.83	228.09	141.33	87.93	104.96	140.34	241.50	143.68
Pot. Silic. 6 cm^3/l	96.46	140.64	186.21	276.19	174.87	99.03	141.06	197.43	285.94	180.86
Calcium 2 cm^3/l	67.42	153.74	139.98	183.83	136.24	80.87	129.57	164.99	276.36	162.94
Calcium 3 cm^3/l	89.82	157.52	221.28	273.80	185.60	96.63	164.92	221.19	290.97	193.42
Sal. acid 100 ppm	56.64	116.38	143.05	185.07	125.28	63.52	122.48	142.26	171.57	124.95
Sal. acid 200 ppm	93.99	169.44	151.48	233.29	162.05	75.42	183.19	149.86	211.62	155.02
Kinetin 50 ppm	125.20	156.78	217.34	332.73	208.01	136.72	155.82	220.17	339.02	212.93
Kinetin 100 ppm	159.63	183.64	271.60	374.28	247.28	157.47	179.22	256.93	378.60	243.05
Mean	90.49	138.64	176.37	246.07		92.99	139.09	177.66	258.01	
LSD at 0.05	A= 16.0		B=24.3	A×B= 48.3		A= 7.14		B= 10.7	A×B=21.4	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 6. Effect of some growth substances and chemical fertilization on dry weight of leaves / plant of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	7.76	12.87	16.86	22.84	15.08	8.06	14.72	16.40	23.14	15.58
Pot. Silic. 4 cm^3/l	14.06	22.43	29.71	41.76	26.99	16.93	22.22	22.84	40.83	25.70
Pot. Silic. 6 cm^3/l	16.96	29.31	36.51	47.21	32.39	22.74	27.87	29.46	49.38	32.36
Calcium 2 cm^3/l	11.18	22.74	24.88	33.83	23.15	14.37	21.20	27.93	45.93	27.35
Calcium 3 cm^3/l	15.34	24.97	32.34	48.42	30.26	16.54	26.04	37.95	51.27	32.95
Sal. acid 100 ppm	9.45	15.54	24.84	35.22	21.26	9.42	15.61	27.16	35.45	21.91
Sal. acid 200 ppm	12.04	17.68	27.87	42.09	24.92	12.97	18.32	32.87	41.49	26.41
Kinetin 50 ppm	19.41	37.11	44.48	59.65	40.16	21.51	29.01	41.89	60.93	38.33
Kinetin 100 ppm	26.76	45.58	51.38	66.92	47.66	26.37	39.72	48.45	67.20	45.43
Mean	14.77	25.35	36.27	44.21		16.54	23.85	31.66	46.18	
LSD at 0.05	A= 9.15		B= 13.2	A×B= 26.4		A= 8.62		B= 12.9	A×B= 25.9	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

and dry weights of leaves increased up to the maximum increasing at the high level of chemical fertilization in both seasons (Tables, 5 and 6). In this sphere, the heaviest fresh and dry weights of leaves/ plant were recorded by 100 ppm kinetin-sprayed plants enriched with NPK fertilization at the high in both seasons.

The obtained results might be due to the role of kinetin on promoting protein synthesis, increasing cell division and enlargement (Cheema and Sharma, 1982). Moreover, these results might be explained according to the role of kinetin on promoting proteins, soluble and non-soluble sugars synthesis, or may be due to the ability of kinetin for making the treated area to act as a sink in which nutrients from other parts of the plant are drawn (Salisbury and Ross, 1974). The stimulated effect of fertilization treatments may be due to the role of mineral fertilization on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for vegetative growth of the plants (Marschner, 1997).

Chemical constituents:

1. Leaf N, P and K %:

Tables (7, 8 and 9) show that all tested treatments of growth substances, chemical fertilization and their combinations succeeded in increasing leaf N, P and K % as compared with control in both seasons. In this concern, the highest leaf N content (1.98 and 1.70 %) was recorded by 100 ppm kinetin- sprayed plants provided with NPK fertilization at the high level in the first and second seasons, respectively, whereas the richest leaf P content (0.196 and 0.198 %) was registered by 200 ppm salicylic-sprayed plants combined with NPK fertilization at the high level in first and second seasons, respectively. While, the greatest leaf K content (1.68 and 1.73%) was scored by 6 cm potassium silicate-sprayed plants supplemented with NPK fertilization at the high level in the first and second seasons, respectively.

