

Response of *Gladiolus grandiflorus* L., cv. "White prosperity" corms to alternative biofertilizer compared to mineral fertilizers.

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Abstract: The current work aimed to study the effect of alternative bio-sources fertilizer like "Active dry yeast" (Y) and "Microben" (M) as the soil microbium fertilizer, "MATERNA®" (V), pharo-products as the source of vitamin and mineral supplement from Global Napi Pharmaceuticals- Egypt., compared to other chemicals such "Kristalon" (K) and combination between them – on growth, flowering, corm yield and chemical composition of *Gladiolus grandiflorus* L., cv. "White prosperity". The present investigation was carried out in El- Harrery village, El Montaza, The second at the east of Alexandria, during two successive seasons of 2015-2016 and 2016-2017. The treatments were applied as follows: 1-["Control" as a full dose of Kristalon (K) 6g / plant divided into three equal doses]. 2- [1/2 K + (Y) as a foliar spray on leaves in the rate of 1g/l at three times]. 3- [(Y) only]. 4- [(M) 1g. /pot for 2 each times + (V) one tablet /l also as a foliar spray]. 5- [(V) only]. 6- [V + M +1/2 K]. 7- [M + Y]. 8- [(M) only]. The first dose of Kristalon was added after the first leaf appearing, the second dose after emergence bloom and the third one after cutting flowers. Each of "MATERNA" and "Active dry yeast", were added at three times. The first one added after plant leaves reached 15 cm height, the second time after inflorescence blooming appears and the third one was applied after showing color. The first addition of "Microben" was applied through the soil preparation. While, the second times after 20 days from planting corms, around surface of pots followed by irrigation, in each seasons. Data showed that all the fertilization treatments had significantly remarkable effects on all parameters, during the both seasons. The highly significant values of vegetative growth [earlier emergence date, foliage height, number of leaves/ plant, leaves fresh and dry weights/ plant, leaf area/ plant], flowering characters [showing color date, flowering date, stalk length, rachis length, spike circumference, number of florets/ spike, spike fresh and dry weights and vas life], corm productivity [corm circumference, corm fresh and dry weight, number of cormels/ plant and cormels dry weight], and chemical constituents [total chlorophyll, N, P and K %] resulted from the treatments of [V + M +1/2 K] and [(M) + (V)] in both seasons in the most cases.

[Georgena, W. R. Gabra. **Response of *Gladiolus grandiflorus* L., cv. "White prosperity" corms to alternative biofertilizer compared to mineral fertilizers.** *Nat Sci* 2017;15(12):225-231]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). <http://www.sciencepub.net/nature>. 24. doi: [10.7537/marsnsj151217.24](https://doi.org/10.7537/marsnsj151217.24).

Keywords: Gladiolus – biofertilizers – pharo-products - chemical fertilizers.

1. Introduction

Gladiolus grandiflorus belongs to family Iridaceae. It is one of the most important ornamental bulbs plants. It has decorative spike which carries numerous florets. Its flowers are excellent attractive cut flowers, which are considered to main exportable ornamental plants in Egypt, and the flower can be available the year around, the foreign markets demand Egyptian gladiolus with higher quality (Abo Leila and Eid, 2011). Also, they are used especially in landscape, production of commercial cut-flowers and act as a source of glorious colors and perfumes. Moreover, Gladiolus plants are commonly used in border and beds of many gardens (Rees, 1992). As a prominent bulbous ornamental plant, Gladiolus occupies a significant position among commercial crops of flowers which are of high demand in the markets both domestically and internationally. The plant comes in eighth position in the world's cut flower trade and has a global history (Ahmad *et. al*, 2008).

Gladiolus is represented by 180 species and 10000 cultivars including almost all colors. Many cultivars varied in size, color, flowering date and other flowering aspects such as "White Prosperity", "Eurovision", "Novolux", "Rose Supreme", "Peter Pears", "Sancerre" and others have been recently introduced to Egypt. Planted areas with such Gladiolus cultivars in Egypt in increasingly expanded in order to meet the increase demand for Gladiolus flowers for local market and exportation. Corms of Gladiolus cultivar "White Prosperity" have popularity and adaptability to the Egyptian environmental conditions (Ghatas, 2016). Also, "White Prosperity" has some important characters such as its favorable height (80 to 100 cm or more), sturdiness of stem is good with large florets size which is showy florets (7.0 to 8.0 cm) (Hogan, 1990).

