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EFFECT OF CHEMICAL NITROGEN FERTILIZER LEVEL AND HUMIC ACID RATE ON *Gladiolus grandiflorus* PRODUCTIVITY

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ABSTRACT

A field experiment was conducted at the Experimental Farm, Faculty of Environmental Agricultural Science, Arish University, Egypt, during two successive seasons 2017-2018 and 2018-2019 to study the effect of various levels of nitrogen fertilizer (0, 100, 200 and 300 kg fed^{-1}) in combination with different rates of humic acid (0, 150, 250 and 350 ppm) as a foliar spray on plant growth, flowering characteristics, corms and cormels characteristics and chemical constituents. The obtained results cleared that using 200 kg fed^{-1} nitrogen in urea forms with 350 mgl^{-1} humic acid as a foliar spray gave the maximum value in each of vegetative growth parameters, flowering characteristics, diameter of corms, weight of cormel, and chemical constituents (N, P and K) content in leaves. However, a non-significant variation was observed in the treatment 200 kg fed^{-1} nitrogen with the three concentrations of humic acid for weight of corms and No. of cormels in plants in most cases. While, plants grown without nitrogen and humic acid (control) gave the minimum values in all parameters.

INTRODUCTION

Gladiolus (*gladiolus grandiflorus* L.) is perennial bulbous flowering belongs to family Iridacea and subfamily Ixoidea. **(Goldblatt and Manning, 1998) and Manning and Goldblatt, 2008).** Gladiolus is one of the most ornamental bulbous plants grown commercially in many parts of the world for its fascinating flowers with variety of colours, huge form of florets and good keeping quality as a cut flower it has earned its place of importance owing to its utility in bouquets, vases, flower decorates and to get high market returns. Further, it may be stated that the shelf life or longevity of its flowers which is an important aspect of cut flower quality (**Patra and Mohanty, 2015**). Nitrogen plays an important role in building up protoplasm and protien, which induce cell division and initiate merstimatic activities when applied in optimum quality **(Singh and Ramasingh, 1969**). It is one of the most important nutrients promoting yield and growth in gladiolus. The leaves should contain 2.5 to 3.0 percent or more nitrogen in dry weight for optimum yield **(Bose and Yadav, 1989)**. Nitrogen deficiency results in pale green coloration of foliage and reduction in the number of florets spike and number of spikes, corms and also hampered the utilization of food in old reserve **(Woltz 1972).**

Humic acid is a natural organic polimar composition produced as a result of decaying organic matter, peat as well as lignin, and so that can be used to increase productivity and its quality **(Valdrighi *et al.*, 1996).** The positive effects are directly on the plant growth and improve the growth of shoots and roots, absorpotion of nitrogen, calcium, potassium, magnesium and phosphorus by plant (**Haghighi *et al.*, 2011).** The application of humic acid

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increase soil aggregation, structure. moisture, holding capacity, fertility and micro-organisms activity **(Chen and Aviad, 1990**, **Sharif *et al*., 2002).**

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm, Fac. Environ. Agric. Sci., Arish Univ., during two successive season 2017-2018 and 2018-2019 to study the effect of various levels of nitrogen fertilizer (0, 100, 200 and 300 kg fed^{-1}) as urea (46.5% N) in combination with different levels of humic acid (0, 150, 250 and 350 mgl^{-1}) on plant growth, flowering characteristics, corms and cormels characteristics and chemical constituents.

Plant Materials

The gladiolus corms were obtained from El-Ahaly Farm in El-Qanater El-Khayrea. The size of used corm was about 2.89 mm.

Corms were planted on first of October during 2017-2018 and 2018-2019 for the two seasons in loamy sand soil of the experimental unites at 50×30 cm distance between plants and rows, respectively. The irrigation system of the experiment was drip irrigation.

Recommended dose of super phosphate at the rate of 200 kg/fed and potassium sulphate at the rate of 50kg/fed as well as chicken manure at the rate of 5 kg/m^2 were added to the soil before planting.

