FACULTY OF AGRICULTURE

Minia J. of Agric. Res. & Develop.
Vol. (28) No. 2 pp 235 -244 , 2008

PARTIAL REPLACEMENT OF MINERAL NPK FERTILIZERS BY THE USE OF BIOFERTILIZERS IN GLADIOLUS PRODUCTION

Gamal E. Attoa
Hort. Dept., Fac. of Agric., Moshtohor, Banha Univ.

Received 22 April 2008 Accepted 22 May 2008

ABSTRACT

A field experiment was conducted during two successive seasons to study the effect of partial replacement of mineral NPK requirements by the use of biofertilizers in growing *Gladiolus grandiflorus*. Mineral NPK fertilizers were applied at full, 3/4, 1/2 and 1/4 dose in combination with 0, 1/4, 1/2, 3/4 and full dose of biofertilizers, respectively. Obtained results indicated that the three treatments of mineral NPK, 3/4 NPK + 1/4 biofertilizers and 1/2 NPK + 1/2 biofertilizers were significantly, equal in producing the best vegetative growth, flowering parameters, corm production and chemical constituents. In the second place came that of 1/4 NPK + 3/4 biofertilizers, while the full biofertilizer treatment ranked last.

INTRODUCTION

Gladiolus grandiflorus is belonging to Fam. iridaceae and known as one of the most imporant flowering bulbs grown in Egypt for the local market and exportation to foreign markets. Peter Pears cultivar, with its superb light orange cut flowers, is one of the promising gladiolus cultivars newly introduced to Egypt.

Many authors revealed the role of mineral NPK fertilizers in enhancing vegetative growth, flowering parameters, corm production and / or NPK content of gladiolus plants such as John *et al.*, (1997);

Mukherjee *et al.*, (1997); Mazrou and Al- Humaid (2000); Waly *et al.*, (2001); Badran *et al.*, (2001); Zaghloul and Moghazy(2001); Abd-Elazeem (2002); Pimpini and Zanin (2002); Attalla *et al.*, (2003) and Sayed (2004). Meanwhile, Kathiresan *et al.*, (2002); Sayed (2004); Badran *et al.*, (2006) and Mohamed *et al.*, (2006) on gladiolus; Wang and Patil (1994); Wang *et al.*, (1995) and El- Naggar (1998) on tuberose and El- Naggar and Mahmoud (1994) on nacrissus pointed out the beneficial effects of N- fixing and/ or P- dissolving biofertilizers on the previous flowering bulbs.

Partial substitution of mineral NPK fertilizers by the use of safe and economical N- fixing and P- dissolving biofertilizers was the aim of this study in order to obtain quantity and quality of flowering parameters and corm production.

MATERIALS AND METHODS

A field experiment was conducted during 2005/ 2006 and 2006/ 2007 successive seasons at the nursery of Fac. of Agric. Moshtohor, banha Univ. to explore the effect of mineral NPK fertilizers and/ or biofertilizers on vegetative growth, flowering aspects, corm formation and N, P and K % in the leaves of Peter Pears gladiolus cultivar. The corms, with an average diameter of 3.12 – 3.24 cm and average weight of 8.50 – 8.72 g, were obtained from Netherland through Basiony nurseries, Giza, Egypt. Prior planting, all corms were soaked for 1 min. in penlate at the concentration of 1g/l.

The experiment was set up in complete randomized block design with three replicates. Carms were planted in rows, 60 cm apart with 20 cm distance between hills, on the first week of Oct. of both seasons. Physical and chemical analysis of the soil are shown in Table (a).

