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INFLUENCE OF DIFFERENT SOURUCES OF FERTILIZERS AND YEAST ON GROWTH, CHEMICAL COMPOSITION, YIELD AND ITS QUALITY OF ONION PLANTS

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ABSTRACT

This investigation was conducted during the two successive winter seasons of 2008/ 2009 and 2009/ 2010 at Private Farm, El-Baalwa Zone, Ismaelia Governorate to study the performance of onion cv. Giza 20 to chicken manure, biofertilizers, i.e. nitrobein and phosphorein ,as well as, biostimulant, i.e. yeast each alone or mixed and NPK chemical fertilizers at the recommended dose as a control treatment on growth, chemical composition of plant, yield and its components ,as well as, the nutritive value of onion bulb.

Obtained results could be summarized as follows: *Applying chicken manure followed by nitrobein, phosphorein and yeast or nitrobein and phosphorein only were the most effective treatments compared to NPK mineral fertilizers at the recommended dose. Also, these applications resulted in the highest values of plant height, number of leaves, neck and bulb diameter and dry weight of roots, leaves, bulb and total plant, minerals concentration (N, P and K % in plant), bulb yield and its components (bulb diameter, bulb fresh weight , marketable and total yield per feddan), as well as, the nutritive value of bulb (TSS, N, P and K percentage and total protein).Meanwhile, the yield of culls was decreased. Generally ,applying transplants with chicken manure or treated onion transplants with mixture of nitrobein , phosphorein and yeast may be advisable to obtain the best growth and yield compared to using chemical fertilizers.*

Keywords: Chicken manure, nitrobein, phosphorein, yeast, chemical fertilizers, yield, onion bulb.

INTRODUCTION

Onion (*Allium cepa* L.) cv. Giza 20 is one of the most important vegetable crops, since it is one of the source for hard currency, due to the early availability

of the crop for foreign markets, as well as, its higher quality compared to other onions. Fertilization is a major factor affecting onion growth and yield, as well as, bulb quality. Recently, a great attention has been directed to use organic and biofertilizers as a substitute or to minimize mineral fertilizers to decrease the pollution of the agricultural environment and produce healthy food for human. Phosphorein plays a fundamental role on converting P fixed form to soluble form available for plant absorption (Rodriguez and Fraga, 1999). Thus, growth of most vegetable crops including onion was improved by applying different organic fertilizers, such as chicken manure. It is serve as a soil amendment by adding organic matter and good source of nutrient and contains both macro and micro nutrients essential for plant growth, dry matter, bulb yield and its quality of onion plants (Karam, 2005; Mahmoud, 2006; Shaheen *et al*., 2007; Yassen and Khalid, 2009; Lee, 2010).

Several investigators reported that using biofertilizers are considered a promoting alternative for mineral fertilizers by N-fixation and releasing certain nutrients elements (P, K, Fe, Ze, Mn), in addition to contributing with some phytohormones such as gibberellins and cytokinins (El-hadad *et al*., 1993) and increasing the available phosphorus in the soil by using phosphate solublizing bacteria (Midan, 2007).

In this regard, previous studies showed that nitrobein biofertilizer affected plant growth, bulb yield and its components, as well as, the chemical composition of plant and bulb (Barakat *et al*. ,2004; El-Shaikh, 2005 on onion and El-Beheidi *et al*., 2006 and Fawzy *et al*., 2007 on tomato).

The beneficial effects of phosphorein on growth, dry weight, chemical composition of plant, yield and its quality were emphasized by Bardisi *et al*.(2004 a and b) and El-Seifi *et al*.(2004) on garlic.

Concerning the effect of biofertilizers mixture, many investigators showed that (N–fixing bacteria and phosphate solubilizing bacteria in combination) promoted plant growth, yield and its components, chemical composition of plant and bulbs (Ibraheim, 2010 on onion and Fekry, 2009 on garlic).

