J. Agric. Sci. Mansoura Univ., 30 (3): 1795 - 1816, 2005

EFFECT OF BIOFERTILIZERS, ORGANIC MANURE AND MINERAL FERTILIZER ON PRODUCTION OF *NARCISSUS TAZETTA*, L. BULBS GROWN ON CALCREOUS SANDY LOAM SOIL

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ABSTRACT

A pot experiment was carried out throughout two successive seasons (2002/03 and 2003/04) at Antoniades Research Branch, Hort. Res. Inst. Alex., Egypt to evaluate the effect of applying organic manure and Kristalon^{TM} mineral fertilizer (19:19:19 of NPK) in presence or absence of biofertilizers of Nitrobein (*Azotobacter chroococcum* and *Azospirillum barasilense*) and Phosphorein (containing phosphate dissolving bacteria) on bulbs production of *Narcissus tazetta*, L. grown in sandy loam soil. The mineral fertilizer was added at three rates (1.0, 2.0 or 3.0 g/ pot/month) four times during the growing season. Organic manure was added to the soil before planting at three rates of 6.0, 12.0 or 18.0 g/ pot. The biofertilizers were added at the rate of 10 g/ pot.

The results indicated, generally, that all biofertilizer treatment significantly increased most of the studied leaf characteristics, bulb circumference, fresh and dry weights of bulbs, root dry weight, bulbs uptake of N and P and the available of these elements in the sandy loam soil.

It was noticed that the interaction effect of applying biofertilizers with gradual amounts of mineral fertilizer resulted in significant gradual increases in most of the studied characteristics. The same trend of results was observed as a result of applying gradual rates of organic manure combined with mineral fertilizer.

The interaction effect between biofertilizers inoculation in the soil amended with organic manure with increasing mineral fertilizer rates caused a gradual significant increase in leaf characteristics, the produced bulb characteristics and bulbs uptake of N and P and the available of these elements in the sandy loam soil. The best results were obtained with application of organic manure and mineral fertilizer at rates of 18 g and 3 g per pot, respectively in the presence of biofertilizer, which increased all leaf and bulbs characteristics, roots dry weight, the uptake of N, P and K of bulbs. As well as, significant increasing was detected on the availability of N, P and K in sandy loam soil. The study recommends that application of organic manure at the rate of 18 g/pot with 3 g/pot of mineral fertilizer and inoculation with biofertilizers is the best treatment for producing high quality narcissus bulbs in sandy loam soil and obtaining suitable levels of available of N, P and K in the soil.

Keywords: *Narcissus tazetta*, L. Biofertilizers. Bulbs. Organic manure. Mineral fertilizer.

INTRODUCTION

Narcissus is one of the most important cut flower crops in the floriculture industry. It is most widely grown outdoor cut flower in Egypt.

Narcissus Belongs to the family *Amaryllidaceae*. There are about 50 species of narcissus; all species are native to central Europe and Mediterranean region. It is hardy or tender herbaceous perennial growing from bulbs and seeds. It is of economic value in home garden landscaping, in decoration as lovely, fragrance, pure-white color and long vase life. It can be planted in beds, in edging and borders along the paths or sides, in pots or bowls in gardens. Moreover, their volatile oils usually used in perfumes manufacturing (Hanks, 2002).

Biofertilizers include microbial inoculants are capable of enhancing soil fertility, increase crop's fertilizer use efficiency consequently crop growth and yield**.** Biofertilizers provide an alternative to agricultural chemicals as more sustainable and ecologically sound practices to increase crop productivity (Zuberer, 1998). The added farm yard manure enhanced the biofertilizers effectiveness in saving N and P mineral fertilizer rates. Alkaff *et al*., (2002) on onion, stated that application of fertilizer (Power 4) increased the bulb diameter, bulb height and total yield of onion. The highest rate of increase in bulb weight was recorded with the mineral fertilizer, followed by the biofertilizer and FYM.

Several investigators studied the combined effects of organic and mineral fertilizers in presence of biofertilizer i.e., El-Naggar and Mahmoud (1994) on *Narcissus tazetta*, L. mentioned that, inoculation with *Azospirillum* improved flower yield and bulb productivity in sandy loam and sandy clay loam soils even without N fertilizer. Mangistu and Singh (1999) reported that the highest bulb diameters were obtained using *Azospirillum* + VAM + 50 kg N. While, application of *Azospirillum* + VAM + 50kg N + 25 kg P resulted in the highest dry weight of bulbs. El- Akabawy (2000) on Egyptian clover found that the biofertilizers could compensate the plant with more than half the recommended rates of the mineral nitrogenous and phosphatic fertilizers. Jayathilake *et al*., (2002) on onion mentioned that the highest values of number of leaves per plant were recorded upon treatment with biofertilizer + 50% recommended nitrogen through organic manures + 50 % N and 100 % P and K through chemical fertilizer. The higher bulb weight and diameter were observed with using *Azospirillum* + 50 % N through vermicompost + 50 % N and 100 P and K through chemical fertilizer. Rashed (2002) found that the applying NPK + biofertilizer increased fresh and dry weights of plants, leaf area, and N, P and K % in the leaves. El- Fawakhry *et al*., (2004) on three species of ficus mentioned that, fertilizing transplants with 1g / pot every 2 weeks (equal to 50 % recommended NPK) in presence of biofertilizers gave the highest values of plant height, leaf number, leaf area, stem diameter, shoot dry weight, root volume and dry weight, as well as the greatest content of total chlorophylls and N in the leaves.

Losses of P in response to N additions are conflicting. For example, Williams and Young (1994) found that P losses increased by 10% following N additions to a reseeded blanket bog. Similarly, Roberts *et al*. (1989) found P concentrations in drainage from an upland site in Wales increased from 0.05 to 0.3 mg P l^{-1}. However, Hawkins & Scholefield (1996) found that applications of N in various forms at 200 or 400 kg ha^{-1} yr^{-1} had no effect on P losses in drainage waters from grazed permanent grassland in Devon.