Table a : Physical and chemical analysis of the soil:

Item	Value	Item	Value	Item		Value
Soil type	Clay loam	$CaCO_3$ %	2.08	Ex. K mg/ 100 g		2.12
Sand %	16.2	pH 1: 2.5	7.85	DTPA ppm	Fe	8.72
Silt %	39.8	E.C. mmhos	1.04		Cu	2.12
Clay %	44.0	Total N %	0.08		Zn	3.05
Org. Matt.%	1.56	Avial. P %	15.20		Mn	25.58

Five fertilization treatments were used as follows:
1-Full mineral NPK (300 kg/ fed. ammonium nitrate , 33.5 % N, 200 kg/ fed. calcium superphosphate, 15.5 % P_2O_5 and 100 kg/ fed. potassium sulphate , 48.5% K_2O). 2-Full biofertilization treatment (4 kg/ fed of each of biogen, N- fixing bacteria product, and phosphorein, P- dissolving bacteria product). 3-1/4 mineral NPK + 3/4 biofertilizers, 4-1/2 mineral NPK + 1/2 biofertilizers and 5- 3/4 mineral NPK + 1/4 biofertilizers. Mineral NPK amounts for each treatment were divided into 2 batches and added after 4 and 8 weeks from planting date. While, the two biofertilziers, biogen and phosphorein, were applied, separately, after mixing with suitable amount of fine sand, after one month from planting date.

During the flowering period, data were recorded for number of leaves/ plant, leaf area, leaf fresh and dry weights, spike length and fresh weight, florets number and florets fresh weight / spike. About six weeks of flower termination, corms and cormels were digged out and diameter and fresh weight of corms and number of cormels/ plant were recorded. Also, leaves % of N, P and K were determined according to Page *et al.*, (1982). All recorded data were statistically analyzed following L.S.D. method of Little and Hills (1978).

RESULTS AND DISCUSSION

Vegetative Growth Characters:

Presented data in Table 1 show that the four studied vegetative growth characters, number of leaves, leaf area and fresh and dry weight of leaf, of *Gladiolus grandiflorus* gave the highest values, in both seasons, in response to the mineral NPK treatment, followed by those of mineral NPK+ biofertilizers, whiel the treatment of biofertilizers only produced the lowest values. Significant differences were obtained between mineral NPK treatment and that received biofertilizers only. But no significant differences were detected between mineral NPK treatment and each of 1/2 NPK + 1/2 biofertilizers and 3/4 NPK + 1/4 biofertilziers, for the four tested vegetative traits in the two seasons as illustrated in Table 1.

Table 1: Effect of mineral NPK and/ or biofertilization treatments on vegetative growth characters of Peter Pears *Gladiolus grandiflorus* cultivcar during 2005/2006 and 2006/ 2007 seasons.

	Number of leaves / plant		Leaf area(cm^2)		Leaf F.W. (g.)		Leaf D.W. (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
NPK	7.12	7.35	41.8	43.3	24.6	26.2	4.14	4.27
Biofert.	5.77	5.94	27.9	26.2	17.3	17.1	2.80	2.74
1/4 Min. + 3/4 Bio.	6.28	6.50	33.5	34.5	20.4	21.4	3.44	3.56
1/2 Min. + 1/2 Bio.	6.82	7.08	38.7	40.6	22.8	23.6	3.78	3.91
3/4 Min. + 1/4 Bio.	6.95	7.18	40.0	42.7	24.2	25.8	3.91	4.08
L.S.D. at 5%	0.42	0.36	3.3	3.7	2.1	2.8	0.38	0.44

Flowering Parameters:

The longest and heaviest spikes, highest number of florets / spike and heaviest florets fresh weight were produced due to the mineral NPK treatment, while the least values were given by biofertilization treatment. meanwhile, the three dual treatments (NPK/ biofertilization treatments at different ratios) gave intermediate values for the four flowering parameters in both seasons. It was interesting to find out that no significant differences were obtained between mineral NPK treatment and either 1/2 NPK + 1/2 biofertilizers or 3/4 NPK / 1/4 biofertilizers. Moreover, the reduction in the four flowering parameters due to 1/4 NPK / 3/4 biofertilziers treatment compared to those of mineral NPK treatment was only 10- 20 % in the two seasons as shown in Table 2.

Table 2: Effect of mineral NPK and/ or biofertilization treatments on flowering parameters of Peter Pears *Gladiolus grandiflorus* cultivcar during 2005/2006 and 2006/ 2007 seasons.