Nitrogen fertilizer in the form of urea (46.5% N) was applied in 4 levels (0, 100, 200 and 300 kg/fed), This amount divided into 3 doses, The first dose was applied after month from the date of planting, the second dose applied in the stage of 2-3 leaves/plant and the last dose was applied after 2 weeks from flowering beginning.

Humic acid (as a form of humate potassium 90%) was obtained from Grow Tech for Agricultural Development Company. Foliar spray with humic acid was applied at 4 levels (0, 150, 250 and 350 ppm). Stock solution of humic acid was prepared by dissolving the amount of humic acid powder in distilled water according to the application doses. Humic acid sprayed on the leaves of the plants three times, the first one was applied in the stage of 2-3 leaves/plant, the second one was applied in the stage of 6-7 leaves /plant and the last one was applied after spike emergence.

Post Harvest Treatment

Immediately after harvest, flowers were kept in cool water to remove the field heat**.** Then, were taken to the laboratory and re-cut again at the base and kept in vase solution composite from 200 ml distilled water, 5% sucrose and 400 ppm cetric acid to study the vase life of spike **(Anserwadekar and Patil, 1986**).

Experimental Design

This experiment included 16 treatments which were the combination between four nitrogen fertilizer levels and humic acid levels. These treatments were arranged in a split plot in randomized complete blocks design with three replicates.

Data Recorded

Growth parameters

After two months and half from corm planting and after spike emergence, the following data were recorded: number of leaves, plant height (cm), spike length (cm), rachis length (cm), fresh and dry weights of leaves (g), diameter of spike (mm) and weight of spike (g).

Flowering characteristics

Number of flowers per spike were taken after three months from corm planting and when first floret from the basal opening, days to spike emergence were taken after two months and half from planting the corm. Also, days to first floret opening were taken after three months from planting the corm. In addition, vase life was taken

Table 1. The physical and chemical analyses of experiment soil during 2017/2018 and 2018/2019 seasons.

Property	First season (2017-2018)	Second season (2018-2019)
Particles size distribution (%)		
Coarse sand (%)	58.0	59.5
Fine sand (%)	19.8	19.3
Silt (%)	12.9	13.0
Clay (%)	9.3	9.2
Soil texture	Loamy sand	Loamy sand
Bulk density (Mgm^{-1})	1662	1661
Chemical properties (Soluble ions (in 1:5 soil water extract)		
Ca^{+} (me^{-1})	3.90	3.90
Mg^{+} (me^{-1})	3.62	3.43
Na^{+} (me^{-1})	2.54	2.59
K^{+} (me^{-1})	0.34	0.32
$CO3^{-}$ (me^{-1})	-	-
$HCO3^{-}$ (me^{-1})	4.30	4.40
Cl^{-} (me^{-1})	4.70	4.35
SO_4 (me^{-1})	1.50	1.45
EC (dSm^{-1}) in 1:5 water extract)	0.08	1.02
pH (in1: 2.5 Soil water suspension extract)	8.10	8.13
Organic matter (%)	0.153	0.171
$CaCO_3$ (%)	22.43	22.48

The experiment soil and irrigation water analyses were presented in Table.1 and Table.2.

Table 2. The chemical analysis of the irrigation water during 2017/2018 and 2018/2019 seasons

pH	EC dSm^{-1}	Soluble ions ($me\ l^{-1}$)							
		Cations					Anions		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_2^{--}	SO_4^{--}
First Season (2017-2018)									
7.55	5.93	20.50	16.80	18.50	0.24	45.92	2.90	-	7.22
Second Season (2018-2019)									
7.60	6.00	21.00	17.00	18.80	0.25	46.75	2.97	-	7.28

when half number of florets per spike were dried **(Khalf-Allah, 2014).** Moreover**,** water uptake by stems was calculated by measuring the volume of water at the termination of vase life and subtracting it from the initial quantity of distilled water in jars.

