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RESPONSE OF CAULIFLOWER TO ORGANIC AND BIOFERTILIZERS AND NITROGEN LEVELS

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ABSTRACT

Cauliflower cv. Snowball Y Improved plants were treated with seven treatments (80 kg N fed^{-1}, 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1}, 60 kg N fed^{-1} + 10 m^3 chicken manure fed^{-1}, 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 10 m^3 chicken manure fed^{-1}, 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1}, 40 kg N fed^{-1} + 20 m^3 chicken manure fed^{-1}, 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 20 m^3 chicken manure fed^{-1}) in two field experiment conducted at Baramoon Experimental Farm, Dakahlia Governorate during 2002/2003 and 2003/2004 seasons. These treatments had significant effects on all traits under study. Using 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 10 m^3 chicken manure fed^{-1}, and 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 20 m^3 chicken manure fed^{-1} gave the highest values for leaves weight / plant, curd weight and diameter, protein (%) and curd yield per feddan as well as N, P and K accumulation in leaves and curd. The same treatments reduced vitamin C (VC) content, protein (%), dry matter (DM) (%) and mean time from transplanting to maturity. Treatment with 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} recorded the highest values for VC content and DM%. Treatment with 80 kg N fed^{-1} recorded the highest values for NO_3 accumulation in curd and mean time from transplanting to maturity. So, application of 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 10 m^3 chicken manure fed^{-1} or 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 20 m^3 chicken manure fed^{-1} was sufficient and could be recommended for good yield and quality of cauliflower under similar conditions of this work.

INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis*) is a popular vegetable crop in Egypt. Fertilization is one of the important field practices to maximize production. Nitrogen is a critically important nutrient for cauliflower production, it is an indispensable factor for increasing the vegetative growth and curd yield and quality (Everaarts, 2000 and Farrag *et al.*, 2000). The use of nitrogen from mineral fertilizers is one of the most effective methods for overcoming the nitrogen deficiency of soil. Because of the rising costs of such nitrogenous fertilizers together with the possible environmental problems attendant upon their use. The use of organic and biofertilizers in agriculture are considered an important strategy.

Organic manures contribute to crop quantity and quality through its effects on physical, chemical and biological properties of the soil, its effect as a source of essential elements as well as its ability to increase the availability of certain nutrients (Clark *et al.*, 1998; Khafagy, 1999 and Bulluck *et al.*, 2002).

Non-symbiotic bacteria present in biofertilizer have beneficial effect on plant host by different mechanisms, *e.g.*, nitrogen fixation and plant hormones production (Bashan and Holguim, 1997 and Hegde *et al.*, 1999). The efficiency of these bacteria in the presence of organic manure was highest. Bacterial strains were highly efficient on promotion of nitrogen fixation, Co_2 evolution and ammonification, which led to adjustment of pH

media, which high increment propagation of bacterial cells when applying with organic materials than using each of them in single application (Kundu and Gaur, 1980; Awad, 1998 and Khafagy, 1999).

Attempts, in the last two decades, were done to replace all or part of nitrogen chemical fertilizer, using organic or/and biofertilizers. Kalayani *et al.* (1996) stated that soil inoculation with *Azospirillum* coupled with less nitrogen (80 kg/ha) had a beneficial effect in improving the growth and yield of cauliflower besides saving on nitrogen fertilizer by up to 50%. Similar findings were detected on cabbage by El-Afifi *et al.* (2002) and Sharma (2002). On the other hand, Bjeli *et al.* (2000) found that the highest average curd diameter and yield of cauliflower were obtained when 45 t/ha manure was applied and the lowest were obtained when 15 t/ha manure was applied. Moreover, cabbage yield was highest when the application of 50% recommended N + 25% poultry manure + biofertilizers (Devi *et al.*, 2003).

Accordingly, growers may apply excess from organic manures such as chicken manure and biofertilizers to reduce the using of mineral fertilizers, but they would not use them in combination very well. Hence, conversion values of them to mineral N fertilizers (for decreasing chemical fertilizers) are studied in this paper.

