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Effect of nano, bio, chemical fertilization and leaves extract of moringa plant on flowering and chemical constituents of gladiolus plant

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Abstract

Pot experiments were carried out during two successive seasons of 2018/2019 and 2019/2020 at the experimental farm of Horticulture Research Institute, Agricultural Research Center, Giza, Egypt to study the effect of different types of fertilizers, traditional NPK (t-NPK) at 2.0 g/pot, nano NPK (n-NPK) at 0.5 and 1.0 g/l, active dry yeast extract (ADYE) at 5.0 and 10.0 g/l, moringa leaves extract (MLE) at 5.0 and 10.0%, and some combinations (ADYE at 5.0 g/l + MLE at 5.0%, MLE at 10% + n-NPK at 1.0 g/l and ADYE at 10.0 g/l + n-NPK at 1.0 g/l) as well as untreated plants (control) on flowering and some chemical constituents of *Gladiolus grandiflorus* cv. Rose Suprem. The results showed that MLE at 10% produced the highest values for number of florets/spike and spike stem length (cm) followed by MLE at 10% + n-NPK at 1 g/l which gave the highest values in case of spike stem diameter (cm), flower diameter (cm), fresh and dry weights of cut spike (g). On the other hand, chemical constituents of chlorophyll a, b, carotenoids of fresh leaves (mg/g), N, P, K and total carbohydrates (%) were influenced by different fertilization treatments, the mastery in this concern was to application of MLE at 10% + n-NPK at 1 g/l. It could be recommended that application of *Gladiolus grandiflorus* cv. Rose Suprem by MLE at 10% + n-NPK at 1 g/l to get the best results regarding flowering and chemical constituents.

Keywords: *Gladiolus grandiflorus* cv. Rose Suprem, chemical fertilization, nano fertilizer, moringa leaves extract, yeast extract.

1. Introduction

Gladiolus plant belongs to family Iridaceae and considered as one of the most important flowering bulbs grown in Egypt. Gladiolus plants probably involved about 250 species originated in the Mediterranean region, tropical and South Africa and being cultivated in different countries. Flowers are funnel type shaped commonly showy, red, purple, yellow, white and other colors [1].

Addition chemical fertilization to the soil plays very important role in production of different plants along with other production factors [2]. Kristalon (as a complete chemical fertilizer with macro and micro elements) proved its superiority for improving quality of various plants as mentioned by many scientists. Moreover, it is well known that its contents of N, P and K elements play a major role in growth and development of plants. N is a main constituent of all proteins and nucleic acids, as well as, of structural and non-structural components of plant cells and buildings of phospholipids and nucleic acids [3]. Meanwhile, K is a very effective macro-element on growth and development of the different plants. It is the factor affecting many functions of plants, as stomata movement, regulating photosynthesis, respiratory role and activating many enzymes involved in plant growth. It also enhances translocation of sugars and carbohydrates through plant organs, increases protein synthesis and different metabolic processes, as well as, reducing respiration, hence energy loss [4]. As well as micronutrients involved in Kristalon which play an important role in most vital processes of plants [5].

Nano fertilizers - as a new fertilization technique - enhance nutrients use efficiency, reduce soil toxicity, minimize the potential negative effects associated

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with over dosage and reduce the frequency of application. Hence, nano technology has a high potential for achieving sustainable agriculture, especially in developing countries [6].

Applying active dry yeast extracts, improving the growth of agricultural crops especially ornamental plants and presenting safe approach to get better plants without being forced to use of chemical nutrients or synthetic growth regulators that may harm the environment. Yeast may be considered superior in its beneficial effects. In this regard [7] reported that the active dry yeast (bakers dry yeast) *Saccharomyces cervisia* proved high beneficial effect on plant nutrition. It contains high nutrient contents, high protein percentage, large amount of vitamin b and natural plant growth regulators such as cytokinins which effectively enhance plant growth [8]. According to [9], the most important compounds found in active dry yeast are protein (47.0%), carbohydrates (33.0%), minerals (8.0%), vitamin B12 (0.001 mg/g) and thiamine (60-100 ml/g).