Corms and cormels parameters

After two months from cutting the flowers the following data were recorded: weight of corms (g), weight of cormels (g), diameter of corms (mm) and number of cormels.

Chemical constituents

The oven dried materials of leaves were ground and wet digested by a sulfuric-perocloric acids and mixture as described by **Peterburgski (1968)**. The total N, P and K were determined according to the methods of **Pregle (1945)** and **Jackson (1967).**

Statical Analysis

All collected data were analyzed with analysis of variance (ANOVA) producer using SPSS. Means differences were compared by using Duncan multiple range test at 0.05 level **(Duncan, 1955).**

RESULTS AND DISCUSSION

Vegetative Growth Parameters

Table (3) presented the effect of nitrogen fertilization as urea in combination with humic acid rate on vegetative growth of *Gladiolus grandiflorus* plant. Results revealed that application of 200 kg N fed^{-1} with 350 and 250 mg l^{-1} gave high values in all vegetative growth parameters in both seasons.

Increasing nitrogen fertilization from 100 to 200 kg fed^{-1} and humic acid from 150 mg l^{-1} to 350 mg l^{-1} influenced the gladiolus (N. of leaves, plant height, length of spike, rachis length, diameter of spike, weight of spike, leaf fresh weight and leaf dry weight). These results are in harmony with **Chaudhary *et al.* (2013**) who proved that Rose var. Top secret plants fertilized with 300 mg nitrogen /plant/week in the form of urea gave a maximum number of leaves. Also, **Baldoto and Baldoto (2013**) observed that number of leaves of gladiolus plant increased with gradually increasing humic acid levels (from 10 to 40 $mmol^{-1}$).

These results may be due to that nitrogen elements is a major component of amino acids, the building blocks of protein (**Harper and Paulsem, 1969**) and thereby it plays an important role in metabolic activities of the plant resulting in the synenthis of chlorophyll and cytochromes, which are essential for photosynthesis and respiration process in the plants **(Thana *et al.*, 2008).** Furthermore**, El-Khateeb *et al.* (2017)** stated that application of humic acid significantly increased the growth attributes and marjordm plants including plants height, fresh weight compared to untreated plants.

Flowering Characteristic

The effect of nitrogen fertilization as urea in combination with humic acid rate on flowering characteristics was presented in Table 4.

Results showed that treatments of nitrogen with humic acid gave a significant difference on all flowering characteristics. Plants fertilized with 200 kg N fed^{-1} and sprayed with 0 and 150 ppm humic acid sprouted the spike early and gave minimum days to first floret opening during both seasons.

While, plants grown without nitrogen and humic acid (control) application had delayed sprouting the spike (95.66 and 99.00 day) and took more number of days to first floret opening (105.33 and 109.33 day).

The highest number of flowers per spike (11.00) were recorded with the application of 200 kg N fed^{-1} with 350 mgl^{-1} humic acid followed by 300 kg N fed^{-1} with 350 mg l^{-1} humic acid (11.00) in the first season. In the

Table 3. Effect of nitrogen fertilizer levels and foliar spray with humic acid combinations on vegetative growth parameters of *Gladiolus grandiflorus* during 2017/2018 and 2018/2019 seasons

