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Effect of Bio and Mineral Fertilizers on Vegetative Growth and Productivity of Spring Onion

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Abstract

This study was conducted at the Experimental Farm of the Faculty of Agriculture, Moshtohor, Benha University, during the two successive winter seasons of 2007/2008 and 2008/2009 to study the effect of the combination between chemical fertilizers (NPK) at 100% of the recommended dose and biofertilizers (nitrobeine ,phosphorene and potassaiumage) on vegetative growth, bulb yield and its components as well as yield quality. Obtained results indicated that using nitrobeine as a single or as mixture with biofertilizers resulted in an increase in plant growth. Moreover,caused enhancenment effect on total yield and its components. Also, using bio-fertilizers (nitrobeine, phosphorene and potassaiumage) increased macro mineral in plants at, biofertilizers combined with mineral fertilizer at recommended dose gained the highest values of plant growth as well as total yield characteristics. Other benefits of these treatments include reduction the cost of chemical fertilizers, and reduced pollution of the product with nitrate content.

Keywords: Spring onion, NPK, nitrobeine, phosphorene and potassaiumage

Introduction

Spring Onion (*Allium cep L.*) is one of the most importont vegetables grown all over the world. Green onion or spring onion were commercials produced in Egypt particularly for fresh vegative. During the last few years green onion growers became very intersred in growing the imported white Lisbon cultivar since such cultuivar Giza 20 can be exported having the same demand in the importing markets as whit Lisbon . Mineral fertilizers play an importont role in onion plants growth and productivity ,Nitrogen is essential for synthesis of chlorophyll ,enzymes and proteins .Phosphorus is essential for root growth , phosphor-proteins , phospholipids ATP and ADP formation . Potassium play an importont role of promotion of enzymes activity and enhancing the translocation of assimilates and protein synthesis. Many investigators reported that the vegetative growth of onion plants and minerals uptake were increased with increasing the level of N,P and K fertilizers (Devlin, Singh *et al* .,1989). Nitrobein is commercial biofertilizers which gave the same effect of full dose of mineral nitrogen application (Tawfik,2008). Biofertilizer application hances the resistonce of plant to root disease and reduce the environmental pollution from chemical fertilizer application (Rizk and Shafeek,2000). Phosphorein partially , over comes the phosphate fixation problem in calcareous soil as found by Han and Lee (2005). Applying of biofertilizers gave the positive responses for onion plants (El-Sheekh, 1997). Utilization of bio-fertilizers is very successful in minimizing chemical fertilizers in different vegetable crops (Shaheen *et al*., 2007 and Sorial and Abd EL-Fattah,1998). Therefor , this study aims to decreasing the amount of major mineral fertilizers (N,P and K) and possibility to reduce and eliminat the pollution of environment by using biofertilizers in production of onion plants under caly loam soil conditions .

Materials and methods:

This study was conducted at the Experimental Farm of the Faculty of Agriculture, Moshtohor , Benha University , during the two successive winter seasons of 2007/2008 and 2008/2009 to study the effect of the combination between chemical fertilizers NPK at 100% of the recommended dose and biofertilizers (nitrobeine ,phosphorene and potassaiumage) on vegetative growth, yield and its components and quality of green onions . The soil of the experimental field was clay loam in texture with PH 7.5 and chemical and mechanical properties of the soil was done according to the methods described by Chapman and Pratt (1961) and Jakson (1967). Data of chemical and mechanical properties of experimental soil are shown in Tables A and B.

Table A &B. Mechanical and chemical analysis of the experimental soil before transplanting.
Table A. Mechanical analysis

Clay %	Silt %	Sand%	Texture	PH	EC (dS/m)	Available (mg/kg)		
						N	P	K
51	24.6	24.4	Caly loam	7.5	2.16	22.5	9.1	120

Table B. chemical analysis

Chemical analysis	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}
Meq /100 g	1.99	1.42	.67	1.28	0.70

The study included 9 treatments which resulted from the combination of different mineral fertilization and biofertilizer treatments as follows:

1- Control without bio or mineral fertilizers addition.
2- Ammonium sulphate at rate of 100% of the recommended dose (400 kg/Fed.)
3- Super phosphate at rate of 100% of the recommended dose (400 kg/Fed.)
4- Potassium sulphate at rate of 100% of the recommended dose (250 kg/Fed.)
5- Ammonium sulphate +super phosphate +potassium sulphate at rate of 100% of the recommended dose for each of them.
6- Nitrobin (nitrogen fixing bacteria) at 400 g /Fed .
7- Phosphorein (phosphate dissolving bacteria) at 250 g/Fed.
8- Potassaiumage (potassium dissolving bacteria) at 400 g/Fed.
9- Nitrobein + Phosphorein + potassaiumage.