MATERIALS AND METHODS

At Baramoon Experimental Farm, Dakahlia Governorate, Egypt, the present investigation was performed during the two winter seasons of 2002/03 and 2003/04, using the cauliflower cultivar "Snowball" to achieve the study objectives.

Some physical and chemical properties of the experimental soil at the depth of 0-30 cm were determined according to the standard procedures as described by Page (1982) and Klute (1986) (Table 1). The chemical analysis of the used chicken manure was determined by using standard methods described by AOAC (1990) (Table 2).

Table 1. Some physical and chemical properties of the experimental soil during 2002/03 and 2003/04 seasons.

Properties	Values		Properties	Values	
	2002/03	2003/04		2002/03	2003/04
Sand (%)	27.8	27.1	pH* values	7.9	7.7
Silt (%)	31.5	31.9	EC (dSm^{-1})	0.9	0.7
Clay (%)	40.6	40.9	Total N (%)	0.12	0.10
Texture class	Clay-loam	Clay-loam	Available P (ppm)	11.2	11.0
$CaCO_3$	3.6	3.4	Exchangeable K		
OM (%)	2.3	2.4	(ppm)	304	293

* pH: (1:2.5 soil extract).

A complete randomized block design with four replications was used. Each plot contained 36 plants in four rows of 9 plants each; rows were 75 apart with 45 cm between plants in rows, *i.e.*, plot area was 4.0 x 3.0 m. The experiment included 7 treatments, which were as follows:-

1- 80 kg N fed^{-1} (80 kg N).

2- 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} (60 kg N + Ni).
3- 60 kg N fed^{-1} + 10 m^3 chicken manure fed^{-1} (60 kg N + 10 m^3 Ch).
4- 60 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 10 m^3 chicken manure fed^{-1} (60 kg N + Ni + 10 m^3 Ch).
5- 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} (40 kg N + Ni).
6- 40 kg N fed^{-1} + 20 m^3 chicken manure fed^{-1} (40 kg N + 20 m^3 Ch)
7- 40 kg N fed^{-1} + 2 kg Nitrobin fed^{-1} + 20 m^3 chicken manure fed^{-1} (40 kg N + Ni + 20 m^3 Ch).

Table 2. Some properties of chicken manure used in 2002/03 and 2003/04 seasons.

Properties	Values		Properties	Values	
	2002/03	2003/04		2002/03	2003/04
N (%)	1.86	2.02			
P (%)	1.71	1.68	Fe (ppm)	1370	1330
K (%)	2.15	2.26	Mn (ppm)	180	198
OM (%)	48.3	47.2	Zn (ppm)	129	137
C / N	13.9	13.2	Cu (ppm)	56	58
pH	8.1	7.8	EC (dSm^{-1})	0.9	0.8

Seeds were sown in the nursery on 9 and 12 Sept. in both seasons, respectively, while transplanting took place when seedlings were 6 weeks old, also transplant root systems were treated with Nitrobin at transplanting. Chicken manure was applied before transplanting in furrow and raked lightly with the soil. Nitrogen treatments in the form of ammonium sulphate (20.6%), superphosphate (16% P_2O_5) at a rate of 40 kg P_2O_5 fed^{-1} and potassium sulphate (48% K_2O) at a rate of 48 kg K_2O fed^{-1} were applied at two equal doses, one was added after 5 weeks and the other after 10 weeks from seedling transplanting. The normal agricultural practices were followed until harvest.

When the majority of curds in each plot were matured (a week before harvest), samples of six plants were taken at random from the two central rows of each plot and the following characters were measured:-

1. Growth parameters:
   1- Leaves weight / plant. 2- Curd weight, and 3- Curd diameter.
2- N, P and K accumulation in curd and leaves, which was estimated based on curd and leaves weight and DM and element percentage in curd leaves.
3- Curd quality:
   1- Vitamin C as ascorbic acid was estimated using titration with 2, 6-dichlorophenol indophenol blue dye (Jacobs, 1951),
   2- Protein percentage: Its value was calculated using multiplying N percentage by the conversion factor 6.25,
   3- Nitrate accumulation in curd, and
   4- Dry matter percentage (DM%) at 70°C to a constant weight.

