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GROWTH AND YIELD OF ONION AS AFFECTED BY BIOFERTILIZATION, APPLICATION OF NITROGEN AND PHOSPHORUS FERTILIZERS UNDER SOUTH VALLEY CONDITIONS

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Abstract: This investigation was carried out at the experimental farm of Fac. Agric., Sohag, South Valley University during 2001/2002 and 2002/2003 winter seasons. This experiment aimed to investigate the efficiency of the rhizobacterin and VA-mycorrhizae as biofertilizers and an effective alternative for the nitrogen and phosphorus chemical fertilizers in onion production. The obtained data indicated that inoculation of onion transplants with rhizobacterin separately or combined with VA-mycorrhiza in the presence or absence of different doses of nitrogen and phosphorus chemical fertilizers significantly increased the most studied characters as compared to the uninoculated transplants in both seasons. However, the inoculation of onion transplants with dual inocula of rhizobacterin plus VA-mycorrhizae combined with (22.5 kg N/fed. + 7.5 kg P_2O_5/fed.) gave the best results of the most studied characters i.e. plant height (cm), number of leaves, bulbing ratio, total bulb yield (ton/fed.), marketable yield (ton/fed.), culls yield ton/fed., T.S.S., nitrogen, phosphorus and potassium percentages in both seasons. Therefore, the use of dual inocula as biofertilizers may replace the application of 75% of the recommended dose of nitrogen and phosphorus chemical fertilizers.

Introduction

Onion (*Allium cepa* L.) 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. Nitrogenous chemical fertilizers are commonly added to soil to produce high yield of vegetable crops. Many plants consume and assimilate much amounts of the formed nitrate and store it in large quantities. It is well known that nitrate ion is an environmental pollutant because its potential role in infants methemoglobinemia associated with the consumption of nitrate-rich waters or vegetables (Alexander, 1977). The necessity of phosphorus as a plant nutrient is emphasized by the fact that it is an essential constituent of many organic components that are very important for metabolic processes, blooming and root development (Russell, 1950). In most soils, in spite of the considerable addition of phosphorus fertilizers, the available P for plants is usually low since it is converted to unavailable form by its reaction with the soil constituents. This could explained why the cultivated soils in Egypt needs high amount of mineral phosphorus fertilization to fulfill requirements of plants. However, the increase in the rate of applied phosphorus fertilizer may be at the expense of increasing production costs and environmental pollution (Mahmoud and Abdel-Hafez, 1982).

Therefore, its become essential to use the untraditional fertilizers as a substitute or supplement for chemical fertilizers. It is noted that bacterial biofertilizers play an important role in fixing the atmospheric nitrogen in many species of plants. Also, the symbiotic relation between higher plants and mycorrhiza, particularly vesicular-arbuscular mycorrhizae (VAM) fungi represents one of the most striking biological phenomena. Mycorrhizal symbiosis with onion plants has attracted more attention for many benefits, such as contributing some promoting substances for plant growth (GA, IAA and CKS) as well as enhancing uptake of phosphorus and several micronutrients, i.e. Fe, Zn, Mn and Cu (Lambert *et al.,* 1979). Moreover, Ibrahim (1986) reported that inoculation of onion plants with mycorrhizae significantly increased plants growth as well as nitrogen, phosphorus, potassium, T.S.S content and total bulb yield. He also, mentioned that the combination between mycorrhizae and phosphorus levels increased plant growth very rapidly after 90 day from planting, nitrogen and phosphorus in mature bulbs, bulb diameter, bulb weight and T.S.S. Nitrogen, phosphorus and potassium markedly affected plant growth (Haggag, *et al.,* 1986; Asandhi, 1989; Setty, *et al.,*1989; EL-Shaikh, 1995 and Rizk, 1997). Moreover, the yield and quality of onion bulb could be increased by increasing nitrogen, phosphorus and potassium fertilization levels (Villagrun and Escaff, 1982; Haggag, *et al.,* 1986; Sato, 1988; Setty *et al.,* 1989; EL-Shaikh, 1995 and Rizk, 1997). Mandhare, *et al.,* (1998) concluded that application of mycorrhizae plus azotobacter plus 50% of the recommended phosphorus rate resulted in the greatest root length, plant height, bulb fresh weight and phosphorus uptake. Sing and Mohanty, (1998) mentioned that increasing nitrogen level increased plant height, number of leaves/plant and bulb weight. Thilakavathy and Ramaswamy, (1998) found that the highest bulb yield 18.37 t/ha was obtained from azospirillum and phosphobacteria with (45 kg N + 45 kg P/ha) compared with 16.59 t/ha was produced by the recommended rates of nitrogen and phosphorus i.e., (60 kg /N + 60 kg P/ha). Kashappanavar and Sreenivasa (2000) descided that the interaction between phosphorus fertilizer and inoculation with mycorrhizaç significantly increased shoot phosphorus concentration, T.S.S., plant dry biomass and fresh bulb weight. Sharma et al., (2000) found that inoculation with mycorrhizae showed higher values for bulb diameter, shoot phosphorus content, shoot dry matter and bulb yield. Charron *et al.,* (2001) showed that increasing phosphorus rates had a significant positive linear effect on the phosphorus tissue concentration of plants inoculated with vesicular arbuscular mycorrhizae but no effect on bulb firmness. The phosphorus tissue concentration of inoculated plants was significantly higher than that of non inoculated controls. The present investigation was designed as an attempt to replace all or part of nitrogen and phosphorus chemical fertilizers through using rhizobacterin and vesicular arbuscular mycorrhizae (V.A.M) in onion production under South Valley conditions.