A complete randomized block design with four replications was adopted. Transplants were transplanted in rows of two rows per ridges 60 cm width and 3.5 m length.

Experimental plot included 4 ridges with an area about 11.2 m^2. Transplanting was done on 15th of November in both seasons of study.

1- Method of inoculation with bio-fertilizers:

Inoculation with biofertilizers took place two times at seed sowing stage.

- Seed were soaked for 20 minutes in the solution consists of single or mixed bio-fertilizer (nitrobin package 400 g /fed , Phosphorin 250 g /fed and Potassaiumage 400 g /fed) befor planting , then dried in a shad place and sowing was done in the nursery .
- Second time: Before transplanting the transplants were inoculated by dipping it in the solution of single or mixed biofertilizer (nitrobin package 400 g /fed , Phosphorin 250 g /fed and Potassaiumage 400 g /fed) for 15 minutes and then transplanted .

2 - Mineral fertilizers:

These amounts of mineral fertilizers were applied as follows:

- The amount of superphosphate (15 % P2O5) fertilizer was added once to the soil before transplanting during soil preparation and before irrigation.
- While the quantity of ammonium sulphate (21.50%N) and potassium sulphate (48 % K2O) doses were divided into three equal portion and applied to the soil 30 and 60 day after transplanting.

These amounts of mineral fertilizers were applied as follows:

Data recorded:

1- Vegetative growth characters:

Sample of 20 plants from each plot were taken at 70 days after seeds sowing and the following data were recorded:

- Plant length, it was measured from the point of stem up to the end of the longest leaf.
- Fresh and dry weight of plant for spring onion.
- Bulb diameter, it was measured at the maximum swollen part of the bulb by using caliper.
- Number of leaves /plant.

2- Yield:

Yield was recorded as ton /fed . which is required for commercial marketing. All plants of each experimental plots were harvested and graded to three main groups according to bulb diameter. bulb diameter of 1 -1.5 , 1.5 – 2 and >2 were considerdas first , second and third respectively (Emam 1999).

3- Plant quality:

At harvest, 10 plants were taken as a representative sample from experiment plot and the following physical bulb characteristics were recoded:

1. Total soluble solids. It was determined by using hand refractometer.
2. Dry matter percentage of plants. It was determined in a representative sample of 100 g. taken from plants and bulbs of experiment plot and dried at 70C° until constont weight.
3. plant chemical constituents. Total nitrogen, phosphorus and potassium contents were determined in dry matter of both plants and bulbs in these experiment respectively as follows:

a- Total nitrogen: It was determined by the micro-kjeldhl method using Auto analyzer as recommended by Jackson (1967).
b- Total phosphorus: It was determined calorimetrically by using Auto analyzer as recommended by Cottenie (1980).
c- Potassium: It was determined by using the Flame photometric method as described by Jackson (1958).
d- Carbohydrate: It was determined according to the method which described by Dubois (1956).

All collected data were subjected to statistical

analysis according to Gomes and Gomes (1984).

Results

1- Vegetative growth characters:

A- Effect of mineral fertilizer application:

Results in Table 1 and 2 show the effect of N,P and K fertilizers application on green onion plant growth i.e plant hight , number of leaves , fresh weight and dry matter per plant during both seasons of study . Data clear that all vegetative growth parameters were significantly responded to using mineral fertilizers in a mixed form at the recommended dose of onion plants fertilization compared the control treatment. These results were true in the both growing seasons. This result may be due to the role of nitrogen on chlorophyll, enzymes and proteins synthesis and role of phosphorus on root growth development, phosphor proteins and phosphor-lipids formaton as well as the role of potassium in promotion of enzymes activity and enhancing the translocation of assimilates. This result are in hormony with those reported by singh *et al* 1989, Rizk ,1997; EL-Desuki and Sawan 2001; and EL-Desuki *et al* 2004 .

