

EFFECT OF SOME FERTILIZATION TREATMENTS AND SPRAYING GARLIC EXTRACT ON GROWTH AND FLOWERING OF *HEDYCHIUM CORONRIUM* PLANTS

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ABSTRACT: A pot experiment was conducted to study the effect of three rates of krestalon compound fertilizer NPK (19:19:19) as 2, 4 and 6g/pot, garlic extract at 25, 50 and 100% and their combinations on growth, flowering and chemical constituents of *Hedychium* plants. Results showed that, NPK fertilizer at either 4 or 6g/pot with 50% garlic extract enhanced vegetative growth parameters in terms of plant height, shoot number/clump, number of leaves/main shoot and leaf area in both seasons. Besides, the highest values of fresh and dry weights of root and main shoot as well as the highest carbohydrate, N, P and K % were recorded in plant leaves fertilized with 4 or 6g/pot and sprayed with 50% garlic extract in both seasons. In addition, the highest flowering parameters such as main stalk length, main stalk diameter, inflorescence number/clump, rachis length, florets number/inflorescence, flowering spike fresh and dry weight were obtained from plants treated with 4 or 6g/pot NPK and sprayed with 50 or 100% garlic extract in both seasons. Also, the treatment of 4 or 6g/pot NPK and spraying with 50 or 100% gave the best vase life (days) and showed to be the superior one to induce earlier flowering as compared to control and other treatments. Therefore, it could be recommended that fertilizing *Hedychium* plants with compound fertilizer of NPK (19:19:19) at 4g/pot and spraying with garlic extract at 50% is considered the best and economic treatment used for enhancing growth, flowering and improving the nutritional status of the plant.

Key words: *Hedychium*, plant extracts, flowering, growth, nutritional status

INTRODUCTION

Hedychiums are medium-sized rhizomatous perennial monocotyledon plants belongs to Family Zingiberaceae which can be easily recognized by their characteristic striking foliage and terminal spikes that produce diversified numerous flamboyant flowers with several hues and fragrances varying depending on the species (Ashokan and Gowda, 2018). These features give them a high ornamental value, being cultivated worldwide mostly for this purpose and for its use in the perfumery industry, since, besides the aromatic flowers; *Hedychium* species rhizomes also originate strongly scented oils (Chan and

Wong 2015 & Yue *et al.*, 2015). Fertilization and natural plant extracts are among the important agricultural treatments which have been proven to improve growth, flowering and bulbs and seeds production of ornamental plants (Ahmad *et al.*, 2014; Hassan *et al.*, 2015 and El-Mahrouk *et al.*, 2016). The effect of fertilization on enhancing nutritional status, growth development and flower production of ornamental plants were reported by many investigators (Ruamrungsri *et al.*, 2011; El-Naggar 2010; Youssef 2014; El-Naggar and El-Nasharty 2016; Al-Ajlouni *et al.*, 2017; Abd El-Gayed and Attia 2018; Gaber, 2019 & Altaee and Alsawaf 2020). In this

respect, Bashir *et al.*, (2016) on *Gladiolus grandiflorus* found that application of N, P and K in different combinations had a remarkable effect on most vegetative growth, flowering and nutritional status as the optimal rate was 10:20:10 g m² of NPK for plant height, leaf area, pike length, floret diameter, floret fresh and dry weight as well as leaf chlorophyll content, NPK uptake and number of cormels per clump. Moreover, they suggested that in order to attain sustainable production of *Gladiolus grandiflorus*, balanced fertilization is necessary and optimum use of compound fertilizer would help better towards vigorous growth and maximum flower production. Also, El-Mokadem and Sorour (2014) reported that *Petunia hybrida* fertilized with 5g/pot complete fertilizer of NPK (19:19:19) gave the best growth parameters in terms of plant height, number of branches and leaf area as well as dry weight of shoots and roots. Moreover, Habib (2012) revealed that Caryota seedlings fertilized with 4 gm/pot NPK gave the highest values of chlorophyll a, b and total carbohydrates in the leaves.