Moreover, several investigators reported that yeast application led to increase vegetative growth, plant chemical composition, yield and its components, as well as, nutritional value of fruits (El-Tohamy *et al*., 2008 on eggplant; Ghoname *et al*., 2010 on sweet pepper).

This experiment was carried out to study the response of onion plants to organic manure (chicken manure), biofertilizers (nitrobein and phosphorein) and biostimulant (yeast) either in a single form or in combination on growth, yield

and bulb quality, as well as, to determine the possibility of partially substitute the NPK mineral fertilizers, consequently to avoid bulb and environmental pollution.

MATERIALS AND METHODS

This experiment was carried out at Private Farm, El-Baalwa Region, Ismaelia Governorate during the two successive winter seasons of 2008 /2009 and 2009/ 2010 to study the effect of organic manure (chicken manure), biofertilizers (nitrobein and phosphorein) and yeast as biostimulant on vegetative growth characters, plant chemical composition, yield and its components ,as well as ,the nutritive value of onion bulbs cv. Giza 20 under sandy clay loam soil conditions.

The physical and chemical properties of the experimental soil field and the analysis of chicken manure were determined according to Black (1982) as shown in Tables 1 and 2, respectively.

Table 1: The physical and chemical properties of the experimental soil field during 2008/2009 and 2009/2010 seasons.

Soil analysis	2008/2009 season	2009/2010 season
Physical properties		
Sand(%)	54.4	50.7
Silt(%)	16.8	17.3
Clay (%)	28.8	32.0
Texture	Sandy clay loam	Sandy clay loam
Chemical properties		
Organic matter (%)	0.70	0.90
N (%)	0.12	0.16
P (mg/g)	12.50	10.90
K(meq/l)	1.60	1.92
E.C. (dsm^{-1}at 25^0C)	1.70	1.85
pH	8.00	8.13

Table 2: Chemical properties of chicken manure during 2008/2009 and 2009/2010 seasons**.**

Chicken manure analysis	**2008/2009 season**	**2009/2010 season**
N (%)	3.00	3.30
P (%)	0.60	0.70
K (%)	1.30	1.24
Zn (ppm)	115	117
Mn(ppm)	285	300
pH	7.42	7.20
Organic matter (%)	36.20	42.1

This experiment included nine treatments as follows:

1- Control (NPK at the recommended dose, 90 kg N, 60 kg P_2O_5 and 100 kg K_2O / fed).
2- Chicken manure (20 $m^3 fed^{-1}$) (weight of m^3 = 300kg).
3- Nitrobein (400g fed^{-1}, as a source of nitrogen fixing bacteria, i.e. *Azotobctoer spp +Azospirillium spp*).
4- Phosphorein (600g/fed, as a source of phosphate dissolving bacteria, i.e. *Bacillus megatherium var phosphaticum*).
5- Yeast (5 g/l)
6- Nitrobein + Posphorein
7- Nitrobein + Yeast
8- Posphorein + Yeast
9- Nitrobein + Phosphorein + Yeast

These treatments were arranged in a randomized complete block design system with four replicates.

Seeds of onion were sown on September 20th and 25th during the two growing seasons, respectively and seedlings were transplanted after 70 days from sowing in both growing seasons of this study. The area of each of experimental unit was 7.2 m^2, it contained four rows with 3m length and 60 cm in width. The distance between plants was 10 cm on two sides of the row. One row was left between each two plots as a guard.antaana. Ammonium sulphate (20.5% N), calcium superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O), were

used as a sources of N, P and K nutrients, respectively. Calcium superphosphate fertilizer was added once before transplanting at soil preparation, while both of ammonium and potassium sulphate fertilizers were applied at three equal portions at 3, 6 and 9 weeks after transplanting.

Chicken manure treatment was added at soil preparation. Active dry yeast were dissolved in water followed by adding sugar at ratio 1:1 and kept overnight for activation and reproduction of yeast. Nietrobein and phosphorein were wetted by water each alone or in mixture.