2. Leaf total carbohydrates %:

Table (10) indicates that all tested growth substances treatments increased leaf total carbohydrates content as compared with un-treated plants in both seasons. Also, the increments of leaf total carbohydrates content were in parallel to the increasing of chemical fertilization level to reach the maximum increasing at the high level in both seasons. In general, all resulted interactions between growth substances and chemical fertilization treatments statistically increased the values of this parameter as compared with control in both seasons. In this respect, the highest values of leaf total carbohydrates (17.9 and 18.4 %) content were recorded by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level, in the first and second seasons, respectively.

As for the explanation of the incremental effect of growth substances on growth and chemical constituents of Matthiola plant, it could be illustrated here on the basis that such growth substances treatments stimulated the endogenous cytokinins synthesis. Cytokinins activate a number of enzymes participating in a wide range of metabolic reactions in the leaves. These reactions included the maturation of proplastid into chloroplasts. Also, these results may explain the role of cytokinins on promoting proteins and pigments synthesis and their ability to delay senescence and withdraw sugars and other solutes from older parts of a plant to the new organs (Salisbury and Ross, 1974). In the same line Leopol and Kawase (1964) stated that cytokinins stimulate the movement of sugars, starch, amino acids and many other solutes from mature organs to primary tissues of other ones. Furthermore, it may be due to the role of kinetin on increasing the growth promoters in the plant tissues at the expense of the inhibitors. The stimulated effect of

Table 7. Effect of some growth substances and chemical fertilization on leaf N%of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	1.13	1.27	1.38	1.46	1.31	1.18	1.29	1.42	1.51	1.35
Pot. Silic. 4 cm^3/l	1.29	1.36	1.43	1.64	1.43	1.32	1.35	1.46	1.73	1.46
Pot. Silic. 6 cm^3/l	1.35	1.42	1.51	1.75	1.50	1.37	1.41	1.54	1.79	1.52
Calcium 2 cm^3/l	1.24	1.32	1.41	1.62	1.39	1.27	1.34	1.47	1.68	1.44
Calcium 3 cm^3/l	1.26	1.37	1.48	1.67	1.44	1.29	1.38	1.49	1.77	1.48
Sal. acid 100 ppm	1.18	1.30	1.39	1.54	1.35	1.21	1.29	1.48	1.63	1.40
Sal. acid 200 ppm	1.21	1.34	1.45	1.60	1.40	1.28	1.36	1.51	1.69	1.46
Kinetin 50 ppm	1.39	1.52	1.73	1.87	1.62	1.42	1.54	1.79	1.91	1.66
Kinetin 100 ppm	1.46	1.59	1.82	1.96	1.70	1.48	1.62	1.84	1.98	1.73
Mean	1.27	1.38	1.51	1.67		1.31	1.39	1.55	1.74	
LSD at 0.05	A= 0.12		B= 0.18		A×B= 0.36	A= 0.11		B= 0.17		A×B= 0.33

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 8. Effect of some growth substances and chemical fertilization on leaf P % of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100 :100)	N.P.K (75:150 :150)	N.P.K (100:200 :200)	Mean (B)
Control	0.118	0.146	0.169	0.173	0.151	0.120	0.145	0.166	0.179	0.152
Pot. Silic. 4 cm^3/l	0.134	0.161	0.183	0.186	0.166	0.136	0.162	0.179	0.186	0.165
Pot. Silic. 6 cm^3/l	0.139	0.169	0.184	0.189	0.170	0.142	0.166	0.185	0.189	0.170
Calcium 2 cm^3/l	0.121	0.153	0.173	0.179	0.156	0.129	0.149	0.171	0.181	0.157
Calcium 3 cm^3/l	0.126	0.158	0.176	0.181	0.160	0.134	0.153	0.175	0.183	0.161
Sal. acid 100 ppm	0.142	0.167	0.186	0.192	0.171	0.144	0.172	0.185	0.193	0.173
Sal. acid 200 ppm	0.149	0.175	0.192	0.196	0.178	0.148	0.176	0.190	0.198	0.178
Kinetin 50 ppm	0.126	0.148	0.172	0.180	0.156	0.128	0.151	0.170	0.186	0.158
Kinetin 100 ppm	0.129	0.153	0.174	0.184	0.160	0.136	0.156	0.176	0.186	0.163
Mean	0.131	0.158	0.178	0.184		0.135	0.158	0.177	0.186	
LSD at 0.05	A= 0.007		B= 0.011		A×B= 0.022	A= 0.008		B= 0.012		A×B= 0.024