The use of extracts of certain plants as bio stimulants for plants such as garlic extract in improving the growth of agriculture crops especially ornamental plants is highly recommended as an environment friendly and safe approach to get better plants without being forced to use chemical nutrients or synthetic growth regulators that may harm the environment. El-Bably (2017) on *Polianthes tuberosa* reported that spraying garlic extract at 9 ml/l increased leaf length, number of leaves and induced precocity in flowering, increased spike and rachis length, number of florets per spike, fresh weight of florets, fresh and dry weights of spike. Also, it significantly increased number of bulblets, fresh weight of clump, fresh weight of new formed bulb and its

diameter as well as increased chlorophyll, carbohydrates content and NPK percentages in the leaves. Also, AL-Kaisy *et al.*, (2013) revealed that spraying garlic extract and on ginger seeds increased in many characteristics: plant height, leaf chlorophyll and carbohydrates content, relative growth rate, absolute growth rate and seed yield. Emam (2010), on *Polianthes tuberosa* reported that garlic extract at 1 and 5ml/l improved flowers traits, increased clump fresh weight, clump dry weight, number of bulbs/plant and number of bulblets/plant. Atowa (2012) on *Freesia refracta* found that application of garlic extract at 500 ml/l increased number and fresh weight of cormlets and chlorophyll (a), whereas using garlic extract at 250 ml/l significantly increased total carbohydrates, N, P and K contents in the leaves. Hanafy *et al.*, (2012) on *Schefflera arboricola* plants stated that the highest values of plant height, dry weight of leaves/plant, total carbohydrates and nitrogen contents were obtained when using garlic extract as a soil drench compared with foliar spray method. EL-Sayed *et al.*, (2015) on *Freesia refracta* reported that using garlic extract at 500 ml/l increased number of cormlets/plot, fresh weight of cormlets and chlorophyll (a) in the leaves as well as a great influence was detected on carbohydrates content due to applying garlic extract.

Therefore, the present study was conducted to evaluate the effect of krestalon compound fertilizer as a source of NPK, spraying garlic extract and their combination on growth and flowering of Hedychium plants.

MATERIALS AND METHODS

A pot experiment was carried out at Sakha Horticulture Research Station, Kafr El Sheikh Governorate Egypt during 2017 and 2018 seasons to study the effect of three rates of the compound

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Kristalon fertilizer (19:19:19 NPK) and spraying with three levels of garlic extract and their combinations on growth, flowering and rhizome production of *Hedychium* plants. *Hedychium coronarium* local cultivar rhizome was obtained from Horticulture Research Institute, Giza, Egypt. Average rhizome weight was 20 – 30 g, length 10 – 15 cm and diameter 4 – 5 cm for the first and second seasons, respectively. Rhizomes were planted on March 21st for both seasons in clay pots of 30 cm diameter containing a mixture of sand and clay (1:2 v/v). Soil samples before treatments and samples from garlic extract used in this study were taken for chemical analysis and minerals content according to Page *et al.*, (1982) and El-Bably (2017); and data are shown in Table (1). The plants received the common agricultural practices such irrigation, manual weed control, etc. were carried out when needed. After four weeks from planting date and plants arrived to 10 cm in length, the plants were subjected to the following treatments.

- Control
- Fertilizing with kristalon at 2 g/pot
- Fertilizing with kristalon at 4 g/pot
- Fertilizing with kristalon at 6 g/pot
- Spraying with garlic extract at 25 %
- Spraying with garlic extract at 50 %
- Spraying with garlic extract at 100 %
- Fertilizing with kristalon at 2 g/pot + spraying with garlic extract at 25 %
- Fertilizing with kristalon at 2 g/pot + spraying with garlic extract at 50 %
- Fertilizing with kristalon at 2 g/pot + spraying with garlic extract at 100 %
- Fertilizing with kristalon at 4 g/pot + spraying with garlic extract at 25 %
- Fertilizing with kristalon at 4 g/pot + spraying with garlic extract at 50 %
- Fertilizing with kristalon at 4 g/pot + spraying with garlic extract at 100 %
- Fertilizing with kristalon at 6 g/pot + spraying with garlic extract at 25 %
- Fertilizing with kristalon at 6 g/pot + spraying with garlic extract at 50 %
- Fertilizing with kristalon at 6 g/pot + spraying with garlic extract at 100 %

Table (1): Physical and Chemical analysis and mineral content of soil and garlic extract.

Soil analysis		Garlic extract analysis	
parameters	Value	Parameters	Value
Clay	36.2	Lysine	0.273 g
Silt	23.4	Carbohydrates	33.07 g
Finesand	14	Lipids	0.50 g
Cross sand	27.3	Sodium	17.00 g
Texture sand clay loom		Magnesium	32.0 g
pH 1:2.5	8.4	Calories	149.00 kca;
EC dSm ⁻¹ 1:5	4.16	Fiber	2.10 g
K ⁺ meq/l	0.4	Glutamic acid	0.805 g
Ca ⁺⁺ meq/l	11.74	Argenine	0.634 g
Mg ⁺⁺ meq/l	5.27	Water	59 g
Na ⁺ meq/l	23.14	Aspartic acid	0.489 g
HCO ₃ ⁻ meq/l	5.79	Leucine	0.308 g
Cl ⁻ meq/l	14.98	Manganese	1672.00 mg
SO ₄ ⁻ meq/l	19.84	Valcum	181.00 mg
CO ₃ ⁻	0	Phosphorus	153.00 mg
Total N , %	23.2	Potassium	401.00 mg
Available P, mg/kg soil	8.3	Sulphur	70.00 mg
Available K, mg/kg soil	51.9	Vit.B6	1235.00 mg