Nitrogen fertilizer levels (Kg fed^{-1})	Vegetative growth parameters								
	Humic acid rate (mgl^{-1})	Number of leaves	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Leaf fresh weight (g)	Leaf dry weight (g)	Weight of spike (g)	Diameter of spike (mm)
First Season 2017- 2018									
Control	**control**	8.00 a	66.00 d	37.00 f	21.83 e	8.46 d	3.53 d	0.070 a	6.00c
	150	8.33 a	66.66 d	42 ef	22.33 e	8.52 d	3.58 cd	0.019 a	6.00c
	250	8.33 a	67.00 d	47.16 de	24.33 de	8.91 cd	3.86 b-d	0.023 a	6.3 c
	350	8.66 a	71.33 cd	54.66 cd	24.50 de	9.42cd	3.91 b-d	0.028 a	6.3 c
100 kg N fed^{-1}	**Control**	8.33 a	75.33 c	61.33 bc	26.50 c-e	10.59 b-d	4.57a-d	0.026 a	6.3 c
	150	8.66 a	76.33 c	61.66 bc	27.00 c-e	10.62 b-d	5.05 a-d	0.030 a	7.3 a-c
	250	8.66 a	84.00 c	62.66 a-c	27.00 c-e	10.87 b-d	5.05 a-d	0.030 a	7.3 a-c
	350	9.00 a	84.33 b	63.00a-c	27.83 c-e	11.00 b-d	5.07 a-d	0.031 a	7.3 a-c
200 kg Nfed^{-1}	**Control**	8.66 a	85.66 ab	67.33 ab	33.33 a-c	13.91 ab	6.07a-c	0.017 a	7.6 a-c
	150	8.66 a	90.66 ab	69.33 ab	33.33 a-c	13.41 ab	6.21ab	0.038 a	7.6 a-c
	250	9.33 a	91.00 a	70.16 ab	36.83 ab	13.52 ab	6.26ab	0.043 a	8.6 ab
	350	9.33 a	92.00 a	70.75 a	40.33 a	14.80 a	6.54 a	0.046 a	9.00 a
300 kg N fed^{-1}	**control**	8.33 a	84.00 b	64.33 ab	30.00b-e	12.03 a-c	4.45a-d	0.12 a	6.6 c
	150	8.33 a	84.00b	64.66 ab	30.00 b-e	12.30 a-c	5.45 a-d	0.13 a	7.00bc
	250	8.33 a	84.00 b	65.16 ab	32.00 b-d	12.16 a-c	5.46 a-d	0.031 a	7.00bc
	350	9.00 a	84.33 b	67.33 ab	34.16 a-c	12.26 a-c	5.71a-d	0.035 a	7.6 a-c
Second Season 2018- 2019									
Control	**Control**	7.66 b	68.66 d	55.00 b	21.00 f	7.65 f	1.91 e	21.33 e	3.40 c
	150	8.66 ab	69.66 d	55.83 b	21.50 ef	9.14 ef	1.91 e	25.66 de	3.45 bc
	250	9.00 ab	72.00 cd	56.66 b	22.33 ef	9.83 ef	2.07 e	26.00 de	3.64 a-c
	350	9.00 ab	75.33 b-d	57.00 b	21.83 ef	9.83 ef	2.55 de	27.00 de	3.90 a-c
100 kg N fed^{-1}	**Control**	9.33 a	89.33 ab	62.00 ab	26.00 df	10.50 df	3.08 c-e	30.00 ce	4.27 a-c
	150	9.33 a	92.00 a	62.00 ab	32.00 a-c	11.21 c-e	6.27 a	39.50 a-c	5.13 a-c
	250	9.33 a	92.00 a	73.33 a	33.33 ab	11.84 c-e	6.43 a	41.00 a-c	5.18 a-c
	350	9.33 a	92.33 a	73.33 a	32.83 ab	11.95 c-e	6.50 a	45.00 ab	5.35 ab
200 kg N fed^{-1}	**Control**	9.00 ab	85.33 a-c	69.50 a	31.33 a-c	13.94 b-d	4.47 bc	34.00 b-d	5.16 a-c
	150	9.00 ab	94.66 a	69.83 a	31.33 a-c	14.09 bc	5.68 ab	43.00 ab	5.35 ab
	250	9.00 ab	95.00a	72.00 a	33.33 ab	17.03 ab	5.90 a	44.00 ab	5.36 ab
	350	9.00 ab	95.33 a	74.33 a	36.83 a	17.32 a	7.12 a	47.00 a	5.38 a
300 kg N fed^{-1}	**Control**	9.00ab	82.00 a-d	64.33 ab	27.00 c-f	10.94 ab	3.65 cd	33.33 b-d	4.78 a-c
	150	9.00 ab	82.66 a-d	65.33 ab	27.83 c-f	11.08 c-f	3.71 cd	33.33 b-d	4.82 a-c
	250	9.00ab	84.33 a-c	66.66 ab	28.00 c-f	11.16 c-e	4.21 c	34.33 b-d	4.83 a-c
	350	9.00 ab	84.66 a-c	67.33 ab	28.50 c-e	11.21 c-e	6.67a	34.33 b-d	4.85 a-c