Materials And Methods

Two field experiments were conducted at the Experimental Farm of Fac. Agric, Sohag, South Valley University during 2001/2002 and 2002/2003 winter seasons to investigate the effect of inoculation with rhizobacterin, VA-mycorrhizae separatly or combined and four levels of nitrogen and phosphorus fertilization on the growth and yield of onion Giza 6 (improved cultivar). Physical and chemical analysis of the experimental soil in the two seasons are presented in Table (1).

Table (1): Chemical analysis of experimental sites in the two seasons.

Analysis / Seasons	Texture	pH	O.M %	Available nutrients (ppm)		
				N	P	K
2001/2002	Clay loam	7.8	1.2	16.0	14.0	210
2002/2003	Clay loam	7.9	1.1	17.0	15.0	221

The experimental plots were randomly assigned in a completely block randomized design with four replicates as follows:

1-Uninoculated (control).

2-Rhizobacterin (Rhizo.).

3-Mycorrhizae(Myco.).

4-Rhizo. + Myco.

5-90 kg N/fed. + 30 kg P_2O_5/fed. (recommended doses of N and P_2O_5).

6-Rhizo. + 22.5 kg N + 7.5 kg P_2O_5 (1/4 NP).

7-Rhizo. + 45.0 kg N + 15.0 kg P_2O_5 (1/2 NP).

8-Rhizo. + 67.5 kg N + 22.5 kg P_2O_6 (3/4 NP).

9-Myco. + 22.5 kg N + 7.5 kg P_2O_5 (1/4 NP).

10-Myco. + 45.0 kg N + 15.0 kg P_2O_5 (1/2 NP).

11-Myco. + 67.5 kg N + 22.5 kg P_2O_5 (3/4 NP).

12-Rhizo. + Myco. + 22.5 kg N + 7.5 kg P_2O_5 (1/4 NP).

13-Rhizo. + Myco. + 45.0 kg N + 15.0 kg P_2O_5 (1/2 NP).

14-Rhizo. + Myco. + 67.5 kg N + 22.5 kg P_2O_5 (3/4 NP).

The area of each experimental unit was 3 x 4 = 12 m^2 and contained 15 rows 20 cm apart.

Biofertilizer of rhizobacterin was obtained from the Microbiology Dep., Soil and Water Research Institute, Agric. Res. Center, Giza, Egypt. The lower part of onion transplants were inoculated before planting by soaking for one hour in the inoculation suspention. Also, uninoculated transplants are involved as a control. Gum arabic solution 4% was used as an adhesive material as recommended. Two species of endomycorrhizael fungi (*Glomus fasiculatum* & *Glomus mosseae*) supplied by Botamy Dep., Fac. Agric. Kafr EL-Sheikh, Tanta University, Egypt, were used.