Furthermore, organic P forms are more mobile than inorganic P that is highly sorbed (Turner and Haygarth 2000). The potential risk of P loss from pasture soils was greater than from cultivated soils, although both lost similar amounts of dissolved organic P. The bioavailability of dissolved organic P clearly needs to be assessed to determine its potential risk for P loads in drainage with increasing N application (McDowell and Monaghan, 2002).

The main objectives of the present study were to evaluate the effect of application of organic manure and mineral fertilizer at different rates, under inoculation and non-inoculation by biofertilizers to study: 1) the vegetative growth and bulbs production of *Narcissus tazetta*, L. cv. "Paper white" cultivated in sandy loam soil, 2) the effects of these fertilizer treatments on uptake of N, P and K by bulbs, and 3) the availability of these elements in the calcareous sandy loam soil at end of the growing season.

MATERIALS AND METHODS

Pot experiment was conducted at Antoniades Research Branch, Horticultural Research Institute, Alex., Egypt during the two successive growing seasons of 2002/03 and 2003/04.

Growing Medium:

PVC pots (20 cm in diameter and 20 cm in depth) were packed with 2 kg sandy Loam soil, which was collected from the surface layer (0-30 cm) of Nubaria region. The collected soil materials were air-dried, ground, passed through a 2-mm sieve and prepared for analysis and planting. Table (1) shows some chemical and physical properties of the used soil, which were determined according to the methods outlined by Page *et al*. (1982) and Westerman (1990).

Table (1): Some chemical and physical properties of the used soil.

E.C*, dS/ m	pH**	Available Nutrients, mg kg^{-1}			O.M, %	C.E.C, me/100g soil	Total Carbonate, %	Mechanical analysis, %		
		N	P	K				Sand	Silt	Clay
								72	17	11
1.33	8.34	10	2	80	0.34	17	20.35	Texture : Sandy Loam		

*** 1:2.5 of soil: water suspension.** **** Saturated soil paste extraction.**

Biofertilizers:

Two types of biofertilizers were used : Nitrobein and Phosphorein. The Nitrobein contains two non-symbiotic nitrogen-fixing bacteria: *Azotobacter chroococcum* and *Azospirillum barasilense* carried on peat moss, vermiculite and plant charcoal (Shalan, *et al*., 2001). The Phosphorein biofertilizer contains phosphate dissolving vesicular arbuscular mycorrhiza and Silicane bacteria (Abdalla *et al*., 2001). The biofertilizers were added to the soil with a rate of 10 g / pot (2 kg) divided into two equal doses. The first dose was added before planting of bulbs while the second was applied one month later.

Organic manure:

The chosen organic manure was a compost of plant waste materials. The characteristics and chemical analysis of the organic manure were

determined according to Mathur *et al*., (1991) and Kaloosh (1994) and the data are presented in Table (2).

Table (2): Chemical analysis of organic manure (on dry weight basis):

E.C*	pH*	Bulk Density, kg/m^3	Total, %				C/N Ratio
			N	P_2O_5	K_2O	O.C.	
2.3	7.2	140	2.01	1.96	1.52	34.0	17:1

***(1:10) manure: water ratio.**

Mineral Fertilizer:

The Kristalon™ mineral fertilizer Holland (19:19:19) was used, (EC= 0.9 dS/m of 1 g/L). The fertilizer contains soluble elements of 19 g N, 19 g P_2O_5 and 19 g K_2O/100g fertilizer. The mineral fertilizer application rates were 4, 8 and 12 g /pot

Soil Treatments:

The treatments were split into two groups. The first group was inoculated with the biofertilizers (inoculated group), while the second one was un-inoculated with biofertilizers (un-inoculated group).

Organic manure was added before planting of bulbs at three application rates of 6 g, 12 g or 18 g / pot. Each rate was mixed thoroughly with the soil (un-inoculated group) or with the soil inoculated with the biofertilizers (inoculated group). The pots were lightly irrigated before planting to establish a good microbial activity for decomposing organic manure material before planting of bulbs.

The mineral fertilizer was added to the soil as top dressing at three rates of 1, 2 and/or 3 g / pot / monthly, four times throughout the growing season. The first addition was applied two weeks after planting bulbs. The four applications were suitable for the different four growth stages, (emergence, leaf growth, bulb growth and maturation stage, respectively). The control treatment received 1 g mineral fertilizer and 6 g organic manure per pot, without biofertilizers inoculation.

Experimental layout:

The treatment was arranged in three replicates with five plants in each experimental unit and the layout was split-split plot design. The biofertilizer treatments (un-inoculation and inoculation) were the main plots, the organic fertilizer treatments were the sub plots, while the mineral fertilizer treatments were the sub-sub plots (Snedecor and Cochran, 1974).

The regular and conventional agricultural practices, such as weeding and watering as basic dressing, were carried out whenever necessary.

Planting narcissus bulbs:

Narcissus mother bulbs, uniform in size (4-5 cm circumference) were planted as one bulb in each pot at 5 - 6 cm depth. Bulbs were planted on 15th and 20th October of the growth seasons 2002/03 and 2003/04, respectively.

Morphological measurements:

The study of vegetative growth characteristics included foliage height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), fresh and

dry weights of leaves per plant (g) while the bulbs and roots characteristics were; bulb circumference (cm), bulb fresh and dry weights (g) and roots dry weight (g).

Soil, Organic manure and plant analysis:

The chemical and physical analysis of the soil were carried out to determine pH (1: 2.5 soil: water) using glass-electrode pH meter, electrical conductivity (E.C) of the saturated extract of soil paste and available P was extracted by 0.5 N $NaHCO_3$, at pH 8.5, (Olson 's method) and determined colorimetrically (Jackson, 1958). Organic matter was determined by Walkley and Black method according to Jackson (1967). The percentage of total carbonates was determined volumetrically using Collin's calcimeter and available N (Av-N), P (Av-P) and K (Av-K) were determined as outlined by Black *et al.,* (1982). Cation exchangeable capacity (CEC) was determined using NH_4-OAc method and the particle size distribution (sand, silt and clay) of soil was determined (Page *et al.*, 1982) and the data obtained are given in Tables (1) and (11). The organic manure analysis (Hydrameter method) was carried out as described by Mathur *et al*., (1991) and Kaloosh (1994) and the obtained data are given in Table (2).