* Means followed by the same letter within each column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

second season the application 200 kg N fed^{-1} with all rates of humic acid gave the highest number of flowers (11.00) and there were no significant differences among these treatments. While, the control treatment gave the lowest number of flowers (6.00 and 7.00 in the two consecutive seasons, respectively).

Plants fertilized with 200 kg N fed^{-1} and sprayed by 350 mg l^{-1} humic acid followed by 200 kg N fed^{-1} with 250 mg l^{-1} humic acid recorded the longest vase life (19.00, 19.00 and 20.33, 20.33 day) and water uptake (93.00, 93.00 and 93.66, 91.00 cm^3) in both seasons, respectively as compared with control treatment. These results are in line with **Singh *et al.* (2001)** who observed that gladiolus plants receiving higher rates of nitrogen ($30g/m^2$) in a form of urea produced the maximum number of florets and diameter of florets. Also**, Baral *et al.* (2012)** on gladiolus found that plants received nitrogen up to 200 kg/ha gave the longest spike with more number of florets /spike. Moreover, largest spike and longest rachis produced by 300kg/ha. In addition, **El-Bably (2017)** on tuberose stated that plants received 9ml/l humic acid with soil drench method gave a significant increase in flowering parameters (spike and rachis length and number of florets per spike).

Corms and Cormels Characteristics

Table (5) shows the effect of nitrogen fertilization in a form of urea in combination with humic acid rate on corms and cormels characteristics.

Results revealed that significant variation were observed in weight of corms and weight of cormels, the heaviest corms and cormels were obtained with the application of 200 kg nitrogen fed^{-1} with 350 ppm humic acid in both seasons, respectively. In addition, diameter of corms (6.14 and 5.38 mm) and weight of cormels (18.75 and 17.53 g) were noticed with the same treatment. However, non-significant variation was observed in the treatment of 200 kg nitrogen fed^{-1} with the three rates of humic acid regard the weight of corms and No. of cormels in plants in the first season.

In the second season, there is no significant differences were showed in the weight of corms among all treatments. The maximum numbers of cormels were obtained in the treatment 200 kg N fed^{-1} in combination with 350 mg l^{-1} (31.33).

These results are in agreement with those of **Bashir *et al.* (2016)** they found that the high level of humic acid (3.0ml) in combination with NPK produced maximum cormels/plant, diameter of cormels and weight of cormels per plant than all other treatments. Also, **Ghasemi *et al.* (2016)** on tuberose, they observed that plants treated with 5 kg/ha humic acid increased main bulbs weight and total bulbs weight.

Chemical Constituents

Table (6) reveals the effect of nitrogen fertilization and foliar spray with humic acid on chemical constituents of *Gladiolus.* Results indicated that a significant difference were observed on N, P and K content in leaves. Also, the highest content of N (2.86 and 2.71%), P (0.32 and 0.36) and K (3.23 and 3.16) were obtained under the application of 200 kg nitrogen fed^{-1} in combination with 350 mg l^{-1} humic acid during both seasons, these results are in agreement with those found by **Abd-All and El-Namas (2017)** who reported significant increase in total nitrogen, potassium and phosphorous of sweet potato plant receiving 4 kg/fed humic acid alone or in combination with potassium silicate as a foliar application., **El-Bably (2017)** on tuberose, stated that plants received 9ml/l humic acid with soil drench method gave a significant increase in nitrogen, phosphorus and potassium percentage in leaves compared to untreated plants.