For preparing VA-mycorrhizal inoculum fried pots of 30 cm in diameter were filled with autoclaved clay loam soil. The soil of each pot was inoculated with two species of endomycorrhizael fungi. Ten onion seedlings were transplanted in each pot as a host plant. At the end of the growth stage of onion, plants were uprooted. The soil of the used pots were mixed together and VAM spores counted as described by Musandu and Giller (1994). The spore count was found to be 120 – 140 spores/g soil. This soil containing mixture of VAM spores, mycelia and chopped roots. The prepared VAM inoculum was added at rate of 6 kg of soil for each plot, which drilled in the planting rows just before planting. Each row received equal quantity from VA-mycorrhizal inoculum i.e. (400 gm). The onion transplants were planted in the 15th of November in 2001/2002 and 2002/2003 winter seasons. Transplants were planted 7.5 cm apart in the shaped rows. Each plot received equal number of onion transplants as well as rows. Then the experimental units irrigated immediately. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5 % N) in three equal doses at 15, 30 and 45 days after transplanting. Whereas, the chemical phosphorus fertilizer was applied as one dose just before transplanting in the form of calcium superphosphate (15.5 % P_2O_5).

The potassium fertilizer was applied as recommended i.e. (50 kg K_2O/fed.) and agricultural practices other than the forementioned treatments were conducted as usual in both seasons.

Studied characteristics :

At 90 days after transplanting, a random sample of 10 plants was taken from each plot to measure the following :

1- Plant height (cm).

2-Number of leaves / plant.

3-Bulbing ratio calculated as (neck diameter / bulb diameter).

After harvesting and curing the following characters were recorded.

1-Total bulb yield (ton/fed.).
2-Marketable yield (ton/fed.).

3-Culls onion.
4-Total soluble solids (T.S.S)

At 90 days after transplanting, five random plants from each treatment were cut and oven dried at 70° and the NPK elements in the dry weight of plant tissues were determined according to method described by Singh (1984); John (1970) and Brown and Lilleland (1946), respectively.

Data obtained during the two seasons of the study were statistically analysed and treatments means were compared using the Duncan's multiple range test (Gomez and Gomez, 1984).

Results And Discussion

Plant height and number of leaves / plant :

Data presented in Table (2) revealed that inoculation of onion plants with VA-mycorrhizal fungi separately or combined with rhizobacterin in the presence or absence of different doses of chemical nitrogen and phosphorus fertilizers dramatically increased plant height (cm) but failed to show any significant effect on the number of leaves per plant from the statistical point of view in both seasons. In addition, inoculation with either rhizobacterin or VA-mycorrhizae led to significant increase in plant height (cm) as compared to uninoculated treatment (control). Application of nitrogen and phosphorus chemical fertilizers to inoculated plants with both dual inocula i.e., (rhizobacetrin + VA-mycorrhizae) significantly increased plant height as compared to uninoculated onion plants in both seasons. However, the highest values of this trait resulted from treatments of inoculated with dual inocula and fertilized with (22.5 kg N/fed. + 7.5 kg P_2O_5/fed.) in the two experimental seasons. Moreover, the above mentioned treatment surpassed the recommended dose of nitrogen and phosphorus but, the differences were more announced and statistically approved in the first

Table (2): Effect of inoculation of Giza-6, onion cultivar, with rhizobacterin, VA-mycorrhizae and different doses of chemical nitrogen and phosphorus on plant height (cm), number of leaves/plant and bulbing ratio in 2001/2002 and 2002/2003 winter seasons.

