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EFFICIENCY OF BIOFERTILIZER NITROBEIN UNDER DIFFERENT LEVELS OF INORGANIC NITROGEN FERTILIZER ON GROWTH, YIELD AND CHEMICAL CONSTITUENTS OF GARLIC PLANTS.

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ABSTRACT

Two field experiments were conducted during 2001/2002 and 2002/2003 seasons at Kaha Experimental Station, Vegetable Research Department, Kalubia Governorate in order to study the effects of nitrobein biofertilizer, nitrogen levels and their interactions on plant growth, yield and its components as well as chemical composition of garlic plants cv. Sids 40 (*Allium sativum, L.*). Seven kilograms of nitrobein (a biofertilizer produced by the Egyptian Ministry of Agriculture, containing active bacteria capable to N_2-fixing) was tested with three levels of nitrogen i.e., 50,100 and 150 kg./fed. in a split plot design. Biofertilizer nitrobein occupied the main plots, while, the nitrogen levels represented the sub-plots. Data showed that, plant height, neck and bulb diameter, as well as fresh and dry weight of leaves and bulb were increased significantly by using nitrobein biofertilizer. Both, total yield (ton/fed.), plant fresh weight (gm.), and clove weight (gm.) were increased significantly with nitrobein compared with the control. Nitrogen, phosphorus and potassium uptake, as well as nitrogen and dry matter percentages were higher in garlic plants that received nitrobein. Concerning nitrogen levels, both (100 and 150 kg./fed.) treatments increased significantly plant height, neck and bulb diameters, as well as fresh and dry weights of leaves and bulb.

No significant interactions were observed between the nitrogen levels and nitrobein biofertilizer on the mineral uptake of N, P and K and the mineral concentration in garlic bulbs and bulbs dry matter as well.

INTRODUCTION

Nitrogen is one of the essential mineral elements for plant growth and one nutrient that is the most frequently in short supply in cultivated soils around the world. The use of biofertilizer such as the nitrogen fixing bacteria may reduce the amount of nitrogen application and consequently reduces production cost Saad *et al.* (1999). The highest yield of sweet potato was obtained by using nitrobein biofertilizer (seven kg./ fed.) with 50 and 25% of nitrogen mineral fertilizer compared with control (100%N), Mansour (2002).

In potato crop, Ibrahim and Aly (1999), reported that increasing nitrogen applied was accompanied by significant increase in plant height, leaf area, fresh weight / plant and dry weight/plant. Moreover, yield potential i.e., yield/ plant, total yield, tubers size were increased as a sequence of increasing N level. Increasing N fertilization up to 90 kg./fed. combined with biofertilizer appeared to be the most efficient combination treatment which gave more vigorous growth, higher yield potential as well as higher chemical

contents in leaves and tubers. This particular treatment, significantly produced a higher yield than that obtained from the application of 135 kg. N / fed. without biofertilizer. Ashour *et al.* (1997) found that inoculation potato tuber seeds with a biofertilizer nitrobein; containing a N-fixing bacteria; before planting, in addition to 60 kg. N/fed., gave the highest total yield as well as a positive effect on some chemical constituents of tubers. In the same line, Shehata and Bakeer (1995) they found that, application of N fertilizers increased yield and its components. Furthermore, the excessive use of nitrogen fertilizers could be increased the crop cost and creates pollution of agroecosystem (Fisher and Richter, 1984). Noel *et al.* (1996) and Jagnow *et al.* (1991) mentioned that, N fixing bacteria enhanced plant growth by contributing growth hormones such as cytokinins or auxins.

In garlic experiments, Ghafoor *et al.* (2001) obtained the highest plant height, number of leaves, number of cloves per bulb, and bulb yield and size with 140 kg. N/ha. The levels of nitrogen used were 0, 50, 80, 110, 140, 170 and 200 kg./ha. The same results were obtained previously by Selvaraj *et al.* (1993) and Grad *et al.* (1993). Mohd *et al.* (1994) studied the combination between nitrogen and potash. Four levels were used from each elements i.e., 0, 50, `100 or 150 kg./ha. and 0, 30, 60 or 90 kg./ha. respectively. They found that, the highest garlic yield was obtained from 100 kg. N/ha. with 90 kg. K_2O/ha. The same results were figured by Wang *et al.* (1992) in garlic. They added that, N had the greatest effect on yield. Concerning the interaction effect between N levels and N sources on N uptake and dry weight of bulbs per plant Kusumainderawati (1986) in garlic found no main effect of N dosage i.e., 75, 112.5 and 150 ppm N on N uptake and dry weight of bulb/plant. The total N uptake of all N fertilization treatments were not significantly different. The N uptake and dry weight bulb/plant of all N fertilization treatments were significantly higher than those of control. Gunadi and Asandhi (1986) illustrated that, nitrogen treatments (0, 80, 160 and 240 kg./ha.) significantly affected the plant height and stem diameter of garlic.