		Vitamin c fiber	31.00 mg 2.10 g
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One hundred and ninety two plants were selected uniformly and arranged in a randomized complete block design with three replicate, each replicate contained four plants. Kristalon as compound fertilizer NPK (19:19:19) was applied via soil at three rates i.e. 2, 4 and 6 g/pot in four doses, the first dose was applied after two months from planting date, the second dose was applied after two months from first dose, the third dose was applied after two months from the second dose and the fourth was applied after cut flowering spikes. One kg fresh mature garlic cloves were blended in the presence of distilled water (1 kg/l), then frozen (24 hours) and thawed two times then filtered according to El-Desouky *et al.* (1998). The size of filtering extract was 300 ml represented 100 % concentration, then 150 ml was taken from the same filtering extract and added water to complete 300 ml with 50% concentration. Also, 75 ml was taken from the same filtered extract and added water to complete 300 ml with 25% concentration. Foliar application of garlic extract at 100, 50 and 25% was done after four weeks from planting date at 15 days intervals at early morning.

The following data was recorded:

1. Vegetative growth:

Plant height (cm), total shoot number/clump, leaf number/main shoot, leaf area (cm²), and main shoot fresh and dry weight, per plant(g)as well as root fresh and dry weights per plant (g).

2. Some chemical constituents in the leaves:

Twenty mature leaves were sampled from each treatment and dried at 70°C to a constant weight, and then 0.5 g powder from dried leaves was taken to determine

total carbohydrates according to Doubis *et al.*, (1956). Dried leaves were ground and digested with H₂SO₄ and H₂O₂ according the method described by Evenhuis and Dewaard (1980) to determine the elements of N, P and K. Total nitrogen % was determined by using the micro-Kjeldahle method as described by Pregl (1945), phosphorus % was determined coloremtrically as described by Murphy and Riley (1962), potassium % was estimated by using flame photometer as described by Brown and Lillelland (1974).

3. Flowering parameters:

Flowering characters: flowering date (days), main stalk length (cm), main stalk diameter (cm), inflorescence number/clump, rachis length (cm), florets number/ inflorescence, fresh and dry weights of flowering spike (g) and vase life (days).

Statistical analysis:

Statistical analysis was done as analysis of variance according to Snedecor and Cochran (1990) and the differences among treatment means were compared by the least significant differences (LSD at 5% level),

RESULTS AND DISCUSSION

1. Vegetative growth characters:

1.1. Growth parameters:

Data presented in Table (2) showed that NPK fertilization and garlic extract foliar spray, alone or combined significantly increased plant height, shoot number/clump, number of leaves/main shoot and leaves area of Hedychium plants compared to control treatment. Fertilization with NPK and garlic extract as individual application increased all growth parameters

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compared with control. It is also clear that NPK fertilization treatments proved better compared to garlic extract concentrations and control. The highest values of plant height, shoot number/clump, number of leaves/main shoot and leaves area were obtained from plants treated with 6 gm NPK + 50% garlic extract followed by 4 gm NPK + 50% garlic extract without significant differences in between them in both seasons. On the other hand, the lowest values of growth parameters belonged to control treatment in both seasons. These findings are in line with those obtained by Abd El-Gayed and Attia (2018) they found that adding compound fertilizer NPK (20:20:20) at rates of 0, 1.5, 3 and 4.5 g/pot on cocks comb (*Celosia argentea*) plants increased number of leaves and branches/plant. In this respect, Youssef (2014) concluded that raising chemical fertilizer of NPK (19:19:19) rates from 0.0 to 6.0 g/pot have high positive effect and significantly improved plant height and leaf number/plant of ponytail palm plants. Similarly, Hanafy *et al.*, (2012) reported that application of garlic extract at 250 g/l

on *Schefflera arboricola* plants markedly increased plant height, number of leaves/plant and leaf area as compared to yeast extract, aloe extract and henna extract. Also, Abdulrazzaq (2017) revealed that spraying *Gazania splendens* plants with 2 ml garlic extract per liter caused highest increase in plant height, leaf number/plant and leaf area compared to licorice root extract. Our results about combined effect among fertilizer rates and garlic extract levels are in agreement with those of Abdou *et al.*, (2018a). In this respect, Abdou *et al.*, (2018) reported that adding compost fertilizers at 7.5 ton/feddin and spraying with garlic extract at 300 mg/l significantly enhanced the most vegetative growth parameters of *Gladiolus grandiflorus* plants. Also, Massoud *et al.*, (2017) indicated that the highest values of plant height and number of branches/ plant of marjoram plants were produced with using biogene plus phosphorene as biofertilizers in combination with active dry yeast or garlic extract treatments compared with control.