Total chlorophylls content (mg/100 g leaf fresh weight) was determined according to Moran and Porath (1980). As well as, chemical analyses of the oven-dried bulbs (60 ^oC for 72 hr) were carried out to determine total N, P and K contents, to determine the bulb uptake, according to the methods described by Westerman (1990). The data obtained are given in Tables (7), (8), (9), (10) and (11).

RESULTS AND DISCUSSION

I - Vegetative growth characteristics:

1- Number of leaves / plant:

Table (3) shows significant increment in number of leaves/ plant due to biofertilizers treatment in both the two seasons. Organic manure treatments revealed the superiority of plants received the highest rate (18g / pot) in this concern in the two seasons as shown in Table (3).Using mineral fertilizer showed a gradual increment on this parameter resulting from increasing its rate.

The interaction between biofertilizers and organic manure revealed the superiority of plants receiving the biofertilizers treatment and the highest rate of organic manure (18 g / pot) for increasing number of leaves / plant in both seasons (Table, 4).

A clear increment in the number of leaves/ plant was recorded resulting from the interaction between biofertilizers treatment and the highest rate of mineral fertilizer in both seasons. Such treatment increased the values to 14.57 and 14.54 leaves with significant differences in both seasons (Table, 5).

The interaction between the organic manure and mineral fertilizer indicated the superiority of treating the plants with the highest rates of organic manure and mineral fertilizer (18 and 3 g / pot, respectively) for producing the highest number of leaves/ plant (12.58 and 15.33 leaves) in both seasons, respectively (Table, 6).

4.5

These results may be related to the effects of biofertilizers on changing nutrients into available forms and increasing N-fixation that can be easily assimilated by plant (El-Karamity and Hammed, 1992). Sudhakar *et al*.,(2000), using *Morus alba,* found that application of biofertilizer with 150 kg N / ha as inorganic nitrogen gave as much leaf as recommended dose (300 kg N / ha / year). Concerning the significant effect of the gradual application rates of mineral fertilizer on leaf number, it is known that N, P and K are very important in most plant growth processes and the influence of N on new cells formation consequently increased leaf characteristics .Similar results were observed by Attia (2000) on *Lawsonia inermis*, Jayathilake *et al*., (2002) on onion and El-Fawakhry *et al*., (2004) on ficus.

2- Leaf length (cm):

It could be concluded from Tables 3,4, 5 and 6 that the leaf length was considerably affected by using the different fertilizer treatments in both seasons. Inoculation with biofertilizers significantly increased leaf length compared with that obtained from the un-inoculated plants in both seasons. In addition, a gradual increment on leaf length was detected as a result of increasing the rates of organic manure or mineral fertilizer.

The interaction between biofertilizers and organic manure showed the great influence of biofertilizers inoculation with the highest rate of organic manure (18 g / pot) for increasing leaf length in both plantations (Table, 4).

Leaf length was also significantly affected by the interaction between biofertilizers and mineral fertilizer in both seasons. In this respect, biofertilizer inoculation and receiving the plants either the medium or the highest rate of mineral fertilizer (2 or 3g/pot) increased leaf length in both seasons(Table, 5).

The interaction between organic manure and mineral fertilizer revealed the superiority of applying the highest rates of mineral and organic manure (18 and3 g / pot, respectively) for plants received the highest rate of organic manure (18 g / pot). Such treatment increased significantly leaf length to 46.93 and 49.30cm in both seasons, respectively (Table, 6).

The enhancement in leaves growth as a result of biofertilizers inoculation may be due to the production of phytohormones by the biofertilizers and/or improving the availability of nutrients (Martin *et al*., 1989 and Jagnow *et al*., 1991). These results are in agreement with those obtained by Barakat and Gaber (1998) who reported that tomato leaves growth was greatly improved by inoculation with non-symbiotic N_2- fixing bacteria of the genera *Azotobacter sp*. and *Azospirillum sp*. Abou El-Khashab (2003) reported that inoculation of olive transplant cvs. "Aggizi" and "Picual", with the two bacterial *sps.* (*Azotobacter* and *Azosspirillum sp*.), enhanced all vegetative growth parameters.

3- Leaf width (cm):

Biofertilizers inoculation significantly increased leaf width comparing with that recorded from untreated plants in both seasons. A gradual increment in leaf width was observed due to increasing the rates of organic manure or mineral fertilizer in both cultivations (Table, 3).

The interaction between biofertilizers and organic manure showed insignificant increment on leaf width (Table 4).

Leaf width was insignificantly affected by the interaction between biofertilizers and mineral fertilizer treatments in both seasons (Table, 5).

The interaction between organic manure and mineral fertilizer revealed the superiority of receiving the plants the highest rates of organic manure and mineral fertilizer (18 and 3 g /pot) with for increasing leaf width (Table, 6).

The obtained results are in accordance with that found by Abou El-Khashab (2003) who mentioned that inoculation olive seedlings with biofertilizers (*Azotobacter* and *Azospirillum*) significantly increased all vegetative growth chatacteristics. Similar trend of results was obtained by El-Akabawy (2000) on Egyptian clover, Sudhakar *et al*., (2000) on *Morus alba*, Jayathilake *et al*., (2002) on onion and Rashed (2002) on some aromatic plants.

4- Total leaf fresh and dry weights (g):

Table (3) reveals an increment of total leaf fresh and dry weights due to applying biofertilizers in both seasons. Gradual increases in these parameters were detected as a result of increasing the rates of organic manure or mineral fertilizer application in both seasons (Table, 3).

The interaction between biofertilizers and organic manure showed the superiority of biofertilizers inoculation and receiving the plants the highest rate of organic manure on increasing total leaf fresh and dry weights in both seasons (Table, 4).

A great influence on these parameters was observed resulting from plants treated with biofertilizers and received the highest rate of mineral fertilizer (3g / pot) as indicated in Table (5).