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 9. Effect of some growth substances and chemical fertilization on leaf K% of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100:100)	N.P.K (75:150:150)	N.P.K (100:200:200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100:100)	N.P.K (75:150:150)	N.P.K (100:200:200)	Mean (B)
Control	1.02	1.19	1.34	1.41	1.24	1.04	1.17	1.37	1.45	1.25
Pot. Silic. 4 cm^3/l	1.16	1.30	1.49	1.64	1.39	1.19	1.32	1.48	1.68	1.41
Pot. Silic. 6 cm^3/l	1.19	1.36	1.52	1.68	1.43	1.21	1.39	1.54	1.73	1.46
Calcium 2 cm^3/l	1.06	1.21	1.36	1.43	1.26	1.06	1.19	1.39	1.48	1.28
Calcium 3 cm^3/l	1.09	1.29	1.37	1.48	1.30	1.11	1.25	1.42	1.51	1.32
Sal. acid 100 ppm	1.11	1.22	1.38	1.46	1.29	1.09	1.24	1.40	1.50	1.30
Sal. acid 200 ppm	1.13	1.26	1.38	1.48	1.31	1.13	1.26	1.45	1.52	1.34
Kinetin 50 ppm	1.13	1.28	1.42	1.56	1.34	1.16	1.29	1.46	1.59	1.37
Kinetin 100 ppm	1.50	1.29	1.46	1.62	1.46	1.18	1.31	1.47	1.67	1.40
Mean	1.15	1.26	1.41	1.52		1.13	1.26	1.44	1.57	
LSD at 0.05	A= 0.12		B= 0.18	A×B= 0.36		A= 0.10		B= 0.15	A×B= 0.30	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

Table 10. Effect of some growth substances and chemical fertilization on total carbohydrates % of *Matthiola incana* plant during 2018/2019 and 2019/2020 seasons.

Growth substances (B)	1st season					2nd season				
	Chemical fertilization (A)									
	N.P.K (0:0:0)	N.P.K (50:100:100)	N.P.K (75:150:150)	N.P.K (100:200:200)	Mean (A)	N.P.K (0:0:0)	N.P.K (50:100:100)	N.P.K (75:150:150)	N.P.K (100:200:200)	Mean (B)
Control	8.19	11.30	14.90	16.30	12.67	8.12	11.40	15.20	16.10	12.70
Pot. Silic. 4 cm^3/l	10.30	13.90	16.20	17.80	14.55	11.10	14.30	16.50	18.10	15.00
Pot. Silic. 6 cm^3/l	10.80	14.20	16.90	18.40	15.07	11.40	14.80	17.30	18.80	15.57
Calcium 2 cm^3/l	9.21	11.80	15.20	16.50	13.17	8.62	11.90	15.60	16.70	13.20
Calcium 3 cm^3/l	9.36	12.20	15.60	17.00	13.54	8.91	12.40	15.80	16.80	13.47
Sal. acid 100 ppm	9.62	11.80	16.00	16.80	13.55	9.32	12.10	16.00	17.10	13.63
Sal. acid 200 ppm	9.86	12.60	16.10	17.20	13.94	9.46	12.80	16.20	17.40	13.96
Kinetin 50 ppm	10.40	13.40	16.10	17.40	14.32	10.80	14.10	16.30	17.60	14.70
Kinetin 100 ppm	10.60	14.00	16.60	17.90	14.77	11.30	14.50	16.90	18.40	15.27
Mean	9.81	12.80	15.95	17.25		9.89	13.14	16.20	17.44	
LSD at 0.05	A= 1.82		B= 2.73	A×B= 5.48		A= 1.63		B= 2.45	A×B= 4.89	

Pot. Silic.: potassium silicate; Sal. acid: salicylic acid

fertilization treatments may be due to the role of mineral fertilization on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for vegetative growth and chemical composition of the plants (Marschner, 1997).