Since leaves of moringa (*Moringa oliefera*) are rich in zeatin, it can be used as natural source of cytokinins [10]. In addition, moringa leaves are also rich in carotenoids, phenols, potassium and calcium, which affect plant growth. Promoting capabilities and often applied as exogenous plant growth enhances [11]. Antioxidants such as ascorbic acid and glutathione, which are found at high concentrations in moringa chloroplasts and other cellular compartments are crucial for plant defense against oxidative stress [12]. In view of all these reports, it is hypothesized that with leaf extract from moringa, having a number of plant growth promoters, mineral nutrients, vitamins in a neutrally balanced composition, amino acids, indol-3-acetic acid, proline, abscisic acid and gibberellins [13] which may promote the plant growth. Moringa leaves extract was sprayed on to leaves of onion, bell pepper, Soya beans, sorghum coffee, tea, chillis, melon and maize and was shown to increase yields of these crops [14].

So, this study aimed to estimate how far using the advanced methods and techniques of fertilization (traditional NPK , nano NPK , active dry yeast extract moringa leaves extract and some combinations btween them) can improve *Gladiolus grandiflorus* quality to meet the increasing demand of its flowers for local as well as for export markets.

Materials and methods

The present experiment was carried out during two successive seasons of 2018/2019 and 2019/2020 at the pots at the excremental farm of Horticulture Research Institute, Agricultural Research Center, Giza, Egypt. It was intended to find out the effect of different types of fertilizer treatments i.e. traditional NPK (t-NPK), nano NPK (n-NPK), active dry yeast extract (ADY) and moringa leaves extract (MLE), with the aim to improve flowering and some chemical constituents of *Gladiolus grandiflorus* cv. Rose Suprem.

Corms of *Gladiolus grandiflorus* cv. Rose Suprem were obtained from Holland by a local company in Egypt. and the circumference of the corms were about 9cm.. Corms were planted under open field conditions on November, 28th in both seasons in 25 plastic pots (one corm/pot) filled with sandy loam soil. Chemical and physical properties of the used medium are shown in Table (a).

After one month from planting (December, 28th) the plants were treated with the different types of fertilizers and then at 15 days intervals till the terminate of the experiment. Thus, the plants received five fertilization treatment batches. Regular agricultural practices such as weeding, watering … etc. were carried out whenever needed.

Table a. Physical and chemical properties of the used medium(soil).

Soil character	Values	Soil character	Values
Physical properties		Anions (meq/l)	
Sand (%)	3.40	HCO_3^-	3.88
Silt (%)	30.10	Cl^-	4.38
Clay (%)	66.50	SO_4^{--}	3.56
Soil type	Sandy loamy	Macronutrients (ppm)	
Chemical properties		N	130.70
pH (1:2.5)	7.81	P	23.40
E.C. (dS/m)	1.84	K	380.0
Cations (meq/l)		Micronutrients (ppm)	
Ca^{++}	3.35	Fe	6.15
Mg^{++}	1.53	Cu	3.68
Na^+	4.69	Zn	5.70
K^+	2.25	Mn	9.40

The experimental layout was designed to provide one factor complete randomized blocks containing 11 treatments (t-NPK at 2 g/pot, n-NPK at 0.5 and 1.0 g/l, ADYE at 5.0 and 10.0 g/l, MLE at 5.0 and 10.0%, ADYE at 5.0 g/l + MLE at 5.0%, ADYE at 10.0 g/l + n-NPK at 1.0 g/l, MLE at 10% + n-NPK at 1.0 g/l, untreated plants as control) and three replicates, each replicate contained four corms.

Traditional fertilization:

Kristalon, (as a traditional chemical fertilizer) of NPK It is a commercial soluble chemical fertilizer produced by OSM Agric. Specialized Co., Holland. It

contains N, P and K at 19:19:19 and also contains 0.0017% Cu, 0.25% B and 0.001% Mo.

Kristalon was applied at 2 g/plant, Yeast extract applied at 5, 10 g/l, Moringa extract applied at 5%,10% whereas Nano NPK was applied at 0.5, 1.0 g/l were applied as foliar spray on the plant foliage until run off point. Meanwhile, Kristalon were applied as soil dressing. Control (untreated plants) was sprayed with water only.