Table (2): Effect of NPK fertilization and spraying garlic extract on some growth parameters of *Hedychium coronarium* plants during 2017 and 2018 seasons

Treatments	Plant height (cm)		Total shoot number/clump		Leaf number/main shoot		leaf area (cm ²)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	63.33	64.00	8.33	8.33	8.33	7.67	29.67	30.11
Kristalon 2 g	69.67	71.33	9.33	11.00	9.00	8.67	31.87	32.21
Kristalon 4 g	78.00	79.67	12.67	13.00	11.00	11.67	38.49	40.16
Kristalon 6 g	74.67	76.33	10.33	12.00	9.67	10.00	31.29	33.98
Garlic 25%	73.07	77.00	8.67	10.67	12.00	12.67	39.85	41.84
Garlic 50%	69.00	72.33	13.00	13.67	9.67	10.33	43.59	45.95
Garlic 100%	71.00	74.00	9.67	11.00	11.33	11.67	40.82	42.87
K 2 g + G 25%	72.33	74.67	11.00	12.33	9.33	10.00	44.88	47.23
K 2 g + G 50%	78.33	81.33	12.00	14.00	10.67	13.33	47.23	51.53
K 2 g + G 100%	72.00	74.33	11.67	12.33	9.33	9.67	40.63	42.27
K 4 g + G 25%	80.33	81.67	12.33	12.67	10.00	10.67	49.26	52.93
K 4 g + G 50%	85.33	84.67	13.00	14.33	12.33	13.00	48.36	50.18
K 4 g + G 100%	81.67	82.00	13.00	13.33	10.33	11.33	43.58	49.20
K 6 g + G 25%	77.67	83.67	11.67	13.00	11.33	12.33	50.27	53.08
K 6 g + G 50%	85.33	87.33	13.33	14.00	12.67	14.00	46.11	48.66

K 6 g + G 100%	80.67	84.67	11.33	12.67	11.33	12.00	44.82	50.56
F test	**	**	**	**	**	**	**	**
LSD 0.05	5.45	5.56	2.26	2.46	1.44	1.70	4.18	4.39

Generally, data in Table (2) indicated that, NPK fertilization and garlic extract foliar application enhanced most vegetative growth parameters of plants in both seasons. The treatment of 6 gm NPK + 50% garlic extract or 4 gm NPK + 50% garlic extract was more effective than other treatments. The obtained increase in vegetative growth parameters as a result of NPK fertilization and garlic extract application may be due to the balance between nutritional status and hormones, resulting in faster cell division and cell elongation; which in turn helped the plant growth and root development, and consequently increased plant growth and size (Gaber, 2019 and Elgohary *et al.*, 2020). Garlic extract is also reported to promote vegetative growth which might be attributed to the presence of phyto-hormones, amino acids and vitamins as well as macro and micro-nutrients (Dahab *et al.*, 2018).

1.2. Fresh and dry weights:

Presented results in Table (3) showed that, fresh and dry weight of root and main shoot were significantly affected by fertilization with NPK (19:19:19) and garlic extract foliar spray alone or combined with the other in both seasons. NPK fertilization and garlic extract foliar application as a single treatments increased fresh and dry weights of root and main shoot of plants as compared to control treatment. Moreover, spraying garlic extract was more effective on increasing fresh and dry weight of root and main shoot than fertilizing with NPK in both seasons. Similar results were obtained by Hassan *et al.*, (2015) and Gaber (2019). In this respect, El-Mokadem and Sorour (2014) reported that *Petunia*