B- Effect of bio fertilizers application:

Data in Table 1 and 2 shows that all vegetative growth parameters were significantly affected by using bio-fertilizers. Results clear that using a single or mixture of nitrobeine, phosphoren and potassiumage gave the highest vegetative growth characters compared to the control treatment. These results were true in both growing seasons. this result may be due to the main role of bio fertilizers in fixing atmospheric nitrogen or transferring unsoluble phosphours and potassium in the soil to soluble form (phosphorien and potassiumage) available to absorption and up take by plants .(Mesharm and shende 1990; Dibat *et al* 1993 ; Amer *et al* 2003; EL-Shaikh *et al* 2005 ; Rizk and and Tadav *et al*, 2005 , EL-Habbasha *et al* 2007).

Moreover , using mineral fertilizers in a mixed form at the recommened dose i.e. , 400 kg ammonium sulphate + 400 kg super phosphate + 250 potassium sulphate reflected the highest values in all measured growth parameter followed by nitrogen , phosphours and potassium fertilizer as well as nitrobin and potassaiumage in a single form without singnificant differences among them.

Table 1. Effect of bio-and mineral fertilizers on vegetative growth in first seasons .

Seasons	2007- 2008			
Treatment	Plant length (cm)	number of leave/plant	fresh weight (plant/g)	Dry matter %
control	32.60	5.80	12.58	11.33
Nitrobin	34.80	6.60	12.74	12.00
phosphorin	34.30	6.50	12.71	11.66
potassiumage	34.70	6.40	12.74	12.00
mixed biofertilizer	34.50	6.60	12.67	12.00
Ammonium sulphate	34.50	6.60	13.38	12.33
calcium superphosphate	34.30	6.60	13.41	12.00
potassium sulphate	34.20	6.60	13.52	12.00
mixed mineral fertilizer	34.60	6.80	13.56	12.66
L.S.D 0.05 %	0.75	0.26	0.080	0.87

Table 2. Effect of bio-and mineral fertilizers on vegetative growth in second seasons .

Seasons	2008-2009			
Treatment	Plant length (cm)	number of leave/plant	fresh weight (plant/g)	Dry matter %
control	32.70	5.70	12.54	11.33
Nitrobin	34.50	6.50	12.61	12.00
phosphorin	34.40	6.60	12.63	11.66
potassiumage	34.20	6.50	12.58	12.00
mixed biofertilizer	34.60	6.60	12.78	12.33
Ammonium sulphate	35.00	6.60	13.48	12.66
calcium superphosphate	34.70	6.70	13.65	13.00
potassium sulphate	34.90	6.50	13.51	12.00
mixed mineral fertilizer	34.20	6.60	13.62	12.33
L.S.D 0.05 %	0.75	0.26	0.080	1.01

Table 3. Effect of bio-and mineral fertilizers treatments on chemical composition and organic constituents in first season

Seasons	2007- 2008				
Treatment	N %	P %	K %	Carbohydrate %	T.S.S
control	1.02	0.09	0.99	11.10	7.60
Nitrobin	1.23	0.18	1.04	12.40	10.70
phosphorin	1.11	0.21	1.07	12.50	10.70
potassiumage	1.14	0.19	1.10	12.60	10.30
mixed biofertilizer	1.13	0.22	1.32	12.70	10.90
Ammonium sulphate	1.25	0.22	1.16	13.00	11.30
calcium superphosphate	1.10	0.28	1.09	12.70	11.00
potassium sulphate	1.03	0.22	1.22	13.10	12.20
mixed mineral fertilizer	1.22	0.25	1.20	13.30	11.50
L.S.D 0.05 %	0.05	0.02	0.07	0.54	0.42

Table 4. Effect of bio-and mineral fertilizers treatments on chemical composition and organic constituents in second season

Seasons	2008-2009				
Treatment	N %	P %	K %	Carbohydrate %	T.S.S
control	1.03	0.09	1.00	11.24	7.00
Nitrobin	1.12	0.21	1.08	12.24	10.77
phosphorin	1.04	0.18	1.06	12.30	9.90
potassiumage	1.10	0.14	1.11	12.24	10.68
mixed biofertilizer	1.12	0.20	1.14	12.30	10.72
Ammonium sulphate	1.27	0.19	1.11	13.04	11.29
calcium superphosphate	1.16	0.27	1.11	12.71	11.49
potassium sulphate	1.12	0.14	1.20	13.11	11.60
mixed mineral fertilizer	1.26	0.14	1.20	13.11	11.60
L.S.D 0.05 %	0.05	0.04	0.05	0.50	0.44