The interaction between organic manure and mineral fertilizer revealed the superiority of applying the highest rates of mineral and organic manure (3 and 18 g / pot, respectively) for increasing total leaf fresh and dry weights (Table, 6).

The increase of leaf fresh and dry weights as affected by applying organic manure and mineral fertilizer may be related to the increase in leaf parameters which led to an increase in photosynthesizing surface.

The results are in parallel line with those obtained by Ali (1998), Attia (2000) on *Lawsonia inermis*, L. Rashed (2002) on some aromatic plants, Abou El-Khashab (2003) and El-Fawakhry *et al*., (2004) on ficus.

Generally, the significant increases in vegetative growth parameters as a result of combined application of biofertilizers with mineral or organic manure could be attributed to the occurred increase in net assimilation rate as mentioned by (Shalaby *et al*., 2000). Moreover, biofertilizers produced adequate amounts of IAA and cytokinin, which increased the surface area per unit root length (Martin *et al*., 1989 and Jagnow *et al*., 1991). El- Gamal (1996) showed that mixed biofertilizers significantly increased leaves dry weight and net assimilation rate of potato plants. Abd-Alla *et al*. (2001) found that all biofertilizer treatments improved the vegetative growth of sweet pepper cv. Golden hybrid plants expressed as fresh and dry weight contents of plant organs, compared with the control (no biofertilizer) and Al-Moshileh (2004) on spinach who found that leaf area, fresh and dry weights of leaves were enhanced as a result of applying the biofertilizers Nitrobine and the chemical fertilizer "Sangral".

II- Bulb and roots characteristics:

Table (7) shows that the significant increment on bulb circumference, fresh and dry weight of bulbs and root dry weight were resulted from inoculation the soil with biofertilizers. Gradual increments were detected in theses parameters due to the increase in the rates of organic manure or mineral fertilizer applications.

Table (8) shows that the interaction between biofertilizers and organic manure resulted in a great effect on all of the studied bulbs parameters, especially when applying the highest rate of organic manure (18 g / pot).

There were significant increases in bulb circumference, dry weight of bulbs and roots and total chlorophylls content of leaves with increasing the mineral fertilizer rates and inoculation with biofertilizers. Whereas, in un-inoculation case, the increasing in values of leaves and bulbs were insignificant at low rates of mineral fertilizer, except for in case of applying the highest rate which caused a significant increase, in both growing seasons (Table, 9).

The interaction between organic manure and mineral fertilizer revealed the superiority of applying the highest rates of mineral and organic manure (3 and 18 g / pot, respectively on enhancing bulb and root characteristics (Table, 10).

The significant increases in bulb and root values as affected by biofertilizers and organic manure or mineral fertilizer treatments might be related to increasing the availability of minerals especially N fixation that may led to an increase in photosynthesizing surface. Therefore, an increase in accumulation of carbohydrates in bulbs occurred and subsequently resulted in an enhancement in bulb parameters. In addition to applied mineral fertilizer in the highest rate with biofertilizers inoculation led to significant increases in leaves elements contents specially nitrogen and this may led to an increase in cell division in subsurface organs, thereby enhanced the bulb and roots values.

The obtained results are in agreement with those of Wange and Patial (1994) on tuberose who found the applying 100 kg N / ha alone or inoculating with *Azotobacter* + *Azospirillum* mixtures significantly increased the bulb yield. Also, Wange *et al*., (1995) found that tuberose bulb yield was highest with 50 kg N/ ha and inoculation with *Azospirillum*. Wange (1995),on garlic, reported that the highest bulb yield was obtained with the treatment of 75 kg N/ ha + inoculation with *Azospirillum*. Sheikh *et al*., (2000) on *Duch iris*, found that the interactions between biofertilizers and nitrogen were significant for bulb weight. Similar results were obtained by Mangistu and Singh (1999) and Alkaff *et al*., (2002) on onion.

III- Chemical composition:

1- Total chlorophylls content (mg / 100 g F.W.):

Evidently data in Table (7) reveals a considerable increment on total chlorophylls content in leaves due to applying biofertilizer treatment. A gradual increment on this parameter resulted from increasing the rates of organic manure or mineral fertilizer treatments with significant effect in both experimental trials.

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The interaction between biofertilizers and organic manure indicated the superiority of biofertilizer inoculation and applying the highest rate of organic manure (18 g/pot) on increasing the total chlorophylls content in both growing seasons where the values increased to 234.90 and 237.24 mg / 100 g leaf fresh weight (L.F.W) in both seasons, respectively (Table, 8).

The interaction between biofertilizers and mineral fertilizer showed a great influence on this parameter in the two growing seasons as the values increased up to 235.72 and 239.73 mg / 100 g L.F.W. with the highest rate of mineral fertilizer application (3 g/pot) compared with that obtained from un-inoculated plants and received the lowest rate of mineral fertilizer only (1 g/ pot) in both seasons, respectively (Table, 9).

The interaction between organic and mineral fertilizers showed a great influence on the plants received the highest rates of organic manure and mineral fertilizer (18 and 3g / pot, respectively) where the values increase to 222.80 and 227.00 mg / 100 g F.W. in both of the growing seasons, respectively (Table, 10).

The significant increase in the total chlorophylls content might be due to the effect of the mixture of biofertilizers and mineral or organic manure, which acted mainly in increasing the availability of nitrogen, consequently increasing its absorption by the plant.

The increase of leaf chlorophylls content was reported by Abd-Alla *et al*., (1994) on wheat, El-Gamal (1996) who found that mixing biofertilizers was significantly increased potato leaf chlorophylls content. Abou El-Khashab (2003) mentioned that inoculating olive plant cvs. "Aggizi" and "Picual" with *Azotobacter* and *Azospirillum* highly influenced chlorophyll pigments. The same trend of results was obtained by El-Fawakhry *et al*., (2004) on ficus.