Little of Arabic gum (20 %) as adhesive agent was added to the used biofertilizers and biostimulant (According to the Agricultural Ministry Lab. Recommendations) and the roots of seedlings were dipped for five minutes in this biofertilizers and yeast according to the treatment before transplanting.Whereas, uninoculated seedlings were dipped in tap water. The source for nitrobein and phosphorein biofertilizers was General Organization for Agricultural Equalization Foundation (GOAEF), Ministry of Agriculture, Egypt, meanwhile dry yeast was obtained from the local market.

The normal agricultural practices were carried out as commonly followed in the district. Drip irrigation system was used and the discharges of the drippers were 2 litters/ hour.

Data recorded:

1.Plant growth measurements: A random sample of five plants from each experimental unit was taken at 100 days after transplanting in both seasons of study and the following data were recorded:

a. Morphological characters: Plant height (cm), number of leaves/plant, maximum neck and bulb diameter (cm), as well as, bulbing ratio.

$$\text{Bulbing ratio} = \frac{\text{maximum neck diameter (cm)}}{\text{maximum bulb diameter (cm)}}$$ (Mann, 1952)

b. Dry weight: The different parts of onion plant, i.e roots, leaves and bulbs were oven dried at 70 ^{0}C till constant of the weight and then the dry weight of these parts /plant (g) and total dry weight /plant (g) were recorded.

***2. Plant nutritional status (chemical composition)*:** The contents of nitrogen, phosphorus and potassium were assayed in the whole plant dry matter (roots, leaves and bulb) at 100 days after transplanting. Samples were finely ground and digested for N, P,and K determination according to the methods described by

Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

***3. Yield and its components*:** Onion plants were harvested when 75% of plant tops were down. After curing, the following data on representative sample of five bulbs were recorded; average bulb diameter (cm) and average bulb fresh weight (g), meanwhile, marketable, culls and total bulb yield in all bulbs of plots were determined and then calculated to faddan (ton/faddan).

4. Nutritional value of bulbs:

a. N, P and K content: At harvest, time five bulbs were randomly taken from each treatment and oven dried at 70 ^{0}C till constant weight and the contents of nitrogen, phosphorus and potassium were determined by the same methods as previously mentioned in the nutritional status of onion plants,

b. Total protein: It was determined by multiplying N-values by 6.25.

c. Total soluble solids (T.S.S): It was determined in fresh bulbs by using Carl Zeis Refract meter.

Statistical Analysis

Collected data were subjected to statistical analysis of variance according to Gomez and Gomez (1984) and treatments means were compared using Duncan's multiple range test (Duncan, 1958).

RESULTS AND DISCUSSION

1.Plant growth

1.1. Morphological characters

Data in Table 3 indicate that all the studied treatments had different significant effect on most studied vegetative growth characters of onion plants

expressed as plant height, number of leaves, diameter of neck and bulb, as well as, bulbing ratio during both seasons of study. In this respect, the same data show that applying chicken manure followed by the mixture of nitrobein, phosphorein and yeast or the two biofertilizers (nitrobein and phosphorein) were the most effective treatments which resulted in the highest values of most studied growth parameters compared with NPK fertilization (control treatment).

As for the increases in plant growth obtained by chicken manure, it might be due to the improvement of physical and chemical properties of soil (Abdel Salam *et al*.,1988 and Karam, 2005), which affects soil fertility and play an important role in nutrient availability and uptake. Moreover, organic manure amended the microorganisms with necessary nutrients elements and increased the microbial respiration and CO_2 out- put for formation the organic acids (Mizur and Wojtas, 1984). These favorable conditions allow roots system and plant to grow better and more assimilations would be stored (Fawzy *et al*., 2007).