Nano fertilization:

Nano NPK fertilizer was applied at 0.5 and 1.0 g/l as foliar spray on the plant foliage until run off point. Nano fertilizer was prepared by Plant Physiology Dept., Fac. Agric., Cairo Univ., Egypt. In this regard, nanoparticles were obtained by (Top to bottom molecular chemical approach method under pressure 2 Mpa) polymerizing methacrylic acid in chitosan solution as carrier coated in buffer solution for 5 hours at room temperature in two-steps processes. In the first step, 0.23 g chitosan was dissolved in methacrylic acid aqueous solution (0.5%, v/v) for 18 h under magnetic stirring. In the second step, with continued stirring, 0.2 mmol of $K_2S_2O_8$ was added to the solution, until the solution became clear. The polymerization was subsequently carried out at 75°C under magnetic stirring for 4 h which leads to the formation of nanoparticle solution, then centrifuged at 500 ppm for 30 minutes, which was thereafter cooled in an ice bath. The sources of N, P and K used were used separately. The loading of N fertilizers in Chitosan nanoparticles was obtained by dissolving of 2M N into 100 ml of chitosan nanoparticle solution under magnetic stirring for 8 h at 25°C. Subsequently dried at 50 C for 72 h. The following concentrations: i) 1000 ppm of N; ii) 1000 ppm of P and iii) 1000 ppm of K were finally obtained in each solution. The resulting solutions had a pH of 5.5. The particles were uncontrolled in shape with a size range of (54.3)M for Nitrogen, (51.2) for Phosphorous and (44.2) nm for potassium with crystal structure and 98.5% purity.

Nano fertilizer Chitosan (MW 71.3 kDa, degree of deacetylation (89%) was purchased from Aldrich (Germany). All reagents were of analytical grade from precursor potassium persulfate ($K_2S_2O_8$) and methacrylic acid were purchased from Aldrich (Germany). Calcium phosphate ($Ca(H_2PO_4)_2 \cdot H_2O$), salt NH_4NO_3, urea ($CO(NH_2)_2$) and potassium chloride KCl were purchased from Sigma Chemical Co. (St. Louis, USA).

The morphology and size of the nanoparticles were investigated using a JEOL 1010 transmission electron microscope (Fig., 1) at 80 kV (JEOL, Japan). One drop of the nanoparticle solution was spread onto a carbon-coated copper grid and was subsequently dried at room temperature for transmission electron microscopy (TEM) analysis. The sizes of the nanoparticles were determined directly from the figure using an Image-Pro Plus 4.5 software. The value is an average size of three parallels.

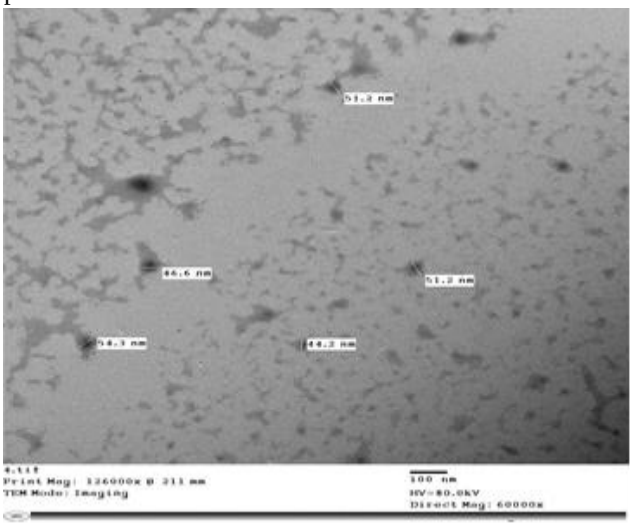

Fig. 1. morphology and size of the nanoparticles of NPK.

Yeast extract:

Yeast extract was done according to the method described by [15]. Thus, 5.0 and 10.0 g of newly produced active dry yeast were weight and put individually in 250 cm beakers with 100 cm of water. Half teaspoonful of sugar was added. These mixtures were kept in a dark worm place for 30 minutes then were filtered into different 1.0 liter measuring flasks then water was added to give 1.0 liter final volume. Chemical composition of the used active dry yeast is shown in Table (b).