Bulbs plants in most cases need more applications of fertilizers during the growing season, but the most important point is that the greatest increment in size and weight of the new developing

bulb takes place in the period during and mostly after flowering, as long as the leaves remains in good condition. So, fertilization must continue for good vegetative growth to produce a good flower and large new mature bulbs (Rees, 1992).

So, chemical nutrients especially nitrogen, phosphorus and potassium which are in "Kristalon" are very important for plants, because N, P and K partake in structure of several components of the whole plant (Protein, hormones, amino acids, enzymes, nucleic acids, fats and regulation of water conditions). But using intense chemical fertilization causes serious problems on human health by pollution of the whole environmental conditions (soil, air and drainage water) (Gabra, 2004).

The utilization of foliar spray with vitamins such as "MATERNA" with supplying macro and micro nutrients, improving growth plants and organic acids enhancing nutrients uptake and consider save for human health.

Using of microorganisms as biofertilizer improve the soil characters by the mode of action of them, whereas, the fixed nitrogen, solubilization of mineral nutrients, synthesis of vitamins, amino acids, auxins and gibberellins, which stimulate growth came as a result of inoculation by these microorganisms (El-Merich *et al*, 1997).

In this respect, (Mazhar and Eid, 2016) studied that the effect of various doses of chemical fertilizer (Kristalon) with different rates (0, 40, 60 and 80gm / m²) of Kristalon only or mixed with different rates of biofertilizers which contains nitrogen fixing bacteria "*Azotobacter sp.*, *Azospirillum sp.* and *Pseudomonas sp.*" As well as phosphate dissolving bacteria "*Bacillus megaterium*", on *Gladiolus grandiflorus* L. cv. "Glad". The results showed that, all treatments increased all growth parameters in both seasons compared with untreated plants. The highest values of corms/plant and spike length were obtained by 80 gm/m² Kristalon + 80 ml/ m² biofertilizer followed by 60 gm/ m² + 60 ml/ m² bio-fertilizer. Kristalon at 80 gm/ m² gave the highest N, P and K percentage followed by 60 gm/ m² Kristalon.

While, Ahmed (2002) investigated that yeast extract proved its mastery in most cases for improving most plant traits compared with that gained from most of other extracts of different plant species, as it contains cytokinins which effectively promote plant growth in addition to its high nutrient contents, high protein, large amount of vitamin B and other natural plant growth regulators such as cytokinins. Thus, (Khattab *et al*, 2016) founded that using yeast extract at 10 g/l combined with kristalon at 2g/l on *Gladiolus grandiflorus* cv "Rose Supreme", gave the highest significant increases of plant height, leaves number and the chemical content of the produced corms of P

and K. Whereas, using yeast extract at 10 g/l combined with actosol at 2.5 ml/l achieved the largest circumference of the produced corms (grade number), corms dry weight and the number of cormels /plant. Besides, using yeast extract at 5g/l combined with actosol (2.5 or 5.0 ml/l) gave the highest corms fresh weight, compared with the control treatment.

Whereas, Gabra, (2004) studied the effect of different treatments of biofertilizers 1g/pot ("Microbine", containing of non symbiotic fixers nitrogen bacteria and phosphate solubilizing bacteria), chemical fertilizers and organic manure on *Canna indica*, L cv. "Scarlet Beauty". She suggested that, the highest significant values of vegetative growth, flowering parameters, rhizome productivity and chemical composition resulted from the treatment of 1/2NPK dose (18,12and 6 N: P: K) + "Microbine" + organic manure (20% from soil/pot) compared with untreated plants in both seasons. In this respect, (Dalve, *et al*, 2009) studied the effect of biofertilizers on growth, flowering and yield of gladiolus. The resulted revealed that use of biofertilizers (*Azotobacter* + *Azospirillum*) with reduced doses of nitrogen significantly influenced the growth, flowering and yield of gladiolus. Thus, there was 25% saving of nitrogenous fertilizer which was replaced by the biofertilizers. While, (Ahmad *et al*, 2013) studied the effect of different biofertilizer treatments containing N-fixer bacteria (*Azotobacter*, *Azospirillum*), *Rhizobium* and P solubilizing bacteria on *Gladiolus* (*Gladiolus grandiflorus* L.), They shown that all the vegetative and reproductive growth accomplished successfully by application of biofertilizers. However, the treatment contain *Azospirillum* (T4) gained highest values in terms of plant height, florets/spike, and spike length, florets fresh weight, earlier sprouting than rest of the treatments and cormels/plant and played leading role in nutrient (NPK) absorption than the control one. So, biofertilizer has been identified as an alternative to chemical fertilizer in this experiment