After all plants in each plot reached maturity stage, cauliflowers were harvested by hand, and the following data were computed on the basis of the two inner rows of each plot:

1- Mean time from transplanting to maturity: It was determined using the following equation:

$$\text{Log } t = \Sigma\, n_e \text{ Log } t_e\, (\Sigma\, n_e)^{-1}$$

2- Head yield: Plots were weighted in kg plot^{-1} to determine head yield, then it was converted to estimate head yield in ton fed^{-1}.

All data were statistically analyzed using technique of the randomized complete block design according to Snedecor and Cochran (1982). The treatment means were compared using Duncan's Multiple Range test at the 5% level of probability as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1- Growth parameters:

Data recorded in Table 3 explain that the growth parameters of cauliflower plants expressed on leaves weight / plant and curd weight and diameter were significantly influenced by different treatments in the two seasons of study.

Table 3. Means of some growth parameters as affected by nitrogen levels, Nitrobin (Ni) and chicken manure (Ch) during 2002/03 and 2003/04 seasons.

Treatments	Leaves weight (kg/plant)		Curd weight (kg/plant)		Curd diameter (cm)	
	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004
80 kg N	1.57 c	1.61 c	1.77 c	1.88 c	21.4 cd	22.1 c
60 kg N + Ni	1.50 c	1.55 c	1.81 c	1.91 bc	22.0 b	22.5 bc
60 kg N + 10 m^3 Ch	1.84 b	1.90 b	1.86 b	1.95 b	22.3 ab	22.7 ab
60 kg N + Ni + 10 m^3 ch	2.21 a	2.31 a	1.95 a	2.03 a	22.7 a	23.0 a
40 kg + Ni	1.11 d	1.16 d	1.73 d	1.83 d	21.1 d	22.0 c
40 kg N + 20 m^3 Ch	1.42 c	1.46 c	1.80 c	1.90 c	21.8 bc	22.5 bc
40 kg N + Ni + 20 m^3 ch	2.13 a	2.24 a	1.99 a	2.07 a	22.8 a	23.2 a

Means followed by a common letter in the same column do not differ significantly using Duncan's Multiple Range test at 5% level

In general, the combined effect of chicken manure plus Nitrobin was more effective on growth parameters than using each of them in individual application. The highest values of all growth parameters were obtained from using 40 kg N + Nitrobin + 10 m^3 chicken manure, while the lowest values of the three growth parameters were obtained from 40 kg N + Nitrobin in comparison with other treatments.

The enhancing effect of chicken manure combined with Nitrobin on plant growth might be attributed to the increment in bacterial population and its activity to supply the plant with fixed nitrogen and release plant promoting substances (mainly IAA, gibberellins and cytokinins-like substances), which could stimulate plant growth (Bashan and Holguim, 1997 and Hegde *et al.*, 1999), and increase the absorption and efficiency of nutrients (Awad. 1998) and, in turn, resulted in more metabolism process, and finally produce good

growth. Also, the use of chicken manure may also improve the soil properties, physically, chemically, microbiologically and hence plant growth (Kaloosh and Koreish, 1995; Awad, 1998 and El-Kassas and El-Sebsy, 2002).

Furthermore, the results may be attributed to the fact that cauliflower plants need nitrogen for healthy, especially where soils are poor in nitrogen and organic matter as this study situation (Table 1), and to the gradual release of available nitrogen sources due to the use of chicken manure and Nitrobin than mineral fertilizer. In this connection, Boogaard and Thorup-Kristensen (1997) pointed out that the efficiency of nitrogen use was increased when more nitrogen was supplied at the time of a higher absolute growth and nitrogen demand. These results are supported by Kalayani *et al.* (1996); Bjeli *et al.* (2000) and Sharma (2002).