The aforementioned results of growth substances are in conformity with those reported by Youssef and Mady (2013) on *Aspidistra elatior*, Abd El Gayed (2019) on *Zinnia elegans* L. plants, Attia and Elbohy (2019) on marigold plants (*Calendula officinalis* L), Mara (2017) on *Echinacea Hybrids*, Mohamed (2017) on aster plant (*Symphyotrichum novi-belgii* L.) cv. Purple Monarch, El-Kinany *etal.,* (2019) on *Gaillardia pulchella* var. pulchella , Zheng *et al.,* (2005) on chrysanthemum plants, Christos (2008) on oregano (*Origanum vulgare*s sp hirtum), Kim *et al.,* (2010) on *chrysanthemum morifolium*, Mirabbasi *et al.,* (2013) on *Asiatic lily* cv. 'Brunello' plant, Armando *et al.,* (2016) on lisianthus (*Eustoma grandiflorum*), Abou El-Ftouh *etal.,* (2018) on *Calendula officinalis* L, Elbohy *et al.,* (2018) on *Zinnia elegans* plants , Mohammad Saeed (2019) on gerbera, Abbass *etal.,* (2020) on *Freesia hybrida* plants, Mohammed and Abood (2020) on *Gerbera jamesonii*, Saeed (2020) on *Gazania rigens* L. cv. Frosty Kiss, El-Kinany (2020) on Viola wittrockiana , and El-Ashwah (2020) on *Cortaderia selloana* plants.

The abovementioned results of fertilization are in harmony with those attained by Abd El-All (2011) on *Aspidistra elatior,* Summan etal., (2016) on Salvia, Abd El Gayed and Attia Eman (2018) on *Celosia argentea*, Attia et al., (2018) on tuberose plants, Kwon etal., (2019) on *Platycodon grandiflorum*, Al-Rubaye and Khudair (2020) on Gazania plant, Ashour et al., (2020) on *Dracaena marginata* 'Bicolor' Ghatas (2020) on *Coriandrum sativum* L. plant and Abou El-Ghait et al., (2020) on jasmine plant.

Conclusively, in order to produce good quality *Matthiola incana* plants it is preferable to spray the plants with kinetin at 100 supplemented with mineral fertilization at 10N:200P:200K kg/fed. six times a year**.**

REFERENCES

Abbass, J.A.; AL-Zurfi, M.T.H.; Al-Abbasi, A.M.; Swadi, M.J. and E.S. Kadhim (2020). Effect of Adding Wheat Organic Residues and Salicylic acid on Growth and Corms Production of *Freesia Hybrida* Plants. plant Archives Vol. 20, No. 1, pp. 574-578.

Abd El Gayed, M. E. (2019). Effect of silicon levels and methods of application on vegetative growth and flowering of zinnia (*Zinnia elegans* L.) J. Product. & Dev., 24(4):929- 944.

Abd El Gayed, M. E. and Eman A. Attia (2018). Impact of Growing Media and Compound Fertilizer Rates on Growth and Flowering of Cocks Comb (*Celosia argentea*) Plants. J. Plant Production, Mansoura Univ., Vol. 9 (11): 895 – 900.

Abd El-All, S.G. (2011). Response of Castiron Plant (Aspidistra elatior Blume) to Foliar Nutrition with Greenzit and GA3. M.Sc. Thesis, Fac. Agric., Benha Univ., Egypt, 300 p.

Abou El-Ftouh, Zeinab, A.; Mohamed Asmaa M.;and A.K. Ibrahim (2018). Effect of saline water irrigation and foliar spraying of salicylic acid on growth, flowering and chemical composition of pot marigold (*Calendula officinalis* L.) Plant. J. Agric. Sci., Ain Shams Univ., 26(2A), 935 – 950.

Abou El-Ghait, Eman M. ; Youssef, A.S.M. ; Mohamed, Y.F. ; Noor El-Deen, T.M. and Heba, I. Mohamed (2020). Effect of benzyladenine and chemical fertilization on growth, flowering and chemical composition of *Jasminum sambac* plant. Scientific J. Flowers & Ornamental Plants 7(4):379-391.

Al-Rubaye, B. C. H. and T. Y. Khudair (2020). The Effect of Fertilization with Boron and Potassium on some Natural and Flowering Traits of the Gazania Plants. Plant Archives Vol. 20, Supplement 2, pp. 140-144.