From the forgoing results too, the superiority of using the mixture of tested biofertilizer may be due to the main role of nitrobein release of the fixing nitrogen, mobilizing of certain macro and micro nutrients to a form available for plant absorption and secretion a set of growth promoting substances and biocontrolling certain soil onion diseases (Saber and Gomma, 1993). In addition, Fallik *et al*. (1994) and Bashan and Holguin (1997) indicated that the non-symbiotic N-fixing bacteria of genera *Azospirillium* produced adequate amounts of IAA and cytokinins which increased the number of lateral roots and root hairs causing absorption of sufficient nutrients and faster luxuriantly.

On the other hand, the promoting effect of phosphorein could be explained in the light of great role played with such phosphate solublizing bacteria in correcting the solubility problem and releasing the fixed phosphate form to be ready available form for plant utilization, then supply the plants with their phosphorus needs.

Moreover, such bacteria of bacillus produced plant growth regulators substances which promoted roots growth, hence enhanced minerals uptake and increased the growth rate of onion plant (El-Beheidi *et al*., 2006).

In addition, yeast is considered as a natural source of cytokinins and has stimulatory effects of cell division and enlargement, as well as , synthesis of protein, nucleic acid and chlorophyll which positively affected on plant growth (El-Tohamy *et al*., 2008).

Consequently,it could be concluded that, application of organic manure, biofertilizers mixture, *i.e.* nitrobein,phosphorein and yeast as a stimulant or

nitrobein and phosphorein only to onion plants grown under the sandy clay loam soil expected a marked effect on most vegetative growth with lest coast and environmental pollution compared with mineral control treatment (NPK).

The obtained results followed the same results of that reported by Barakat *et al*.(2004), El-Shaikh (2005), Abou El-Salehein *et al*.(2008), Ahmed, (2009), Yassen and Khalid (2009), Ibraheim (2010) and Lee (2010) on onion; Bardisi *et al*.(2004 a), El-Seifi *et al*.(2004); Fekry (2009) on garlic and El-Tohamy *et al*.(2008) and Ghoname *et al*.(2010) on different vegetable crops.

1.2. ***Dry weight***

Data presented in Table 4 indicate that application of chicken manure followed by the biofertilizers mixture nitrobein, phosphorein and yeast exerted marked effect on dry weight of roots, leaves, bulbs and total onion plant compared to application of NPK fertilization (control treatment) and the other treatments. These treatments followed by the mixture of nitrobein and phosphorien, as well as, mixture of phosphorein and yeast in descending order. These results were true in the two growing seasons

In this regard, the enhancing effect of the chicken manure, mixture of (nitrobein, phosphorein and yeast) and the mixture of phosphorein and yeast might be attributed to the increase in photosynthetic capacity to which the number of leaves per plant could be reliable index with application of biofertilizers and stimulant mixture. Moreover, application of these mixtures promoting the physiological, biochemical and metabolic processes in which in turn increased the accumulation of the dry matter content in the plant.

The obtained results are in harmony with those reported by Barakat *et al*. (2004), El-Shaikh (2005), Abou El-Salehein *et al*.(2008) and Ibrahem (2010) on onion and Ghoname *et al*.(2010) on sweet paper.

2. Plant nutritional status

Data presented in Table 5 show clearly that all used treatments had a marked effect on N, P and K content of onion plant. In general, application the chicken manure came in the first rank followed by using the mixture of nitrobein, phosphorein and yeast, mixture of the two biofertilizers nitrobein and phosphorein which mostly achieved the highest values of N, P and K concentrations of onion plant during both growing seasons compared with the control treatment.

The favorable effect of organic manure on N, P and K contents might be ascribed to its high nitrogen content and other essential plant nutrients and serve as a soil amendment by adding organic matter (Sloan, *et al.* 1996).

The enhancing effect of biofertilizers application may be due to the effect on mobilizing nutrients by such microorganisms and accelerate microbial processes, which help in availability of minerals and increased levels of extractable minerals (El-Kramany *et al*., 2000).