2- N, P and K accumulation in curd and leaves:

From Table 4, it could be seen that the effect of different treatments on N, P and K accumulation in curd and leaves was significant in both seasons. The highest values of these traits were obtained at 40 kg N + Nitrobin + 20 m^3 chicken manure and 60 kg N + Nitrobin + 10 m^3 chicken manure in comparison with other treatments. This might be due to that the same treatments improved the transpiration surface (leaves weight, Table 3), that might be related closely with water and nutrients uptake and translocation that in light relation with water and minerals uptake. In addition, this effect is attributed to the chicken manure, which themself considered a source of nutrients (Table 2), as well as to their effect on improving soil properties and supplying it with available nutrients (Clark *et al.*, 1998; Khafagy, 1999 and Bulluck *et al.*, 2002). In the same line, Sharma and Arya (2001) on cabbage, found that the uptake of N, P and K increased significantly with organic manure. Moreover, Saber and Gomaa (1993) pointed out that microorganisms increased the availability of nutrients in soil by forming carbonic acid and organic acids, which they synthesize.

Table 4. Means of N, P and K accumulation in curd and leaves as affected by nitrogen levels, Nitrobin (Ni) and chicken manure (Ch) during 2002/03 and 2003/04 seasons.

Treatments	N accumulation (mg/plant)		P accumulation (mg/plant)		K accumulation (mg/plant)	
	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004
80 kg N	6044 bc	5774bcd	1235 bc	1155 bc	7674 b	7402 ab
60 kg N + Ni	5555 cd	5347 cd	1165 bc	1115 bc	7296 b	7213 ab
60 kg N + 10 m^3 Ch	7083 b	6836 b	1388 ab	1291 ab	8764 ab	8548 ab
60 kg N + Ni + 10 m^3 ch	8404 a	8495 a	1561 a	1458 a	11499 a	10738 a
40 kg + Ni	4465 d	4556 d	983 c	971 c	6461 b	6488 b
40 kg N + 20 m^3 Ch	6165 bc	6076 bc	1154 bc	1105 bc	7566 b	7394 ab
40 kg N + Ni + 20 m^3 ch	8844 a	8740 a	1575 a	1474 a	11039 a	8771 ab

Means followed by a common letter in the same column do not differ significantly using Duncan's Multiple Range test at 5% level

3- Curd quality:

As shown in Tables 5 and 6, mean values of curd quality of cauliflower plants (VC content, protein %, NO_3 accumulation, and DM%) were significantly affected by the different treatments in both seasons.

Table 5. Means of some curd quality as affected by nitrogen levels, Nitrobin (Ni) and chicken manure (Ch) during 2002/03 and 2003/04 seasons.

Treatments	Vitamin C (mg/100g fresh wt)		Protein (%)		NO_3 accumulation (mg/kg dry wt)	
	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004
80 kg N	70 b	75 b	13.5 cd	12.9 cd	113 a	118 a
60 kg N + Ni	72 b	76 b	12.8 d	12.2 d	101 b	104 b
60 kg N + 10 m^3 Ch	66 c	70 c	14.9 bc	14.4 bc	91 c	94 bc
60 kg N + Ni + 10 m^3 ch	63 c	65 d	17.3 ab	16.8 ab	85 c	87 cd
40 kg + Ni	76 a	79 a	10.3 e	10.2 e	75 d	76 de
40 kg N + 20 m^3 Ch	66 c	72 c	15.5 bc	15.2 bc	65 e	68 e
40 kg N + Ni + 20 m^3 ch	64 c	67 d	18.6 a	18.0 a	61 e	65 e

Means followed by a common letter in the same column do not differ significantly using Duncan's Multiple Range test at 5% level

For VC content, it is obvious that the highest values were recorded at 40 kg N + Nitrobin in comparison with other treatments in both seasons. This may be due to the amount of nitrogen at this treatment is insufficient for needs of plant, in this respect, Szwonek and Michalik (1991) indicated that the amount of VC in curd was decreased with increasing amount of N fertilizer.

As for protein percentage, data collected in Table 5 show that 40 and 60 kg N with Nitrobin and chicken manure had the better values of protein content, while 40 kg N + Nitrobin gave the lowest means in comparison with other treatments in both seasons. This may be due to the role of Nitrobin with chicken manure in an increase of nitrogen availability (Bashan and Holguim, 1997 and Bulluck *et al.*, 2002), which lead to increase the uptake of nitrogen by plant (Table 4) and consequently, the biosynthesis of protein (Hara and Sonoda, 1981).