Besides, all biofertilizers and vitamins treatments significantly increased all vegetative growth characters, flowering parameters and corm and cormels production in comparison with untreated plants. When, *Gladiolus grandiflorus* cv. "Eurovision" treated with bio-fertilizers (effective microorganisms and active yeast), as well as, some vitamins (vitamin E and vitamin B1) according to (Abdou *et al*, 2013), then effective microorganisms and active yeast treatment seemed to be more effective than other treatments in this concern. While, (Abo Leila and Eid 2011) investigated that *Gladiolus* plant which received the combined treatments of thiamin and ascorbic acid vitamins (200ppm thiamin + 200 ppm ascorbic acid), recorded the highest growth, delayed flowering

opening of vase life quality, cornelets induction and increased macro nutrients status. Also, (Gabra, 2010) founded the highest values of vegetative growth, flowering parameters, corms productivity and chemical constituents of *Gladiolus hybrida*, L. cv "Rose Supreme", resulted from the treatment of 3/4 NPK+ "Promex" (1g/l seaweed extractions), 1/2NPK + 7.5% compost + "Promex" and 12.5% composte + "Promex" in tow seasons in the most cases. Thus, using of 1g/l seaweed extractions ware decreased the chemical fertilizers to 3/4 dosage of NPK, while NPK were decreased to 1/2 dosage when added to "Promex" and 7.5% compost or using "Promex" and 12.5% compost without needed yet to any chemical fertilization.

2. Materials and Methods

Two field experiments were carried out at El-Harrery village, El Montaza, The second at the east of Alexandria, during two successive seasons of 2015-2016 and 2016- 2017, to study the effect of alternative bio-sources fertilizer comparison to other chemicals and some of their combinations, on growth, flowering, vas life, corm yield and chemical composition of *Gladiolus grandiflorus* L., cv. " White prosperity".

Plant material:

Gladiolus grandiflorus L., cv. "White prosperity" corms devoted for this study were imported from Holland, and planted on 11 and 15 October 2015 and 2016 for tow seasons, respectively. There average circumference between 8 – 8.5 cm and average fresh weight was 4.5- 5g. They were planted at 5cm depth in pots of 30 cm diameter, filled with 9 kg clay-loamy soil under open filed condition. Soil's physical and chemical analysis, are shown in Table (1).

Fertilization treatments:

Four type of fertilizers were used in this experiment i.e. Chemical fertilizer "Kristalon" (K.) this commercial preparation of (kristalon, 19:19:19) has 19N:19 P2O5: 19 K2O was used at 6g / plant with water irrigation, divided into three equal doses: The first dose of Kristalon (2 g/ plant) was added after the first leaf appearing, the second dose after emergence bloom and the third one after cutting flowers. Whereas, "MATERNA®" (V.) tablets are the pharo-products as the source of vitamin and mineral supplement from Global Napi Pharmaceuticals-Egypt for Pfizer-Egypt, Under License From Pfizer Inc, Canada. It was added at three times in the rate of one tablet /l of water as a foliar spray with addition of 1g/l "folium" as a foliar material. The first one added after plant leaves reached 15 cm height, the second time after inflorescence blooming appears and the third one was applied after showing color. Spraying was done to the run off from the plant foliage. The chemical composition of the used of MATERNA® tablet is

presented in Table (2). Thus, active dry yeast (Y) also, was added as a foliar spray on leaves in the rate of 1g/l at three times. It was solubilized in 100 ml of warm tap water with 1g sugar and leaved it 30 minutes after that completed to 1 liter, with addition of 1g/l "folium" also, before just spraying. The three times additions were applied at the same growth stages like the past treatment.