Moringa extract:

According to [13], fresh leaves of moringa (*Moringa oleifera* Lam tree) were collected directly from mature plants grown in the Agricultural Research Center, Giza, Egypt. The samples were cleaned by rinsing both in distilled water, dried by shaking vigorously with hand. The leaves were air dried in shade place. After draying, the leaves were ground by an electrical grinder and made powder. The powder was weight and mixed with distilled water at a ratio

of 1:10 (w/v) i.e., 100 g powder + 1000 cm^3 distilled water for preparing 10% aqueous extract. The mixture was then shaken for four hours by an electrical stirrer and kept in dark room temperature for 24 hours. Therefore, the solution was heated till just before boiling. Afterwards, it was filtered through two cheese cloth. The extract served as a stock contain (10%) where different levels of natural extracts (5 and 10 %) were prepared using the crude aqueous of 10% of each and distilled water.

Data recorded:

At the end of each seasons, the following data were recorded:

1. Flowering parameters:

Number of florets/spike, spike stem length (cm), spike stem diameter (cm), flower diameter (cm), fresh weight of cut spike (g) and dry weight of cut spike (g).

2. Chemical constituents:

Pigments content (Chlorophyll a, b and carotenoids mg/g f.w. of fresh leaves) were Determined according to[16].

Total carbohydrates content in the newly formed croms (% D.W.) was determined using colorimetric method described by [17].

Nitrogen, phosphorus and potassium (% D.W.) were determined in the new formed corms. In this regard, nitrogen % was determined by micro–Kjeldahl apparatus [18]. Phosphorus was colorimetrically determined in the acid digested using ascorbic acid [19], while potassium was determined using the Flamephotometer [20].

Statistical analysis

Data were statistically analyzed using SAS computer program [21] and the means of individual factor were compared by L.S.D test at 5% level of probability [22].

3. Results

Effect of chemical fertilization (t-NPk and nano NPK) , MLE and ADYE extracts on flowering and chemical constituents:

A- flowering parameters :

1- Number of florets/spike

It could be noticed from data averaged in Table (1) that all fertilization treatments increased number of florets/spike compared with untreated plant, these increaments were significant with most treatments. In this connection, supplying plants with the combination of MLE at 10% + nano-NPK at 1 g/l and MLE at 10% significantly gave the highest number of florets/spike without significant differences between them as recorded 9.00 and 8.51 in the first season and 8.96 and 8.22 in the second one, respectively when compared with untreated plants (control) as recorded 5.33 and 5.66 in the first and second seasons, respectively.

2- Spike stem length (cm):

Spike stem length showed considerable variations, with significant differences due to applying the different fertilization treatments in both seasons, Table (1).

A clear increment with significant effect in spike stem length in most treatments was observed due to using the different types of fertilization treatments in both seasons. In this connection, supplying plants with either MLE at 10% or the combination of MLE at 10% + nano-NPK 1 g/l significantly gave the highest spike stem length in both seasons, as recorded 91.00 and 86.00 cm in the first season and 90.00 and 88.00 cm in the second one against 65.20 and 67.00 cm for treatment in during seasons, respectively.

3- Spike stem diameter (cm):

Data averaged in Table (1) show the effect of different fertilizer treatments on stem diameter. Fertilization treatments revealed clear increment on spike stem diameter with significant effect in most treatments when compared with that obtained from untreated control plants in the two seasons. In this regard, the treatment of MLE 10% with nano-NPK 1 g/l proved its superiority in raising spike stem diameter (2.20, 2.00 cm), followed in the second rank by applying MLE at 5% (2.00 and 1.90 cm) then the treatment of yeast 5 g/l + moringa 5% (1.90 and 1.90 cm) without significant differences between them, against 0.90 and 0.80 cm for control treatment in both seasons, respectively.

4- Flower diameter (cm):

Although the data presented in Table (1), reveal that the different fertilization treatments recorded insignificant effects on flower diameter in the two seasons, it could be mentioned that the combination btween MLE 10% + nano NPK 1 g/l, followed by moringa 5% then yeast 10 ml/l were the best treatments used in this respect, but the effect did not reach to the level of significance. The results were 8.40,7.60 and 7.40 cm in the first season and

8.10, 7.90 and 7.80 cm in the second one for the same treatments, respectively against 6.00 and 6.20 cm for control(untreated plants),in both seasons respectively. ON the other hand nano-NPK (0.5 g/l) resulted the lowest values in this regard 5.50 and 6.00(cm), during two seasons respectively.