2- Availability of N, P and K in soil and N, P and K uptake of bulbs:

2-1 The effect of biofertilizers:

2-1-1 Availability of N, P and K in soil:

Table (11) shows that the application of biofertilizers significantly increased the amounts of the available N, P and K, as comparing the same rate of organic manure and means of mineral fertilizer application rates, except the increasing of available N at the highest rate of organic manure (18 g/pot) was insignificant. Biofertilizers application was magnified the increase of bioavailability. These results may be due to increasing of organic manure decomposition at highest rate of manure and increasing the nitrogen mineralization, at low C:N ratio less than 20:1, ammonium tends to accumulate which can volatilization in the calcareous soil condition (Table, 11).

2-1-2 The N, P and K uptake of bulbs:

Application of biofertilizers highly significantly effect on increase the bulbs uptake of N, P and K, especial at increasing the organic manure and mineral fertilizer application rates (Table, 11). Uptake of P was more affected with increasing of organic manure. In soils with high P-fixing capacities, organic compounds released during decomposition of organic manure processes may increase P availability by blocking P-adsorption sites (Easterwood and Sartain, 1990), or via anion exchange (Kafkafi *et al*., 1988).

Repeated incorporation of organic manures can also result in decreased soil bulk density and increased soil aggregation and moisture retention, all factors that may help increase P uptake by crops via their effects on increased root and mycorrhizal growth (Michel *et al*., 2003).

2-2 The effect of organic manure:

2-2-1 Availability of N, P and K in the soil:

Table (11) shows that the availability of N, P and K, in general, was significantly increased with increasing rates of application of organic manure. The used soil had very low of available N, P and K, cations exchangeable capacity (CEC) and organic matter content (Table, 1).

The available nitrogen increased significantly with organic manure application and increased with increase the application rates. Availability of P and K was insignificantly increased and the increasing was more affected biofertilizers application (Table, 11).

2-2-2 The N, P and K uptake of bulbs

The N, P and K uptake were significantly increased with incremental increasing of organic manure application rates, and addition biofertilizers was more affective on bulbs N, P and K uptake (Table, 11).

2-3 The effect of mineral fertilizer:

2-3-1 Availability of N, P and K:

There were highly significant increases of available N, P and K were resulted from addition of mineral fertilizer. The mineral fertilizer addition offers the soluble N, P and K nutrients to growth medium, and this action enhance the increase of N, P and K uptake of bulbs.

2-3-2 The N, P and K uptake of bulbs

The availability and uptake of N, P and K were affected by increase of incremental organic manure application rates, as well as biofertilizers application. These mean that two sources of fertilizers are very suitable for nutrition of *Narcissus tazetta* plant, especially under low soil organic matter, calcareous soil and sandy loam texture of study soil (Table, 1).

2- 4 The effect of the interaction of fertilizers:

2- 4-1 The interaction of biofertilizers and organic manure:

The data in Table (11) showed that the interaction between the biofertilizers and organic manure were significantly increased the availability and uptake of N and P, while the increasing the availability and uptake of K were insignificant. These results were done in response to the actions of microorganisms of biofertilizers on organic manure material and its transformation processing.

2- 4-2- The interaction of biofertilizers and mineral fertilizer:

The interaction of biofertilizers and mineral fertilizer applications were not significant on the availability and uptake of N, P and K. These results may revert to the mineral fertilizer which is already soluble materials.

2- 4-3 The interaction of organic manure and mineral fertilizer:

There were no significant difference between the organic manure and mineral fertilizer on the available N, P and K nutrient in the soil, these may be due to that mineral fertilizer is very soluble source of N, P and K elements and the organic manure is slow release of nutrients to soil.

Table (11): Effect of Fertilizer treatments on average of N, P_2O_5 and K_2O available in soil (mg kg^{-1}) and N, P and K uptake (g/pot) of *Narcissus tazetta*, L. plants in the two successive seasons (2002/03 and 2003/04)

Fertilizer treatments			Available element in soil, mg kg^{-1}			Element uptake, g/pot		
Bio Fertilizer g/pot	Organic manure g/pot	Mineral Fertilizer g/pot	N	P_2O_5	K_2O	N	P	K
0	6	1	23	7.0	202	1.15	0.30	2.10
		2	26	9.0	222	1.45	0.35	2.70
		3	28	11.0	234	2.15	0.45	3.40
		Mean	25.7	9.0	219.3	1.60	0.35	2.75
	12	1	30	9.0	208	2.30	0.45	3.10
		2	37	10.0	220	3.00	0.55	3.40
		3	45	12.0	236	3.40	0.70	4.20
		Mean	37.3	10.3	221.3	2.90	0.55	3.55
	18	1	36	9.0	210	5.15	0.65	3.70
		2	43	12.0	226	6.80	0.85	4.60
		3	45	14.0	236	9.95	1.35	5.35
		Mean	41.3	11.7	224	7.30	0.95	4.55
10	6	1	30	12	220	1.90	0.35	2.65
		2	39	16	235	2.35	0.50	3.25
		3	50	18	250	2.80	0.75	4.00
		Mean	39.7	15.3	235	2.35	0.55	3.30
	12	1	41	13	234	3.30	0.65	3.25
		2	50	17	246	4.55	0.85	3.95
		3	58	18	265	6.05	1.00	4.95
		Mean	49.7	16	248.3	4.65	0.85	4.05
	18	1	42	15	232	8.00	1.05	4.10
		2	48	17	240	9.85	1.35	4.95
		3	55	20	252	16.60	2.05	6.15
		Mean	48.3	17.3	241.3	11.45	1.50	5.05
L.S.D. (0.05) Biofertiliz. (Bi)			11.29^{*}	5.64^{*}	9.88^{*}	0.35	0.035^{*}	0.014^{*}
L.S.D. (0.05) Organic fert.			1.19^{**}	1.51^{*}	5.72^{*}	0.35	0.015^{*}	0.012^{*}
L.S.D. (0.05) Mineral fert.			1.64^{**}	1.22^{**}	2.98^{**}	0.02^{**}	0.02^{**}	0.012^{*}
L.S.D. (0.05) (Bi x Or)			5.36^{**}	3.73^{**}	NS	0.47^{**}	1.35^{*}	NS
L.S.D. (0.05) (Bi x Mi)			NS	NS	NS	NS	NS	NS
L.S.D. (0.05) (Or x Mi)			NS	NS	NS	1.20^{*}	0.14^{*}	0.44^{**}
L.S.D. (0.05) (Bi x Or x Mi)			NS	NS	NS	NS	NS	NS

Whereas, the two fertilizers were high significantly increased the N, P and K uptake of bulbs, these results were clearly bared that both of organic and mineral fertilizers were shared together for increasing the uptake of N, P and K (Table, 11).