Treatments	Plant height		Number of leaves/plant		Bulbing ratio	
	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Uninoculated (control)	60.63 H	67.13 F	5.27 A	6.20 A	0.55 E	0.53 D
Rhizobacterin (Rhizo.)	81.43 BC	81.33 AB	6.47 A	7.93 A	0.40 ABC	0.50 BCD
Mycorrhizae (Myco.)	87.37 A	80.27 A-D	6.33 A	7.27 A	0.44 CD	0.52 CD
Rhizo. + Myco.	73.63 G	75.67 DE	6.20 A	7.33 A	0.39 ABC	0.47 ABC
Recommended dose of N and P	77.10 C-G	83.20 A	6.13 A	6.33 A	0.43 BCD	0.47 ABC
Rhizo. + ¼ NP	79.60 B-E	75.93 DE	5.73 A	7.67 A	0.38 AB	0.45 AB
Rhizo. + ½ NP	74.90 FG	83.10 A	6.27 A	6.47 A	0.39 ABC	0.52 CD
Rhizo. + ¾ NP	75.27 EFG	75.20 E	6.47 A	6.53 A	0.44 CD	0.51 CD
Myco. + ¼ NP	76.27 D-G	76.80 B-E	5.87 A	7.93 A	0.44 CD	0.51 CD
Myco. + ½ NP	78.67 D-F	76.20 CDE	6.23 A	6.67 A	0.43 BCD	0.50 BCD
Myco. + ¾ NP	82.23 B	75.93 DE	6.70 A	7.20 A	0.46 D	0.50 BCD
Rhizo. + Myco. + ¼ NP	88.00 A	83.90 A	6.87 A	6.60 A	0.37 A	0.44 A
Rhizo. + Myco. + ½ NP	79.90 BC	74.50 E	5.77 A	6.80 A	0.41 A-D	0.45 AB
Rhizo. + Myco. + ¾ NP	81.00 BC	80.80 ABC	6.07 A	6.73 A	0.43 BCD	0.47 ABC

Means followed by the same letter or letters are not significantly different at 5% level.

season. Such result could be explained by the effect of rhizobacterin in fixing the atmosphric nitrogen beside to the role of VA-mycorrhizael fungi in supplying the growing plants with available phosphorus, some micro-nutrients and phytohormones (Lambert *et al.,* 1979). This result take the same trend with those found by Ibrahim (1986) and Mandhare *et al.,* (1998) who reported that application of mycorrhizae plus azotobacter plus 50 % of the recommended phosphorus rate resulted in the greatest values of the plant height.

Bulbing ratio :

The effect of inoculation of onion plants with either rhizobacterin or VA-mycorrhizae or both in the presence or absence of different doses of nitrogen and phosphorus chemical fertilizers are showed in Table (2). Data indicated that inoculation with rhizobacterin or VA-mycorrhizae significantly affected this character in the first season only as compared to uninoculated plants. Using dual inocula significantly affected the bulbing ratio trait in the two experimental seasons as compared to uninoculated plants. In concerning to application of different doses of nitrogen and phosphorus to either inoculum or to both dual inocula significantly affected the bulbing ratio character as compared to uninoculated plants in the two experimental seasons. However, the best results were obtained from the inoculation with rhizobacterin plus VA-mycorrhizae and (22.5 kg N/fed. + 7.5 kg P_2O_5/fed.) in both seasons. Also, this treatment surpassed the recommended dose from nitrogen and phosphorus in both seasons, but the differences were more announced and statistically approved in first season only.

Total bulb yield (ton/fed.) :

Data dealing with the effect of inoculation with rhizobacterin and/or VA-mycorrhizae solely or in combined with various levels of nitrogen and phosphorus on total bulb yield ton/fed. are shown in Table (3).

Inoculation with rhizobacterin significantly increased total bulb yield ton/fed. in both seasons as compared to uninoculated plants (control), this result are in line with this reported by Thilakavathy and Ramaswamy, (1998). Also, inoculation with VA-mycorrhizae significantly increased this character in both seasons as compared to uninoculated plants, but there were no significant differences detected between both inoculum in both seasons. This result are in harmony with this found by Sharma *et al.,* (2000). Moreover, both dual inocula take the same general trend in both seasons. Applying the recommended dose of nitrogenious and phosphorus chemical fertilizers significantly

Table (3): Effect of inoculation of Giza-6, onion cultivar, with rhizobacterin, VA-mycorrhizae and different doses of chemical nitrogen and phosphorus on total bulb yield ton/fed., marketable yield ton/fed., culls yield ton/fed. and T.S.S % in 2001/2002 and 2002/2003 winter seasons.