Table 4. Effect of nitrogen fertilizer levels and foliar spray with humic acid combinations on flowering characteristics of *Gladiolus grandiflorus* during 2017/2018 and 2018/2019 seasons.

Nitrogen fertilizer levels (Kg Fed^{-1})	Humic acid rate (mgl^{-1})	Days to spike emergence	Days to floret opening	No. of flowers per spike	Vase life day	Water uptake Cm^3
			First Season 2017- 2018			
Control	**Control**	95.66 a	105.33a	6.00 e	9.66 e	59.66gh
	150	95.00 a	103.00 ab	6.66 de	12.33 de	66.66 f-h
	250	92.66 ab	102.66 a-c	7.66 c-e	12.33 de	89.66 ac
	350	82.50 c-e	101.66 a-d	8.00 b-e	12.66 de	91.00 ab
100 kg N fed^{-1}	**Control**	84.66	93.66ef	7.66 c-e	14.33 cd	76.00 d-f
	150	86.33 c-e	94.00ef	9.00 a-d	14.33 cd	78.33 c-f
	250	87.33 bd	98.00b-f	9.00a-d	14.66 b-d	81.66 a-e
	350	88.00 bc	99.33 b-e	9.33 a-c	15.33 a-d	85.00 ad
200 kg Nfed^{-1}	**Control**	80.46e	92.33 f	10.00 a-c	17.00 a-c	56.00h
	150	81.00de	92.33 f	10.33 ab	18.66 a	58.33 gh
	250	81.33 de	94.66 ef	11.00 a	19.00 a	93.00 a
	350	82.50 c-e	96.66ef	11.00 a	19.00 a	93.00 a
300 kg N fed^{-1}	**Control**	84.00 c-e	96.33 d-f	10.00 a-c	15.33 a-d	76.00 d-f
	150	84.50 c-e	97.33 b-f	10.33 ab	15.66 a-d	76.66 d-f
	250	84.66 c-e	98.00 b-f	10.33 ab	18.00 a-c	68.33 e-g
	350	85.00 c-e	98.66 b-e	11.00 a	18.33 ab	79.33 b-e
			Second Season 2018- 2019			
Control	**Control**	99.00 a	109.33 a	7.33 b	12.00 d	24.00 f
	150	98.33 ab	109.00 a	8.33 ab	13.66 cd	51.66 e
	250	97.00 a-c	107.66 a	8.33 ab	13.66 cd	53.33 d-e
	350	96.66 a-c	105.33 ab	8.66 ab	14.33 cd	58.33c-e
100 kg N fed^{-1}	**Control**	91.00d-e	101.66 a-c	9.33 ab	15.33 b-d	69.33 b-e
	150	92.00 b-d	102.00a-c	9.33 ab	16.66 a-c	70.00 b-e
	250	93.00a-c	103.00 a-c	9.33 ab	16.66 a-c	71.66 a-d
	350	93.66 a-c	103.33 a-c	9.66 ab	17.00 a-c	71.66a-d
200 kg N fed^{-1}	**Control**	79.00f	95.66 c	11.00 a	19.66 a	84.33 ab
	150	79.00 f	95.66 c	11.00 a	19.66 a	88.33 ab
	250	80.00 f	95.66 c	11.33a	20.33 a	90.66 a
	350	80.33 f	96.33 c	11.33 a	20.33a	91.00a
300 kg N fed^{-1}	**Control**	83.33 f	98.33 bc	10.00 ab	19.00 ab	75.00a-c
	150	83.66 f	98.66 bc	10.00 ab	19.00 ab	76.66 a-c
	250	84.33 f	98.66 bc	10.33 ab	19.33ab	77.00 a-c
	350	85.33 ef	99.00bc	10.33 ab	19.33ab	77.33a-c

* Means followed by the same letter within each column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

Table 5. Effect of nitrogen fertilizer levels and foliar spray with humic acid combinations on corms and cormels charachteristics of *Gladiolus grandiflorus* during 2017/2018 and 2018/2019 seasons.