2-4-4 The interaction of biofertilizers, organic manure and mineral fertilizer:

The interaction between of three fertilizers were increased the availability and uptake of N, P and K, but the increase was insignificant. These results may revert to present the soluble and suitable concentration of N, P and K from mineral fertilizer, on the other hand, there were slow release of available N, P and K from organic manure; push the plant to feed from easy sources first.

The best treatments, which were significantly increased the available N and K, were obtained at the application rates of 10 g, 12 g and 3 g per pot of biofertilizers, organic manure and mineral fertilizer, respectively. While, the highest available P was obtained at rates of 10 g, 18 g and 3 g of biofertilizers, organic manure and mineral fertilizer, respectively.

The highest uptake was obtained at the highest application rates of organic manure and mineral fertilizer (18 g and 3 g per pot) with biofertilizers addition.

The decomposition of organic manure by microorganisms as well as the mycelia, mucus, and slime produced; help bind together soil aggregates, increase availability of nutrients to plants and release of locked nutrients. The obtained data from present study were agreed with those data reported by Turner *et al*., (2003).

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تـأثير معـاملات الأسـمدة الحيويـة والسـماد العضـوى والسـماد المعـدنى علـى إنتـاج أبصال النرجس البلدى النامية فى التربةالجيرية الرملية اللومية

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أجريـت هـذه الدراسـة فـى موسـمى النمـو ٢٠٠٣/٢٠٠٢ و ٢٠٠٤/٢٠٠٣ بفـرع البحـوث بحديقـة أنطونيادس التابع لمعهد بحوث البساتين ، الاسكندرية ، مصر حيث أجريت تجربة أصص تحتوى ٢ كجم تربة جيريةرملية لومية

بهدف دراسة تأثير إضافة السماد العضوى و السماد المعدنى كريستالون (NPK١٩:١٩:١٩) فى وجود أوغياب الأسمدة الحيوية النتروبين (أزوتوباكتر + ازوسبيريللم) و الفوسفورين (يحتـوى على بكتيريا مذيبة للفوسفور) على إنتـاج أبصـال النـرجس البلـدى النـامى فـى التربـة الرمليـة اللوميـة. استخدم السماد المعدنى فى ثلاث مستويات ١ ، ٢ أو ٣ جم / أصيص/ شهر (مضـاف ٤ مرات خلال موسم النمو) أما السماد العضوى (النباتى) فقد أضيف للتربة قبل الزراعة بالجرعات ٦ ، ١٢ أو ١٨جم / أصيص. فى حين أن الأسمدة الحيوية أضيفت بمعدل ١٠ جم/ أصيص.

أشارت النتائج إلى أن كل معاملات إضـافة السماد الحيوى أحدثت زيـادة معنويـة فـى معظم صفات الأوراق ومحيط البصلة ووزنها الطازج والجاف والوزن الجاف للجذور وامتصاص الأبصال لعناصر النتروجين والفوسفور وكذلك المتاح من هذه العناصر فى التربة.

لوحظ أن الاثر المتبادل الناتج من أضـافة الاسمدة الحيويـة مـع معدلات متزايدة من السماد المعدنى قد أدى الى زيادات معنوية متدرجة فى معظم الصفات المدروسة. ولوحظت نتائج مماثلة كنتيجة لاضافة معدلات متزايدة من السماد العضوى مع السماد المعدنى.

أحـدث الأثـر المتبـادل النـاتج مـن التلقـيح بالأسـمدة الحيويـة فـى الأرض المعاملـة بالسـماد العضوى مع زيادة معدل إضافة السماد المعدنى زيادة معنوية فى صفات الأوراق وصـفات الأبصـال المنتجة وزيادة المتاح من عناصر النيتروجين والفوسفور فى التربة الرملية اللومية. وتحققت أفضل النتائج عند استخدام السماد العضوى والمعدنى بمعدل ١٨ و٣ جم/أصيص علـى الترتيـب فـى وجـود السماد الحيوى حيث حدثت زيـادة معنويـة فـى كل صـفات الأوراق والأبصـال المدروسـة ومحتـوى الأوراق مـن الكلوروفيـل الكلـى والـوزن الجـاف للجـذور وازداد امتصـاص عناصـر النيتـروجين والفوسفور والبوتاسيوم فى الأبصال وكذلك أزداد معنويا المتاح من هذه العناصر فـى التربـة الرمليـة اللومية، فيما عدا النتروجين فكانت الزيادة غير معنوية.

توصـي الدراسـة باسـتخدام معـدل الإضـافة ١٨ جـم/ أصـيص مـن السـماد العضـوى ومعـدل الإضافة ٣ جم/ أصيص شهرياً من السماد المعدنى مع التلقيح بالأسمدة الحيويـة وهذه هـى أفضـل المعاملات لانتاج أبصال النرجس البلدى فى التربة الرملية اللومية مع الحصـول علـى مستوى متـاح مناسب فى التربة من عناصر النتروجين و الفوسفور والبوتاسيوم.