Treatments	Bulbs yield (ton/fed.)						T.S.S %	
	Total bulb yield (ton/fed.)		Marketable yield (ton/fed.)		Culls yield (ton/fed.)			
	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Uninoculated (control)	5.37 D	5.51 E	4.41 C	4.58 F	0.96 A	0.93 C	12.90 BCD	12.51 EF
Rhizobacterin (Rhizo.)	12.09 ABC	11.42 CD	11.28 AB	10.95 CDE	0.81 A	0.47 AB	13.03 BC	13.37 BCD
Mycorrhizae (Myco.)	11.50 C	10.93 D	10.74 B	10.58 DE	0.77 A	0.35 A	13.35 B	14.10 A
Rhizo. + Myco.	11.82 BC	11.80 BCD	11.26 AB	11.31 B-E	0.56 A	0.49 AB	12.75 BCD	12.88 AB
Recommended dose of N and P	13.22 ABC	12.52 A-D	12.69 AB	12.03 A-E	0.53 A	0.49 AB	13.15 B	13.77 ABC
Rhizo. + ¼ NP	11.97 BC	11.36 CD	11.33 AB	10.91 CDE	0.64 A	0.44 AB	12.33 CD	12.70 EF
Rhizo. + ½ NP	11.74 BC	11.69 BCD	11.19 AB	11.03 B-E	0.55 A	0.65 B	12.30 D	12.78 DEF
Rhizo. + ¾ NP	12.14 ABC	11.29 CD	11.60 AB	10.68 DE	0.54 A	0.61 AB	12.68 BCD	13.82 AB
Myco. + ¼ NP	13.48 ABC	12.95 ABC	12.62 AB	12.42 A-D	0.84 A	0.54 AB	12.93 BCD	12.55 EF
Myco. + ½ NP	13.66 ABC	13.41 AB	13.18 A	12.87 AB	0.48 A	0.54 AB	13.03 BC	13.15 CDE
Myco. + ¾ NP	13.93 AB	13.33 AB	13.34 A	12.72 ABC	0.59 A	0.61 AB	13.38 B	12.63 EF
Rhizo. + Myco. + ¼ NP	14.20 A	13.83 A	13.42 A	13.25 A	0.78 A	0.58 AB	14.38 A	14.08 A
Rhizo. + Myco. + ½ NP	12.99 ABC	12.35 A-D	12.43 AB	11.90 A-E	0.56 A	0.44 AB	12.38 CD	12.53 EF
Rhizo. + Myco. + ¾ NP	13.35 ABC	12.99 ABC	12.58 AB	12.61 ABC	0.77 A	0.37 AB	14.25 A	12.43 F

Means followed by the same letter or letters are not significantly different at 5% level.

increased total bulb yield ton/fed. in both seasons as compared to control plants. Same general trend was found by Haggag *et al.,* (1986); Sato, (1988) and Setty *et al.*, (1989). However, there were no significant differences noticed in the total bulb yield between nitrogen and phosphorus recommended dose fertilizers and either inoculum or both dual inocula in both two experimental seasons. Data illustrated in Table (3) also, indicated that applying different levels of nitrogen and phosphorus to either inoculum or both dual inocula significantly increased total bulb yield as compared to uninoculated plants in the two experimental seasons.

The highest values of total bulb yield were (14.20 and 13.83 ton/fed.) obtained when onion plants received both dual inocula plus one fourth of the recommended dose from nitrogen and phosphorus. Whereas, the lowest values were (5.37 and 5.51 ton/fed.) resulted from uninoculated plants in the two experimental seasons. This bemifical effect may be due to the highly nutritional status caused by inoculation with rhizobacterin. Also, this result could be explained in the light of the fact that the hyphae of VA-mycorrhizae explore much greater volume of soil. It can be suggested that mycorrhizael roots can obtained up to 60 times of the soil minerals as the amount that can be taken from the soil by non-mycrorrhizal roots Bieleski (1973). This results are in agreement with that reported by Mandhare *et al.,* (1998); Sing and Mohanty (1998); Kashappanavar and Screenivasa (2000) and Sharma *et al.,* (2000).

Marketable yield :

It is clear from the data presented in Table (3) that inoculation with rhizobacterin separately or combined with VA-mycorrhizae in the presence of absence of different doses of nitrogen and phosphorus chemical fertilizers dramatically increased the marketable yield (ton/fed.) in the two experimental seasons as compared to uninoculated onion plants. Moreover, data in the above mentioned Table clearly showed that inoculation with rhizobacterin has the almost similar effect as that of VA-mycorrhizae in improving these traits in both seasons. In addition, the dual inocula significantly increased the abovementioned character as compared to uninoculated plants in both seasons. Supplying different doses of nitrogen and phosphorus to plants received any inoculum or dual inocula resulted in an increase in marketable yield ton/fed. and the differences were statistically approved from the statistical point of view in the two experimental seasons. However, the highest values of this trait were obtained when onion plants received the dual inocula plus one fourth of nitrogen and phosphorus. Also, the prementioned treatment surpassed the uninoculated plants by 67.1 % and 65.4 % in the first and second seasons, respectively and surpassed the recommended dose of nitrogen and phosphorus by 5.4 % and 9.2 % in the first and second seasons, respectively. these results are in harmony with those reported by Ibrahim (1986); Sing and Mohanty (1998) and Kashappanavar and Screenivasa (2000).

