Scientific J. Flowers & Ornamental Plants
www.ssfop.com/journal
ISSN: 2356-7864 **doi:** ×××××××××

INFLUENCE OF SOME GROWTH SUBSTANCES AND CHEMICAL FERTILIZATION ON FLOWERING AND CHEMICAL COMPOSITION OF *MATTHIOLA INCANA* PLANT

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Scientific J. Flowers & Ornamental Plants, 9(1):×××-××× (2022).

Received:
28/12/2021
Accepted:
13/1/2022

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ABSTRACT: Two field trials were conducted 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 and chemical fertilization (N.P.K) as well as their combinations on flowering growth and chemical composition of *Matthiola incana* plants to increase and improve the flowering quality of this plant to bed gardens ornamentation. Obtained results showed that the heaviest fresh and dry weights of inflorescence and flowering portion were recorded by 100 ppm kinetin-sprayed plants fertilized with NPK fertilization at the high level in both seasons. The tallest and the thickest flowering portion were recorded by 100 ppm kinetin-sprayed plants joined with NPK fertilization at the high level in the two seasons. The highest values of the number, diameter and fresh weight of floret were scored by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level in both seasons. The combined treatment between kinetin at 100 ppm and chemical fertilization at the high level gave the highest flowering duration. The highest leaf total chlorophylls and total indoles contents were recorded by 100 ppm kinetin- sprayed plants supplemented with chemical fertilization at the high level in the two 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 flowering growth and quality of this plant.

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

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). Many authors demonstrated that growth and flowering of many ornamental plants are greatly influenced by different growth substances among which kinins group. Kinetin is recognized by its ability to induce cell division in certain plant tissues (Cheema and Sharma, 1982) it can also overcome the apical dominance of many plants and stimulate the lateral buds to develop into an entire new plant. Kinetin can delay senescence and cause transport of many solutes from older parts of the leaves or even from older leaves into the treated zone (Salisbury and Ross, 1974). In this respect, Abou El-Ghait *et al.,* (2021) reported that spraying *Hippeastrum vittatum* plants with BA at 60 ppm induced prospective effects on vegetative growth and flowering parameters with higher bulbs productivity.

Salicylic acid (SA) is an endogenous growth regulator of the phenol nature, which participates in the regulation of physiological processes in plants. It plays an important role in the plant response to adverse environmental conditions such as salinity. Salicylic acid (2- hydroxybenzoic acid) may help regulate several plants functions, including systemic acquire resistance to pathogens and the formation of flowers. Recent review has demonstrated physiological and biochemical processes in plants and it is considered phytohormones among the morphogenetic processes affected by salicylic acid were flowering (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 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. Careful planning and understanding of silicon's unique role in plant nutrition will ensure success with silicon. The form of silicon taken up by plants is silicic acid which in an agricultural setting is usually supplied as potassium (K2SiO4) or sodium (Na2SiO4) silicate. (Marschner *et al.*, 1997). In this respect, Abd El Gayed (2019) showed that sprayed *Zinnia elegans* L. plants with silicon at 500 ppm significantly increased all vegetative and flowering growth parameters. 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.,* (2021) showed that, fertilizing *Hippeastrum vittatum* plants with mineral fertilization with N: P: K at 6g/plant induced prospective effects on vegetative growth and flowering parameters with higher bulbs productivity..

Therefore, this investigation was established to study the effect of some growth substances and chemical fertilization on flowering 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 flowering quality and chemical composition of *Matthiola incana* plants to enhance the flowering 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%. On 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 2 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.) levels.

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:

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:

1. Flowering parameters:

Number of florets per inflorescent, diameter of floret per inflorescent (cm), fresh weight of floret (g), fresh weight of inflorescent per plant (g), dry weight of inflorescent per plant (g), flowering portion height per plant (cm), diameter of flowering portion per plant (cm), fresh weight of flowering portion per plant (g), dry weight of flowering portion per plant (g) and flowering duration (days).