	Spike length (cm)		Spike F.W. (g)		Florets No. / spike		Florets F.W. (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
NPK	78.2	76.7	48.0	46.2	10.7	11.3	41.4	43.2
Biofert.	64.5	62.2	35.6	34.7	7.3	8.2	32.1	33.9
1/4 Min. + 3/4 Bio.	69.6	66.3	38.9	38.0	8.9	9.6	35.0	36.4
1/2 Min. + 1/2 Bio.	74.0	73.8	44.8	43.6	10.2	10.1	39.5	39.8
3/4 Min. + 1/4 Bio.	77.8	75.1	46.0	45.8	10.8	10.6	40.2	41.4
L.S.D. at 5%	5.1	4.6	4.2	3.7	0.8	1.3	3.1	3.7

Corm and Cormels Production:

Table 3 shows that mineral NPK treatment gave the longest and heaviest corms and the highest number of cormels in comparison with all biofertilizers or NPK/ biofertilizer treatments in the two seasons. Significant differences were detected between such superior treatment and both biofertilizer and 1/4 NPK / biofertilzier treatments. But no significant differences were found between NPK treatment and both 1/2 NPK / 1/2 biofertilizer and 3/4 NPK/ 1/4 biofertilizer treatments in both seasons as clearly shown in Table 3.

Table 3: Effect of mineral NPK and/ or biofertilization treatments on corm and cormels production of Peter Pears *Gladiolus grandiflorus* cultivcar during 2005/2006 and 2006/ 2007 seasons.

	Corm diameter (cm)		Corm F.W. (g)		No. of cormels per plant	
	1st	2nd	1st	2nd	1st	2nd
NPK	4.31	4.06	8.36	8.56	17.2	21.2
Biofert.	2.77	2.58	6.39	6.21	9.3	11.9
1/4 Min. + 3/4 Bio.	3.14	3.07	6.74	6.80	13.0	17.4
1/2 Min. + 1/2 Bio.	3.98	3.84	8.08	8.27	15.8	19.0
3/4 Min. + 1/4 Bio.	4.05	3.90	8.21	8.41	16.6	21.4
L.S.D. at 5%	0.35	0.25	0.48	0.46	1.8	2.6

Leaves Nitrogen , Phosphorus and Potassium %:

Table 4 shows that the highest N, P and K % in *Gladiolus* leaves were resulted from the NPK mineral treatment in comparison with the other four bio- or mineral / bio treatments in the two seasons. Thereafter, N, P and K % were gradually decreased accoridng to the reducing ratio in NPK % in the mixed NPK/ biofertilizer treatment. The least values of N, P and K % were given due to the biofertilization treatment. It is worth to mention that N, P and K % of either 1/2 NPK/ 1/2 biofertilization or 3/4 NPK/ 1/4 biofertilization treatments were not significantly differ than that of complete NPK treatment, in both seasons, (Table 4).

Table 4: Effect of mineral NPK and/ or biofertilization treatments on leaves nitrogen, phosphorus and potassium of Peter Pears *Gladiolus grandiflorus* cultivcar during 2005/2006 and 2006/ 2007 seasons.

	Leaves nitrogen %		Leaves phosphorus %		Leaves potassium %	
	1st	2nd	1st	2nd	1st	2nd
NPK	3.08	2.98	0.433	0.406	3.92	3.71
Biofert.	2.58	2.41	0.350	0.310	3.22	3.33
1/4 Min. + 3/4 Bio.	2.79	2.62	0.392	0.364	3.50	3.51
1/2 Min. + 1/2 Bio.	2.94	2.84	0.415	0.381	3.88	3.58
3/4 Min. + 1/4 Bio.	3.03	2.88	0.417	0.388	3.94	3.71
L.S.D. at 5%	0.16	0.18	0.021	0.027	0.08	0.15

In agreement with our vegetative, flowering, corm production and NPK % results concenring NPK were those revealed on gladiolus by John *et al.,* (1997); Mukherjee *et al.,* (1997); Mazrou and Al-Humaid (2000);Badran *et al.,* (2001); Waly *et al.,* (2001); Zaghloulk and Moghazy (2001); Abd – Elazeem (2002); Pimpini and Zanin (2002) ; Attala *et al.,* (2003) and Sayed (2004). Some other investigators pointed out the role of biofertilizers, separately or in combination with mineral fertilization, such as Kathiresan *et al.,* (2002); Sayed (2004); Badran *et al.,* (2006) and Mohamed *et al.,* (2006) on gladiolus; Wang and Patil (1994); Wang *et al.,* (1995) and El- Naggar (1998) on tuberose and El- Naggar and Mahmoud (1994) on narcissus.