Nitrogen fertilizer Level (Kg fed^{-1})	Corms charachteristics				
	Humic acid rate (mgl^{-1})	Weight of corms (g)	Diameter of corms (mm)	Number of cormels	Weight of cormels (g)
			First Season 2017- 2018		
Control	Control	25.95 d	3.77 d	7.33 b	8.22 ab
	150	27.90 cd	4.08 cd	8.33 b	9.84 ab
	250	31.99 b-d	4.72 a-d	9.00b	14.33 ab
	350	32.98 b-d	5.07ad	11.00 b	19.66 a
100 kg N fed^{-1}	Control	46.20 ab	4.53e-d	16.00ab	5.56 b
	150	46.55ab	4.96 a-d	16.66 ab	7.67 ab
	250	44.87 a-c	5.08 a-d	17.33 ab	7.71 ab
	350	52.30 a	5.73 ab	17.33 ab	14.04 ab
200 kg Nfed^{-1}	Control	48.67ab	5.22 a-d	21.00ab	5.24 b
	150	56.69 a	5.27 a-d	29.00 a	8.77 ab
	250	56.82 a	5.49 a-c	29.33 a	10.09 ab
	350	59.08 a	6.14 a	31.33 a	18.75 a
300 kg N fed^{-1}	Control	47.30 ab	4.12 cd	21.00 ab	4.86 b
	150	48.04 ab	5.21 a-d	21.00 ab	5.82 b
	250	50.40 ab	5.26 a-d	23.33 a b	11.19 ab
	350	50.73ab	5.13 a-d	23.33 ab	11.61 ab
			Second Season 2018- 2019		
Control	Control	28.42 a	3.40 c	5.33 c	3.66 e
	150 mgl	28.91 a	3.45 bc	5.66 c	4.13de
	250	30.01 a	3.64 a-c	6.66 bc	4.92 c-e
	350	30.32 a	3.90 a-c	8.33 bc	6.68 b-e
100 kg N fed^{-1}	Control	35.40 a	4.27 a-c	14 .00 a-c	9.25 a-e
	150	35.83a	5.13 a-c	15.66 a-c	9.45 a-e
	250	49.05 a	5.18 a-c	28.00 a-c	14.45 a-d
	350	50.08 a	5.35 ab	33.66 a-c	15.14 ab
200 kg N fed^{-1}	Control	51.08 a	5.16 a-c	30.66 a-c	13.83 a-e
	150	51.64 a	5.35 ab	31.00 a-c	14.10 a-e
	250	51.71 a	5.36 ab	36.33 ab	15.18 a-c
	350	53.81 a	5.38 a	39.00 a	17.53 a
300 kg N fed^{-1}	Control	42.86 a	4.82 a-c	21.66 a-c	8.44 a-e
	150	43.21 a	4.83 a-c	22.33 a-c	9.14 a-e
	250	43.68 a	4.85 a-c	26.33 a-c	9.22 a-e
	350	45.91 a	4.78 a-c	29.00 a-c	12.66 a-e

* Means followed by the same letter within each column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

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Table 6. Effect of nitrogen fertilizer levels and foliar spray with humic acid combinations on chemical constituent of *Gladiolus grandiflorus* during 2017/ 2018 and 2018/2019 seasons.