2. Chemical composition determinations:

On 1st of April for both seasons (after 125 - 130 days from planting the seeds), three plants were randomly chosen at 5% flowering from each plot during both seasons and the following data were recorded:

Pigments content (mg/100 g of fresh weight):

Chlorophylls a, b and carotenoids were determined in fresh leaf samples (mg/100g FW) by using colorimetric method (A.O.A.C, 1990).

Total indols and phenols contents:

Total indols and phenols contents were determined in fresh leaf samples (mg/100 g FW) by using colorimetric method (A.O.A.C, 1990).

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

Flowering growth parameters:

1. Fresh and dry weights of inflorescence (g):

Tables (1 and 2) clear that all tested sprays of growth substances succeeded in increasing the fresh and dry weights of *Matthiola incana* inflorescence (g) as compared with un-sprayed plants in both seasons. In this regard, 100ppm kinetin-sprayed plants gave the highest values of these parameters, followed by kinetin at 50 ppm in both seasons. On the other hand, there was a positive correlation between the inflorescence fresh and dry weights values and fertilization levels, so the values of these parameters 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.

Furthermore, data in Tables (1 and 2) indicate that all the interactions between growth substances and chemical fertilization levels statistically increased inflorescence fresh and dry weights of *Matthiola* plants as compared with untreated plants in both seasons. In this concern, the heaviest fresh inflorescence (186.13 and 183.88 g) and the heaviest dry inflorescence (28.83 and 28.77 g) were recorded by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level treatment in the first and second seasons, respectively**.**

2. Fresh and dry weights of flowering portion (g):

Tables (3 and 4) show that all tested sprays of growth substances succeeded in increasing the fresh and dry weights of *Matthiola inccan* flowering portion 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 observe that there was a positive correlation between the fresh and dry weights of flowering portion and chemical fertilization treatments. So, as the level of chemical fertilization increased the fresh and dry weights of flowering portion increased up to the maximum increasing at the high level of chemical fertilization in both seasons (Tables, 3 and 4). In this regard, the heaviest fresh and dry weights of flowering portion were recorded by 100 ppm kinetin-sprayed plants fertilized with NPK fertilization at the high in both seasons.

3. Length and diameter of flowering portion (cm):

Tables (5 and 6) declare that all tested growth substances and chemical fertilization treatments as well as their interactions increased the length and diameter of flowering portion as compared with un-treated plants in both seasons. In this concern, the increment in the length and diameter of flowering portion 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 length and diameter of flowering portion values when compared with un-treated plants in both seasons. In general, the tallest (33.33 and 22.00 cm) and thickest (9.76 and 9.93 cm) flowering portion were recorded by 100 ppm kinetin-sprayed plants joined with NPK fertilization at the high level in the first and second seasons, respectively.

4. Number, diameter and fresh weight of floret:

Data presented in Tables (7, 8 and 9) clear that all tested growth substances treatments increased the number, diameter and fresh weight of floret when compared with un-treated plants in both seasons. In this concern, 100 ppm kinetin-sprayed plants scored the highest values of these parameters in both seasons. In parallel, the number, diameter and fresh weight of floret increased with all tested levels of chemical fertilization, particularly the high level in both seasons.

Table 1. Effect of some growth substances and chemical fertilization on fresh weight of inflorescence (g) 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	52.52	74.93	90.13	101.08	79.66	53.63	76.41	90.17	98.63	79.71
Pot. Silic. 4 cm^3/l	88.86	130.87	148.58	171.40	134.92	88.37	130.20	144.33	171.22	133.53
Pot. Silic. 6 cm^3/l	96.26	131.29	156.59	172.89	139.25	94.92	133.33	154.62	176.11	139.74
Calcium 2 cm^3/l	78.42	122.02	136.74	145.26	120.61	79.11	118.14	137.06	146.40	120.17
Calcium 3 cm^3/l	87.04	130.10	145.44	167.01	132.39	85.89	127.28	145.37	170.51	132.26
Sal. acid 100 ppm	66.59	102.35	131.55	144.01	111.12	68.60	104.35	134.33	145.13	113.10
Sal. acid 200 ppm	76.46	116.63	140.27	157.63	122.74	78.56	124.35	145.71	156.13	126..18
Kinetin 50 ppm	91.66	130.65	158.96	183.13	141.10	95.34	133.68	155.07	180.99	141.27
Kinetin 100 ppm	102.05	137.42	163.35	186.13	147.23	106.38	137.82	163.69	183.88	147.94
Mean	82.20	119.58	141.29	158.72		83.42	120.61	141.15	158.77	
LSD at 0.05	A= 12.4		B= 18.6	A×B= 37.2		A= 11.7		B= 17.6	A×B=35.1	