The role of mineral NPK fertilizers in improving different aspects of growth and flowering of gladiolus plants is attributed to the unique physiological roles of such three essential nutrients in plant growth and development. Meanwhile, the role of biogen might be attributed to the increase in soil available nitrogen as a result of fixing the atmospheric nitrogen, synthesizing stimulatory compounds i.e. gibberellins, cytokinins and IAA, stimulating photosynthesis, producing different amino acids like glutamate, aspartate, histidine and serine and/ or improving water status, (Mustafa and Omar, 1993 and El- Haddad *et al.,* 1993). On the other hand, it was found that phosphorein enhances the availability and solubility of phosphorus

through the release of organic and inorganic acids and CO_2, produced various growth hormones and increasing the available phosphorus in plant tissues, (Follet *et al.*, 1981 and Pamela and Hayasaka, 1982).

REFERENCES

Abd- Elazeem., M.A. (2002): Response of two gladiolus cultivars to some fertilization and growth regulator treatments. Ph. D. Diss, Fac. of Agric., Minia Univ.

Attalla, H.K.; Zaghloul, M.A. and Hashish, K.H. (2003): Effect of organic manure and NPK fertilizers on vegetative growth, flowering and chemical composition of some gladiolus cultivars. Annals Agric. Sci., Moshtohor, 41 (2): 680- 691.

Badran, F.S.; Attia, F.A. and Abou- Elela, H.A. (2001): Response of gladiolus bulbs to different soil and foliar nitrogen, phosphorus and potassium fertilization treatments. Proc. Fifth Arabian Hort. Conf. Ismailia, Egypt, March 24- 28, 2001: 157- 167.

Badran, F.S.; Mohamed, M.A.; Messeha, A.M. and Hassan, Z.B. (2006): Effect of soem fertilzier sources on Gladiolus grandiflorus plants. II. Effect of nitrogen sources and Aztotobacter. Third Egyptian- Syrian Conf. , Nov. 6-9, 2006, Vol.3 No. 1: 119- 129.

El- Haddad, M.E.; Ishac, Y.Z. and Mostafa, M.I. (1993): The role of biofertilizers in reducing agricultural costs, decreasing environmental pollution and raising crop yield. Arab. Univ. J. Agric. Sci., Ain Shams Univ. (1): 147- 159.

El- Naggar, A.L. (1998): Investigation on the response of tuberose plants (*Polinathes tiberosa*, L.) cv. Double to biofertilization with *Azospirillum* strains mixture and nitrogen fertilization under four different soil textures, J., Agric. Sci., Mansoura Univ., 23(12): 6177- 6203.

El- Naggar, A.L. and Mahmoud, S.M. (1994): Effect of inoculation with certain *Azospirillum* strains and nitrogen fertilization on *Narcissus tazetta*, L. under different soil textures. Assiut J. Sci., 25 (4): 135- 151.

Follet, R.H.; Murphy, L.S. and Dorahue, R.L. (1981): Fertilization and Soil Amendments. Pretice Hall Inc. Inglewood, Cliffs, New Jersy, U.S.A.

John, A.Q.; Paul, T.M. and Siddique, M. A. (1997): Nutritional studies on gladiolus I. Growth and floral characters. Advance in Plant Science, 10 (1): 45- 49. (C.F. Hort. Abst. 67(12): 10675).

Kathiresan, C.; Venkatesha, J.; Misra, R.L. and Sanyta, M. (2002): Effect of biofertilizers with levels of N and P on gladiolus. Proc. Nat. Symp. on Indian Floric, 25- 27. (C.F. www. Bids.ac.UK)

Little, I.M. And Hills, F.J. (1978): Agricultural Experimentation, Design and Analysis. John Wiley & Sons, Inc. New York.

Mazrou, M.M. and Al- Humaid, A.L. (2000): Growth and flowering of some gladioli cultivars in relation to chemical fertilizaiton rates. Zagazig J. Agric. Res., 27 (3): 635- 644.