Nitrogen fertilizer level (kg fed^{-1})	Chemical constituent			
	Humic acid rate (mgl^{-1})	N (%)	P (%)	K (%)
		First Season 2016- 2017		
Control	Control	0.92 o	0.13 d	1.13 p
	150	0.94 n	0.13 d	1.16 o
	250	0.95 mn	0.14 d	1.25 n
	350	0.96 m	0.15 d	1.36 m
100 kg N fed^{-1}	Control	1.09 l	0.18 c	1.73 l
	150	1.21 k	0.19 c	1.75 k
	250	1.32 j	0.19 c	1.87 j
	350	1.41 i	0.20 c	1.98 i
200 kg Nfed^{-1}	Control	2.59d	0.29 a	2.96 d
	150	2.63 c	0.30 a	3.06 c
	250	2.75 b	0.31 a	3.15 b
	350	2.86 a	0.32 a	3.23 a
300 kg N fed^{-1}	control	1.80 h	0.24 b	2.35h
	150	1.84 g	0.24 b	2.44 g
	250	1.95 f	0.25 b	2.55 f
	350	2.06 e	0.26 b	2.65 e
		Second Season 2017- 2018		
Control	Control	0.91 i	0.14 h	1.05 f
	150	0.92 hi	0.15 h	1.07 f
	250	0.93 hi	0.16 g	1.16 f
	350	0.95 hi	0.17 f	1.38 ef
100 kg N fed^{-1}	Control	1.33 f	0.33 d	1.61 e
	150	1.64 e	0.33 d	1.66 e
	250	1.06 gh	0.35 b	1.76 e
	350	1.17 gf	0.36a	2.29 d
200 kg N fed^{-1}	Control	2.47 c	0.33 c	2.65 b-d
	150	2.49bc	0.34 d	2.77 a-c
	250	2.62 ab	0.35 b	3.06 ab
	350	2.71 a	0.36 a	3.16 a
300 kg N fed^{-1}	Control	1.63 d	0.27 e	2.24 d
	150	1.64d	0.28 d	2.34cd
	250	1.74 de	0.28 d	2.46 cd
	350	1.85 d	0.28 d	2.56 cd

*Means followed by the same letter within each column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

Also, **Fahmy and Hassan (2019)** demonstrated that the combination between 100% of recommended dose with 4 l/fed humic acid gave a significant effect for roselle chemical constituents (N, P and K) compared to control.

Conclusion

From above mentioned results, it is preferable to fertilized *Gladiolus grandiflorus* with 200 kg nitrogen fed^{-1} in a form of urea and spraying with 350 mg l^{-1} humic acid to enhance the vegetative growth, flowering characteristics, corms and cormels characteristics and chemical constituents.

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الملخص العربي

تأثير مستوي التسميد النيتروجيني ومعدل حامض الهيوميك علي إنتاجية الجلاديولس

هدير رمضان محمد القط، سونيا عطيه شحاته، هاني محمد سامي حسن ومحمد أحمد محمود علي

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أجريت تجربة حقلية في المزرعة التجريبية لكلية العلوم الزراعية البيئية، جامعة العريش خلال موسمي ٢٠١٧/ ٢٠١٨ و٢٠١٨/٢٠١٩، تهدف هذه التجربة لدراسة تأثير مستويات مختلفة من التسميد النيتروجيني (صفر، ١٠٠، ٢٠٠، ٣٠٠ كجم/فدان) والتداخل مع الرش الورقي بمستويات مختلفة من حامض الهيوميك (صفر، ١٥٠، ٢٥٠، ٣٥٠ مللجم/لتر) على النمو الخضري وصفات التزهير وصفات الكورمات والكوريمات والتركيب الكيماوي، أوضحت النتائج أن استخدام ٢٠٠ كجم نيتروجين/ فدان في صورة (يوريا) مع الرش الورقي بتركيز ٣٥٠ مجم/ لتر حمض الهيوميك أعطت أعلى القيم في النمو الخضري وصفات الأزهار وقطر الكورمات ووزن الكوريمات والمحتوى الورقي من التركيب الكيماوي (النيتروجين، الفوسفور والبوتاسيوم)، على الرغم أن لا توجد اختلافات معنوية تم ملاحظتها عند استخدام ٢٠٠ كجم/ فدان نيتروجين مع ٣ مستويات من حامض الهيوميك علي وزن الكورمات وعدد الكوريمات في معظم الحالات، بينما النباتات التي زرعت بدون تسميد ورش ورقي (الكنترول) أعطت أقل النتائج في كل الصفات.

الكلمات الإسترشادية: التسميد النيتروجيني الكيماوي، رش حمض الهيوميك، الجلاديولس.

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