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

Table 2. Effect of some growth substances and chemical fertilization on dry weight of inflorescence (g)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	8.08	14.58	17.29	18.89	14.71	7.51	14.16	17.17	18.61	14.36
Pot. Silic. 4 cm^3/l	16.81	18.81	21.78	25.78	20.79	16.44	19.28	22.24	25.62	20.89
Pot. Silic. 6 cm^3/l	17.22	19.13	23.77	26.14	21.56	18.24	20.23	23.45	26.86	22.19
Calcium 2 cm^3/l	13.10	18.85	21.09	22.33	18.84	15.24	18.94	20.44	23.52	19.53
Calcium 3 cm^3/l	14.48	19.36	22.60	25.25	20.42	16.95	19.86	23.13	24.77	21.17
Sal. acid 100 ppm	14.76	17.86	20.27	21.90	18.69	13.83	17.85	21.25	22.34	18.81
Sal. acid 200 ppm	16.49	18.94	22.24	23.91	20.39	15.03	18.14	22.57	22.40	19.53
Kinetin 50 ppm	16.99	19.71	23.69	28.78	22.29	17.35	19.96	22.86	27.59	21.94
Kinetin 100 ppm	18.42	20.73	25.01	28.83	23.24	19.21	20.63	23.87	28.77	23.12
Mean	15.15	18.66	21.97	24.64		15.53	18.78	21.88	24.49	
LSD at 0.05	A=2.04		B= 3.06	A×B= 6.12		A= 2.21		B= 3.32	A×B= 6.64	

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

Table 3. Effect of some growth substances and chemical fertilization on fresh weight of flowering portion (g) 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	42.96	59.52	68.68	78.34	62.36	40.44	65.54	69.36	73.96	62.32
Pot. Silic. 4 cm^3/l	55.20	87.96	92.84	101.30	84.32	58.04	81.02	102.14	104.12	86.32
Pot. Silic. 6 cm^3/l	57.42	94.26	103.14	114.14	92.24	60.10	103.14	112.28	116.90	98.10
Calcium 2 cm^3/l	54.08	89.32	91.54	99.76	83.66	57.28	87.96	89.40	101.52	84.04
Calcium 3 cm^3/l	54.86	92.54	98.96	103.72	87.52	58.26	95.48	96.76	106.12	89.14
Sal. acid 100 ppm	50.48	69.22	81.82	87.32	72.20	52.42	73.92	77.34	86.06	72.42
Sal. acid 200 ppm	53.22	89.74	91.66	93.70	82.08	55.00	87.76	93.00	96.08	82.96
Kinetin 50 ppm	63.62	99.08	102.76	108.78	93.56	60.40	106.48	107.04	110.50	96.10
Kinetin 100 ppm	64.58	105.02	106.24	118.28	98.52	67.68	109.90	116.34	119.64	103.38
Mean	55.14	87.40	93.06	100.58		56.62	90.12	95.96	101.64	
LSD at 0.05	A= 7.45		B= 11.18		A×B= 22.35	A= 6.74		B= 10.11		A×B= 20.22