hybrida fertilized with 5g/pot complete fertilizer of NPK (19:19:19) gave the best fresh and dry weight of shoots and roots. Also, El-Naggar (2010) found that adding compound fertilizer NPK (19:19:19) at rates of 1.0, 2.0 and 3.0 g/pot on *Narcissus tazetta* plants caused a gradual significant increase in fresh and dry weight of leaves. Similarly, Emam (2010), on *Polianthes tuberosa* reported that garlic extract at 1 and 5ml/l increased fresh and dry weight of whole plant. Also, Hanafy *et al.*, (2012) on *Schefflera arboricola* found that garlic extract at the rate of 250 g/l as a foliar spray significantly increased fresh and dry weight of leaves/plant. Similar results were obtained by El-Bably (2017) on tuberose bulbs. A great influence was found between NPK fertilizer and garlic extract foliar application on fresh and dry weights of root and main shoot as shown in Table (3). The highest values occurred in plants fertilized with 6 g/pot plus spraying garlic extract at 50% followed by 4 g/pot plus spraying garlic extract at 50% in both seasons. In contrary, the lowest values were found in untreated plants (control). These results are in agreement with those obtained by Abdou *et al.*, (2017a) who revealed that, fertilizing guar plants with the medium level of compost at 5.0 ton/feddand and spraying the plants with garlic extract (300 ppm) or green tea extract (150 ppm) gave the highest values for dry weight of leaves/plant. Also, Abdou *et al.*, (2018) showed that, gladiolus plants treated with organic compost and foliar spray with extracts of green tea, moringa leaves, garlic, licorice roots, active dry yeast and seaweed led to improving all vegetative growth parameters, which

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included dry weight of leaves/plant.

Table (3): Effect of NPK fertilization and spraying garlic extract on main shoot and root fresh and dry weight of Hedychium coronarium plants during 2017 and 2018 seasons

Treatments	Main shoot weight (g)				Root weight (g)			
	Fresh		Dry		Fresh		Dry	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	160.32	164.52	24.49	27.23	522.76	387.67	84.70	69.53
Kristalon 2 g	199.34	211.24	31.48	33.93	593.00	586.53	92.80	84.98
Kristalon 4 g	205.93	214.97	36.94	41.43	655.47	719.74	94.24	87.14
Kristalon 6 g	200.57	212.98	34.82	37.84	748.07	792.31	95.84	90.23
Garlic 25%	247.75	251.48	42.84	49.90	701.47	696.77	107.18	83.63
Garlic 50%	258.84	265.86	48.83	51.50	858.17	804.10	114.83	90.50
Garlic 100%	244.79	256.55	40.80	44.56	988.97	831.62	121.00	91.87
K 2 g + G 25%	338.26	342.60	69.97	70.37	778.10	767.27	100.50	86.60
K 2 g + G 50%	380.27	385.30	81.57	90.63	888.20	774.30	112.00	80.93
K 2 g + G 100%	237.06	241.66	37.50	41.20	899.13	836.73	119.60	113.24
K 4 g + G 25%	341.15	346.20	72.91	72.13	792.33	878.30	100.30	118.37
K 4 g + G 50%	447.55	449.20	91.58	92.18	870.93	908.33	120.83	116.48
K 4 g + G 100%	339.83	345.83	69.59	73.27	970.43	932.30	120.18	114.19
K 6 g + G 25%	348.47	316.20	78.60	83.97	1115.13	938.47	110.87	110.90
K 6 g + G 50%	422.89	429.94	85.29	89.59	1123.84	1039.53	112.20	117.30
K 6 g + G 100%	308.51	312.92	63.48	73.20	1150.73	1156.54	110.89	122.12
F test	**	**	**	**	**	**	**	**
LSD 0.05	57.25	62.71	9.15	6.00	127.80	87.80	10.57	10.31

2. Leaf chemical constituents:

Presented data in Table (4) indicate that, NPK fertilization and foliar spray with garlic extract as well as their combinations had a pronounced effect on increasing leaf N, P, K and total carbohydrates % of Hedychium plants as compared to control in both seasons. NPK fertilization and garlic extract foliar application as a single treatment increased leaf N, P, K and total carbohydrates % of Hedychium plants as compared to control treatment. Moreover, fertilizing with NPK was more effective on increasing leaf total carbohydrates % than spraying garlic extract in both

seasons. Whereas, leaves from plants sprayed with garlic extract at 25 and 50% had higher N, P and K % than that fertilized with NPK. These findings are in accordance with those of Youssef (2014) and Bashir *et al.*, (2016). In this respect, El-Mokadem and Sorour (2014) revealed that using NPK fertilizer at rate of 5g/pot produced the significantly highest values of leaf N, P and K % compared with plants without fertilization. These results are similar with those reported by Abd El-Gayed and Attia (2018) who revealed that, increasing NPK rate from 0.0 to 4.5 g/pot significantly enhanced percentages of N, P and K in leaves of cocks comb (*Celosia*

argentea) plants. Our results about the effect of garlic extract foliar application are in agreement with those of El-Bably (2017) who reported that, spraying garlic extract, yeast and humic acid on tuberose plants led to increase total carbohydrates, N, P and K % in the leaves compared to control. Moreover, treatment of 6 g/ pot NPK + foliar spray with garlic extract at 50% recorded the highest total carbohydrates, N, P and K % in leaves of followed by 4 g/pot NPK + 50% garlic extract compared with the other treatments in both seasons. On the other hand, control treatment recorded the lowest total carbohydrates, N, P and K in both seasons. The obtained results are in agreement with those reported by Abdou et al., (2017b) as they concluded that adding compost fertilizers at 5 ton/feddan and spraying with garlic extract at 300 mg/l increased total carbohydrate, N, P and K % in the leaves of guar plants compared with other plant extracts (moringa, aloe and green tea).