While, Microben (M) was obtained from Agriculture Research Center, Ministry of Agriculture, Giza, Egypt, (containing of non symbiotic fixers nitrogen bacteria and phosphate solubilizing bacteria) was added at the rate of 1g. /pot for 2 each times as a powder through the soil preparation, and the second time after 20 days from planting corms around surface of pots followed by irrigation, in tow seasons. On the other hand, irrigation and agriculture practices were done whenever plant needed.

Experiment layout:

The experimental design was factorial experiment CRD (complete randomized design) with 8 treatments were conducted as Kristalon (K.) full dose, Active dry yeast (Y.) + 1/2 (K.), Active dry yeast (Y.) only. MATERNA® (V.) + Microben (M.), MATERNA® (V.) only, MATERNA® (V.) + (M.) + 1/2 (K.), Microben (M.) + Active dry yeast (Y.) and Microben (M.) only.

Data recorded:

Vegetative growth characters:

Earlier emergence date, foliage height (cm), Number of leaves/plant, Leaves fresh and dry weight/plant (g), Leaf area (cm²).

Flowering parameters:

Flowering parameter showing color date, flowering date, stalk length, rachis length, spike circumference, number of florets / spike and spike fresh and dry weights and vas life.

Data of the vegetative growth and flowering were recorded at the flowering stage.

Corm productivity:

Corm circumference, corm fresh and dry weight, number of cormels / plant and cormels dry weight. Those of corms productivity were estimated after cut flowers and the end of yellowish leaves on 28 and 31 January for each season.

Chemical constituents:

Total chlorophyll (mg/g fresh weight) during the flowering stage due to the method described by (Moran, 1982), N% was determined according to (Evenhuis and Deward, 1980), P% was determined according to (Trough and Meyer, 1939) and K % was determined according to (Brown and Lilliland, 1946) in the dried leaves powder.

Statistical analysis:

The experimental design was CRD (complete randomized design) as 8 treatments were replicated 3

times each replicate contains 4 pots (each pot containing one plant). The experiment consists of 96 plants, in both seasons. Also, Means of data of the different treatments were compared using Duncan's Multiple Range test according to (Snedecor and Cochran, 1974).

3. Results and Discussion

Effect of alternative bio-sources fertilizer on *Gladiolus grandiflorus* L., cv. "White prosperity":

Growth parameters:

Data of vegetative growth parameters evident in Table (3) are in two seasons 2015-2016 and 2016-2017, affected by the different fertilization treatments. The results indicated that, all fertilization treatments had significantly effective on vegetative growth parameters of *Gladiolus grandiflorus* L. cv. "White Prosperity" such as earlier emergence date, foliage height (cm), Number of leaves/plant, Leaves fresh and dry weight/plant (g), Leaf area (cm²). The highly significant values resulted from the treatments of [MATERNA® (V) + Microbin (M) +1/2 Kristalon

(K)] followed by [Microbin (M) + MATERNA (V)] in most cases compared with control "full dose of Kristalon". While, the other treatments gave intermediate values with significance among themselves in both seasons. These results may be due to increase the amount of absorbed and translocated of macro and micronutrients, mineral supplement, vitamins, within the plants and amino acids from MATERNA® and enzymatic system in root zone from application of nitrogen fixing bacteria and NPK from Kristalon, they increase soil available nitrogen. Besides, nitrogen is an important element in increasing many biological and metabolites processes which encourage cell division. While phosphorus has an important role introducing energy for synthesizing proteins by formation of co-enzyme adenine triphosphate (ATP), furthermore K play a direct or indirect role in plant metabolism Develin (1975), hence the plant vegetative growth. These findings are in accordance to those of Gabra (2004), Mazhar and Eid, (2016) and Abo Leila and Eid (2011).