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

Table 4. Effect of some growth substances and chemical fertilization on dry weight of flowering portion (g) 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	5.54	11.04	11.94	13.78	10.56	5.94	8.98	12.30	13.66	10.22
Pot. Silic. 4 cm^3/l	9.70	14.82	16.06	17.80	14.58	10.98	16.44	17.00	18.12	15.62
Pot. Silic. 6 cm^3/l	10.16	16.68	16.88	18.72	15.60	11.48	17.60	18.04	18.86	16.48
Calcium 2 cm^3/l	7.86	14.68	15.64	17.38	13.88	9.94	15.64	16.00	17.70	14.82
Calcium 3 cm^3/l	9.60	15.86	16.38	18.14	14.98	10.74	16.10	16.66	18.14	15.40
Sal. acid 100 ppm	7.66	12.32	13.04	14.00	11.74	9.26	13.82	13.94	14.88	12.96
Sal. acid 200 ppm	8.14	14.84	15.84	16.18	13.74	9.94	14.32	14.66	17.30	14.04
Kinetin 50 ppm	11.16	16.98	17.60	19.38	16.28	11.60	17.14	18.36	19.70	16.70
Kinetin 100 ppm	11.40	17.38	17.80	19.88	16.60	12.42	18.56	19.12	20.12	17.54
Mean	9.02	14.94	15.68	17.24		10.24	15.40	16.22	17.60	
LSD at 0.05	A= 1.17		B=1.76		A×B= 3.51	A= 1.23		B=1.85		A×B= 3.69

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

Table 5. Effect of some growth substances and chemical fertilization on flowering portion length (cm) 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	16.66	18.50	18.83	19.33	18.33	16.50	18.33	18.66	19.50	18.24
Pot. Silic. 4 cm³/l	18.50	19.16	19.66	19.83	19.28	18.66	19.00	19.33	19.66	19.16
Pot. Silic. 6 cm³/l	19.66	19.81	20.33	20.50	20.07	19.33	19.83	20.00	20.16	19.83
Calcium 2 cm³/l	17.83	19.00	19.66	20.66	19.28	18.66	18.66	19.50	20.00	19.20
Calcium 3 cm³/l	19.00	19.66	20.16	21.00	19.95	19.50	19.83	20.33	20.33	19.99
Sal. acid 100 ppm	18.16	19.83	20.33	21.00	19.83	17.66	20.00	20.33	20.66	19.66
Sal. acid 200 ppm	19.16	20.16	21.16	21.33	20.45	18.33	20.50	20.66	21.66	20.28
Kinetin 50 ppm	19.50	19.83	20.16	21.66	20.28	19.83	20.00	20.50	21.66	20.49
Kinetin 100 ppm	20.50	20.83	21.33	33.33	23.99	20.50	20.50	20.66	22.00	20.91
Mean	18.77	19.64	20.18	22.07		18.77	19.62	19.99	20.62	
LSD at 0.05	A= 0.78		B= 1.19		A×B= 2.34	A= 0.69		B=1.04		A×B=2.08

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

Table 6. Effect of some growth substances and chemical fertilization on diameter of flowering portion (cm) 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	6.88	8.06	8.20	8.26	7.85	6.40	8.00	8.10	8.43	7.73
Pot. Silic. 4 cm³/l	7.76	8.60	9.26	9.43	8.76	8.43	8. 66	9.26	9.43	8.94
Pot. Silic. 6 cm³/l	8.10	8.63	9.50	9.70	8.98	8.56	8. 73	9.33	9.50	9.03
Calcium 2 cm³/l	7.43	8.50	8.60	8.66	8.29	7.56	8.40	8.66	9.00	8.40
Calcium 3 cm³/l	7.83	8.83	8.96	9.33	8.73	8.00	8.76	9.10	9.16	8.75
Sal. acid 100 ppm	7.00	8.33	8.33	8.40	8.01	7.50	8.38	8.66	8.70	8.31
Sal. acid 200 ppm	8.06	8.50	8.66	9.16	8.28	7.84	8.60	8.83	9.00	8.56
Kinetin 50 ppm	8.22	8.83	9.50	9.60	8.59	8.66	8.96	9.53	9.70	9.21
Kinetin 100 ppm	8.83	9.16	9.46	9.76	9.30	9.10	9.33	9.83	9.93	9.54
Mean	7.79	8.60	8.97	9.14		8.00	8.64	9.03	9.20	
LSD at 0.05	A= 0.27		B= 0.41		A×B=0.82	A= 0.21		B=0.32		A×B= 0.64