Table (1): Effect of kristalon (t-NPK), nano-NPK, MLE and ADYE extracts treatments on flowering characteristics of *Gladiolus grandiflorus* cv. Rose supreme during the two seasons (2018/2019 – 2019/2020).

Treatments	No. of florets/spike		Spike stem length (cm)	
	1st season	2nd season	1st season	2nd season
Control	5.33	5.66	65.20	67.00
t-NPK (2 g/pot)	5.95	5.88	72.30	71.00
n -NPK (0.5 g/l)	6.18	6.84	78.36	76.00
n- NPK (1 g/l)	5.96	6.00	80.40	82.00
ADYE (5 g/l)	5.66	5.77	74.00	71.00
ADYE (10 g/l)	7.07	7.44	75.60	75.00
MLE (5%)	7.44	7.66	85.00	85.00
MLE (10 %)	8.96	9.00	91.00	90.00
ADYE (5 g/l) + MLE (5%)	7.66	7.88	84.00	86.00
ADYE(10 g/l)+n-NPK (1 g/l)	6.44	7.33	83.00	82.00
MLE (10%) + n- NPK (1 g/l)	8.22	8.51	86.00	88.00
L.S.D at 0.05	2.67	2.00	2.88	2.82
Treatments	**Spike stem diameter (cm)**		**Flower diameter (cm)**	
Control	0.90	0.80	6.00	6.20
t-NPK (2 g/pot)	1.40	0.90	6.50	7.10
n -NPK (0.5 g/l)	1.30	1.30	5.50	6.00
n- NPK (1 g/l)	1.80	1.60	6.00	7.30
ADYE (5 g/l)	1.20	1.30	7.10	7.40
ADYE (10 g/l)	1.60	1.60	7.40	7.80
MLE (5%)	2.00	1.90	7.60	7.90
MLE (10 %)	1.60	1.80	7.00	7.50
ADYE (5 g/l) + MLE (5%)	1.90	1.90	7.00	7.60
ADYE(10 g/l)+n-NPK (1 g/l)	1.30	1.10	6.50	7.20
MLE (10%) + n- NPK (1 g/l)	2.20	2.00	8.40	8.10
L.S.D at 0.05	0.32	0.92	N.S	N.S
Treatments	**Fresh weight of cut spike (g)**		**Dry weight of cut spike (g)**	
Control	28.94	30.45	7.17	7.98
t-NPK (2 g/pot)	37.76	34.07	8.21	8.09
n -NPK (0.5 g/l)	40.28	39.28	10.55	10.05
n- NPK (1 g/l)	36.01	32.08	8.92	8.92
ADYE (5 g/l)	38.31	36.92	9.38	9.05
ADYE (10 g/l)	39.55	38.94	9.48	9.40
MLE (5%)	54.38	55.09	12.38	12.90
MLE (10 %)	55.28	56.28	13.00	13.96
ADYE (5 g/l) + MLE (5%)	44.96	46.05	11.67	12.06
ADYE(10 g/l)+n-NPK (1 g/l)	44.51	40.98	11.48	11.02
MLE (10%) + n- NPK (1 g/l)	61.16	62.14	14.48	14.09
L.S.D at 0.05	9.05	2.91	2.91	2.91

t-NPK: traditional NPK, n-NPK: nano NPK, ADYE: active dry yeast extract and MLE: moringa leaves extract

5- Fresh weight of cut spike (g):

Data exhibited in Table (1) show that the mixture of MLE 10% + nano-NPK 1 g/l followed by MLE 10% and then MLE at 5% increased fresh weight of cut spike than control treatment. These treatments recorded 61.16, 55.28 and 54.38 g in the first season and 62.14, 56.28 and 55.09 g in the second one for the same treatments respectively. against Meanwhile, the lowest values were obtained by control (untreated plants) 28.94 and 30.45 in both seasons, respectively.

6- Dry weight of cut spike (g):

Data in Table (1) show a positive significant influence on dry weight of cut spike due to applying the different fertilization treatments. In this regard mixture MLE of 10% + nano-NPK at 1 g/l resulted in the highest values as recorded 14.48 and 14.09 g in the first and second seasons, respectively, when compared with control untreated plants (7.17 and 7.98 g in both seasons, respectively). MLE at 10% and 5% came in the second and third position without significant differences between them or with the previous superior mentioned treatment.