In garlic pot trial, Pevicharova (1998) found that, under the influence of the nitrogen fertilization the content of nitrates in garlic plants increases in a rectline subordination. He added that, the distribution of nitrates in the plant organs is not uniform. The highest nitrates was accumulated in the real stem and root. Meanwhile, leaf part accumulated the lowest quantity. In addition, increasing nitrogen application from zero, to 60, or 120kg./ha. was done by Neuweiler *et al.*, 1996 in strawberry crop. They found that, fruit weight, total yield were increased. Moreover, high rates of N produced excessive leaf formation at the expense of fruit formation. Increasing N application rate from 0 to 120 kg./ha. was associated with increased leaf nitrate content.

The accumulation of NO^-_3 or NO^-_2 in edible food represent a serious problem for human's health, because NO^-_3 or NO^-_2 absorbed into the blood and may oxidize Fe^{++} of hemoglobin to Fe^{+++} and hence producing methemoglobin, which can not transport oxygen (Swann, 1975).

The present study aimed to qualify the effect of mineral nitrogen fertilizer levels with or without nitrobein biofertilizer on garlic crop.

MATERIALS AND METHODS

Series of experiments were carried out during the two winter seasons of 2001/2002 and 2002/2003 at Kaha Experimental Station, Vegetable Research Department, Kalubia Governorate. Garlic cloves of Sids 40 were planted on October 1st and the harvest date was on April 1st in the two seasons. Soil samples were taken before planting for physical and chemical analysis according to Jackson (1973) and presented in table(1).

Table (1) Principal physical and chemical properties of the soil

Season	Texture class	O.M.%	pH 1 : 2.5 Soil: Water	E.C. (m.mohs/cm.) 1: 5, Soil : Water	Available (ppm)		
					N	P	k
1	Clayey	1.3	8.11	0.36	35	6.2	360
2	Clayey	1.1	8.20	0.41	50	9.1	315

A split plot design was adopted with four replicates. The main plots contained two levels of nitrobein i.e., zero and seven kilo grams per feddan. The sub-plots represented three levels of nitrogen i.e., 50, 100 and 150 kg./fed. The experimental sub-plot area was 6.3m^2, contained three rows each 0.6 meter width and 3.5 meters length. Garlic cloves were planted at 10 (cm.) apart on both sides of the row. Nitrobein(*) was mixed with wet soft sand (1 : 10) ratio and distributed into the root absorption zone of plants 15 days after planting, Dawa *et al.* (2000), whereas, nitrogen rates were applied as ammonium nitrate (33.5% N) in three equal doses at 4, 8 and 12 weeks after planting. Agricultural practices were followed according to the recommendations of Ministry of Agriculture and Land Reclamation.

Studied characteristics:

1- Vegetative growth parameters:

A sample of five plants from each plot was randomly uprooted on March 5th to determine the following data.

Plant height (cm.).
Leaves number / plant.
Neck and bulb diameter (cm.).
Bulbing ratio = n/b according to Mann (1952) equation.
Where : n = Neck diameter (cm.).
b = Bulb diameter (cm.).
Fresh weight of leaves and bulbs (gm.).
Dry weight of leaves and bulbs (gm.).

(*) **Nitrobein is a commercial name of the biofertilizer. It was supplied by the General Organization for Agriculture Equalization Fund (G.O.A.E.F.) Ministry of Agriculture, Egypt. It contains live cells of efficient bacteria strains for nitrogen fixation.**

2- Yield and its components:

Total yield was determined and calculated per feddan on April, 1st. A sample of ten random plants were taken from each plot for the following measurements:

Plant fresh weight (gm.).
Bulb diameter (cm.).
Number of cloves / bulb.
Clove weight (gm.).

3- Mineral nutrient uptake :

Mineral elements uptake were calculated in leaves and bulbs of garlic plants according to Jakson (1973).

Total N/plant (mg.).
Total P_2O_5/plant (mg.).
Total K_2O/plant (mg.).