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

Table 7. Effect of some growth substances and chemical fertilization on No. of florets/ inflorescence 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	13.33	15.33	15.66	17.66	15.49	12.33	15.33	16.00	16.66	15.08
Pot. Silic. 4 cm^3/l	17.33	18.00	18.33	18.66	18.08	17.33	17.33	18.00	18.00	17.66
Pot. Silic. 6 cm^3/l	18.00	18.66	19.00	19.33	18.74	18.00	18.33	18.66	19.33	18.58
Calcium 2 cm^3/l	16.66	17.00	17.33	17.66	17.16	17.00	17.66	17.66	18.33	17.66
Calcium 3 cm^3/l	17.33	17.66	18.33	18.66	17.99	18.00	18.33	18.66	19.00	18.49
Sal. acid 100 ppm	16.00	16.33	16.66	17.33	16.58	17.00	17.33	17.66	18.00	17.49
Sal. acid 200 ppm	16.66	17.00	17.66	18.66	17.49	17.33	17.66	18.00	18.66	17.91
Kinetin 50 ppm	18.33	18.66	18.66	20.33	18.99	18.33	18.66	19.00	19.33	18.83
Kinetin 100 ppm	18.66	19.00	19.66	20.66	19.49	19. 00	19. 33	19.66	20.33	19.58
Mean	16.92	17.51	17.92	18.77		17.14	17.77	18.14	18.62	
LSD at 0.05	A= 0.18		B= 0.27		A×B=0.54	A= 0.15		B=0.23		A×B= 0.46

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

Table 8. Effect of some growth substances and chemical fertilization on fresh weight of floret (g) 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	1.93	2.33	2.27	2.48	2.25	1.87	2.08	2.40	2.56	2.22
Pot. Silic. 4 cm^3/l	2.30	3.31	3.09	3.41	3.02	2.21	3.01	3.17	3.44	2.95
Pot. Silic. 6 cm^3/l	2.35	3.14	3.37	3.42	3.07	2.39	3.31	3.33	3.53	3.14
Calcium 2 cm^3/l	2.16	2.78	2.93	3.13	2.75	2.17	2.87	3.00	3.33	2.84
Calcium 3 cm^3/l	2.28	3.00	3.12	3.61	3.00	2.18	3.03	3.10	3.27	2.89
Sal. acid 100 ppm	1.86	2.45	2.52	2.60	2.35	1.93	2.47	2.56	2.76	2.43
Sal. acid 200 ppm	2.18	2.87	3.09	3.12	2.81	2.08	2.84	2.91	3.25	2.77
Kinetin 50 ppm	2.36	3.39	3.42	3.49	3.16	2.32	3.55	3.56	3.63	3.26
Kinetin 100 ppm	2.41	3.50	3.51	3.59	3.25	2.48	3.59	3.60	3.73	3.35
Mean	2.20	2.97	3.03	3.20		2.18	2.97	3.07	3.27	
LSD at 0.05	A= 0.11		B= 0.17		A×B=0.34	A= 0.13		B=0.20		A×B= 0.40