B- Effect on Chemical constituents:

1- Chlorophyll (a) content (mg/g f.w).

Data presented in Table (2) show that although the application of MLE at 10% + nano-NPK at 1 g/l significantly resulted in the highest values in terms of chlorophyll a content(0.95 ,0.89mg/g) when compared with many other treatments e.g. ADYE at 5 g/l + MLE at 5% and (0.77,0.81mg/g) MLE at 5% (0.72,0.79 mg/g). in the first season and second one, respectively. Control (untreated plants) produced the lowest values in this regard (0.26 and 0.10 mg/g., in both seasons, respectively).

2- Chlorophyll (b) mg/g.f.w:

As shown in Table (2) the application of at MLE 10% + nano-NPK at 1 g/l resulted the highest values of chlorophyll b content followed by MLE at 5% and then. ADYE at 5 g/l + MLE at 5%. The recorded results for these three superior treatments were 0.96, 0.76 and 0.67mg/g f.w. in the first season and 0.81, 0.62 and 0.59 mg/g f.w. in the second season, respectively. As for Control treatment produced the lowest values in this regard (0.15 and 0.12 mg/g f.w., in both seasons, respectively).

3- Total carotenoids (mg/g.f.w):

Data tanulated in Table (2) show clearly that application of all different fertilization treatments increased the total carotenoids (mg/g) in fresh leaves of *Gladiolus grandiflorus* cv. Rose supreme as compared to untreated plants during two seasons. the maximum values were obtained from MLE at 10% +

nano-NPK at 1 g/l, (0.74 ,0.91 mg/g f.w.) versus 0.72, 0.80 mg/gf.w.) with at ADYE 5 g/l + MLE at 5% MLE and at 5% (0.71, 0.68mg/g f.w.) in the first and second seasons ,respectively without significant differences between them. Control (untreated plants) produced the lowest values in this regard (0.21 and 0.34 mg/g f.w., in both seasons, respectively).

4- Total charbohydrates %

Data presented in Table (2) show that although the application of MLE at 10% + nano-NPK at 1 g/l resulted in the highest values in terms of total carbohydrates percentage, such effect was insignificant when compared with many other treatments e.g. ADYE at 5 g/l + MLE at 5% and MLE at 5%. The recorded results for these three treatments were 70.76, 67.54 and 58.27% in the first season and 77.37, 61.94 and 58.54% in the second one, respectively. Control untreated plants produced the lowest values in this regard (37.16 and 37.57% in both seasons, respectively).

5- Nitrogen% in newly formed corms:

Data presented in Table (3) show that application of MLE at 10% + nano-NPK at 1 g/l, MLE at 5% and a ADYE t 5 g/l + MLE at 5% resulted in the highest values in terms of N% without significant differences between them as recorded 3.62, 3.55 3.08 and 3.08 % in the first season and 4.11, 4.05 and 3.63 % in the second one, respectively. Control (untreated plants) produced the lowest values in this regard (1.07 and 1.34%, in both seasons, respectively).

6-Phosphorus% in newly formed corms:

Data presented in Table (3) show that although the application of MLE at 10% + nano-NPK at 1 g/l resulted in the highest values in terms of P%, such effect was insignificant when compared with many other treatments e.g. ADYE at 5 g/l + MLE at 5% and MLE at 5%. The recorded results for these three treatments were 0.69, 0.67 and 0.59 % in the first season and 0.85, 0.80 and 0.68 % in the second one, respectively. Control (untreated plants) produced the lowest values in this regard (0.29 and 0.30%, in both seasons, respectively).

7-Potassium% in newly formed corms:

Data presented in Table (3) show that application of MLE at 10% + nano-NPK at 1 g/l, MLE at 5% and ADYE at 5 g/l + MLE at 5% and resulted in the highest values in terms of K% without significant differences between them as recorded 1.44, 1.37 and 1.42% in the first season and 1.51, 1.40 and 1.41% in the second one, respectively. Control (untreated plants) produced the lowest values in this regard (1.08 and 1.08%, in both seasons, respectively).

Table (2): Effect of kristalon (t-NPK), nano-NPK, MLE and ADYE extracts treatments on pigment contents in the leaves and total carbohydrates in the newly formed croms of *Gladiolus grandiflorus* cv. Rose supreme during the two seasons (2018/2019 – 2019/2020).