Armando, H. P; Luis, A. V. A; Oscar, G. V. T.; Irán, A. T; Libia, I. T. and J. S. A Manuel (2016). Effects of ammonium and calcium on lisianthus growth. Hortic. Environ. Biotechnol. 57(2):123-131.

Ashour, H. A. ; El- Attar, Asmaa B. E.; M. M. Abdel Wahab (2020). Combined effects of NPK fertilizer with foliar application of benzyladenine or gibberellic acid on *Dracaena marginata* 'Bicolor' grown in different potting media. Ornamental horticulture .V. 26, No. 4, 2020 p. 545-561.

Attia, K. E. and Naglaa F. S. Elbohy (2019). The influence of spraying with Potassium silicate and irrigation with saline water in sandy soil on *Calendula officinalis* L. The future Journal of Biology ;2:39-56.

Attia, K. E.; Naglaa F.S. Elbohy and Nahla A.M. Ashour (2018). Response of Tuberose Plants (*Polianthes Tuberosa* L.) to Chemical and Bio Fertilization and Their Effect on Vegetative Growth, Flowering and Chemical Composition Under Sandy Soil Conditions. Scientific J. Flowers & Ornamental Plants. 5(3):261-273.

Boodley, J.W. (1975). Plant nutrition and flower quality. HortScience. 10:41-48.

Bosse, C. A. and J. Van staden (1989). Cytokinin in cut carnation flowers. V- Effect of cytokinin type, concentration and mode of opplication on flower longevity. C. F. Hort., Abst.,60: (6304).

Brown, J. D. and O. Lilleland (1946). Rapid determination of potassium and sodium in plant material and soil extract by flame photometry. Proc. Amer. Soc., Hort., Sci., 48:341-346.

Cheema, G.S. and D.P. Sharma (1982). In vitro propagation of apple rootstocks. Int. Hort. Congr XXI. Hamburg, German Federal Republic, Int. Soc. Hort. Sci. 1: 1035 (C.F. Chem. Abst., 52: 7692).

Christos, D. (2008). Foliar application of calcium and magnesium improves growth, yield, and essential oil yield of oregano (*Origanum vulgares* sp. hirtum). Industrial Crops and Products 29: 599–608.

El-Ashwah, M.A. (2020). Improving tolerance of *cortaderia selloana* plants to irrination water salinity through salicylic acid application. Scientific J. Flowers & Ornamental Plants 7(3):349-361.

Elbohy, N. F.S. ; Attia, K. E. and T.M. Noor El-Deen(2018). Increasing quality of *Zinnia elegans* plants by foliar spraying with ascorbic and salicylic acids. Middle East Journal of Agriculture Research ISSN 2077-4605.

El-Keltawi, N. E.; Mousa, G. T. and B. S. Makary (1996). Regulation of chrysanthemum growth using GA_3 and Alar to overcome salinity depressions. Acta Horticulturae 426:657-669.

El-Kinany R. G. (2020). The Beneficial Role of Salicylic Acid, Triacontanol and δ-Aminolevulinic Acid on the Growth, Flowering and Chemical Composition of Pansy (*Viola wittrockiana* Gams) under Salt Stress Conditions. Hortscience Journal of Suez Canal University 9 (1): 13-30.

El-Kinany, R. G.; Nassar, A. M. K. and A. A.A. El-Settawy (2019). The Role of Benzyl Amino Purine and Kinetin in Enhancing the Growth and Flowering of three Gaillardia Varieties. Alex. J. Agric. Sci. Vol. 64, No.5, pp. 277-288, 2019.

EL-Quesni F. E.M., Mazhar A.A.M., Abdul EL aziz N.G. & S.A. Metwally (2012). Effect of compost on growth and chemical composition of Matthiola incana L. under different water intervals. Journal of Applied Sciences Research 8(3): 1510-1516.

Ghatas, Y. A. (2020). Impacts of Using some Fertilization Treatments in Presence of Salicylic Acid Foliar Spray on Growth and Productivity of *Coriandrum sativum* L. Plant. Journal of Plant Production , Mansoura Univ., Vol. 11 (2):119 – 125.