Table 5. Effect of bio-and mineral fertilizers treatments on total yield

Seasons	2007- 2008			
Treatment	yield ton/fed	Division of the yield on the basis of bulb diameter ton/fed .		
		1 – 1.5 cm	1.5-2 cm	2-2<cm
control	3.783	3.329	0.303	0.151
Nitrobin	4.130	3.428	0.413	0.289
phosphorin	4.092	3.396	0.409	0.287
potassiumage	4.106	3.367	0.412	0.287
mixed biofertilizer	4.149	3.527	0.415	0.207
Ammonium sulphate	4.343	3.329	0.303	0.151
calcium superphosphate	4.304	3.615	0.431	0.258
potassium sulphate	4.321	3.630	0.432	0.259
mixed mineral fertilizer	4.346	3.563	0.435	0.348
L.S.D 0.05 %	0.111	0.152	0.105	0.110

Table 6. Effect of bio-and mineral fertilizers treatments on total yield

Seasons	2008-2009			
Treatment	yield ton/fed	Division of the yield on the basis of bulb diameter ton/fed.		
		1 – 1.5 cm	1.5-2 cm	2-2<cm
control	3.756	2.892	0.376	0.113
Nitrobin	4.170	3.461	0.417	0.292
phosphorin	4.101	3.404	0.410	0.287
potassiumage	4.121	3.132	0.372	0.207
mixed biofertilizer	4.180	3.469	0.418	0.293
Ammonium sulphate	4.331	3.551	0.434	0.346
calcium superphosphate	4.296	3.651	0.387	0.258
potassium sulphate	4.334	3.684	0.390	0.260
mixed mineral fertilizer	4.351	3.611	0.435	0.305
L.S.D 0.05 %	0.232	0.375	0.121	0.117

2-Chemical composition:

A- Effect of mineral fertilizer application:

Data in Table 3 and 4 show the effect of mineral fertilizers (N,P and K) solely or in mixed form on total nitrogen , phosphorus , potassium , T.S.S and carbohydrates concentration in plant foliage of spring onion during the both seasons of study . In this regard , such data indicate that application of tested mineral fertilizers at the recommended dose either solely or as a mixed significantly increased the concentration of total nitrogen, phosphorus and potassium during both seasons of study compared with the control treatment. In this connection , the highest concentration of nitrogen , phosphorus and potassium were recorded as a result of using ammonium sulphate as single or mixed with other mineral fertilizers. This results may be due to the application of mineral fertilizers carring such macro nutrient and consequently increased the obsorption of it by plant and concequently increased their concentration and accumulation in plant tissues. Such data show that the application of mineral fertilizers in a single form or as a mixture positively increased both total soluble solids and total carbohydrates percentage compareing with the control treatment. In addition, application of mineral fertilizers in a mixture form exhibites the highest values of T.S.S and carbohydrates percentage compared with application of them alone . Obtained result may be attributed to their sinergestic effect for mineral fertilizers in mixture form which affect positively on photosynthetic assimilation and in turn increased carbohydrate and T.S.S percentage in plant. Obtained results are agree with those reported by, Hanna Alla *et al* 1991 , Amado and Teixeira ,1992 and Lipinski *et al* 1994.

B- Effect of bio fertilizers application:

Date in Table 3 and 4 show the effect of bio-fertilizer (nitrobeine, phosphrine, potassimage on total nitrogen, phosphorus , potassium , T.S.S and carbohydrate percentage . Results clear that application of tested bio-fertilizers solely or in a mixed form significantly increased the total concentration of total nitrogen , phosphorus , potassium , T.S.S and carbohydrate during both seasons of study ,compared to the control treatment. The significant effect of biofertilizers may be due to the effect of different strains groups of microorganisms such as nitrogen fixer, nutrient mobilizing microorganisms which help in increasing the availability of minerals and consequently increasing their uptake which play importont role in the plant assimilation rate which in turn increased N,P and K , T.S.S and carbohydrate . obtained results are agree with those reported by , Meshram and Shende 1990, Mandhare *et al* 1998 and Ali *et al* 2001.