Table (1): Physical and chemical analysis of the used experiment media (average of both seasons), according to (Jackson, 1967).

| Soil particles | Value | Chemical analysis | Value |
|----------------|-----------------|--------------------------------|-------|
| Clay | 59.3 % | Total N | % |
| Silt | 21.62 % | Total P | ppm |
| Sand | 19.08 % | K + | 1.96 |
| Texture | Clay loamy soil | Ca ++ | 0.94 |
| Ec dS/m | 1.054 | Mg ++ | 1.23 |
| | | Na + | 1.54 |
| pH | 7.68 | HCO ₃ ²⁻ | meq/l |
| | | Cl ⁻ | 1.69 |
| | | SO ₄ ²⁻ | 2.16 |

Table (2): Chemical analysis of "MATERNA®", for each tablet.

| Vitamins: | Unit | Value | Minerals: | Unit | Value |
|---|------|-------|----------------------------------|------|-------|
| 1- Beta-Carotene (a source of vitamin A) | IU | 1500 | 1- Calcium (calcium carbonate) | mg | 250 |
| 2- Vitamin A (acetate) | | 1500 | 2- Magnesium (magnesium oxide) | | 50 |
| 3- Vitamin E (acetate) | | 30 | 3- Iodine (potassium iodide) | | 0.15 |
| 4- Vitamin D (cholecalciferol) | | 250 | 4- Iron (ferrous fumarate) | | 60 |
| 5- Vitamin C (ascorbic acid) | mg | 100 | 5- Copper (cupric oxide) | mcg | 2 |
| 6- Folic acid. | | 1 | 6- Zinc (zinc oxide) | | 25 |
| 7- Vitamin B1 (thiamine mono-nitrate) | | 3 | 7- Manganese (manganese sulfate) | | 5 |
| 8- Vitamin B2 (riboflavin). | | 3.4 | 8- Molybdenum (sodium molybdate) | | 25 |
| 9- Niacin-amide | | 20 | 9- Selenium (sodium selenate) | | 25 |
| 10- Panto-thenic Acid (calcium panto-thenate) | | 10 | 10- Chromium (chromium chloride) | | 25 |
| 11- Vitamin B6 (pyridoxine hydrochloride) | | 10 | | | |
| 12- Vitamin B12 (cyano-cobal-amin) | mcg | 12 | | | |
| 13- Biotin | | 30 | | | |

Table (3): Effect of fertilization treatments on vegetative growth parameters of *Gladiolus grandiflorus* L. cv. "White Prosperity" during two seasons of 2016 and 2017.

| Fertilization treatments | Emergence date (day) | Foliage height (cm) | Number of leaves / plant | Leaves fresh weight / plant (g) | Leaves dry weight/ plant (g) | Leaf area / plant (cm ²) |
|--------------------------|----------------------|---------------------|--------------------------|---------------------------------|------------------------------|--------------------------------------|
| Season 1 | | | | | | |
| 1- control | 10.21 cd | 81.37bc | 10.21abc | 22.04 ab | 2.68 cd | 703.34 b |
| 2- Y.+1/2 K | 12.0 abc | 82 ab | 9.87 d | 20.91 bc | 2.49 de | 663.13 bc |
| 3- Y. | 11.50 bc | 75.5 c | 9.87 d | 18.61 c | 2.31 e | 624.08 c |
| 4- M. + V. | 9.72 d | 85.5 ab | 9.92 cd | 22.80 ab | 3.09 ab | 815.89 a |
| 5- V. | 10.50 cd | 75.5 c | 10.0 bcd | 20.68 bc | 2.46 de | 647.94 bc |
| 6-V+M+1/2 K. | 9.50 d | 86.5 a | 10.33 a | 23.66 a | 3.22 a | 832.29 a |
| 7- M. + Y. | 12.25 ab | 75.21 c | 10.26 ab | 21.28 b | 2.89 abc | 690.54 b |
| 8- M. | 13.37 a | 75.5 c | 9.99 bcd | 20.22 bc | 2.75 bcd | 680.40 bc |
| Season 2 | | | | | | |
| 1- control | 11.50 bcd | 84.5 b | 10.0 bcd | 21.23 b | 2.59 bce | 712.80 b |
| 2- Y.+1/2 K | 13.0 ab | 87.25 ab | 10.0 bcd | 18.04 c | 2.45 ce | 672.25 bce |
| 3- Y. | 11.0 cd | 78.5 c | 9.50 d | 17.14 c | 2.38 e | 628.85 d |
| 4- M. + V. | 10.25 de | 89.5 a | 10.50 ab | 21.24 b | 3.33 a | 821.96 a |
| 5- V. | 12.37 abc | 79.5 c | 10.12 abc | 18.08 c | 2.64 bce | 652.86 cd |
| 6-V+M+1/2 K. | 9.25 e | 88.0 a | 10.62 a | 23.96 a | 3.02 ab | 834.54 a |
| 7- M. + Y. | 12.0 abc | 79.0 c | 10.0 bcd | 22.00 ab | 2.86 bc | 696.56 bc |
| 8- M. | 13.37 a | 75.75 c | 9.75 cd | 21.19 b | 2.92 abc | 688.70 bc |