Table (3): Effect of biofertilizers, organic manure and mineral fertilizer on number of leaves per plant, leaf length (cm), leaf width (cm) and total leaf fresh and dry weights (g) of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments	Number of leaves / plant		Leaf length (cm)		Leaf width (cm)		Total leaf fresh weight (g)		Total leaf dry weight (g)	
	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04
Biofertilizers										
Inoculation	12.45	12.45	40.08	42.20	1.45	1.49	21.02	21.25	3.61	3.67
Un-inoculation	13.85	13.98	44.18	45.67	1.70	1.75	17.22	17.39	2.80	2.88
L.S.D. (0.05)	0.38**	0.56**	1.78*	1.52*	0.08**	0.04**	0.05**	0.14**	0.05**	0.05**
Organic manure										
6 g/ pot	11.35	11.35	38.88	39.66	1.29	1.32	16.13	16.26	2.66	2.73
12 g/ pot	13.55	13.67	41.77	43.90	1.53	1.57	20.25	20.55	3.35	3.44
18 g/ pot	14.56	14.63	45.75	48.23	1.90	1.96	20.97	21.14	3.60	3.67
L.S.D. (0.05)	0.21**	0.27**	1.48**	0.70**	0.03**	0.03**	0.31**	0.56**	0.04**	0.03**
Mineral fertilizer										
1 g / pot/month	12.55	12.61	39.03	40.46	1.41	1.48	17.65	17.75	2.95	3.03
2 g / pot/month	13.13	13.30	42.96	45.01	1.59	1.61	18.98	19.26	3.23	3.30
3 g / pot/month	13.78	13.75	44.41	46.32	1.71	1.78	20.72	20.95	3.43	3.51
L.S.D. (0.05)	0.15**	0.16**	0.73**	1.02**	0.03**	0.03**	0.46**	0.39**	0.05**	0.03**

Table (4): Effect of the interaction between biofertilizer and organic manure on number of leaves per plant, leaf length (cm), leaf width (cm), total leaf fresh weight (g) and total leaf dry weight (g) of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Number of leaves / plant		Leaf length (cm)		Leaf width (cm)		Total leaf fresh weight (g)		Total leaf dry weight (g)	
Biofert.	Organic fertilizer	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	02 / 03
Inoculation	6 g/ pot	10.21	10.23	36.11	36.41	1.16	1.22	14.79	14.85	2.42	2.49
	12 g/ pot	12.68	12.78	39.94	42.73	1.40	1.43	18.06	18.28	2.88	2.98
	18 g/ pot	14.46	14.35	44.21	47.45	1.77	1.83	18.81	19.04	3.10	3.19
Un-inoculation	6 g/ pot	12.50	12.47	41.65	42.92	1.42	1.43	17.48	17.68	2.91	2.96
	12 g/ pot	14.41	14.56	43.61	45.07	1.66	1.71	22.43	22.82	3.83	3.90
	18 g/ pot	14.65	14.92	47.28	49.02	2.02	2.10	23.14	23.24	4.10	4.15
L.S.D. $_{(0.05)}$ biofert. × organic		0.11**	0.21**	3.57**	1.45**	N.S	N.S	0.04**	0.22**	0.31**	0.22**

Table (5): Effect of the interaction between biofertilizers and mineral fertilizer on number of leaves per plant, leaf length (cm), leaf width (cm), total leaf fresh weight (g) and total leaf dry weight (g) of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Number of leaves / plant		Leaf length (cm)		Leaf width (cm)		Total leaf fresh weight (g)		Total leaf dry weight (g)	
Biofert.	Mineral fertilizer added monthly	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	02 / 03
Inoculation	1 g/ pot	11.91	11.96	37.33	34.71	1.31	1.38	15.99	15.90	2.54	2.64
	2 g/ pot	12.46	12.44	40.72	41.30	1.46	1.47	16.98	17.31	2.83	2.91
	3 g/ pot	12.98	12.96	42.21	42.98	1.57	1.63	18.69	18.96	3.02	3.10
Un-inoculation	1 g/ pot	13.18	13.25	40.73	39.78	1.51	1.57	19.32	19.61	3.36	3.41
	2 g/ pot	13.80	14.16	45.21	45.23	1.73	1.74	20.98	21.21	3.63	3.68
	3 g/ pot	14.57	14.54	46.61	46.70	1.86	1.93	22.75	22.93	3.85	3.91
L.S.D. $_{(0.05)}$ biofertilizer × mineral		0.11*	0.21*	N.S	N.S	N.S	N.S	0.04**	0.22**	0.31**	0.22**

Table (6): Effect of the interaction between organic manure and mineral fertilizer on number of leaves per plant, leaf length (cm), leaf width (cm) and total leaf fresh and dry weights (g) of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Number of leaves / plant		Leaf length (cm)		Leaf width (cm)		Total leaf fresh weight (g)		Total leaf dry weight (g)	
Organic manure	Mineral fertilizer added monthly	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	02 / 03
6 g/ pot	1 g/ pot	10.70	10.71	34.58	34.71	1.12	1.19	13.51	13.42	2.32	2.37
	2 g/ pot	11.31	11.48	40.13	41.30	1.33	1.31	15.92	16.18	2.68	2.72
	3 g/ pot	12.05	11.86	41.93	42.98	1.42	1.47	18.97	19.20	3.00	3.09
12 g/ pot	1 g/ pot	13.03	13.05	38.00	39.78	1.35	1.41	19.33	19.63	3.20	3.30
	2 g/ pot	13.60	13.91	42.96	45.23	1.58	1.58	20.30	20.60	3.36	3.42
	3 g/ pot	14.01	14.06	44.36	46.70	1.66	1.73	21.11	21.43	3.50	3.59
18 g/ pot	1 g/ pot	13.91	14.06	44.51	46.90	1.76	1.83	20.11	20.21	3.33	3.41
	2 g/ pot	14.48	14.51	45.80	48.51	1.87	1.93	20.73	21.00	3.66	3.76
	3 g/ pot	15.28	15.33	46.93	49.30	2.05	2.14	22.08	22.21	3.80	3.84
L.S.D. (0.05) organic × mineral		0.11*	0.21*	3.57**	1.45**	0.48*	N.S	0.04**	0.22**	0.31**	0.22**