In this connection , the highest concentrations of nitrogent, phosphours and potassium were recorded as a result of using ammonium sulphate as a single or mixed with other mineral fertilizers followed by using nitrobin solely in case of total nitrogen , using calcium super phosphate and application of potassium sulphate either in a single form or as a mixture with nitrogen and phosphorus fertilizers and using potasage in case of potassium. In addition, application of biofertilizers as a mixture and mineral (N, P and K) fertilizers in a mixture form exhibites the highest values of T.S.S and carbohydrates percentage compared with application of them alone.

3- **Green onion yield:**

A- Effect of mineral fertilizer application:

Data in Tables 5 and 6 show the effect of N,P and k fertilizers on premature consumed green onion yield . Data clear that the total green onion plants yield and its indices particulary the yield of plants with bulb diameter rangded between 1-1.5 and 1.5-2cm in diameter were significantly increased compared with the control. However application of mixed mineral fertilizers followed by ammonium sulphate and potassium sulphate in a single form reflected the highest values in ascending order compared with the other used mineral fertilizers and the control. The increments in total green onion yield are connected with the effect of applied mineral fertilizers on increasing vegetative growth parameters, (Tables 1and 2) and chemical composition and organic constituents (Tables 3and 4) which in turn affect the produced yield. This results are in harmony with those reported by Setty and Hulamani 1989, Singh *et al* 1989 ,Rizk *et al* 1997, EL-Desuki and sawan 2001, and EL-Desuki 2004.

B- Effect of bio-fertilizers application:

Data in Table 5 and 6 show the effect of bio-fertilizers on premature consumed green onion yield . data clear that the total green onion yield and its indices particulary the yield of plants with bulb diameter rangded between 1-1.5 and 1.5-2cm in diameter as required by importing markets for bunching onion were increased as result of biofertilizers application compared to the control treatment in addition to bulb diameter as maturity. Results clear that the total green onion yield Table (6). These results were true in both growing seasons. Generally the highest values of total yield were recorded with mixed biofertilizers followed by potassiumage, nitrobeine and phosphorine in discending order. These result were the connected with the effect of applied bio – fertilizers on increasing vegetative growth parameters (Tables 1 and 2). Increasing mineral and organic chemical constituents (Tables 3 and 4) which in turn affect the produced yield. Obtained results are agree with those

reported by Gunjan *et al* (2005). , Jha *et al* (2006). Mendez *et al* (2007) . Navale *et al* (2008) .and Ethel and Singh ,2009. Moreover, In this respect, application of both mixed bio-fertilizers and mineral fertilizers reflected the highest total yield and its indices (different yield grades) on bases of bulb diameter compared with using of each of them solely . However application of nitrobein, ammonium sulphate and potassium sulphate in a single form reflected the highest values in assending order compared with the other used bio and mineral fertilizers each of them alone .

Conclusions

Biofertilizers treatments will reduce the cost of chemical fertilizer and decrease the pollution of the environment.

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تاثير المخصبات الحيوية و الاسمدة المعدنية على النمو الخضرى و الانتاجية فى البصل الاخضر .

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أجريت هذه الدراسة في عامى 2008/2007 و 2009/2008 فى مزرعة كلية الزراعة ، بمشتهر، جامعة بنها، محافظة القليوبية لدراسة تأثير بعض الأسمدة الكيماوية بالكميات الموصى بها و الأسمدة الحيوية (النتروبين و الفوسفورين و البوتاسيوماج)على النمو الخضري والمحصول ومكوناته و كانت اهم النتائج التي تم الحصول عليها المعاملات التى تم استخدام الاسمدة الحيوية فيها سوء منفردة أو المخلوطة ادت الى زيادة فى صفات النمو الخضرى و زيادة فى المحصول و ذلك مقارنة بالمعاملة الكنترول وادى استخدام الاسمدة الحيوية الى زيادة نسبة الكربوهيدرات الكلية فى النباتات مقارنة بالمعاملة الكنترول ولكن هذه الزيادة لم تكن معنوية مع معاملات التسميد المعدنى و التى تم استخدام الجرعات الموصى بها و قد ادت هذه النتائج الى تحقيق الغرض من استخدام الاسمدة الحيوية الى خفض كميات الأسمدة الكيماوية، و تقليل تلوث البيئة بالاضافة الى تقليل تكاليف الانتاج .