Control: full dose of "Kristalon" K, Y: Active dry yeast, M: Microbin, V: MATERNA®

Flowering Characteristics:

Generally, data presented in Table (4): a, b) showed that, the treatment of using combination between [foliar spray of MATERNA® (V.) (1g/l) + Microbin (M) (2g/pot)] and the other treatment of [V + M +1/2 dosage of Kristalon (K) (3g/plant)], respectively led to a significant reduction in the number of days needed for flowering compared to the other treatments in two seasons. These treatments recorded the highly significant values of stalk and rachis length (cm), and spike fresh and dry weight (g) in both seasons. While treatments of [V+M+1/2 K], control and Microbin (M) only, caused highly significant increase of spike circumference (cm) in both seasons. Whereas, the same treatments in addition the treatment of MATERNA® (V.) alone, recorded the highest values of florets number/ spike. But, the treatment of [V+M+1/2 K], and / or MATERNA® (V.) only and /or Microbin (M) only caused the highest values of vase life (day) in both seasons. These results may be attributed to that the flower bud initiation and development depend so much on the balanced amounts and types of fertilization. Thus, the positive affect of materials and vitamins which are used of suitable concentration on activation of the photosynthesis process. These results are in harmony with those of Khattab *et al.*, (2016), Abdou *et al.*, (2013), Mazhar and Eid, (2016) and (Gabra, 2010).

Corms productivity:

Data in Table (5) revealed the used fertilization treatments exhibited stimulatory effects on corms productivity in both seasons, the highly significant values resulted from the treatments of (V+M+1/2 K)

and (M+V) in corm and cormels dry weight in both seasons. While, there is no significant different between the treatments of (V+M+1/2 K), (M+V) and control or V. only, in corm circumference and corm fresh weight in both seasons and (V+M+1/2 K), (M+V), (M +Y) and or V. only in number of cormels/ plant.

This results may be attributed to important role of NPK from Kristalon, micronutrients, vitamins and amino acids from MATERNA® and Microben on photosynthetic and metabolic processes, consequently led to more sugar and carbohydrates storage in corms thus, the size and corms fresh and dry weight would be incremented and as well as number and dry weight of cormels. Similar findings were obtained by Abo Leila and Eid (2011), Mazhar and Eid, (2016) and Gabra, (2010).

Chemical constituents:

It is appears from data in Table (6) that leaves chlorophylls content as influenced by application the different fertilization treatments in the both seasons. The highest total chlorophyll, N %, P % and K% values resulted from the treatment of (V+M+1/2 K) and (M. + V) in first season and the same treatments in addition of (M. + Y.) for increase total chlorophyll in the second one. These results may be referred to the increment of N in the root zone for "Kristalon" and inoculation by "Microben" (nitrogen fixed and phosphate solubilizing bacteria), vitamins and/ or active dry yeast. That improves N, P, K, and Mg uptake. Similar trend of results was obtained by Abdou *et al.*, (2013), Dalve, *et al.*, (2009), Khattab *et al.*, (2016) and Ghatas (2016).

Table (4: a): Effect of fertilization treatments on flowering parameters of *Gladiolus grandiflorus* L. cv. "White Prosperity" during two seasons of 2016 and 2017.