Table (7): Effect of biofertilizers, organic manure and mineral fertilizer on bulb circumference (cm), bulb fresh weight (g), bulb dry weight (g), root dry weight (g) and total chlorophylls content of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments	Bulb circumference (cm)		Bulb fresh weight (g)		Bulb dry weight (g)		Root dry weight (g)		Total chlorophylls content (mg / 100 g fresh weight)	
	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04	02 / 03	03 / 04
Biofertilizers										
Inoculation	14.21	14.40	54.62	54.71	15.10	15.30	18.94	19.34	180.42	185.57
Un-inoculation	15.55	15.70	58.62	57.72	17.22	17.37	27.47	28.03	222.49	226.72
L.S.D. (0.05)	0.18**	0.18**	2.90*	1.67*	0.07**	0.17**	0.56**	0.51**	2.61**	3.52**
Organic manure										
6 g/ pot	13.27	13.41	49.68	49.73	13.63	13.71	20.67	20.96	190.82	195.36
12 g/ pot	15.51	15.66	57.25	57.09	16.36	16.51	23.56	24.23	201.26	206.70
18 g/ pot	15.85	16.07	62.56	61.69	18.48	18.71	25.38	25.86	212.30	216.36
L.S.D. (0.05)	0.13**	0.19**	1.40**	1.47**	0.08**	0.21**	0.45**	0.28**	3.28**	1.27**
Mineral fertilizer										
1 g / pot/ month	14.14	14.33	52.91	52.55	15.21	15.30	19.81	20.16	187.04	191.36
2 g / pot/ month	15.01	15.18	56.95	56.15	16.16	16.32	23.33	23.88	204.93	209.47
3 g / pot/ month	15.48	15.63	59.62	59.82	17.10	17.38	26.48	27.01	212.41	217.60
L.S.D. (0.05)	0.12**	0.18**	1.45**	1.44**	0.08**	0.21**	0.38**	0.34**	1.94**	1.39**

Table (8): Effect of the interaction between biofertilizers and organic manure on bulb circumference (cm), bulb fresh weight (g), bulb dry weight (g), root dry weight (g) and total chlorophylls content of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Bulb circumference (cm)		Bulb fresh weight (g)		Bulb dry Weight (g)		Root dry weight (g)		Total chlorophylls content (mg / 100 g fresh weight)	
Biofert.	**Organic fertilizer**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**02 / 03**
Inoculation	**6 g/ pot**	12.75	12.91	47.01	47.52	12.58	12.81	16.98	17.11	172.35	176.18
	12 g/ pot	14.65	14.84	54.90	54.96	15.31	15.49	19.02	19.52	179.22	185.03
	18 g/ pot	15.22	15.45	61.21	61.41	17.40	17.60	20.81	21.38	189.71	195.48
Un-inoculation	**6 g/ pot**	13.80	13.92	52.35	51.95	14.69	14.77	24.36	24.81	209.28	214.54
	12 g/ pot	16.36	16.47	59.61	59.22	17.40	17.52	28.10	28.94	223.30	228.37
	18 g/ pot	16.48	16.70	63.91	61.97	19.56	19.80	29.96	30.34	234.90	237.24
L.S.D. (0.05) biofert. × organic		0.03**	0.04**	5.49*	3.32*	0.03**	0.11**	0.34**	0.19**	11.52**	6.04**

Table (9). Effect of the interaction between biofertilizers and mineral fertilizer on bulb circumference (cm), bulb fresh weight (g), bulb dry weight (g), root dry weight (g) and total chlorophylls content of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Bulb circumference (cm)		Bulb fresh weight (g)		Bulb dry weight (g)		Root dry weight (g)		Total chlorophylls content (mg / 100 g fresh weight)	
Biofert.	**Mineral fertilizer added monthly**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**02 / 03**
Inoculation	**1 g/ pot**	13.47	13.67	51.20	51.66	14.12	14.33	16.52	16.77	170.91	174.56
	2 g/ pot	14.44	14.60	54.62	54.91	15.14	15.31	18.68	19.06	181.27	186.67
	3 g/ pot	14.71	14.93	57.30	57.32	16.03	16.25	21.61	22.17	189.10	195.46
Un-inoculation	**1 g/ pot**	14.81	14.98	54.63	53.43	16.31	16.27	23.10	23.55	203.17	208.16
	2 g/ pot	15.57	15.76	59.28	57.38	17.18	17.32	27.97	28.71	228.58	232.26
	3 g/ pot	16.26	16.34	61.95	62.33	18.16	18.49	31.35	31.83	235.72	239.73
L.S.D. (0.05) biofertilizers × mineral		0.03**	0.04**	N.S	N.S	0.03**	0.11**	0.34**	0.19**	11.52**	6.04**

Table (10): Effect of the interaction between organic manure and mineral fertilizer on bulb circumference (cm), bulb fresh weight (g), bulb dry weight (g), root dry weight (g) and total chlorophylls content of *Narcissus tazetta*, L. plants during 2002/2003 and 2003/2004 seasons.

Treatments		Bulb circumference (cm)		Bulb fresh weight (g)		Bulb dry weight (g)		Root dry weight (g)		Total chlorophylls content (mg / 100 g fresh weight)	
Organic manure	**Mineral fertilizer**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**03 / 04**	**02 / 03**	**02 / 03**
6 g/ pot	**1 g/ pot**	12.10	12.25	44.15	44.08	12.80	12.70	16.93	17.10	176.13	180.61
	2 g/ pot	13.43	13.51	51.93	50.88	13.61	13.81	21.46	21.76	195.15	199.31
	3 g/ pot	14.30	14.48	52.96	54.25	14.49.	14.85	23.63	24.01	201.18	206.16
12 g/ pot	**1 g/ pot**	15.03	15.21	55.51	54.26	15.65	15.80	20.75	21.28	186.03	190.31
	2 g/ pot	15.56	15.75	56.11	56.48	16.60	16.73	23.70	24.28	204.50	210.16
	3 g/ pot	15.93	16.01	60.13	60.53	16.83	16.98	26.23	27.13	213.25	219.63
18 g/ pot	**1 g/ pot**	15.30	15.53	59.08	59.30	17.19	17.41	21.75	22.11	198.96	203.16
	2 g/ pot	16.03	16.28	62.81	61.08	18.27	18.42	24.83	25.61	215.15	218.93
	3 g/ pot	16.23	16.41	65.78	64.70	19.97	20.28	29.58	29.86	222.80	227.00
L.S.D. (0.05) organic × mineral		0.03**	0.04**	5.49**	3.32*	0.03**	0.11**	0.34**	0.19**	11.52*	6.04*