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

Table 9. Effect of some growth substances and chemical fertilization on diameter of floret (cm) 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	4.23	4.66	4.76	4.86	4.62	3.93	4.40	4.66	4.83	4.45
Pot. Silic. 4 cm^3/l	4.80	5.30	5.76	6.23	5.52	4.60	5.23	6.00	6.20	5.50
Pot. Silic. 6 cm^3/l	5.06	5.66	5.83	6.33	5.72	4.86	5.46	6.16	6.26	5.68
Calcium 2 cm^3/l	4.76	5.23	5.33	5.66	5.24	4.66	5.26	5.93	6.06	5.47
Calcium 3 cm^3/l	4.86	5.46	5.70	6.06	5.52	4.90	5.30	6.10	6.16	5.61
Sal. acid 100 ppm	4.66	4.96	5.16	5.60	5.09	4.60	4.66	5.33	5.60	5.04
Sal. acid 200 ppm	4.70	5.10	5.50	6.00	5.32	4.76	4.96	5.70	5.86	5.32
Kinetin 50 ppm	4.83	5.56	6.13	6.23	5.68	4.90	5.56	6.26	6.33	5.76
Kinetin 100 ppm	5.23	5.76	6.26	6.30	5.88	5.13	5.66	6.43	6.50	5.93
Mean	4.79	5.29	5.60	5.91		4.70	5.16	5.84	5.97	
LSD at 0.05	A= 0.14		B= 0.21		A×B=0.42	A= 0.18		B=0.27		A×B= 0.54

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

In brief, all interaction between growth substances and chemical fertilization treatments succeeded in increasing the number, diameter and fresh weight of floret as compared with control in the two seasons. In this sphere, the highest values of these parameters were scored by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level in the first and second seasons, respectively.

5. Duration of flowering:

Data in Table (10) indicate that kinetin at both concentrations achieved the highest flowering duration, followed by potassium silicate at 6 cm/l in both seasons. Irrespective un-treated plants, the lowest values of this parameter were scored in most cases by salicylic acid at 100 ppm in the two seasons. The remained treatments occupied an intermediate position between the aforementioned treatments in both seasons. Concerning the effect of chemical fertilization, data in Table (10) show that the duration of flowering were increased in the two seasons, due to the three used levels of chemical fertilization over those of control plants, with superiority for the high level (100N:200P:200K) in the two seasons. As for the interaction effect between growth substances and chemical fertilization treatments, data in the same Table (10) reveal that all the combinations between growth substances and chemical fertilization succeeded in increasing the flowering duration of Matthiola plant in both seasons. Generally, the combined treatment between kinetin at 100 ppm and chemical fertilization at the high level gave the highest flowering duration as it scored 65.00 and 66.66 days, in the first and second seasons, respectively.

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

Table 10. Effect of some growth substances and chemical fertilization on duration of flowering (day) 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	25.66	28.33	35.00	38.33	29.33	26.66	28.66	33.66	39.33	32.07
Pot. Silic. 4 cm³/l	32.66	38.33	42.33	46.66	39.99	38.00	40.33	43.66	47.00	42.24
Pot. Silic. 6 cm³/l	38.88	41.00	44.00	48.66	43.13	41.00	43.00	47.66	49.33	45.24
Calcium 2 cm³/l	34.66	35.00	38.00	43.66	37.83	34.00	36.66	39.33	42.66	38.16
Calcium 3 cm³/l	36.66	38.66	41.33	45.00	40.41	38.66	39.66	43.00	45.66	41.74
Sal. acid 100 ppm	29.00	32.66	35.00	39.66	34.08	30.00	32.00	36.33	38.33	34.16
Sal. acid 200 ppm	33.33	35.66	38.66	41.00	37.16	33.33	35.66	39.00	41.00	37.24
Kinetin 50 ppm	40.00	47.00	50.00	55.33	48.08	42.00	48.00	51.33	58.00	49.83
Kinetin 100 ppm	43.66	54.33	58.66	65.00	55.41	45.66	52.00	60.00	66.66	56.08
Mean	34.94	38.99	42.55	47.03		36.59	39.55	43.77	47.55	
LSD at 0.05	A= 3.17		B= 4.76	A×B=9.51		A= 2.87		B=4.31	A×B= 8.62	

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

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).

Chemical constituents:

1. Leaves total chlorophylls and indoles contents (mg/100 g fw):

Tables (11 and 12) show that all tested treatments of growth substances, chemical fertilization and their combinations succeeded in increasing leaves total chlorophylls and indoles (mg/100g fw) as compared with control in both seasons. In this concern, the highest leaf total chlorophylls content (186 and 184 mg/100g fw) and the richest leaves total indoles content (299 and 296 mg/100g fw) were recorded by 100 ppm kinetin- sprayed plants supplemented with chemical fertilization at the high level in the first and second seasons, respectively. Additionally, kinetin at 50 ppm and potassium silicate at 6 cm/l supplemented with the high level of chemical fertilization induced high increments in this concern in the two seasons.