Mohamed, M.A.; Badran, F.S.; Meseha, A.M. and Hasssan, Z.B. (2006): Effect of some fertilizer sources on Gladiolus grandiflorus , L. Plants. I. Effect of P source and P-dissolving microorganisms. Third Egyptian- Syrain Conf., Nov. 6-9, 2006, Vol. 3, No.1: 109- 118.

Mukherjee, S.; Jana, S.C. and Chatterjee, T.K. (1997): Effect of nitrogen and phosphorus sources on production of flowers and corms of *Gladiolus grandiflorus*, L. Indian Agriculturist, 28: 211- 213. (C.F. Hort. Abst. 67(1): 594).

Mustafa, S.S. and Omar, M.W. (1993): Estimation of N_2- fixed by some diazotrophs in tomato plant using N_{15} dilution technique. Assiut J. Agric. Sci., 24(1): 74- 96.

Page, A.L.; Miller, R.H. and Kenney, D.R. (1982): Methods of Soil Analysis, Part II., Amer. Soc. Agron. Inc. Madison, Wisconsin, U.S.A.

Pamela, A.C. and Hayasaka, S.S. (1982): Inorganic phosphate solubilization by rhizosphere bacteria in azasters marina community. Con. J. Microbiol, 28 (6): 805- 810.

Pimpini, F. and Zanin, G. (2002): Gladiolus. the effect of soil type and fertilizer, Culture, Protette, 31 (9): 107- 114. (C.F. www. Beds. Ac. UK)

Sayed, I.H. (2004): Response of gladiolus plants to some bio- and chemical fertilization treatments . Ph. D. Diss., Fac. of Agric., Minia Univ.

Waly, A.A.; Aly, M.M.; Hassan, M.A. and Sadek, F.O. (2001): Response of gladiolus plants to different complete fertilizer treatments under North Sinai condition. Annals of Agric. Sci., Moshtohor, 39 (3): 1665- 1680.

Wang, S.S. and Patil, P.L. (1994): Response of tuberose to biofertilizers and nitrogen . J. Moharashra Agric. Univ., 19 (3): 484- 485.

Wang, S.S.; Patil, P.L. and Patil, J.J. (1995): Effect of biofertilizers alone and with nitrogen levels on tuberose cv. "Spring Petaled". J. of Soil and Crops, 5 (2): 97- 99.

Zaghloul, M.A. and Moghazy, E.I. (2001): Response of some gladiolus cultivars to organic manure and NPK fertilizers in sandy soil under Sinai conditions. Annals Agric. Sci., Moshtohor, 39 (1): 585- 602.

Gamal E. Attoa

الاستبدال الجزئى للأسمدة المعدنية باستعمال الأسمدة الحيوية فى إنتاج الجلاديولس

د. جمال الدين إبراهيم عطوة
قسم البساتين – كلية الزراعة بمشتهر – جامعة بنها

تم إجراء تجربة حقلية خلال موسمين متتاليين لدراسة تأثير الاستبدال الجزئى للاسمدة الأزوتية الفوسفاتية البوتاسية المعدنية باستعمال الأسمدة الحيوية لإنتاج الجلايولس جراند فلورس. ولقد تم استعمال تلك الأسمدة المعدنية بالمعدل الكامل وكذلك بنسبة ٤/٣ ، ٢/١ ، ٤/١ هذا المعدل بالتداخل مع الأسمدة الحيوية بمعدل صفر ، ٤/١ ، ٢/١ ، ٤/٣ ، الجرعة الكاملة على الترتيب.

ولقد أظهرت النتائج عدم ظهور فروق معنوية بين الثلاثة معاملات الخاصة بالتسميد المعدنى الكامل، معاملة ٤/٣ معدنى + ٤/١ حيوى ومعاملة ٢/١ معدنى + ٢/١ حيوى حيث أعطت كل من هذه المعاملات الثلاثة أفضل نمو خضرى وزهرى ، وانتاج كورمات وتركيب كيماوى ، بينما جاء فى المرتبة الثانية معاملة ٤/١ معدنى + ٤/٣ حيوى فى حين جاءت معاملة التسميد الحيوى الكامل فى المرتبة الثالثة.