3. Flowering parameters:

Results in Tables (5 & 6) and Figure (1) showed that, NPK fertilization, foliar spray with garlic extract and their combinations had significant effects on all flowering parameters in terms of flowering date, main stalk length, main stalk diameter, inflorescence number/clump, rachis length, florets number/inflorescence, flowering spike fresh and dry weight and vase life in both seasons. Regarding the effect of NPK fertilization and spraying with garlic extract on flowering date, results illustrated in Figure (1) revealed that NPK fertilization and spraying with garlic extract alone or combined induced earlier flowering of *Hedychium* plants as compared with control in both seasons. In this respect, plants fertilizing with 4 and 6g/pot and sprayed with garlic extract at 50% tended to flower earlier than that of the other treatments in both seasons.

Table (4): Effect of NPK fertilization and spraying garlic extract on total carbohydrate and NPK % in leaves of *Hedychium coronarium* plants during 2017 and 2018 seasons

Treatments	Total carbohydrate %		N %		P %		K %	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	19.09	18.40	1.23	1.19	0.27	0.29	1.76	1.66
Kristalon 2 g	21.68	21.67	1.61	1.64	0.32	0.32	2.58	2.55
Kristalon 4 g	24.51	24.57	1.68	1.64	0.34	0.34	2.60	2.59
Kristalon 6 g	23.25	23.17	1.80	1.81	0.40	0.41	2.59	2.62
Garlic 25%	25.72	25.13	1.83	1.81	0.43	0.45	2.54	2.46
Garlic 50%	27.87	29.00	1.70	1.89	0.35	0.35	2.68	1.92
Garlic 100%	27.06	26.00	1.48	1.46	0.40	0.37	2.67	2.70
K 2 g + G 25%	33.41	30.90	1.74	1.72	0.43	0.48	2.58	2.52
K 2 g + G 50%	38.05	37.38	1.81	1.85	0.34	0.35	2.64	2.64
K 2 g + G 100%	30.51	30.40	1.75	1.77	0.37	0.39	2.76	2.74
K 4 g + G 25%	28.59	29.03	1.79	1.83	0.42	0.44	2.73	2.75
K 4 g + G 50%	35.54	35.80	1.87	1.88	0.50	0.51	2.76	2.78

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K 4 g + G 100%	33.66	34.53	1.80	1.83	0.45	0.47	2.83	2.83
K 6 g + G 25%	29.84	29.37	1.89	1.88	0.60	0.60	2.76	2.73
K 6 g + G 50%	31.47	31.13	1.90	1.93	0.56	0.55	2.84	2.81
K 6 g + G 100%	29.37	29.13	1.86	1.88	0.49	0.48	2.80	2.79
F test	**	**	**	**	**	**	**	ns
LSD 0.05	2.01	1.41	0.03	0.03	0.02	0.02	0.03	--

Table (5): Effect of NPK fertilization and spraying garlic extract on some flowering parameters of Hedychium coronarium plants during 2017 and 2018 seasons

Treatments	Main stalk length (cm)		Main stalk diameter (cm)		Inflorescence No./clump		Rachis length (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	68.67	70.33	1.13	1.12	4.67	5.67	5.00	4.33
Kristalon 2 g	70.67	73.00	1.14	1.13	6.00	8.67	5.33	4.67
Kristalon 4 g	79.33	86.00	1.15	1.15	8.33	10.33	7.67	7.00
Kristalon 6 g	82.50	83.33	1.17	1.14	8.25	11.00	8.00	6.33
Garlic 25%	84.67	84.33	1.24	1.25	8.00	9.33	9.00	7.67
Garlic 50%	89.67	92.33	1.22	1.25	9.67	11.67	10.00	9.33
Garlic 100%	86.33	91.67	1.22	1.22	8.00	9.67	9.33	9.00
K 2 g + G 25%	82.33	81.33	1.24	1.25	9.00	11.00	9.67	8.00
K 2 g + G 50%	90.00	92.67	1.23	1.24	10.50	12.33	11.00	9.67
K 2 g + G 100%	90.00	92.00	1.27	1.28	10.00	11.00	10.33	9.33
K 4 g + G 25%	90.67	92.67	1.28	1.30	9.00	11.00	11.33	10.00
K 4 g + G 50%	94.00	97.00	1.31	1.33	10.67	12.33	12.00	10.33
K 4 g + G 100%	91.00	94.00	1.30	1.34	10.33	11.33	10.67	9.67
K 6 g + G 25%	97.00	100.00	1.31	1.32	9.67	11.33	12.00	11.67
K 6 g + G 50%	102.67	105.67	1.34	1.35	10.67	11.67	13.00	12.00
K 6 g + G 100%	99.67	101.33	1.38	1.38	9.33	10.33	12.33	11.67
F test	**	**	**	**	**	**	**	**
LSD 0.05	4.12	3.95	0.03	0.03	2.01	2.24	1.44	1.48