2. Leaves total phenols content (mg/100 g fw):

Table (13) indicates that all tested growth substances treatments decreased leaves total phenols content, with superior for kinetin and potassium silicate treatments as compared with un-treated plants in both seasons. Also, the decrements of leaves total phenols content were in parallel to the increasing of chemical fertilization level to reach the maximum decreasing at the high level in both seasons. Generally, all resulted interactions between growth substances and chemical fertilization treatments statistically decreased the values of this parameter as compared with control in both seasons. In this respect, the lowest values of leaves total phenols content (112 and 108 mg/100g fw) were recorded by 100 ppm kinetin-sprayed plants supplemented with NPK fertilization at the high level, in the first and second seasons, respectively. On contrary, the

Table 11. Effect of some growth substances and chemical fertilization on total chlorophylles (mg/100g fw) 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	119	128	139	156	136	113	125	136	152	132
Pot. Silic. 4 cm^3/l	128	134	151	168	145	125	135	148	164	143
Pot. Silic. 6 cm^3/l	134	141	158	175	152	131	139	155	172	149
Calcium 2 cm^3/l	126	137	143	163	142	127	129	144	161	140
Calcium 3 cm^3/l	131	140	147	167	146	129	133	150	168	145
Sal. acid 100 ppm	124	134	148	165	143	121	132	142	167	141
Sal. acid 200 ppm	129	139	150	171	147	126	137	149	170	146
Kinetin 50 ppm	136	145	162	179	156	134	141	160	176	153
Kinetin 100 ppm	141	148	168	186	161	139	146	169	184	160
Mean	130	138	152	170		127	135	150	168	
LSD at 0.05	A= 6.14		B= 15.7	A×B=31.3		A= 5.29		B=7.94	A×B= 15.9	

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

Table 12. Effect of some growth substances and chemical fertilization on total indoles (mg/100g fw) 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	214	249	271	280	254	219	246	273	283	255
Pot. Silic. 4 cm^3/l	234	260	276	290	265	231	262	281	287	265
Pot. Silic. 6 cm^3/l	239	268	279	294	270	236	265	286	289	269
Calcium 2 cm^3/l	219	251	273	286	257	226	249	276	284	259
Calcium 3 cm^3/l	226	259	276	287	262	231	256	279	286	263
Sal. acid 100 ppm	231	256	275	282	261	230	257	274	286	262
Sal. acid 200 ppm	234	258	277	286	264	237	261	278	288	266
Kinetin 50 ppm	246	271	282	296	274	249	273	289	291	276
Kinetin 100 ppm	251	279	289	299	280	256	278	291	296	280
Mean	233	261	278	289		235	261	281	288	
LSD at 0.05	A= 12. 7		B= 19. 1	A×B=38. 2		A= 11.4		B=17.1	A×B= 34.2	

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

Table 13. Effect of some growth substances and chemical fertilization on leaves total phenols content (mg/100g fw) 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	194	176	137	123	158	191	179	131	120	155.25
Pot. Silic. 4 cm^3/l	187	169	132	120	152	186	154	129	115	146
Pot. Silic. 6 cm^3/l	186	163	131	118	150	183	149	128	113	143
Calcium 2 cm^3/l	189	173	134	121	154	189	162	130	119	150
Calcium 3 cm^3/l	187	171	132	119	152	188	159	127	117	148
Sal. acid 100 ppm	192	168	134	119	153	187	168	129	118	151
Sal. acid 200 ppm	191	165	133	118	152	187	163	128	116	149
Kinetin 50 ppm	186	159	129	117	148	181	146	126	111	141
Kinetin 100 ppm	181	156	124	112	143	178	141	121	108	137
Mean	188	167	132	119		186	158	128	115	
LSD at 0.05	A=13.3	B= 20.0	A×B= 40.0			A= 11.9	B= 17.9	A×B= 35.7		

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

highest values of leaves total phenols content were gained by those sprayed with tape water and received no chemical fertilization treatments as it recorded 194 and 1914 mg/100 g fw in the first and second seasons, respectively. The remained treatments occupied an intermediate position between the abovementioned treatments in the two seasons of this study.