These results are in conformity with those obtained by Abdel-Mawgoud *et al*.(2005), Ahmed (2009) and Ibraheim (2010) on onion and Midan (2007) and

Table 5: Effect of chemical, organic, biofertilizers and yeast on the mineral content of onion plants during 2008/2009 and 2009/2010 seasons.

Seasons	2008/2009			2009/2010		
Characters / Treatments	Mineral content (%)			Mineral content (%)		
	N	P	K	N	P	K
NPK (control)	3.006^{a}	0.445^{a}	3.583^{a}	3.303^{a}	0.460^{a}	3.611^{a}
Chicken manure	2.896^{b}	0.435^{b}	3.550^{ab}	3.260^{a}	0.448^{b}	3.592^{b}
Nitrobein	2.753^{d}	0.397^{ef}	3.413^{cd}	2.853^{de}	0.420^{d}	3.442^{f}
Phosphorein	2.673^{e}	0.427^{bc}	3.382^{de}	2.776^{ef}	0.437^{c}	3.402^{g}
Yeast	2.640^{e}	0.396^{f}	3.358^{e}	2.743^{f}	0.404^{e}	3.382^{h}
Nitropein+Phosphorein	2.826^{c}	0.422^{cd}	3.516^{b}	2.980^{c}	0.447^{b}	3.540^{d}
Nitrobein+ Yeast	2.790^{cd}	0.405^{e}	3.447^{c}	2.973^{c}	0.431^{c}	3.462^{e}
Phosphorein+ Yeast	2.396^{b}	0.415^{d}	3.410^{cd}	2.893^{d}	0.428^{cd}	3.430^{f}
Nitrobein+Phosphorein+ Yeast	2.836^{bc}	0.428^{bc}	3.543^{b}	3.070^{b}	0.449^{b}	3.556^{c}

Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.

Fekry (2009) on garlic, as well as, El-Tohamy *et al*.(2008) and Ghoname *et al* (2010) on different vegetable crops.

3. Yeild and its components

It is clearly evident from data in Table 6 that application of chicken manure followed by biofertilizers mixture,i.e. nitrobein and phosphorein with yeast and the treatment of phosphorein and yeast as a mixture to onion plants significantly increased bulb diameter, fresh and dry weight as compared to the control treatment (NPK fertilization). The results hold true in the two growing seasons. Furthermore, the maximum values of marketable and total yield (ton/fed) were obtained by the application of NPK chemical fertilizer, followed by chicken manure and the mixture of the triple treatment used nitrobein and phosphorein in combination with yeast, and those containing the two biofertilizers nitrobein and phosphorein in descending order, compared with the other treatments. On the other hand, the lowest values of culls bulb (ton/fed) were obtained by the mixture of the triple treatment nitrobein, phosphorein and yeast or the two biofertilizers only compared with the other treatments. Obtained results are going in the same trend during both seasons of growth.

The superiority in total bulbs yield by application of chicken manure and biofertilizers and stimulant mixture directly owing to the increase in average bulb weight (Table 6), and also, this might be due to the favourable effect of such treatment on vegetative growth (Table, 3), dry weight (Table, 4) and total nutrients contents (Table,5) which may be increased the efficiency of photosynthetic capacity and in turn resulted in more accumulation of stored food in onion bulbs.

The obtained results are in accordance with those reported by El-Shaikh (2005) Karam (2005), Mahmoud (2006), Ahmed (2009), Yassen and Khalid (2009) and Ibraheim (2010) on onion ; Bardisi *et al*.(2004 b) and Fekry (2009) on garlic.

4.Nutritional value of bulbs

Data recorded in Table 7 indicate that N, P and K contents, total protein, as well as, total soluble solids in onion bulbs exhibited the maximum values in case of treating onion plants with the control (NPK) followed, in descending order by chicken manure and the mixture of nitrobein, phosphorein and yeast, as well as, mixture of nitrobein and phosphorein treatment.