4- Chemical analysis in garlic bulbs :

Percentage of bulb dry matter.
Percentage of N, P and K according to Jackson (1973).

The obtained data were statistically analyzed and treatment means were compared by using least significant difference (LSD) as reported by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Plant growth parameters: -

1.1 Effect of nitrobein :

Data presented in Tables 2 and 3 indicated that, plant height, neck diameter, bulb diameter, fresh and dry weight of leaves and bulb increased significantly by using nitrobein biofertilizer compared with control (without nitrobein). Such data were in line with Ashour *et al.* (1997) on potato crop and Dawa *et al.* (2000) on sweet potato.

1. 2 Effect of nitrogen:

The results showed that most growth parameters of plant increased significantly by increasing nitrogen from 50 to 100 kg./fed. Thus, plant height, neck and bulb diameter, fresh and dry weigh of leaves and bulb were increased progressively and significantly as the supplied rate were increased from 50 to 100kg.N/fed. The data are in agreement with Ghafoor *et al.* (2001). However, there were no significant differences between the levels of nitrogen 50, 100 and 150 kg./feddan on the leaves number in both seasons or the bulbing ratio in the second year as presented in Tables 2 and 3.

1. 3 Effect of interaction between nitrobein biofertilizer and nitrogen:

Interaction between nitrobein biofertilizer and nitrogen levels increased the plant height. No significant effect were observed on the other vegetative growth parameters as presented in Tables (2 and 3).

Table (2) : Effect of nitrobein biofertilizer, nitrogen levels and their interaction on different parameters of garlic during 2001/2002 season.

Treatments		Plant height (cm.)	No. of leaves /plant	Neck diameter (cm.)	Bulb diameter (cm.)	Bulbing ratio	Fresh weight (gm.) of		Dry weight (gm.)of	
Nitrobein (kg./fed.)	Nitrogen kg.N/fed.						Leaves	Bulb	Leaves	Bulb
0		74.3	9.2	1.46	3.96	0.370	62.76	25.24	9.09	6.12
7		77.8	9.1	1.54	4.13	0.374	66.96	27.31	9.71	6.76
L.S.D. at 5%		2.0*	N.S.	0.07*	0.05**	N.S.	3.95*	1.88*	0.60**	0.36*
	50	73.9	9.2	1.40	3.97	0.352	60.61	24.82	8.55	5.91
	100	77.1	9.3	1.57	4.07	0.387	67.47	27.14	9.75	6.86
	150	77.1	9.1	1.54	4.09	0.378	66.49	26.84	9.90	6.56
L.S.D. at 5%		1.43**	N.S.	0.11*	0.05**	0.026*	5.71*	1.30**	0.55**	0.64*
0	50	71.3	9.5	1.36	3.88	0.350	59.32	24.40	8.30	5.64
	100	75.4	9.2	1.53	3.94	0.387	65.62	25.40	9.25	6.49
	150	76.2	9.1	1.50	4.04	0.372	63.32	25.92	9.71	6.25
7	50	76.6	9.0	1.44	4.07	0.354	61.90	25.25	8.80	6.18
	100	78.7	9.3	1.62	4.20	0.386	69.32	28.92	10.24	7.24
	150	77.9	9.1	1.58	4.13	0.383	69.65	27.75	10.10	6.84
L.S.D. at 5%		2.0*	N.S.	N.S.	0.07*	N.S.	N.S.	N.S.	N.S.	N.S.

Table (3): Effect of nitrobein biofertilizer, nitrogen levels and their interaction on different parameters of garlic during 2002/2003 season.

Treatments		Plant height (cm.)	No. of leaves /plant	Neck diameter (cm.)	Bulb diameter (cm.)	Bulbing ratio	Fresh weight (gm.) of		Dry weight (gm.)of	
Nitrobein (kg./fed.)	Nitrogen kg.N/fed.						Leaves	Bulb	Leaves	Bulb
0		72.4	9.8	1.26	4.28	0.296	48.42	27.61	8.43	7.04
7		76.7	10.0	1.50	4.53	0.331	58.52	32.09	9.39	8.00
L.S.D. at 5%		2.7*	N.S.	0.19*	0.21*	N.S.	9.40*	4.32*	0.79*	0.83*
	50	72.9	10.0	1.30	4.27	0.305	48.62	27.55	8.17	7.01
	100	75.3	9.8	1.40	4.44	0.316	55.94	30.70	9.03	7.77
	150	75.4	9.8	1.44	4.51	0.320	55.85	31.30	9.52	7.79
L.S.D. at 5%		0.91**	N.S.	0.10*	0.16*	N.S.	4.45**	3.07*	0.96*	0.69*
0	50	70.1	9.8	1.17	4.12	0.284	43.40	26.20	8.06	6.74
	100	73.3	9.7	1.26	4.29	0.294	50.25	27.33	8.56	6.93
	150	73.8	9.8	1.36	4.43	0.309	51.60	29.31	8.66	7.47
7	50	75.6	10.3	1.44	4.42	0.327	53.83	28.90	8.28	7.28
	100	77.4	10.0	1.54	4.58	0.337	61.64	34.08	9.49	8.62
	150	77.0	10.0	1.52	4.59	0.331	60.09	33.30	10.38	8.12
L.S.D. at 5%		1.3*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