As for the explanation of the incremental effect of kinetin on growth and chemical constituents of Matthiola plant, it could be illustrated here on the basis that kinetin treatments stimulated the endogenous cytokinins synthesis and there is an intimate relationship between cytokinins and chlorophylls metabolism in both excided or detached leaf disks and intact plants i.e., cytokinins retard chlorophylls degradation, preserve it and increase its synthesis (Devlin and Witham, 1983). Besides, 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. These enzymes could be divided into two groups according to their response to cytokinins. The first group of enzymes could be said to relate to chloroplast differentiation, while the second one could be related to cytokinin stimulated group (Kulaeva, 1979). 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. In this concern, Kenneth (1979) reported that total control of plant growth is vested not in a single hormonal type – that of auxin – but is shared by several specially auxins, cytokinins, gibberellins and ethylene and this further subjected to namely the phenols, flavons and absicsic acid. 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, flowering 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, Zeinab *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*, El-Ashwah (2020) on *Cortaderia selloana* plants and Abou El-Ghait *et al.,* (2021) on *Hippeastrum vittatum* plant.

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', Abou El-Ghait *et al.,* (2020) on jasmine plant and Abou El-Ghait *et al.,* (2021) on *Hippeastrum vittatum* 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.

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

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أجريت تجربتان خلال موسمين متتاليين ٢٠١٩/٢٠١٨ و ٢٠٢٠/٢٠١٩ في مزرعة الزينة بقسم البساتين بكلية الزراعة جامعة بنها لدراسة تأثير الرش ببعض مواد النمو من مادة الكينيتين وحمض الساليسيليك وثيوسلفات الكالسيوم وسيليكات البوتاسيوم. وكذلك التسميد الكيميائي (النيتروجين والبوتاسيوم والفوسفور) والتداخل بينهم على النمو الزهرى والتركيب الكيماوي لنباتات المنثور لزيادة وتحسين جودة الازهار لهذا النبات لتزيين وتجميل الاحواض بالحدائق.أظهرت النتائج المتحصل عليها أن أكبر وزن للشمراخ الزهرى والجزء المزهر الطازج والجاف تم تسجيلها بواسطة الرش بالكينتين بتركيز ١٠٠ جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين. وتم تسجيل الجزء الأطول والأكثر سمكا من الجزء المزهر بواسطة الرش بالكينتين بتركيز ١٠٠جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين . وتم تسجيل أعلى قيم لعدد وقطر والوزن الطازج للزهيرات بواسطة الرش بالكينتين بتركيز١٠٠ جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين . أعطت المعاملة المشتركة بين الكينتين عند ١٠٠ جزء في المليون والمستوى الاعلى من التسميد الكيميائي من النيتروجين والبوتاسيوم والفوسفور أعلى فترة إزهار للنباتات فى كلا الموسمين. تم تسجيل أعلى نسبة من الكلوروفيل الكلي و الإندولات الكلية لمحتوى الاوراق عند الرش بالكينتين بتركيز ١٠٠ جزء في المليون بالاضافة مع التسميد بالمستوى الاعلى من النيتروجين والبوتاسيوم والفوسفور في كلا الموسمين. الخلاصة: رش نباتات المنثور بالكينيتين عند ١٠٠ جزء في المليون والتسميد بالاسمدة الكيماوية (١٠٠ نيتروجين:٢٠٠ فوسفور: ٢٠٠ بوتاسيوم) /كجم/فدان يتم الحصول على افضل نمو زهرى وجودة للازهار من هذا النبات.