Table (6): Effect of NPK fertilization and spraying garlic extract on some flowering parameters of Hedychium plants during 2017 and 2018 seasons

Treatments	Floret No./inflorescence		Flowering spike fresh weight (g)		Flowering spike dry weight (g)		Vase life (days)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	5.67	6.00	116.30	115.17	10.23	9.65	5.33	4.67
Kristalon 2 g	8.33	6.67	119.71	119.73	11.57	11.63	5.67	5.33
Kristalon 4 g	9.67	7.67	125.73	123.00	12.34	12.93	7.00	7.00
Kristalon 6 g	11.00	9.00	124.25	120.83	12.00	11.91	7.50	7.33
Garlic 25%	10.67	11.33	128.37	128.23	13.16	14.70	5.67	5.67
Garlic 50%	10.67	9.33	127.67	121.60	12.94	13.06	5.33	4.67
Garlic 100%	11.67	10.67	127.57	122.87	12.99	11.87	7.00	6.33
K 2 g + G 25%	12.00	10.33	144.97	137.97	15.27	16.04	8.67	7.33
K 2 g + G 50%	13.00	12.33	147.95	143.43	14.39	17.02	9.00	7.67
K 2 g + G 100%	11.67	11.33	143.93	140.20	15.07	16.32	8.33	8.00
K 4 g + G 25%	10.67	11.67	152.93	149.23	16.12	17.61	7.33	7.33

K 4 g + G 50%	12.67	13.33	159.30	157.43	17.90	18.74	9.00	9.33
K 4 g + G 100%	11.67	12.67	156.00	154.63	17.01	17.25	8.67	9.33
K 6 g + G 25%	11.33	13.67	161.70	159.70	18.22	17.91	8.33	10.00
K 6 g + G 50%	13.67	14.67	167.23	165.67	19.43	19.12	10.33	10.67
K 6 g + G 100%	13.33	12.33	162.63	160.30	19.33	19.12	10.00	10.00
F test	**	**	**	**	**	**	**	**
LSD 0.05	2.13	2.23	4.61	4.51	1.63	1.02	1.40	1.38