The results agreed with Desmond and Walter (1990) who suggested that the inoculation of sweet potato with Azospirillum contributes the growth mechanisms rather than supplying nitrogen. Stimulation of growth by growth hormones, as noted earlier, may be one such mechanism.

2- Yield and its components:

2.1 Effect of nitrobein:

Tables (4 and 5) showed the effect of nitrobein biofertilizer and nitrogen levels and the interaction between them on garlic yield and its components. Nitrobein biofertilizer significantly increased total yield (ton/fed.), plant fresh weight, bulb diameter, and clove weight in both seasons, when the garlic plants were inoculated by seven kilo grams of nitrobein biofertilizer per feddan.

Table (4): **Effect of nitrobein biofertilizer, nitrogen levels and their interaction on garlic yield and its components during 2001/2002 season.**

Treatments		Total yield (ton/fed.)	Plant weight (gm.)	Bulb diameter (cm.)	No. of cloves / bulb	Clove weight (gm.)
Nitrobein (kg./fed.)	Nitrogen (kg.N/fed.)					
0		6.927	65.6	4.55	18.7	1.65
7		7.761	70.4	4.68	18.0	1.77
L.S.D. at 5%		0.747*	3.8*	0.02**	N.S.	0.10*
	50	6.662	63.0	4.43	18.1	1.59
	100	7.796	71.7	4.71	18.7	1.77
	150	7.575	69.2	4.70	18.4	1.77
L.S.D. at 5%		0.563**	3.6**	0.13**	N.S.	0.08**
0	50	6.216	60.1	4.37	18.2	1.54
	100	7.400	69.8	4.62	19.0	1.66
	150	7.166	66.8	4.65	18.0	1.75
7	50	7.108	65.8	4.48	17.9	1.64
	100	8.192	73.7	4.80	18.3	1.88
	150	7.983	71.6	4.75	17.9	1.79
L.S.D. at 5%		N.S.	N.S.	N.S.	N.S.	N.S.

The data were supported by Noel *et al.* (1996) and Jagnow *et al.* (1991) through the hormones contribution by nitrogen fixing bacteria. Whereas, number of cloves / bulb was not significantly affected by nitrobein biofertilizer.

2.2 Effect of nitrogen:

From Tables 4 and 5, its evident that total yield / fed., plant fresh weight, bulb diameter and clove weight were generally higher with 100 kg. N treatment than the other two treatments. In addition, increasing the nitrogen rates from 50 to 100kg./fed. significantly increased all studied attributes of total yield and its components with exception the number of cloves/ bulb in both years. The data agreed with Wang *et al.*(1992); Pevicharova (1998) and Ghafoor *et al.* (2001) in garlic. Ashour *et al.*, 1997 on potato crop concluded that, nitrogen is an important constituent factor of chlorophyll which increased photosynthesis, resulting in assimilation of more carbohydrates.

Table (5) : Effect of nitrobein biofertilizer, nitrogen levels and their interaction on garlic yield and its components during 2002/2003 season.

Treatments		Total yield (ton/fed.)	Plant weight (gm.)	Bulb diameter (cm.)	No. of cloves / bulb	Clove weight (gm.)
Nitrobein (kg./fed.)	Nitrogen (kg.N/fed.)					
0		6.611	61.9	5.14	17.2	1.88
7		7.158	71.0	5.41	17.6	2.14
L.S.D. at 5%		0.315*	6.6*	0.26*	N.S.	0.15*
	50	6.408	62.8	5.07	17.4	1.79
	100	7.175	67.5	5.30	17.3	2.11
	150	7.071	69.1	5.45	17.5	2.14
L.S.D. at 5%		0.643*	4.7*	0.20**	N.S.	0.27*
0	50	6.150	58.0	4.96	16.9	1.69
	100	6.767	63.0	5.11	17.2	1.98
	150	6.917	64.8	5.45	17.5	1.99
7	50	6.666	67.5	5.18	17.8	1.89
	100	7.583	72.0	5.49	17.4	2.25
	150	7.225	73.4	5.56	17.4	2.30
L.S.D. at 5%		N.S.	N.S.	N.S.	N.S.	N.S.