The favourable effect of chicken manure on the chemical composition of bulb might be attributed to the high contents of N, P and K in it (Mahmoud, 2006). The increment in total nitrogen percentage as a result of nitrobein application might be attributed to the promoting effect of it on the fixation of

atmospheric nitrogen and consequently increased its content in root zooe which led to the improvement of nitrogen uptake (Subba Rao, 1993). Meanwhile, used of phosphate solubilizing bacteria, i.e. phosphorein, plays a fundamental role in converting P fixed form to be available.

Moreover, the enhancing effect of NPK chemical fertilizers may be referred to the available N, P and K in soil and (or) the high absorbing efficiency of onion root which promoting the metabolism and translocation of bulb (Edmond *et al*., 1981) as well as, increased growth and yield of onion (Abdul Ghaffoor *et al* (2003).

These results are in agreement with those reported by Karam (2005), Yassen and Khalid (2009), Ibrahem (2010) and Ghoname *et al*.(2010) on onion and El-Seifi *et al*. (2004) and Fekry (2009) on garlic.

Consequently and conclusion, it can be recommended from the obtained results that treating of onion transplants with chicken manure followed by mixture of nitrobein, phosphorein and yeast or nitrobein and phosphorein only treatment enhancing plant growth characters, improve nutritional status of both plants and bulbs, as well as ,gave on economic yield. NPK mineral fertilizers gave the same effect on plant growth and increased yield slightly than the application of those chicken manure or biofertilizers, but from the economic side, the treatments used in this experiment achieved a great beneficial influence in reducing the cost of mineral fertilizers beside decreasing the pollution of both produced bulbs and the environment and encourage export healthy bulbs for foreign markets.

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تأثير المصادر المختلفة للأسمدة و الخميرة علي النمو،التركيب الكيماوى والمحصول وجودته لنباتات البصل

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أجري هذا البحث خلال الموسمين الشتويين لعامي ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/ ٢٠١٠ بمزرعة خاصة بمنطقة البعالوه، محافظة الإسماعيلية بهدف دراسة تأثير سماد الدواجن وبعض الأسمدة الحيوية مثل (النتروبين والفوسفورين) و المنشط الحيوى (الخميرة) كل منها بمفرده أو في صورة مخلوط وكذلك الأسمدة النتروجينية والفوسفاتية والبوتاسية بالمعدل الموصي به كمعاملة مقارنة (كنترول) علي النمو والتركيب الكيماوي للنبات، المحصول ومكوناته وكذلك القيمة الغذائية لأبصال البصل صنف جيزة ٢٠.

ويمكن تلخيص النتائج المتحصل عليها كالآتي :

إضافة المعاملة بسماد الدواجن و تليها مخلوط المعاملة الثلاثية المكونه من النتروبين والفوسفورين والخميرة أو النتروبين مع الفوسفورين فقط، هي المعاملات الأكثر فاعلية مقارنة بالمعدلات الموصي بها من الأسمدة الكيماوية النتروجينية والفوسفاتية والبوتاسية .كما أعطت هذه المعاملات أعلي القيم لصفات النمو (طول النبات ، عدد الأوراق ،قطر العنق والبصلة كذلك الوزن الجاف للجذر،الاوراق ،البصلة والكلي للنبات) ، محتوي النبات من النتروجين، الفوسفور والبوتاسيوم ، ومحصول الأبصال ومكوناته (قطر البصلة والوزن الغض والجاف للبصلة و المحصول القابل للتسويق والكلي للفدان) و كذلك زادت القيمة الغذائية للأبصال (النسبة المئوية للمواد الصلبة الذائبة الكلية ، النتروجين ، الفوسفور ، البوتاسيوم و البروتين الكلي). بينما قل محصول النقضة.

عامة يمكن النصح باضافة سماد الدواجن أو معاملة شتلات البصل بمخلوط من النتروبين والفوسفورين والخميرة أو النتروبين والفوسفورين فقط للحصول علي أفضل نمو و محصول عند المقارنة باستعمال الأسمدة الكيماوية.