Gullen, J.; Alexander, J.C.M.; Brady, A.; Brickell, C.D.; Green, P.S.; Heywood, V.H.; Jorgensen, P.M.; JURY, S.L.; Knees, S.G.; Lesile, A.C.; Mattheews V.A.; Robson N.K.B.; Walters S.M.; Wijnand,s D.O. and P.F. Yeo (1995). The European Garden Flora. Cambridge University. Great Britain, 138-139.

Harper, J. F.; Breton, G. and A. Harmon (2004). Decoding calcium signals through plant protein kinases. Annu. Rev. Plant Biol. (55):263-288.

Hedayat, M. (2001). Application of plant growth retardants in greenhouse. Proc First Applied Sci Seminar on Flowering and Ornamental Plants. Mahallat, Iran. pp. 55-56.

Hepler, P. K. and R. O. Wayne (1985). Calcium and plant development. Annu. Rev. Plant Physiol. 36:394-439.

Herbert, D.; Phipps, P. J. and R. E. Strange (1971). Determination of total carbohydrates. Methods in Microbiology, 5 (8): 290-344.

Heuer, B. A. C. ; Ravina, I. B. and S. Davidov (2005). Seed yield, oil content, and fatty acid composition of stock (*Matthiola incana*) under saline irrigation. Australian Journal of Agricultural Research 56(1) 45-47.

Hisamatsu, T.; Koshioka, M.; Kubota, S.; Fujime, Y.; King, W.R. and L.N. Mander (2000). The role of Gibberellin biosynthesis in the control of growth and flowering in *Matthiola incana*. Physiologia Plantarum 109: 97-105.

Kashif, N. (2001). Effect of NPK on growth and chemicals effect on vase-life of zinnia. M.Sc. Thesis. PMAS Arid Agri. Univ. Rawalpindi, Pakistan. p. 23.

Kim, Y.; Khan, A.; Hamayun, M; Kim, J.; Lee, J. Hwang, I.; Yoon, C. and I. Lee (2010). Effects of prohexadione calcium on growth and gibberellins contents of *Chrysanthemum morifolium* R. cv Monalisa White. Scientia Horticulturae 123(3):423-427.

Kwon, S.J.; Kim, H.R.; Roy, S. K.; Kim, H.J.; Boo, H.O.; Woo, S.H. and H.H. Kim (2019). Effects of Nitrogen, Phosphorus and Potassium Fertilizers on Growth Characteristics of Two Species of Bellflower (*Platycodon grandiflorum*). J. Crop Sci. Biotech. 22 (5) 481 :487.

Leopol, A.C. and M. Kawase (1964). Senescence of a trifoliate bean leaf caused by treating the primary leaves of cuttings with benzyladenine. Amer. J. Bot., 51: 294-298.

Leshem, Y.; Grossman, S.; Frimer, A. and J. Zir (1979). Endogenous Lipoxygenase control and lipid associated free redical scavenging as model of cytokinin action in plant senescence retardation. p. 193-198. In. L. Aplequist and C. L. Liljenberg (eds) Advances in the biochemistry and physiology of plant Lipids, vol. 3. Elisevier, Amsterdam.

Mara, C. G. (2017). Controlling growth in *Echinacea Hybrids*. Ph. D. Thesis, Virginia Polytechnic Institute and state University.

Marschner etal., (1990). Growth enhancement by silicon in cucumber (*Cucumis sativus*) plants depends on imbalance in phosphorus and zinc supply. Plant and Soil 124:211-219.

Marschner, H. (1997). Mineral Nutrition of Higher Plants. 2^{nd} ed. Acadimic press. Pub. New York (USA).

Mirabbasi, N.; Nikbakht, A.; Etemadi, N. and M. R. Sabzalian (2013). Effect of different concentrations of potassium silicate, nano silicon and calcium chloride on concentration of potassium, calcium magnesium, chlorophyll content and number of florets of *Asiatic lily* cv. 'Brunello. J. Sci. & Technol. Greenhouse Culture, 4 (2) :41-50.

Mohamed, Y. F. Y (2017). Effect of some growth stimulants on growth, flowering and postharvest quality of aster (*Symphyotrichum novi-belgii* L.) cv.

Purple Monarch. Middle East Journal of Agriculture Research 6(2) 264-273.