Culls yield (ton/fed.) :

Data presented in Table (3) illustrated the effect of inoculation with each inoculum solely or inoculation with both dual inocula in the presence or absence different doses from nitrogen and phosphorus chemical fertilizers on the above mentioned trait in the two experimental seasons. It could be concluded that both inoculum i.e. (rhizobacterin & VA-mycorrhizae) affected culls yield (ton/feddan). In addition, rhizobacterin plus VA-mycorrhizae affected this trait but the differences were more announced statistically in the second season as compared to uninoculated plants. However, application nitrogen and phosphorus chemical fertilizers to each inoculum separately or to both dual inocula showed the same general trend in both seasons. These results could be explained by the increments in the marketable yield as previously discussed.

Total soluble solids (T.S.S.) :

Data in Table (3) clearly showed that inoculation of onion plants with rhizobacterin and/or VA-mycorrhizae was very effective in increasing total soluble solids in both seasons. The inoculation with rhizobacterin increased the values of this character as compared to uninoculated treatments in both seasons, but differences were more announced and statistically approved in the second season only. Moreover, inoculation with VA-mycorrhizae took the same general trend. This result in line with those found by Ibrahim (1986) and Kashappanavar and Screenivasa (2000). Regarding to the effect dual inocula i.e. (rhizobacterin plus VA-mycorrhizae) as well as the dual inocula in combined with different doses of nitrogen and phosphorus, we could concluded that dual inocula plus one fourth nitrogen and phosphorus affected this character significantly in the two experimental seasons. This treatment achieved values surpassed the treatments received the recommended dose of nitrogen and phosphorus in both seasons. These results are in harmony with those obtained by Ibrahim (1986) and Kashappanavar and Screenivasa (2000).

Percentage of nitrogen, phosphorus and potassium :

Data presented in Table (4) clearly showed that inoculation of onion transplants with rhizobacterin

Table (4): Effect of inoculation of Giza-6, onion cultivar, with rhizobacterin, VA-mycorrhizae and different doses of chemical nitrogen and phosphorus on percentage of nitrogen, phosphorus and potassium in 2001/2002 and 2002/2003 winter seasons.

Treatments	N %		P %		K %	
	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Uninoculated (control)	2.31 F	2.73 D	0.27 E	0.28 H	1.88 G	1.94 E
Rhizobacterin (Rhizo.)	2.88 BC	2.99 BC	0.37 D	0.38 G	2.62 BC	2.63 AB
Mycorrhizae (Myco.)	3.06 AB	3.10 B	0.40 CD	0.41 EFG	2.82 A	2.78 A
Rhizo. + Myco.	2.78 BCD	2.94 BCD	0.41 BCD	0.42 D-G	2.75 AB	2.72 A
Recommended dose of N and P	3.24 A	3.43 A	0.50 A	0.52 A	2.73 AB	2.73 A
Rhizo. + ¼ NP	2.36 EF	2.78 CD	0.46 ABC	0.45 B-F	2.55 CD	2.51 BC
Rhizo. + ½ NP	2.52 DEF	2.96 BCD	0.41 BCD	0.42 D-G	2.43 DE	2.45 BC
Rhizo. + ¾ NP	2.57 C-F	2.99 BC	0.41 BCD	0.40 FG	2.40 E	2.40 C
Myco. + ¼ NP	3.01 AB	3.08 B	0.46 ABC	0.43 C-G	2.08 F	2.44 BC
Myco. + ½ NP	2.66 CDE	2.96 BCD	0.47 ABC	0.48 A-D	2.30 E	2.17 D
Myco. + ¾ NP	2.87 BC	3.06 B	0.48 ABC	0.49 ABC	2.09 F	2.08 DE
Rhizo. + Myco. + ¼ NP	2.64 C-F	3.03 B	0.47 ABC	0.48 A-D	2.04 F	2.14 DE
Rhizo. + Myco. + ½ NP	2.75 BCD	3.13 B	0.46 ABC	0.47 A-E	2.07 F	2.12 DE
Rhizo. + Myco. + ¾ NP	2.61 C-F	3.01 BC	0.49 AB	0.51 AB	2.03 F	2.10 DE