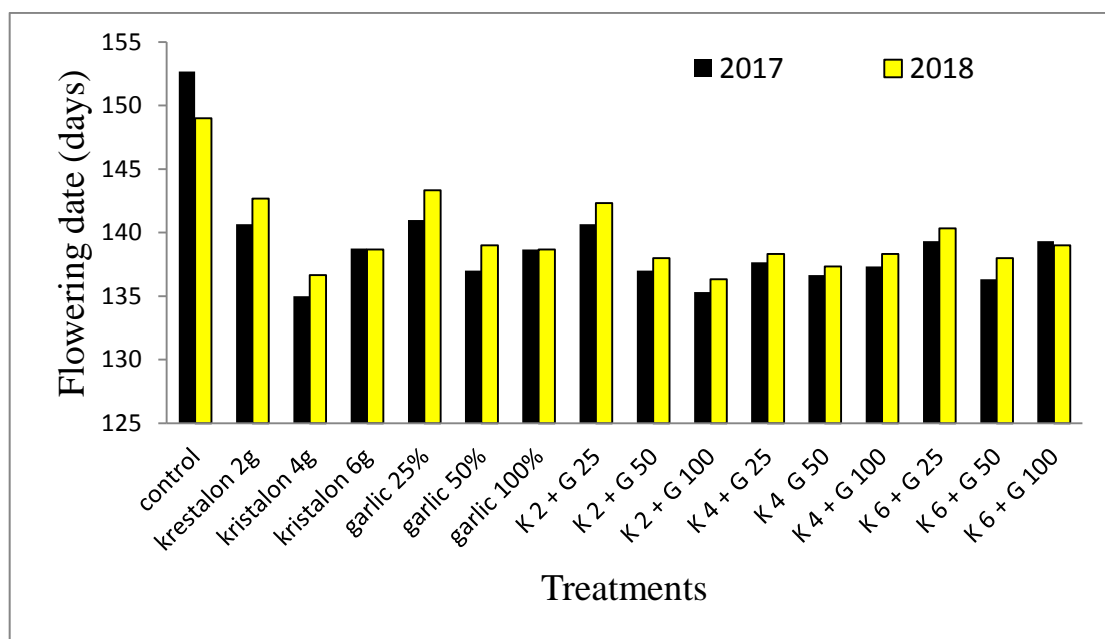


Figure (1): Effect of NPK fertilization and spraying garlic extract on flowering date (days) of *Hedychium coronarium* plants during 2017 and 2018 seasons

Whereas the flowering in the control treatments took the longest time to occur comparing with the other treatments in both seasons. Similar results were obtained by Bazaraa *et al.*, (2012), Abdulrazzaq (2017) and El-Bably (2017).

Also, it is obvious from data presented in Tables (5 & 6) that, krestalon compound fertilizer of NPK (19:19:19) and spraying with garlic extract, alone or combined significantly increased main stalk length, main stalk diameter, inflorescence number/clump, rachis length, florets number/inflorescences, flowering spike fresh and dry weight and vase life plants compared to control treatment. NPK fertilizer and garlic

extract as individual application increased all flowering parameters compared with control. It is also clear that spraying with garlic extract treatments was more effective in improve all flowering parameters compared to NPK fertilization treatments and control. The highest main stalk length, main stalk diameter, inflorescence number/clump, rachis length, floret number/inflorescence, flowering spike fresh and dry weight and vase life were obtained from plants treated with 6 and 4g/pot NPK and sprayed with 50 and 100% garlic extract without significant different among themselves in both seasons. On the other hand, the lowest values of

flowering parameters belonged to control treatment. These findings are in line with those obtained by El-Naggar (2010), Bazaraa *et al.*, (2012), Hassan *et al.*, (2015), Abdulrazzaq (2017), El-Bably (2017) and Abdou *et al.*, (2018).

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تأثير بعض معاملات التسميد ورش مستخلص الثوم على نمو و تزهير لنباتات الهيدكيم

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الملخص العربي

أجريت تجربة أصص وذلك لدراسة تأثير ثلاثة معدلات من السماد المركب كرسنالون ١٩:١٩:١٩ وهم ٢ و ٤ و ٦ جم / أصيص ، ومستخلص الثوم بنسبة ٢٥ و ٥٠ و ١٠٠٪ والتفاعل بينهم على النمو الخضري والتزهير ومحتوى الاوراق من النيتروجين و الفوسفور و البوتاسيوم و الكربوهيدرات الكلية لنباتات الهيدكيم.

أظهرت النتائج أن تسميد نباتات الهيدكيم بمعدل ٤ أو ٦ جم / أصيص سماد مركب (الكرستالون) ورش مستخلص الثوم بمستوى ٥٠٪ أدى الى تحسين قياسات النمو الخضري من حيث طول النبات، عدد الفروع / للجورة، عدد الأوراق / الفرع الرئيسي والمساحة الورقية في كلا الموسمين. إلى جانب ذلك، تم تسجيل أعلى قيم للوزن الطازج والجاف للجذر والساق الرئيسي ومحتوى الاوراق من الكربوهيدرات والنيتروجين والفوسفور والبوتاسيوم وذلك عند تسميد النباتات بـ ٤ أو ٦ جم / أصيص ورشها بمستخلص الثوم بنسبة ٥٠٪.

بالإضافة إلى ذلك ، تم الحصول على أعلى الصفات الزهرية مثل طول، وقطر الحامل النوري، وعدد الإزهار / جورة، وطول الشمراخ الزهري ، وعدد الأزهار / نورة، والوزن الطازج والجاف للحامل الزهري من النباتات المسمدة بـ ٤ أو ٦ جم / أصيص وتم رشها بـ ٥٠ أو ١٠٠٪ مستخلص الثوم في كلا الموسمين.

كما أعطت المعاملات السابقة أفضل و أطول عمر للازهار و أظهرت أنها الأفضل في إحداث التزهير المبكر مقارنة بمعاملة الكنترول و المعاملات الأخرى.

لذلك يوصى بتسميد نباتات الهيدكيم بالسماد المركب الكرسنالون ١٩:١٩:١٩ بمعدل ٤ جرام / أصيص والرش بمستخلص الثوم بنسبة ٥٠٪ وهي أفضل معاملة إقتصادية تستخدم لتحسين النمو والازهار و الحالة الغذائية للنباتات.

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