Treatments	Chlorophyll a content (mg/g f.w).		Chlorophyll b content (mg/g f.w).	
	1st season	2nd season	1st season	2nd season
Control	0.26	0.10	0.15	0.12
t-NPK (2 g/pot)	0.34	0.14	0.31	0.32
n -NPK (0.5 g/l)	0.70	0.62	0.35	0.42
n- NPK (1 g/l)	0.71	0.74	0.41	0.44
ADYE (5 g/l)	0.52	0.25	0.32	0.36
ADYE (10 g/l)	0.52	0.28	0.22	0.34
MLE (5%)	0.72	0.79	0.76	0.62
MLE (10 %)	0.64	0.70	0.55	0.54
ADYE (5 g/l) + MLE (5%)	0.77	0.81	0.67	0.59
ADYE(10 g/l)+n-NPK (1 g/l)	0.55	0.67	0.46	0.49
MLE (10%) + n- NPK (1 g/l)	0.95	0.89	0.96	0.81
L.S.D at 0.05	0.02	0.02	0.02	0.02
Treatments	**Total carotenoids (mg/g f.w.)**		**Total carbohydrates (%)**	
Control	0.21	0.34	37.16	37.57
t-NPK (2 g/pot)	0.29	0.46	42.92	45.06
n -NPK (0.5 g/l)	0.32	0.48	51.81	55.71
n- NPK (1 g/l)	0.44	0.64	55.48	58.04
ADYE (5 g/l)	0.40	0.53	48.40	48.23
ADYE (10 g/l)	0.45	0.56	45.06	47.79
MLE (5%)	0.71	0.68	58.27	58.54
MLE (10 %)	0.50	0.43	48.38	49.16
ADYE (5 g/l) + MLE (5%)	0.72	0.80	67.54	61.94
ADYE(10 g/l)+n-NPK (1 g/l)	0.36	0.56	47.79	53.45
MLE (10%) + n- NPK (1 g/l)	0.74	0.91	70.76	77.37
L.S.D at 0.05	0.02	0.02	2.91	2.91

t-NPK: traditional NPK, n-NPK: nano NPK, ADYE: active dry yeast extract and MLE: moringa leaves extract

Regarding the positive effect of moringa leaves extract and/or chemical NPK fertilization (whether traditional or nano) on flowering and chemical composition of gladiolus and other plants a similar trend of these results was reported by [23]on *Euonymus japonicas*, [24] on *Narcissus tazetta*, [25]on *Freesia refrecta* cv. Red lion, [26]on gladiolus cv. Novalux, [27]on *Hymenocallis speciosa* bulb, [28]worked on jojoba plants, [29]on gerbera plants, [30]on *Gladiolus grandiflorus*, [31]on *Gladiolus grandiflorus*, [32]of *Freesia hybrida* and [33]of *Codiaeum Variegatum.* [34]found that treating *Artocarpus heterophyllus* with moringa leaves extract at 5% increased chlorophyll a, b, carotenoids, N, P, K and total carbohydrates. [35]found that foliar application of moringa leaves extract (MLE) (1:30), increased significantly chlorophyll content over non

sprayed dill plants. [36]reported that moringa leaves extract at 300 mg/l increased spike length (cm), floret diameter (cm) and number of florets/spike of *Gladiolus grandiflorus* cv. Peter Pears. [37]showed that increasing moringa leaves extract concentration led to increase chlorophyll a, b, carotenoids and total carbohydrates of ajwain plants.

The nano-NPK was superior in increasing all studied traits when compared with untreated control plants and traditional NPK fertilizer. In general, N, P and K nutrients (whether traditional or nano) play a vital role in enhancing gladiolus growth and development as reported by a lot of authors e.g. [38],[39], [40], [41], [26], [42], [43], [44]. In this regard [45-46] reported that mineral NPK fertilization increased both flowering parameters (length of spike, rachis length, number of florets/spike, first floret diameter and fresh weight) and some chemical constituents (N, P, K and total sugars % in corms and total chlorophyll in leaves).

Table (3): Effect of kristalon (t-NPK), nano-NPK, MLE and ADYE extracts treatments on N, P and K % of new formed corms of *Gladiolus grandiflorus* cv. Rose supreme during the two seasons (2018/2019 – 2019/2020).