As shown in Table 5, the lowest nitrate accumulations were found when lower N-dose (40 kg N/fed) was applied to plants treated with Nitrobin or/and chicken manure, whereas the highest NO_3 accumulation was detected in curds of the mineral fertilized plants (80 kg N/fed) in comparison with the other treatments in both seasons. This result can be explained on the basis that non-symbiotic N_2-fixer increase nitrate reductase activity (Hedge *et al.*, 1999) and excrete ammonia in rhizosphere (Wild, 1993) and in turn increase NH_4:NO_3 ratio in the soil, which gives the chance to absorb more NH_4-N, which might be inhibit NO_3 accumulation in plant (Serna *et al.*, 1992). Also, the steady release of the nitrogen from organic fertilizers (Bulluck *et al.*, 2002) could have resulted that nitrogen has been taken up mainly in the form

in correspondence with those obtained by Premuzic *et al.* (2002) on lettuce, who found that the mineral fertilizer treatments had a higher nitrate concentration compared to organic treatments.

Table 6. Means of dry matter (DM%) in curd, mean time from transplanting to maturity (MTTM) and curd yield as affected by nitrogen levels, Nitrobin (Ni) and chicken manure (Ch) during 2002/03 and 2003/04 seasons.

Treatments	DM (%)		MTTM (day)		Curd yield (ton/fed)	
	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004	2002/ 2003	2003/ 2004
80 kg N	9.6 b	9.2 b	136 a	140 a	16.02 d	18.11 c
60 kg N + Ni	9.4 bc	9.1 bc	134 ab	137 ab	16.78 c	18.38 c
60 kg N + 10 m^3 Ch	8.1 cd	8.8 cd	131 ab	134 ab	17.62 b	19.19 bc
60 kg N + Ni + 10 m^3 ch	8.8 de	8.6 de	128 bc	131 bc	18.93 a	20.85 a
40 kg + Ni	10.3 a	9.9 a	112 e	114 e	15.24 e	16.11 d
40 kg N + 20 m^3 Ch	8.5 ef	8.3 ef	123 cd	125 cd	16.96 bc	18.19 c
40 kg N + Ni + 20 m^3 ch	8.3 f	8.2 f	120 d	122 d	19.18 a	20.18 ab

Means followed by a common letter in the same column do not differ significantly using Duncan's Multiple Range test at 5% level

Regarding DM%, it is obvious from Table 6 that the highest significant DM% means were obtained by using 40 kg N + Nitrobin and the lowest were obtained by using 40 or 60 kg N with Nitrobin + chicken manure in comparison with other treatments in both seasons. The probable reason for these findings may be due to the fact that when N supplies are adequate and conditions are favorable for growth proteins are formed from the manufactured carbohydrates (Hara and Sonoda, 1981). Less carbohydrate is thus deposited in the vegetative portion, more protoplasm is formed, and because protoplasm is highly hydrated, a more succulent plant results (Tisdale *et al.*, 1985).

4- Mean time from transplanting to maturity:

Data presented in Table 6 indicate clearly that the effect of different fertilizer treatments on this trait was significantly in both seasons. The highest means were noticed with the treatments of 80 kg N, 60 kg N + Nitrobin and 60 kg N + 10 m^3 chicken manure, while the lowest means were resulted from using 40 kg N + Nitrobin in comparison with other treatments in both seasons. This might be attributed to the role of excess of nitrogen in delayed maturity (Thakur *et al.*, 1991; Burns, 1996 and Bambal *et al.*, 1998).

5- Head yield:

From Table 6, it is clear that head yield per feddan was significantly affected by the different treatments in both seasons. The highest head yields were obtained from 60 and 40 kg N with Nitrobin + chicken manure in comparison with other treatments in both seasons. The high yield reflected increases in average head weight (Table 3) and number of plants producing

curds. These results coincide with those obtained by Kalayani *et al.* (1996), Bambal *et al.* (1998), Bhardwaj *et al.* (2000), Bjeli *et al.* (2000), El-Afifi *et al.* (2002), Sharma (2002) and Devi *et al.* (2003).