2.3 Effect of interaction between nitrobein biofertilizer and nitrogen:

No significant change was found in the interaction between nitrobein biofertilizer and nitrogen mineral fertilizer on both total yield or it components in both studied years.

3- Chemical constituents:

3.1 Effect of nitrobein on N, P and K uptake :

Table 6 cleared the nutrient N, P and K uptake in garlic crop. It is evident that mineral uptake of N, P_2O_5 and K_2O were generally higher with than without nitrobein biofertilizer in the two seasons of 2001/2002 and 2002/2003. Such data are in agreement with Jagnow *et al.* (1991) and Noel *et al.* (1996) on canola and lettuce. They indicated that N-fixing bacteria may produce adequate amounts of indol acetic acid (IAA) and cytokinins which increase the surface area of root length and consequently enhancing the uptake of nutrients from the soil, leads to increase the plant vigorous.

3-2 Effect of nitrogen on N, P and K uptake:

In Table 6, the garlic uptake of N, P and K were increased significantly with increasing the nitrogen application levels. Data clearly demonstrate that the use of mineral nitrogen at different amounts to garlic obviously increased concentrations of mineral N, P and K uptake. In addition, application of mineral nitrogen rate from 50 to 100 or 150 kilo grams per feddan increased constantly and significantly N, P and K uptake by garlic plant. The data were in line with Kusumainderawati (1986) in garlic.

Table (6) : Effect of nitrobein biofertilizer, nitrogen levels and their interaction on nutrient uptake in garlic plant (leaves and bulb) during 2001/2002 (I) and 2002/2003(II) seasons.

Treatments		mg. N/plant		mg. P_2O_5 / plant		mg. K_2O/ plant	
Nitrobein (kg./fed.)	Nitrogen (kg.N/fed.)	I	II	I	II	I	II
0		339.8	353.7	37.84	39.32	281.4	319.3
7		353.6	395.9	44.19	44.18	298.7	362.0
L.S.D. at 5%		3.5**	38.3*	0.73**	4.78*	11.4*	32.1*
	50	323.9	339.5	36.54	38.30	268.5	310.0
	100	360.1	380.7	43.81	42.11	306.6	349.4
	150	356.1	404.3	42.68	44.83	295.2	362.4
L.S.D. at 5%		29.8*	48.6*	2.51*	3.80*	26.7*	30.4**
0	50	322.4	337.6	33.23	37.49	259.0	299.4
	100	346.3	348.2	39.49	39.01	300.9	327.8
	150	350.8	375.5	40.80	41.45	284.4	330.6
7	50	325.5	341.4	39.86	39.12	277.9	320.6
	100	373.9	413.2	48.13	45.21	312.2	371.0
	150	361.4	433.1	44.57	48.21	306.1	394.3
L.S.D. at 5%		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

3.3 Effect of interaction between nitrobein biofertilizer and nitrogen on N, P and K uptake :

No statistical significant interaction were observed in both seasons of study by means of nutrients elements N, P and K uptakes (Table 6).

3.4 Effect of nitrobein biofertilizer on N, P and K concentrations, and dry matter percent in garlic bulbs:

Data presented in Table 7, cleared that nitrogen concentration and dry matter percentage were increased significantly in treatment received N fixing bacteria (Nitrobein) comparing with non received (control) in the two years. Nitrobein application showed significant effect on K concentration in garlic bulbs in the 1st season only. Meanwhile, phosphorus concentration percentage was not significantly effected by nitrobein biofertilizer.

3.5 Effect of nitrogen treatments on N, P and K concentrations and dry matter percentage in garlic bulbs:

Table7, showed that, nitrogen levels were increased significantly in dry matter of garlic bulbs in the two years of trial. Meanwhile, the concentration percent of N, P and K were not influenced by the nitrogen levels. In addition, no significant differences were obtained by 50 kg. or 100 kg. or 150 kg. N/fed. on N, P and K percent in both years.