| Fertilization treatments | Showing color date (day) | Flowering date (day) | Stalk length (cm) | Rachis length (cm) | Spike circumference (cm) | Number of florets/spike |
|--------------------------|--------------------------|----------------------|-------------------|--------------------|--------------------------|-------------------------|
| Season 1 | | | | | | |
| 1- control | 97.50 c | 100.5 c | 86.50 c | 30.71 cde | 2.23 ab | 12.00 cd |
| 2- Y.+1/2 K | 109.00 a | 111.42 b | 95.50 b | 30.00 de | 1.85 e | 11.62 d |
| 3- Y. | 107.37 ab | 110.5 b | 81.87 d | 27.62 e | 2.00 de | 11.87 cd |
| 4- M. + V. | 84.00 d | 87.5 e | 98.00 ab | 34.50 ab | 2.05 cd | 13.50 a |
| 5- V. | 105.66 bc | 109.0 b | 86.00 cd | 32.75 bc | 2.1 bcd | 13.00 ab |
| 6-V+M+1/2 K. | 91.25 cd | 94.5 de | 101.0 a | 35.50 a | 2.3 a | 12.67 abc |
| 7- M. + Y. | 110.42 a | 113 ab | 88.62 c | 31.37 cd | 2.1 bcd | 12.33 bcd |
| 8- M. | 115.25 a | 118.5 a | 85.50 cd | 30.75 cde | 2.2 abc | 12.62 abc |
| Season 2 | | | | | | |
| 1- control | 108.75 ab | 114.5 ab | 88.50 cd | 31.0 cd | 2.25 abc | 12.37 cde |
| 2- Y.+1/2 K | 95.25 de | 99.50 d | 97.50 b | 31.0 cd | 1.77 e | 12.00 e |
| 3- Y. | 106.75 ab | 113.0 ab | 84.50 d | 28.5 d | 1.95 de | 12.75 bcd |
| 4- M. + V. | 83.75 f | 88.75 e | 98.25 ab | 35.5 ab | 2.05 cde | 13.50 a |
| 5- V. | 99.75 cd | 106.0 c | 91.25 c | 33.25 bc | 2.10 bcd | 13.00 ab |
| 6-V+M+1/2 K. | 89.50 ef | 93.00 e | 103.0 a | 37.0 a | 2.40 a | 13.25 ab |
| 7- M. + Y. | 104.25 bc | 110.0 bc | 93.5 bc | 31.5 c | 2.15 abcd | 12.25 de |
| 8- M. | 110.75 a | 116.5 a | 89.75 cd | 30.25 d | 2.30 ab | 12.87 abcd |

Control: full dose of "Kristalon" K, Y: Active dry yeast, M: Microbin, V: MATERNA®

Table (4: b): Effect of fertilization treatments on flowering parameters of *Gladiolus grandiflorus* L. cv. "White Prosperity" during two seasons of 2016 and 2017.

| Fertilization treatments | Spike fresh weight (g.) | Spike dry weight (g.) | Vas life (day) |
|--------------------------|-------------------------|-----------------------|----------------|
| Season 1 | | | |
| 1- control | 39.45 bc | 6.10 cd | 11.33 bc |
| 2- Y.+1/2 K | 35.92 cd | 5.07 e | 10.25 c |
| 3- Y. | 32.25 d | 6.54 bc | 12.12 ab |
| 4- M. + V. | 41.67 ab | 7.01 ab | 12.23 ab |
| 5- V. | 37.75 bc | 5.92 cd | 13.00 a |
| 6-V+M+1/2 K. | 45.68 a | 7.50 a | 13.25 a |
| 7- M. + Y. | 38.74 bc | 5.70 de | 12.29 ab |
| 8- M. | 36.12 cd | 6.42 bc | 12.25 ab |
| Season 2 | | | |
| 1- control | 40.98 bc | 4.87 bc | 10.75 d |
| 2- Y.+1/2 K | 38.44 c | 4.34 d | 11.50 cd |
| 3- Y. | 33.66 d | 4.13 d | 12.25 bc |
| 4- M. + V. | 41.16 bc | 5.02 b | 13.50 a |
| 5- V. | 38.0 c | 4.62 bcd | 12.99 ab |
| 6-V+M+1/2 K. | 46.02 a | 6.81 a | 12.75 ab |
| 7- M. + Y. | 43.40 ab | 5.13 b | 12.50 abc |
| 8- M. | 40.42 bc | 4.48 cd | 13.50 a |

Control: full dose of "Kristalon" K, Y: Active dry yeast, M: Microbin, V: MATERNA®

Table (5): Effect of fertilization treatments on corms productivity of *Gladiolus grandiflorus* L. cv. "White prosperity" during two seasons of 2016 and 2017.