Treatments	N (%)		P (%)		K (%)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	1.07	1.34	0.29	0.30	1.08	1.08
t-NPK (2 g/pot)	1.36	1.77	0.32	0.37	1.09	1.17
n -NPK (0.5 g/l)	1.45	2.37	0.36	0.44	1.12	1.21
n- NPK (1 g/l)	2.81	2.45	0.57	0.51	1.31	1.28
ADYE (5 g/l)	1.44	2.16	0.35	0.41	1.11	1.20
ADYE (10 g/l)	2.95	2.71	0.58	0.53	1.35	1.29
MLE (5%)	3.55	4.05	0.67	0.80	1.42	1.41
MLE (10 %)	2.46	2.40	0.48	0.51	1.25	1.22
ADYE (5 g/l) + MLE (5%)	3.08	3.63	0.59	0.68	1.37	1.40
ADYE(10 g/l)+n-NPK (1 g/l)	1.39	1.94	0.34	0.38	1.10	1.19
MLE (10%) + n- NPK (1 g/l)	3.62	4.11	0.69	0.85	1.44	1.51
L.S.D at 0.05	0.02	0.02	0.02	0.02	0.02	0.04

t-NPK: traditional NPK, n-NPK: nano NPK, ADYE: active dry yeast extract and MLE: moringa leaves extract

4- Discussion

Moringa leaves extract contain major and minor nutrients (K, Ca, Fe), amino acids, vitamins (A, B, C), cytokinins (zeatin), auxin like growth substances, antioxidants (ascorbate, phenolics), leaf extracts exhibited more pest and diseases resistance, higher sugar levels and an overall 20-35% increase in yield [11-47].The active growth enhancing substances in moringa leaf extract are reported to be

zeatin, dihydrozeatin and isopentyladenine which are natural (endogenous) cytokinins [48].

In addition, moringa leaves are also rich in ascorbates, caroteniods, phenols, potassium and calcium which have plant growth promoting capabilities and often applied as exogenous plant growth promoters [11]Antioxidant such as ascorbic acid and glutathione which are found at high concentrations in moringa chloroplasts and other cellular compartments are crucial for plant defense against oxidative stress [12].

If it is an aqueous or ethanol extract, exogenous application of moringa leaves extract (MLE) enhances productivity in many crops because MLE has great antioxidant activity and is rich in secondary plant metabolites such as ascorbic acid and total phenols, and cytokinin in the form of zeatin, making it a potential natural stimulant of growth, that may be applied as an environmentally friendly alternative source of chemical fertilizers [49-50-51].

The positive effect of NPK fertilizer treatments might be attributed primarily to their stimulative effect on the different vegetative growth parameters. Better vegetative growth should be directly reflected on various flowering aspects. This could be interpreted by that nitrogen is a main constituent of all proteins and nucleic acids, as well as, of structural and non-structural components of plant cells and buildings of phospholipids and nucleic acids. Potassium is a very effective macro-element on growth and development of the different plants as a factor affecting many functions of plants, as stomata movement, regulating photosynthesis, respiratory role and activating many enzymes involved in plant growth and also by enhancing translocation of sugars and carbohydrates through plant organs, increases protein synthesis and different metabolic processes, as well as, reducing respiration, hence energy loss[5-3-4]. Such beneficial effect of NPK fertilizers could be maximized by using it in forms of nano particles, nanoparticles have high reactivity because of more specific surface area, more density of reactive areas, or increased reactivity of these areas on the particle surfaces. These features in nano-scale simplify their absorption in plants [52].

Also, this study proved the positive role of active dry yeast application. This may be attributed to its contents of nutrients, protein, carbohydrates,

vitamin B, thiamine, and cytokinins [8 - 9]. In this regard [53] reported that active dry yeast at 5 g/l increased all vegetative growth characters (leaf length, number of leaves/plant and dry weight of leaves/plant) and flowering parameters (length of spike, number of florets/spike) of Gladiolus grandifloras.

4. conclusion

From the previous results, it could be recommended to treat *Gladiolus grandiflores* cv. Rose Suprem with moringa leaves extract at 10% + nano NPK at 1 g/l five times at 15 days intervals to get the best results regarding flowering and chemical constituents.

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