Means followed by the same letter or letters are not significantly different at 5% level.

significantly increased percentage of nitrogen in both seasons as compared to the uninoculated ones. This increment might be attributed to the promoting effect of inoculation on the fixation of atmospheric nitrogen and consequently the improvement of nitrogen uptake. Also, inoculation with rhizobacterin significantly increased percentage of phosphorus and potassium in the tissue of onion plants in both seasons as compared to uninoculated ones. Whereas, the inoculation with VA-mycorrhizae significantly increased the percentage of nitrogen, phosphorus and potassium in the onion plants tissues. This result held good in both seasons. This increment in the nutrient uptake by VA-mycorrhizae might be due to the effect of endophyte mycellium in the soil on increasing the absorptive area of the root by exporting larger volume of soil than the root alone. This results are in harmony with those found by Lambert *et al.,* (1979); Ibrahim (1986); Sharma *et al.,* (2000) and Charron *et al.,* (2001). Regarding to the effect of dual inocula i.e., (rhizobacterin plus VA-mycorrhizae) on the prementioned traits, data indicated that dual inocula significantly increased percentage of nitrogen, phosphorus and potassium in onion plants tissues as compared to uninoculated plants (control) in both seasons. Moreover, data in the same Table (4) indicated that the application of different doses of nitrogen and phosphorus to plants inoculated with both rhizobacterin and VA-mycorrhizae increased the previously mentioned characters. These results are in agreement with those found by Ibrahim (1986); Mandhare *et al.,* (1998) and Kashappanavar and Screenivasa (2000).

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تأثير التسميد الحيوى والتسميد بالنيتروجين والفوسفور على نمو وصفات محصول البصل تحت ظروف جنوب الوادى

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قسم البساتين ــ كلية الزراعة بسوهاج ــ جامعة جنوب الوادى .

أجــرى هــذا البحث فى المزرعة البحثية بكلية الزراعة بسوهاج – جامعة جنوب الوادى فى موسمين شتويين زراعيين ناجحين (٢٠٠١/٢٠٠٢ & ٢٠٠٢/٢٠٠٣م) .وقد صممت هذه التجربة كمحاولــة لبحث إمكانية إستخدام التسميد الحيوى (الريزوباكترين وفطر الميكورهيزا) كبديل فعال لإستخدام الأسمدة النيتروجينية والفوسفاتية الكيميائية فى إنتاج البصل .

دلت النتائج التى تم الحصول عليها على أن تلقيح شتلات البصل بالريزوباكترين منفرداً أو مع الميكورهيزا فى وجود أو غياب التسميد النيتروجينى والفوسفورى قد أعطى زيادة معنوية لمعظم الصفات وذلك مقارنة بشتلات البصل التى لم يتم تلقيحها وذلك فى الموسمين . وكذلك فقد اظهرت النـــتائج أن تلقيح شتلات البصل بكلاً من لقاحى الريزوباكترين والميكورهيزا مع ربع كمية السماد الكــيماوى مــن النيتروجيــن والفوسفور (٢٢,٥ كجم نتروجين/فدان + ٧,٥ كجم فوسفور/فدان) أعطى أفضل النتائج لمعظم الصفات موضع الدراسة وهى إرتفاع النبات ، عدد الأوراق ، معامل التبصــيل ، محصول الأبصال الكلى طن/فدان ، المحصول القابل للتسويق طن/فدان ، محصول الأبصـــال النقضـــة طن/فدان ، نسبة المواد الصلبة الذائبة ، النسبة المئوية للنيتروجين والفوسفور والبوتاســيوم فـــى الموسمين . وبناءاً عليه فإن إستخدام اللقاحين معاً كسماد حيوى يمكن أن يحل محل ثلاثة أرباع الكمية الموصى بها من السماد الكيماوى لكلاً من النيتروجين والفوسفور .