3.6 Effect of the interaction between nitrobein and nitrogen on mineral N, P and K concentrations and dry matter percent in garlic bulbs:

The interaction between nitrobein treatments and those of different nitrogen levels under investigation did not achieve any significant difference in relation to garlic bulb dry matter or mineral N, P and K nutrient concentration in both seasons (Table 7).

Table (7): Effect of nitrobein biofertilizer, nitrogen levels and their interaction on mineral nutrients concentrations and dry matter percent in garlic bulbs during 2001/2002 (I) and 2002/2003 (II) seasons.

Treatments		N(%)		P(%)		K(%)		Bulb dry matter (%)	
Nitrobein (kg./fed.)	Nitrogen (kg.N/fed.)	I	II	I	II	I	II	I	II
0		2.19	2.10	0.342	0.381	1.341	1.320	34.33	35.14
7		2.36	2.33	0.341	0.390	1.382	1.340	35.05	36.33
L.S.D. at 5%		0.13*	0.21*	N.S.	N.S.	0.030*	N.S.	0.67*	1.12*
	50	2.24	2.21	0.348	0.388	1.362	1.360	34.32	35.10
	100	2.30	2.27	0.345	0.369	1.370	1.303	34.89	36.09
	150	2.28	2.16	0.331	0.399	1.353	1.327	34.87	36.03
L.S.D. at 5%		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.27**	0.77*
0	50	2.15	2.15	0.355	0.390	1.332	1.352	33.83	34.25
	100	2.25	2.12	.0342	0.371	1.367	1.282	34.61	35.53
	150	2.17	2.04	0.330	0.381	1.323	1.325	34.56	35.65
7	50	2.32	2.28	0.342	0.386	1.391	1.367	34.81	35.95
	100	2.36	2.42	0.348	0.367	1.372	1.324	35.18	36.65
	150	2.38	2.27	0.333	0.416	1.382	1.330	35.17	36.40
L.S.D at 5%		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

CONCLUSION

From the previous results it is clear that treating garlic plants with nitrobein under 100 kg. N/fed. gave the highest yield compared with (50 or 150) kg./fed. Therefore application of nitrobein would save about 50 N unit/fed. of nitrogen and will decrease the major cost of crop production and reduce pollution of agroecosystem.

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فعالية السماد الحيوي نتروبين تحت مستويات مختلفة من التسميد النيتروجيني المعدني على النمو، والمحصول، والتركيب الكيماوي لنباتات الثوم

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أجريت تجربتان حقليتان خلال موسمي ٢٠٠١/٢٠٠٢، ٢٠٠٢/٢٠٠٣ بمحطة بحوث الخضر بقها – محافظة القليوبية لدراسة تأثير السماد الحيوي النتروبين ومستويات مختلفة من التسميد النيتروجيني وكذلك التفاعل بينها على النمو والمحصول ومكوناته والمحتوى الكيماوي لنباتات الثوم صنف سدس ٤٠.

في تصميم قطع منشقة مرة واحدة تم اختبار السماد الحيوي نتروبين (صفر، ٧كجم/فدان) مع ثلاث مستويات من النيتروجين (٥٠، ١٠٠، ١٥٠ كجم/فدان) حيث شغل السماد الحيوي المعاملات الرئيسية بينما شغل التسميد النيتروجيني المعاملات الشقية.

وقد أوضحت النتائج أن ارتفاع النبات، قطر العنق، قطر البصلة، والوزن الطازج والجاف للأوراق والأبصال قد زادوا معنوياً باستخدام السماد الحيوي نتروبين.

كما أن المحصول الكلي (طن/فدان)، الوزن الطازج للنبات (جم)، ووزن الفص (جم) قد زادوا معنوياً باستخدام النتروبين مقارنة بالكنترول (بدون النتروبين).

الامتصاص الكلي للنيتروجين والفوسفور والبوتاسيوم وكذلك النسبة المئوية للنيتروجين والمادة الجافة زادت زيادة معنوية في نباتات الثوم المسمدة بالنتروبين.

كما أوضحت الدراسة أن ١٠٠، ١٥٠ كجم نيتروجين / فدان زادا معنوياً من ارتفاع النبات، وقطر العنق والبصلة وأيضا الوزن الطازج والجاف للأوراق والأبصال.

لم يكن هناك تأثير معنوي للتفاعل بين مستويات النيتروجين والسماد الحيوي نتروبين على الامتصاص الكلي للنيتروجين والفوسفور والبوتاسيوم وكذلك المادة الجافة للأبصال وتركيز العناصر بها.