Mohammad Saeed, A. A. J.; Abdulhadi, M. D. and S. M. Salih (2019). Response of Gerbera (*Gerbera jamesonii*) cv. 'Great Smoky Mountains' to Foliar Application of Putrescine, Spermidine and Salicylic Acid. International Conference on Agricultural Sciences IOP Conf. Series: Earth and Environmental Science 388 012067 IOP Publishing doi:10.1088/1755-1315/388/1/012067.

Mohammed, R. A. J. and B. M.A. Abood (2020): Effect of bacterial inoculum, spraying with calcium nitrate and salicylic and in vegetative and flowery growth traits of *Gerbera jamesonii*. Plant Archives Vol. 20 No. 1, 2020 pp. 633-638.

Onyilagho, J.: Bala, A., Hallett, R.: Gruber, M.: Soroka, J. and N. Westcott (2003): Leaf flavonoids of the cruciferous species, Camelina sativa, Crambe spp., Thlaspi arvense and several other genera of the family Brassicaceae. Biochem. System. Ecol., 31: 1309-1322.

Pregl, F. (1945): Quantitative Organic Micro Analysis. 4th ED. J. & Achurnil, London. Regul., 4: 111-122.

Saeed A. K. A.J. M. (2020): Effect of ascorbic and salicylic acids on growth and flowering of Gazania cv. Frosty Kiss Mixed Sociedade brasileira de floricultura ,plants ornamentais or orNameNtalhortIculture.emNuveNS.com .br/rbho V. 26, No. 4, 2020 p. 537-544.

Salisbury, F.B. and C.W. Ross (1974): Plant Physiology. Publishing Inc. Belmont. California, 2nd ed., pp. 422.

Sharma, S. and R. Kumar (2012). Effect of nitrogen on growth, biomass and oil composition of clary sage (*Salvia sclarea* Linn.) under mid hill of north western Himalayas. Intl. J. Natural Prod. Resources. 3(1):79-83.

Snedecor, G. W. and W.G. Cochran (1980). Statistical Methods. 7th Ed. Iowa State Univ. Press. Ames Iowa, USA.

Summan, I.; Iftikhar, A. Khan , M. A. and M. Qasim (2016). Modelling Growth, Yield and Quality Attributes of *Salvia splendens* L. in Response to Various Nutrition Regimes. International Conference on Horticultural Sciences. Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Punjab 38040, Pakistan

Trouge, E. and A. H. Meyer (1939). Improvement in deiness calorimetric for phosphorus and arsenic. Ind. Eng. Chem. Anal. Ed., 1: 136-139.

Youssef, A.S.M. and Mady, M.A. (2013). Influence of light intensity and benzyladenine on growth performance of *Aspidistra elatior* Blume plant. Research Journal of Agriculture and Biological Sciences, 9(5):248-257.

Zheng, C.; Oba, S.; Matsui, S. and T. Hara (2005). Effects of calcium and magnesium treatments on growth, nutrient contents, ethylene production, and gibberellin content in chrysanthemum plants. Journal of the Japanese Society for Horticultural Science; 74(2):144-149.

تأثير بعض مواد النمو والتسميد الكيماوى على النمو الخضرى والمحتوى الكيماوى لنبات المنثور

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أجريت هذة التجربة خلال موسمين متتاليين ٢٠١٩/٢٠١٨ و ٢٠٢٠/٢٠١٩ بمزرعة الزينة بقسم البساتين بكلية الزراعة جامعة بنها لدراسة تأثير الرش ببعض مواد النمو من مادة الكينتين وحمض الساليسيليك وثيوسلفات الكالسيوم وسيليكات البوتاسيوم وكذلك التسميد الكيميائي (النيتروجين والبوتاسيوم والفوسفور) على النمو الخضري والتركيب الكيماوي لنباتات المنثور لزيادة وتحسين جودة النبات لتزيين وتجميل الاحواض بالحدائق. أظهرت النتائج المتحصل عليها أن أطول النباتات و اسمك ساق للنبات تم الحصول عليها بواسطة الرش بالكينتين بتركيز١٠٠ جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين.و تم تسجيل اكبر وزن للاوراق / نبات الطازجة والجافة بواسطة الرش بالكينتين بتركيز١٠٠ جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين.