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EFFECT OF CERTAIN NP-RATES AND APPLICATION METHODS OF BIOFERTILIZER (MICROBEIN) ON PRODUCTIVITY AND STORABILITY OF GARLIC

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ABSTRACT

Two field trials were conducted on garlic clone Sids-40, in the privet farm at Kafr meet Fares village, Dakahlia Governorate, during 2005/2006 and 2006/2007 seasons to study the effect of certain NP-rates (100%, 75% and 50% from recommended dose) either single and/or in combination with some application methods of biofertilizer (seed cloves inoculate, soil inoculate, seed cloves inoculate + soil inoculate and control treatment) on plant growth, yield and its components, as well as chemical constituents and storability of bulbs during the storage period (five months). The obtained results could be summarized as follows:

In general, studied characteristics of the plants received the higher rates of NP-fertilizers better than those of low rate. Increasing the applied mineral NP-rate from 50% to 100% from recommended dose significantly increased all vegetative growth parameters, yield and its components, as well as N, P, K and volatile oils concentrations in cloves. Besides, the most interesting observation was the enhancing of storability by application NP at 100% rate followed by 75%.

On the other hand, application of biofertilizer (microbein) had significant increases in plant height, number of leaves, shoot dry weight, bulbing ratio, total yield, bulb weight and diameter, clove weight, as well as Chemical constituents in cloves and decreasing bulb weight loss percentage during the storage period compared with the control treatment. The higher values of this parameters were obtained when used cloves inoculate + soil inoculate method. The combined treatments of NP-rates with biofertilizer application methods seemed to be more effective than the single ones. The best results were obtained by using 75% NP-rate from recommended dose/fed in the presence of microbein as (cloves inoculate + soil inoculate) method, the values were superior to those achieved by 100% NP-rate/fed without microbein.

From the foregone it is evident that, application of biofertilizer microbein as a (cloves inoculate + soil inoculate) method for garlic plants rising their efficiency and reduce application rate of NP-fertilizers (about 25 %), thereby reducing costs and environmental pollution problems. Therefore, this treatment could be recommended for raising garlic yield and improving bulb quality during the storage period under similar conditions to this work.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important bulb vegetable crops and is next to onion in importance. It is commonly used as a spice or in many medicinal purposes. In Egypt, it has been generally cultivated for both local consumption and export. Therefore, increasing garlic yield and improving bulb quality are essential aims for both growers and consumers, but that advances usually depends on many factors especially that influence the plant growth throughout the growth period.

Nitrogen and phosphorus nutrition are two of major factors affecting growth, yield and quality of garlic. Nitrogen is a main constituent of many organic compounds in plants, such as proteins, enzymes, pigments, hormones and vitamins, (Gardener *et al*., 1985). Likewise, phosphorus plays an important role in certain essential steps, such as accumulation and release of energy during cellular metabolism. In addition, it is a constituent of many organic compounds in plants (Marschner, 1995). However, there are some problems which prevent the farmers to use sufficient amounts of nitrogene and phosphorus, such as nutritional requirements of garlic plants are quite high, the continuous increases in the costs of using chemical fertilizers and environment pollution problems.

Up to now a several investigations have been carried out to evaluate the effects of N fertilization on growth and productivity of garlic plants. In this respect, (Pal and Pandey, 1986; Setty *et al*., 1989; Abd El-Hamid *et al*., 1991 and 1996; Silva *et al*., 2000, Nadiu *et al*., 2000, El-Moursi, 1999 and El-Morsy and Shokr, 2005) found that plant height, number of leaves, neck thickness, bulb size, number of cloves/bulb and total yield were increases with increasing N-fertilizer level. Furthermore, contents of N, P and K in leaf and bulbs of garlic and volatile oils in bulbs were much increased by increasing N-level (Hilman and Noordiyati, 1988; Bertoni *et al*., 1988; Verma *et al*., 1996; El-Moursi, 1999, Naruka, 2002 and El-Morsy and Shokr, 2005). Besides, Several investigators reported that garlic plants growth, yield and storability were generally markedly advanced by phosphate fertilization (Setty *et al*., 1989; Panchal *et al*., 1992; Ashok *et al*., 1996; Wankhade *et al*., 1996; Cheng *et al*., 1997 and Abdel-Fattah, 2002).

On the other hand, the continuous increase in the costs of chemical fertilizers and environmental pollution problems prevents to application of sufficient amount for plants by many farmers. Thus, it has become essential to use of untraditional fertilizers as substitutes or supplements for chemical fertilizers. In this respect, El-Haddad *et al.* (1993) indicated that using biofertilizers is considered a promising alternative for chemical fertilizers under Egyptian soil conditions. There are many beneficial effects for using biofertilizer in agriculture such as, quick supplying of plant nutrients and increasing crop productivity, as well as reducing costs and the pollution of environment.

Many studies pointed out that inoculation of garlic plants with N_2-fixing bacteria of *Azospirillum* or *Azotobacter* either single or in combinations markedly increased plant shoot growth, bulb size, total yield and chemical compositions in plant, especially with their mixtures compared with the untreated plants (Mahendran and Kumar, 1996; Wange, 1998; Gomez and Munoz, 1998). Recently, Gouda (2002), Mohamad (2003) and El-Morsy and Shokr (2005) found that application of 75% recommended rate of chemical N-fertilizers in the presence of biofertilizers i.e., nitrobien or rhizobacterin significantly increased vegetative growth characteristics and yield and its components. Also, under such conditions, some microorganisms known as phosphate solubilizing bacteria (phosphobacterium) play a fundamental role in correcting the solubility problem in many soils by converting the fixed form to a soluble form to be ready for plant nutrition (Forster and Freter, 1988 and

El-Dahtory *et al*., 1989). Likewise, Abdel–Hafez (1966) indicated that phosphobacterium are involved in the availability of phosphorus and other elements in soils, through the decomposition of organic compounds and oxidation or reduction of inorganic compounds, which may lead to a change in the soil reaction (pH).

In this respect, some researchers found that inoculation of garlic plants with phosphobacterium clearly increased vegetative growth, bulb yield and chemical contents over the untreated ones (Gurubatham *et al*., 1989; Wange, 1995; Mahendran and Kumar , 1996, Gomez and Munoz, 1998 and Abdel-Fattah, 2002). Recently, the inclined to use of biofertilizers, as a substitute or supplement of chemical fertilizers, become necessary. Therefore, the main objectives of present investigation to study the influence of some application methods of biofertilizer (microbein) under some mineral NP-rates to reach the best one to have the perfect beneficial towards better growth, yield and its components, as well as storability of garlic bulbs (Sids–40 clone) under the local conditions.

MATERIALS AND METHODS

Two field experiments were carried out at the privet Farm at Kafr meet Fares village, near El-Mansoura, Dakahlia Governorate, during two growing seasons of 2005/ 2006 and 2006/2007, to study the effects of NP rates either single or in combination with some application methods of biofertilizer (microbein) on garlic (Sids-40) growth, yield and its components, as well as chemical constituents in cloves and bulb storability. Microbein is a commercial product name for mixture of N2 fixing bacteria (Azosprillium sp. and Azotobacter sp.) and P solubilizing bacteria (Bacillus sp.), its product was the General Organization Equalization Fund (GOEF), Ministry of Agriculture, Egypt. The soil of the experimental field was clay loam in texture with pH of 7.9. Soil available N, P and K contents were 19.6 - 22.3, 2.6 - 2.9 and 290 - 310 ppm during the first and second seasons, respectively. The experiment included 12 treatments were as follows:

a- NP-rates:

1- 100% from recommended dose (120 kg N + 72 kg P/fed).
2- 75% from recommended dose (90 kg N + 54 kg P/fed).
3- 50% from recommended dose (60 kg N + 36 kg P/fed).

b- Biofertilizer application methods:

1- Control treatment. (untreated by biofertilizer).
2- Cloves inoculate (by mixed with thick pastes of carrier based inoculants).
3- Soil inoculate (biofertilizer mixed with wet soft dust (1: 10 ratio) and it was supplied in the sub-plots as a soil inoculation into the root absorption zone of plants at the 15 th day from planting, just before irrigation).
4- Cloves inoculate + soil inoculate.

Garlic cloves in all application methods of biofertilizer or control treatment were soaked in running water for 24 h before treatment or planting.

Planting was carried out during the first week of October for both seasons. Nearly Uniform cloves were hand-planted on both sides of the ridges at 10 cm apart. The NP fertilizers rates were applied after 30 and 60 days from planting, likewise, all plants were fertilized with 96 kg K2O/fed (potassium sulphate, 48% K_2O). The other cultural practices for garlic commercial production were used according to the instruction laid down by the Ministry of Agriculture, Egypt. The harvesting was done 180 days after planting in both seasons.

Data recorded:

1- Growth parameters:

A random sample of ten plants was taken from the two outside rows of each plot after 120 days from planting to estimate plant height, number of leaves/plant, bulbing ratio (neck diameter/bulb diameter) and shoot dry weight/plant.

2- Yield and its components:

At harvest time, marketable plants (300 plants) in the three central rows of each plot were cured, 15 days after harvest weighed in kg and converted to record as total yield (ton/fed). A random sample (10 bulbs) was taken from each treatment to determine average of bulb weight and diameter, as well as the number of cloves/bulb and clove weight.

3- Chemical analysis:

Samples of the dried cloves were ground, wet digested as described by Hesse (1971) and their nitrogen (N), phosphorus (P) and potassium (K) contents were determined according to the methods described by Chapman and Pratt (1961), John (1970) and Brown and Lilleland (1946), respectively. Volatile oils (cm^3/kg bulbs fresh weight) was determined according to Guenther (1961).

4- Storability:

After curing, random samples (10 kg of marketable yield from every plot) were taken, stored at the normal room conditions and the percentage of weight loss was recorded monthly during the storage period (five months).

Data obtained during the two seasons of the study were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Plant growth parameters :

1.1- Effect of NP-rates :

The data presented in Table (١) show that plant height, number of leaves/plant and shoot dry weight/plant were significantly increased with increasing NP-rates. Also, the bulbing ratio was better with supplying higher rates of nitrogen and phosphorus in both seasons. The increase in plant growth might be attributed to the favorable effects of nitrogen on stimulating the meristematic activity for producing more tissues and organ, since nitrogen plays an important role in protein and nucleic acids synthesis as well as protoplasm formation (Marschner, 1995), Also, the great role of phosphorus element which is extremely important as a structural part of many organic

compounds in plants, in addition, it has an important role in energy metabolism as the high energy released from hydrolysis of pyrophosphate and various organic phosphate bonds is used to induce chemical reactions of plant growth (Gardener *et al*., 1985). The obtained results are in harmony with those of (Setty *et al*., 1989; Abd El-Hamid *et al*., 1991 and 1996; El-Moursi, 1999; Silva *et al*., 2000; Nadiu *et al*., 2000; Abdel-Fattah, 2002 and El-Morsy and Shokr, 2005), they found that plant growth characters studied were significantly increased with increasing of application N or P.

Table (1): Vegetative growth characters of garlic plant as affected by NP levels, application methods of biofertilizer (microbein) and their interactions during 2005/2006 (S1) and 2006/2007(S2) seasons.

characters / Treatments		Plant height (cm)		Number of leaves/plant		Shoot dry weight/plant (gm)		Bulbing ratio	
		S1	S2	S1	S2	S1	S2	S1	S2
NP-rates									
100% NP		٨٣,7	٨٦,8	١٢,٠	١٢,٥	١٢,٩٤٢	١٣,٧٢٥	٠,٣3	٠,٣1
75% NP		٨٣,٦	٨٦,٦	١١,٧	١٢,4	١٢,٦٣٣	١٣,٤٤٢	٠,٣٣	٠,٣١
50% NP		٧٩,7	٨٢,٣	١٠,1	١١,٤	١١,٥٩٢	١١,٨٠٨	٠,٣٥	٠,٣4
LSD at 5%		2.4	1.1	0.4	0.5	0.329	0.439	0.01	0.01
Application method of biofertilizer									
Control		٧٩,٤	٨٣,3	١٠.8	١١,٥	١١,٨١١	١٢,٥٨٩	٠,٣٥	٠,٣4
Cloves inoculate		٨٠,6	٨٤,8	١١,٠	١٢,٠	١٢,١٤٤	١٢,٦٠٠	٠,٣٤	٠,٣3
Soil inoculate		٨٣,٩	٨٥,٧	١١,٧	١٢,٢	١٢,٥٢٢	١٣,١٨٩	٠,٣4	٠,٣2
Cloves ino. + soil ino.		٨٥,٣	٨٧,٢	١٢,4	١٢,٧	١٣,٠٧٨	١٣,٥٨٩	٠,٣٢	٠,٣١
LSD at 5%		0.4	0.5	0.3	0.3	0.357	0.256	0.01	0.01
Interactions:									
NP-rates	**App. method of bio.**								
100% NP	Control	٨٠,٧	٨٥,٠	١١,٢	١١,٨	١٢,٣٣٣	١٣,٣٣٣	٠,٣٤	٠,٣3
	Cloves ino.[1]	٨١,٥	٨٦,٧	١١,٧	١٢,٦	١٢,٦٦٧	١٣,٣٣٣	٠,٣٣	٠,٣١
	Soil ino.[2]	٨٥,٣	٨٧,١	١٢,٣	١٢,٧	١٣,١٠٠	١٣,٩٠٠	٠,٣3	٠,٣١
	1+ 2	٨٧,٠	٨٨,٢	١٢,٩	١٣,٠	١٣,٦٦٧	١٤,٣٣٣	٠,٣١	٠,٣٠
75% NP	Control	٨٠,٩	٨٤,9	١١,٠	١٢,٠	١٢,٢٠٠	١٣,١٠٠	٠,٣٤	٠,٣٢
	Cloves ino.[1]	٨١,5	٨٦,٣	١١,٢	١٢,٢	١٢,٤٣٣	١٣,٠٠٠	٠,٣٤	٠,٣2
	Soil ino.[2]	٨٥,1	٨٦,٩	١١,٩	١٢,٣	١٢,٦٦٧	١٣,٥٦٧	٠,٣٣	٠,٣١
	1+ 2	٨7.0	٨٨,٤	١٢,٨	١٢,٩	١٣,٢٣٣	١٤,١٠٠	٠,٣2	٠,٣٠
50% NP	Control	٧٦,٦	٨٠,٠	١٠,٠	١٠,8	١٠,٩٠٠	١١,٣٣٣	٠,٣٧	٠,٣٦
	Cloves ino.[1]	٧٨,٧	٨١,٣	١٠,٢	١١,٢	1١,٣٣٣	١١,٤٦٧	٠,٣6	٠,٣٥
	Soil ino.[2]	٨١,٣	٨٣,٠	١١,٠	١١,٧	١١,٨٠٠	١٢,١٠٠	٠,٣٥	٠,٣٣
	1+ 2	٨٢,٠	٨٥,٠	١١,٤	١٢,١	١٢,٣٣٣	١٢,٣٣٣	٠,٣٣	٠,٣٣
L.S.D. at 5%		0.8	0.8	0.5	0.6	0.619	0.443	0.01	0.01

1= Cloves inoculate & 2 = Soil inoculate

1.2- Effect of biofertilizer (Microbein) application methods:

In Table (1), it is noticed that all application method of biofertilizer (microbein significantly increased plant height, number of leaves/plant and shoot dry weight comparing with those of the plants in uninoculated plots in both seasons of study. Also, the bulbing ratio was better with microbein inoculums in both seasons. The highest values of plant growth characters were obtained from (cloves inoculate + soil inoculate) method in both seasons. These increases in plant growth may be due to the great role of biofertilizer bacteria in enhancing plant growth by N_2-fixing in cultivated soils

and/or contributing some growth hormones, such as gibberellins, auxins and cytokinins (Bouton *et al.*, 1985 and Cacciari *et al.*, 1989), in addition to the vital role of phosphate-solubilizing bacteria (phosphobacterium) in supplying the growing plants with available phosphorus needs, some micronutrients and phytohormons, such as gibberellins, auxins or cytokinins (Cacciari *et al*., 1989). These promoting substances may stimulate shoot growth and/or root initiations of plants. Similar results were reported by (Wange, 1998; Gomez and Munoz, 1998; Abdel-Fattah, 2002 and El-Morsy and Shokr, 2005).

1.3- Effect of interaction between NP-rates and application methods of biofertilizer:

The data in Table (1) show the effect of the interaction between NP-rates and application methods of biofertilizer on growth of garlic plants. It is clear from data, the combined treatments are more superior effect than single ones, this is true for both seasons. Plants received 75% from NP recommended rate with cloves inoculate + soil inoculate of microbein gave the maximum height, number of leaves/plant and shoot dry weight for both seasons. Such results previously were explained by Reynders and Vlassak (1982), who suggested that the moderate or lower chemical N addition with biofertilizers may activate N_2-fixing bacteria in the soil, these bacteria have the ability to supply the plants with fixed-N and release plant growth promoting substances (GA, IAA and cytokinins), also, use of chemical phosphorus in combination with phosphobacterium may activate P-solubilizing bacteria in soil and consequently increase available phosphorus and plant growth promoting substances (El- Dahtory *et al*.,1989). The obtained results are in accordance with those of (Abdel-Fattah, 2002; Gouda, 2002; Mohamad, 2003 and El-Morsy and Shokr, 2005).

2- Yield and its components:

2.1- Effect of mineral P-levels :

The data presented in Table (2) reveal that all the studied characteristics of garlic yield and its components, were generally greater with higher NP-rates. Increasing the supplied NP-rate significantly increased total yield, bulb weight and diameter, as well as clove weight in both seasons, while, number of cloves/bulb was reduced.

Yield increases may be due to the increases in plant growth characteristics, i.e, plant height, number of leaves and shoot dry weight which increase photosynthesis rate and this in turn increased the total yield and its components. The obtained results are in harmony with those reported by (Pal and Pandey, 1986., Setty *et al*., 1989; Abd El-Hamid *et al*., 1991 and 1996; Silva *et al*., 2000; Nadiu *et al*., 2000; Abdel-Fattah, 2002 and El-Morsy and Shokr, 2005).

2.2- Effect of biofertilizer (Microbein) application methods:

In Table (2), the data show that inoculation with microbein exerted significant increases in the total yield, bulb weight, number of cloves/bulb and clove weight for both seasons as compared with those of the plants uninoculated. The application method (Cloves inoculate + soil inoculate) of biofertilizer gave the highest yield compared with the other ones in both seasons. Such results may suggest that the perfect beneficial effects for this application method of biofertilizer on total yield and its components, this might

be due to one or more from following mechanisms: N_2-fixation, production of plant growth promoting substances or organic acids, enhancing nutrient uptake or protection against plant pathogens (EL-Haddad *et al*., 1993). Also, microbein contains live efficient-bacteria which have the ability to supply the growing plants with phosphorus, micronutrients and phytohormones that could stimulate nutrients absorption, photosynthesis and hence increasing plant yield (Abdel-Hafez, 1966). The obtained results were confirmed by (Mahendran and Kumar, 1998; Gomez and Munoz, 1998; Abdel-Fattah, 2002 and El-Morsy and Shokr, 2005), they found that application of biofertilizer for garlic plants markedly increased the availability of all the major nutrients and also the nutrient uptake by plants and total bulb yield was increased by about 15.04% than with the untreated ones.

Table (2): Total yield and its components as affected by NP levels, application methods of biofertilizer (microbein) and their interactions during 2005/2006 (S1) and 2006/2007 (S2) seasons.

Characters / Treatments		Total yield (ton/fed)		Bulb Weight (gm)		Bulb diameter (cm)		No. of cloves/ bulb		Clove weight (gm)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
NP-rates											
100% NP		٦,٩٧٨	٧,١٢٩	٦٢,٣٤٢	٦٦,٣٨٣	٥,9	٦,٥	١٥,٥	١٥,6	٣,٦٧٥	٣,٩٥٨
75% NP		٦,٨٥٢	٧,٠٣٤	٦١,٩٦٧	٦٥,٨٣٣	٥,9	٦,٣	١٦,٠	١٥,٥	٣,٥٥٨	٣,٨٠٨
50% NP		٥,٩٨٧	٦,٢٥١	٥٥,٥٥٠	٥٩,٧٢٥	٥,2	٥,4	١٧,٢	١٦,٤	٢,٩٢٥	٣,٤٥٠
LSD at 5%		0.131	0.271	0.670	0.608	0.2	0.4	0.7	0.3	0.356	0.339
Application method of bio.											
Control		٦,١٣٠	٦,٤٥٤	٥٥,٦٣٣	٦٠,٦٥٦	5.3	٥,8	١٦,٩	١٦,4	٢,٩٥٦	٣,٣٦٧
Cloves inoculate		٦,٣٤٦	٦,٥٥٨	٥٨,٧٠٠	٦١,٣٧٨	٥,٦	٥,٩	١٦,٥	16.0	٣,١٦٧	٣,٥٣٣
Soil inoculate		٦,٧٨٢	٧,٠٠٩	٦٠,٨٨٩	٦٥,٠٦٧	٥,٧	٦,١	16.0	١٥,٧	٣,٥٢٢	٣,٨٧٨
Cloves ino. + soil ino.		٧,١٦٦	٧,١٩٨	٦٤,٥٨٩	٦٨,٨٢٢	6.0	٦,٤	١٥,٥	١٥,٣	٣,٩٠٠	٤,١٧٨
LSD at 5%		0.088	0.221	0.804	0.674	0.1	0.2	0.5	0.3	0.136	0.187
Interactions:											
NP-rates	**App. method of bio.**										
100% NP	Control	٦,٤٣٧	٦,٨٥٧	٥٨,٨٠٠	٦٣,٤٣٣	٥,٧	٦,٣	١٦,١	١٦,١	٣,٢٠٠	٣,٦٠٠
	Cloves ino.[1]	٦,٦٣٣	٦,٥٥٧	٦١,٣٣٣	٦٣,٦٦٧	٥,٧	٦,٣	١٥,٧	١٦,٠	٣,٥٠٠	٣,٨٠٠
	Soil ino.[2]	٧,٢٠٠	٧,٤٠٧	٦٣,٠٠٠	٦٧,٢٠٠	٥,٩	٦,٥	١٥,٢	١٥,٣	٣,٨٠٠	٤,٠٠٠
	1+ 2	٧,٦٤٣	٧,٦٩٧	٦٦,٢٣٣	٧١,٢٣٣	٦,٢	٦,9	١٥,٠	١٤,٩	٤,٢٠٠	٤,٤٣٣
75% NP	Control	٦,٤٠٧	٦,٥٨٠	٥٦,٦٦٧	٦٢,١٠٠	٥,٤	٦,1	١٧,٢	١٦,٢	٣,٠٦٧	٣,٤٠٠
	Cloves ino.[1]	٦,٥٩٠	٦,٩٤٧	٦١,٣٣٣	٦٣,١٣٣	٥,٨	٦,٢	١٦,٣	١٥,٦	٣,٣٠٠	٣,٤٦٧
	Soil ino.[2]	٧,٠١٧	٧,٢٨٠	٦٢,٦٦٧	٦٧,١٠٠	٥,٩	٦,٣	١٥,٢	١٥,٣	٣,٧٦٧	٤,٠٦٧
	1+ 2	٧,٣٩٣	٧,٣٣٠	٦٧,٢٠٠	٧١,٠٠٠	٦,١	٦,٦	١٥,٢	١٤,٨	٤,١٠٠	٤,٣٠٠
50% NP	Control	٥,٥٤٧	٥,٩٢٧	٥١,٤٣٣	٥٦,٤٣٣	٤,٧	٤,٩	١٧,٣	١٦,8	٢,٦٠٠	٣,١٠٠
	Cloves ino.[1]	٥,٨١٣	٦,١٧٠	٥٣,٤٣٣	٥٧,٣٣٣	٥,2	٥,٢	١٧,٦	١٦,٣	٢,٧٠٠	٣,٣٣٣
	Soil ino.[2]	٦,١٣٠	٦,٣٤٠	٥٧,٠٠٠	٦٠,٩٠٠	٥,٣	٥,٦	١٧,٤	١٦,٣	٣,٠٠٠	٣,٥٦٧
	1+ 2	٦,٤٦٠	٦,٥٦٧	٦٠,٣٣٣	٦٤,٢٣٣	٥,٦	٥,٩	١٦,٤	١٦,٢	٣,٤٠٠	٣,٨٠٠
L.S.D. at 5%		0.154	0.383	1.393	1.168	0.1	N.S	N.S	N.S	0.236	0.324

1= Cloves inoculate & 2 = Soil inoculate

2.3- Effect of interaction between NP-rates and application methods of biofertilizer:

Regarding to the interaction effect of NP-rates and application methods of biofertilizer (microbein) on the yield and its components, the data illustrated in Table (2) show that total yield and bulb weight, bulb diameter, number of cloves/bulb and clove weight were significantly affected at both seasons. It is

notable that plants fertilized with 75% from NP recommended rate in the presence of microbein as (cloves inoculate + soil inoculate) method achieved abundant yield which was superior that produced by using 100% NP recommended rate alone. These results may be due to beneficial effect of both NP and this application method of microbein on plant growth. Similar results were obtained by Abdel-Fattah (2002) and El-Morsy and Shokr (2005) they found that the maximum yield of garlic bulbs was resulted from adding 90 kg N/fed in the presence of rhizobacterin and using 72 kg P_2O_5/fed in the presence of phosphorin.

3- Chemical constituents:

3.1- Effect of NP-rates:

Data in Table (3) indicate that increasing the applied NP from 50% to 100% from recommended rate was significantly increased N, P K and volatile oils concentrations in garlic cloves. These results are in agreement with those of (Hilman and Noordiyati, 1988; Bertoni *et al*., 1988; Verma *et al*., 1996; El-Moursi, 1999; Abdel-Fattah, 2002; Naruka, 2002 and El-Morsy and Shokr, 2005). they found that levels of N, P, K, TSS and volatile oils in cloves were increased by increasing of application N and P.

Table (3): Chemical constituents in garlic bulbs as affected by NP-rates, application methods of biofertilizer (microbein) and their interactions during 2005/2006 (S1) and 2006/2007 (S2) seasons.

Treatments / characters		Volatile oils (Mg/100g f.w)		N %		P %		K %	
		S1	S2	S1	S2	S1	S2	S1	S2
NP-rates									
100% NP		٠,٤٣٥	٠,٤٥٧	١,٥6	١,٥٩	٠,٤9	٠,٥٠	١,٤6	١,٤٨
75% NP		٠,٤٢٤	٠,٤٤٥	١,٥7	١,٥4	٠,٤9	٠,٤٩	١,٤7	١,٤٩
50% NP		٠,٣٩٨	٠,٣٨٥	١,٣٩	١,٤4	٠,٤١	٠,٤1	١,٣٩	١,٣٩
LSD at 5%		0.089	0.048	0.13	0.10	0.01	0.01	N.S	N.S
Application method of bio									
Control		٠,٣٨٩	٠,٤٠٠	١,٤٥	١,٤٥	٠,٤4	٠,٤٥	١,٤2	١,٤٣
Cloves inoculate		٠,٤٠٧	٠,٤١٧	١,٤٧	١,٤٨	٠,٤5	٠,٤6	١,٤3	١,٤5
Soil inoculate		٠,٤٣٣	٠,٤٤٣	١,٥٤	١,٥٣	٠,٤٧	٠,٤٧	١,٤5	١,٤٦
Cloves ino. + soil ino.		٠,٤٤٧	٠,٤٥٧	١,٥٩	١,٦١	٠,٤9	٠,٤٩	١,٤٧	١,٤٨
LSD at 5%		0.042	0.049	0.06	0.06	0.0١	0.01	N.S	N.S
Interactions:									
NP-rates	**App. methods of bio.**								
100% NP	Control	٠,٤١٠	٠,٤٣٠	١,٥١	١,٥٢	٠,٤7	٠,٤9	١,٤٣	١,٤٥
	Cloves ino.[1]	٠,٤٢٠	٠,٤٥٠	١,٥٤	١,٥٦	٠,٤٨	٠,٤٩	١,٤5	١,٤٨
	Soil ino.[2]	٠,٤٥٠	٠,٤٧٠	١,٦٢	١,٦١	٠,٥0	٠,50	١,٤٧	١,٥٠
	1+ 2	٠,٤٦٠	٠,٤٨٠	١,٦٧	١,٦٧	٠,٥١	٠,٥٣	١,٤٩	١,٥٠
75% NP	Control	٠,٣٩٧	٠,٤٢٠	١,٥١	١,٤٨	٠,٤٦	٠,٤٧	١,٤٤	١,٤٧
	Cloves ino.[1]	٠,٤١٠	٠,٤٣٠	١,٥٢	١,٤٧	٠,٤٧	٠,٤8	١,٤٥	١,٤٧
	Soil ino.[2]	٠,٤٤٠	٠,٤٦٠	١,٦٠	١,٥٤	٠,٤٩	٠,٤٩	١,٤٨	١,٥٠
	1+ 2	٠,٤٥٠	٠,٤٧٠	١,٦٣	١,٦٦	٠,٥٢	٠,٥٢	١,٥٠	١,٥٢
50% NP	Control	٠,٣٦٠	٠,٣٥٠	١,٣٣	١,٣٦	٠,٣٩	٠,40	١,٣٨	١,٣٧
	Cloves ino.[1]	٠,٣٩٠	٠,٣٧٠	١,٣٦	١,٤٢	٠,40	٠,40	١,٣٨	١,٣٩
	Soil ino.[2]	٠,٤١٠	٠,٤٠٠	١,٤٠	١,٤٥	٠,٤٣	٠,٤١	١,٣٩	١,٣٩
	1+ 2	٠,٤٣٠	٠,٤٢٠	١,٤٧	١,٥١	٠,٤٣	٠,٤٣	١,٤١	١,٤٢
L.S.D. at 5%		0.074	0.085	0.11	0.10	0.01	N.S	0.1٢	0.11

1= Cloves inoculate & 2 = Soil inoculate

3.2- Effect of biofertilizer application method:

Concerning to the effect of biofertilizers application method on chemical constituents in garlic cloves, data in Table (3) show that N,P, K and volatile oil concentrations in garlic cloves were increased significantly with application of microbein as cloves inoculae + soil inoculate method. These results concerted with those of (Abdel-Fattah 2002; Gouda, 2002; Mohamad, 2003 and El-Morsy and Shokr, 2005).

3.3- Effect of interaction between NP-rates and application methods of biofertilizer:

The data in Table (3) show that NP-rates with application methods of biofertilizers interaction had significant influences on N, P, K and volatile oils concentrations in garlic cloves. Garlic plants fed on 100% or 75% NP from recommended rate with all application methods of biofertilizer gave the highest values of N, P, K and volatile oils in cloves. The highest values of N, P, K and volatile oils were obtained from plants received 100% or 75% NP from recommended rate with the method of (cloves inoculate + soil inoculae) in both seasons. Similar results were found by Gouda (2000) and Mohammed (2003).

4- Storability :

4.1- Effect of NP-rates:

As for the effect of mineral NP-rates on the storability of garlic bulbs, data in Table (4) show that the total weight loss of bulbs was markedly increased with increasing the storage period and reached its maximum value at the end of fifth month of storage. Moreover, the most interesting observation was the enhancing of storability by increasing NP-application up to the relatively higher rates, i.e. 75 or 100% NP-recommended rate. On the other hand, maximum weight loss percentage was produced by the 50% from NP-recommended rate. These results are in agreement with those of Cheng *et al*. (1997), who found that storability of garlic bulbs and levels of N , P and TSS in cloves were increased by application of 150 kg P_2O_5/ha than with 75 kg P_2O_5/ha .

4.2- Effect of biofertilizer application method:

Concerning to the effect of biofertilizer application methods on weight loss percentage in garlic bulbs, the data in Table (4) show that the total weight loss percentage of bulbs was significantly affected during the storage period, but it increased by increasing the storage period and reached its maximum values at the fifth month of storage. In general, all application methods of biofertilizer (microbein) decreased the total weight loss percentage compared with the untreated ones. The lowest values of total weight loss were attained by application of microbein as (cloves inoculae + soil inoculate) method. Similar results were found by Abdel-Fattah (2002), Gouda (2002) and El-Morsy and Shokr (2005).

4.3- Effect of interaction between NP-rates and application methods of biofertilizer:

It is clear from Table (4) that interaction of NP-rates with application methods of biofertilizers interaction had a significant affected on bulb weight loss percentage during the storage period. The lowest values of bulb weight loss were obtained by the method of (cloves inoculate + soil inoculae) of

microbein combined with the higher NP-rates. These results in agreement with those of Wange (1995).

Finally, it may be concluded that the inoculation of garlic cloves and soil with the biofertilizer microbein in combination with NP-rate of 75% or 100% from recommended dose/fed were the most supperior treatments for enhancing the garlic plant growth, yield and its components, as well as bulb quality and storability, where there is no significant difference between the two NP-rates. Thus, the application of biofertilizer microbein as (cloves inoculate + soil inoculate) method with 75% from NP-recommended dose/fed was sufficient to produce the good quantity and quality of garlic, in addition to reducing the need for chemical NP-manuring by 25%, thereby reducing costs and environmental pollution. Therefore, this treatment it could be recommended under similar conditions to this work .

Table (4): Weight loss percentage of garlic as affected by NP levels, application methods of biofertilizer (microbein) and their interactions during 2005/2006 (S1) and 2006/2007 (S2) seasons.

characters		Weight loss (%) during the storage period									
		30 days		60 days		90 days		120 days		150 days	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
NP-rates											
100% NP		٢٤,٠8	٢٤,١٩	٣٤,٢3	٣٣,٣٥	٤١,١١٧	٣٨,٩8	٤١,٦٥	٤٠,٧6	٤٤,٩٤	٤٣,٢8
75% NP		٢٤,٣١	٢٤,٨1	٣٤,٤٤	٣٣,٨٩	٤١,٩٩٢	٣٩,٨٨	٤٢,٧٧	٤٢,١٧	٤٦,٠٥	٤٤,٤8
50% NP		٣١,٤3	٣١,٦1	٣٨,٨٧	٣٩,٥8	٤٦,٣٥٨	٤٧,٥٤	٥٢,٦٧	٥٢,٠٧	٥٧,٨8	٥٤,٩٠
		0.32	0.64	0.20	0.64	0.76	0.51	0.50	0.69	0.34	0.40
Application method of bio											
Control		٢٨,٩	٢٨,٨١	٣٧,٨٩	٣٧,٩١١	٤٦,٣٤	٤٥,٥٦	٥٠,٨٠	٤٨,٤٨	٥٤,١٣	٥٢,٦١
Cloves inoculate		٢٦,٣٨	٢٧,٧٩	٣٦,٣٩	٣٦,٤٤٤	٤٣,٩٩	٤٣,٤٣	٤٦,٩٧	٤٦,١٢	٥٠,٤١	٤٨,٥٧
Soil inoculate		٢٦,١٤	٢٦,١٧	٣٥,٢٢	٣٥,٢٨٩	٤٢,١٨	٤٠,٦٦	٤٣,٨٩	٤٣,٩٠	٤٨,٤٤	٤٥,٧٣
Coating + soil ino.		٢٤,٩٨	٢٤,٧١	٣٣,٨٨	٣٢,٧٧٨	٤٠,١١	٣٨,٨٩	٤١,١٠	٤١,٤٩	٤٥,٥٠	٤٣,٢٩
		0.40	0.40	0.36	0.28	0.40	0.32	0.40	0.34	0.39	0.48
Interactions:											
NP-rates	App. Methods of bio.										
100% NP	Control	٢٦,٩٥	٢٦,٤٠	٣٦,٤٧	٣٥,٩٦٧	٤٣,٩٧	٤١,٧٧	٤٧,٣٠	٤٣,٩٠	٤٩,٠٠	٤٧,٧٣
	Cloves ino.[1]	٢٣,٤٢	٢٤,٦٠	٣٥,٠٠	٣٤,١٠٠	٤٢,٠٠	٤٠,٥٧	٤٣,٠٠	٤١,٥٧	٤٥,٣٣	٤٣,٦٠
	Soil ino.[2]	٢٣,١٠	٢٣,٠٣	٣٣,٤٧	٣٣,٣٣٣	٤٠,٢٣	٣٧,٦٧	٣٩,٠٠	٣٩,٥٧	٤٤,٠٣	٤٢,٠٧
	1+ 2	٢٢,٨4	٢٢,٧٣	٣١,٩٧	٣٠,٠٠٠	٣٨,٢٧	٣٥,٩٠	٣٧,٢٠	٣٨,٠٠	٤١,٤٠	٣٩,٧٠
75% NP	Control	٢٦,٦٧	٢٧,٠٠	٣٦,٤٣	٣٦,١٠٠	٤٤,٧٧	٤٣,٠٠	٤٨,١٠	٤٥,٦٧	٥١,٠٠	٤٩,٣٣
	Cloves ino.[1]	٢٣,٧٢	٢٦,٠٧	٣٥,١٠	٣٤,٨٠٠	٤٢,٧٣	٤١,٤٣	٤٤,٣٣	٤٣,٣٣	٤٧,٦٠	٤٥,٦٠
	Soil ino.[2]	٢٣,٨٩	٢٣,٥٣	٣٣,٨٠	٣٣,٦٦٧	٤١,٠٠	٣٨,٤٣	٤١,٠٠	٤١,٠٠	٤٤,٠٠	٤٣,٠٠
	1+ 2	٢٢,٩6	٢٢,٦٣	٣٢,٤٣	٣١,٠٠٠	٣٩,٤٧	٣٦,٦٧	٣٧,٦٧	٣٨,٦٧	٤١,٦٠	٣٩,٩٧
50% NP	Control	٣٣,١1	٣٣,٠٣	٤٠,٧٧	٤١,٦٦٧	٥٠,٣٠	٥١,٩٠	٥٧,٠٠	٥٥,٨٧	٦٢,٤٠	٦٠,٧٧
	Cloves ino.[1]	٣٢,٠٠	٣٢,٧٠	٣٩,٠٧	٤٠,٤٣٣	٤٧,٢٣	٤٨,٣٠	٥٣,٥٧	٥٣,٤٧	٥٨,٣٠	٥٦,٥٠
	Soil ino.[2]	٣١,٤٣	٣١,٩٣	٣٨,٤٠	٣٨,٨٦٧	٤٥,٣٠	٤٥,٨٧	٥١,٦٧	٥١,١٣	٥٧,٣٠	٥٢,١٣
	1+ 2	٢٩,١٧	٢٨,٧٧	٣٧,٢٣	٣٧,٣٣٣	٤٢,٦٠	٤٤,١٠	٤٨,٤٣	٤٧,٨٠	٥٣,٥٠	٥٠,٢٠
L.S.D. at 5%		0.69	0.69	0.62	0.48	0.69	0.55	0.70	0.58	0.68	0.82

1= Cloves inoculate & 2 = soil inoculate

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تأثير بعض معدلات النتروجين والفوسفور و طرق اضافة السماد الحيوى ميكروبين على إنتاجية وقابلية تخزين الثوم

عبد الله حلمى على المرسى ، على محمد المغازى و أسامة محمد سيف الدين
قسم بحوث الخضر .. معهد بحوث البساتين .. مركز البحوث الزراعية (الجيزة .. مصر).

نُفذت تجربتان حقليتان على محصول الثوم (صنف سدس- ٤٠) فى حقل خضر خاص بقرية كفر ميت فارس بالقرب من المنصورة- محافظة الدقهلية، خلال موسمى الزراعة ٢٠٠٦/٢٠٠٥ و ٢٠٠٦ / ٢٠٠٧ لدراسة تأثير التسميد الأرضى بمعدلات مختلفة من الآزوت والفوسفور وهى: ٥٠ ٪، ٧٥٪ و ١٠٠٪ من الجرعة الموصى بها للفدان كلٌ منها منفرداً أو مع بعض طرق إضافة المخصب الحيوى ميكروبين (تلقيح فصوص الثوم المستخدمة كتقاوى، تلقيح التربة بالمخصب الحيوى بعد الزراعة أو تلقيح الفصوص + تلقيح التربة بالإضافة إلى معاملة الكنترول) على نمو النباتات والمحصول ومكوناته وكذلك أيضاً المحتويات الكيماوية فى الفصوص ونسبة الفقد فى وزن الأبصال خلال فترة التخزين (٥ شهور).

ويمكن تلخيص النتائج المتحصل عليها فيما يلى :-

حدوث زيادات ملموسة فى كل الصفات المختبرة بزيادة معدل النتروجين والفوسفور المضاف. وقد أدت زيادة معدل النتروجين والفوسفور المعدنى المضاف من ٥٠٪ حتى ١٠٠٪ من الجرعة الموصى بها للفدان إلى حدوث زيادات معنوية فى كل صفات النمو الخضرى للنباتات والمحصول الكلى ومكوناته، كذلك زادت معنوياً تركيزات النتوجين والفوسفور والبوتاسيوم و الزيوت الطيارة فى الأبصال، علاوة على ذلك، حدث انخفاض معنوى فى نسبة نقص وزن الأبصال خلال فترة التخزين.

أدى التلقيح بالسماد الحيوى (ميكروبين) إلى حدوث زيادات معنوية فى ارتفاع النبات،عدد الأوراق والوزن الجاف لعرش النبات، كما تحسنت أيضاً نسبة التبصيل وكذلك ازداد المحصول الكلى، متوسط وزن وقطر البصلة ومتوسط وزن الفص، كما أدى إلى زيادة تركيزات المواد الكيميائية وكذا الزيوت الطيارة فى الأبصال، وبجانب ذلك أدى إلى نقص نسبة انخفاض وزن الأبصال عند نهاية فترة التخزين معنوياً وذلك بالمقارنة مع معاملة الكنترول.

التفاعلات بين المعاملات المضافة من النيتروجين و الفوسفور المعدنى وطرق إضافة السماد الحيوى (ميكروبين) كانت أكثر تأثيراً، ولقد كانت كل القيم المتحصل عليها من التفاعل بين المعاملات بصفة عامة أفضل من تلك الناتجة باستخدام كل منها منفرداً. ولقد أدى استخدام ٧٥٪ من الجرعة الموصى بها من النيتروجين والفوسفور للفدان مع استخدام طريقة (تلقيح الفصوص + تلقيح التربة) بالمخصب الحيوى إلى انتاج محصول يتفوق على ذلك المتحصل عليه باستخدام ١٠٠٪ من الجرعة الموصى بها بدون التلقيح بالمخصب الحيوى.

مما تقدم، يمكن القول أن طريقة (تلقيح الفصوص + تلقيح التربة)، بالمخصب الحيوى ميكروبين كانت هى الطريقة المثلى لإضافة المخصب الحيوى مما أدى إلى نقص المعدل المطلوب من النتروجين والفوسفور المعدنى لمحصول الثوم بمقدار ٢٥٪ ، وبذلك يمكن تخفيض تكاليف الإنتاج وتلوث البيئة ، لذلك يمكن التوصية باستخدام هذه المعاملة لرفع إنتاجية الثوم وتحسين جودة الأبصال وقابليتها للتخزين تحت الظروف المشابهة.