| Fertilization treatments | Corm circumference (cm) | Corm fresh weight (g.) | Corm dry weight (g.) | Number of cormels/ plant | Cormels dry weight plant (g.) |
|--------------------------|-------------------------|------------------------|----------------------|--------------------------|-------------------------------|
| Season 1 | | | | | |
| 1- control | 9.65 a | 8.21 ab | 3.12 b | 22.21 c | 0.596 c |
| 2- Y.+1/2 K | 9.112 bc | 6.675 c | 2.09 cd | 22.12 c | 0.442 d |
| 3- Y. | 7.95 d | 5.22 d | 1.86 d | 18.5 d | 0.403 d |
| 4- M. + V. | 9.43 ab | 9.01 a | 4.17 a | 28.83 a | 1.039 a |
| 5- V. | 8.95 c | 6.18 cd | 2.44 c | 26.67 ab | 0.726 b |
| 6-V+M+1/2 K. | 9.85 a | 9.08 a | 4.42 a | 26.83 ab | 0.990 a |
| 7- M. + Y. | 9.075 bc | 7.22 bc | 2.49 c | 29.42 a | 0.59 c |
| 8- M. | 9.0 c | 7.03 c | 2.34 cd | 25.75 b | 0.736 b |
| Season 2 | | | | | |
| 1- control | 9.15 cd | 8.74 bc | 3.02 b | 28.5 c | 0.65 d |
| 2- Y.+1/2 K | 8.125 e | 7.61 cd | 2.06 c | 31.5 bc | 0.482 e |
| 3- Y. | 9.2 bcd | 5.31 e | 2.61 c | 21.75 d | 0.463 e |
| 4- M. + V. | 9.725 ab | 9.50 ab | 5.21 a | 35.25 ab | 1.211 a |
| 5- V. | 9.625 abc | 7.37 cd | 2.7 bc | 30.5 bc | 0.847 bc |
| 6-V+M+1/2 K. | 10.05 a | 10.36 a | 5.30 a | 39.25 a | 1.143 a |
| 7- M. + Y. | 9.175 bcd | 7.98 cd | 2.93 b | 35.75 ab | 0.609 de |
| 8- M. | 9.075 d | 6.92 d | 2.64 bc | 26.75 cd | 0.734 cd |

Control: full dose of "Kristalon" K, Y: Active dry yeast, M: Microbin, V: MATERNA®

Table (6): Effect of fertilization treatments on chemical composition of *Gladiolus grandiflorus* L. cv. "White Prosperity" during two seasons of 2016 and 2017.

| Fertilization treatments | Total chlorophyll (mg/g. leaves fresh weight) | N% | P% | K% |
|--------------------------|---|------|------|------|
| Season 1 | | | | |
| 1- control | 2.66 bc | 2.21 | 0.19 | 1.25 |
| 2- Y.+1/2 K | 2.69 bc | 2.29 | 0.20 | 1.96 |
| 3- Y. | 2.54 c | 1.89 | 0.16 | 1.09 |
| 4- M. + V. | 2.85 ab | 2.41 | 0.37 | 1.64 |
| 5- V. | 2.62 bc | 2.12 | 0.27 | 1.76 |
| 6-V+M+1/2 K. | 3.06 a | 2.84 | 0.41 | 2.18 |
| 7- M. + Y. | 2.57 c | 2.28 | 0.32 | 1.47 |
| 8- M. | 2.72 bc | 1.99 | 0.24 | 1.22 |
| Season 2 | | | | |
| 1- control | 2.567 cd | 2.17 | 0.22 | 1.11 |
| 2- Y.+1/2 K | 2.463 cd | 2.34 | 0.39 | 2.02 |
| 3- Y. | 2.214 d | 2.03 | 0.18 | 1.03 |
| 4- M. + V. | 3.024 ab | 2.40 | 0.26 | 1.74 |
| 5- V. | 2.427 cd | 2.25 | 0.31 | 1.82 |
| 6-V+M+1/2 K. | 3.340 a | 3.06 | 0.45 | 2.22 |
| 7- M. + Y. | 2.998 ab | 2.28 | 0.34 | 1.57 |
| 8- M. | 2.775 bc | 2.19 | 0.26 | 1.30 |

Control: full dose of "Kristalon" K, Y: Active dry yeast,

M: Microbin,

V: MATERNA®

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12/25/2017