REFERENCES

AOAC (Association of Official Analytical Chemists) (1990). Official Methods of Analysis. 15th Ed., Washington, DC, USA.

Awad, N.M. (1998). The use of microorganisms in ecological farming systems. Ph.D. Thesis, Fac. Sci., Cairo Univ., Egypt.

Bambal, A.S.; Verma, R.M.; Panchbhai, D.M.; Mahorkar, V.K. and Khankhane, R.N. (1998). Effect of biofertilizer and nitrogen levels on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*). Orissa J. Hort., 26(2):14-17.

Bashan, Y. and Holguim, G. (1997). *Azospirillum*-plant relationship: environmental and physiological advances (1990-1996). Can. J. Microbiol., 43:103-121.

Bhardwaj, M.L.; Harender, R. and Koul, B.L. (2000). Yield response and economics of organic sources of nutrients as substitute to inorganic sources in tomato (*Lycopersicon esculentum*), okra (*Hibiscus esculentus*), cabbage (*Brassica oleracea* var. *capitata*) and cauliflower (*B. oleracea* var. *botrytis*). Indian J. Agric. Sci., 70(10):653-656.

Bjeli, V.N.; Stankovi, L.N. and Pavlovi, R.M. (2000). Effects of manuring on cauliflower development and yields. Acta Hort., 533:397-400.

Boogaard, R. and Thorup-Kristensen, K. (1997). Effects of nitrogen fertilization on growth and soil nitrogen depletion in cauliflower. Acta Agric. Scandinavica, 47(3):149-155.

Bulluck, L.R.; Brosius, M.; Evanylo, G.K. and Ristaino, J.B. (2002). Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. Applied Soil Ecology, 19:147-160.

Burns, I.G. (1996). Nitrogen supply, growth and development. Acta Hort., 428:21-30.

Clark, M.S.; Horwath, W.R.; Shennan, C. and Scow, K.M. (1998). Changes in soil chemical properties resulting from organic and low input farming practices. Agron. J., 90:662-671.

Devi, H.J.; Maity, T.K. and Paria, N.C. (2003). Effect of different sources of nitrogen on yield and economics of cabbage. Environment and Ecology, 21(4):878-880.

El-Afifi, S.T.; Zaghloul, M.M. and Ibrahim, E.I. (2002). Effect of transplant age, nitrogen fertilizer levels and biofertilization on cabbage. 2nd Inter. Conf. Hort. Sci., 10-12 Sept., Kafr El-Sheikh, Tanta Univ., Egypt. J. Agric. Res. Tanta Univ., 28(3/1):119-130.

El-Kassas, A.I. and El-Sebsy, A.A. (2002). Effect of chicken manure and pressed olive cake on growth, productivity and water use efficiency of sweet pepper (*Capsicum annuum* L.) under El-Arish conditions. 2nd Inter. Conf. Hort. Sci., 10-12 Sept., Kafr El-Sheikh, Tanta Univ., Egypt. J. Agric. Res. Tanta Univ., 28(3/1):106-118.

Everaarts, A.P. (2000). Nitrogen balance during growth of cauliflower. Scientia Hort., 83(3/4):173-186.

Farrag, A.M.; Mishriky, J.F. and El-Nagar, A.M. (2000). Effect of drip irrigation levels and nitrogen rates on growth and yield of cauliflower plants and salts accumulation in soil. J. Agric. Sci. Mansoura Univ., 25(5):2855-2875.

Hara, T. and Sonoda, Y. (1981). The role of macronutrients for cabbage-head formation. IV. Effect of nitrogen supply on the growth and $^{14}CO_2$ and $^{15}NO_3$-N assimilation of cabbage plants. Soil Sci. Plant Nutr., 27(2):185-194.

Hegde, D.M.; Dwivedi, B.S. and Sudhakara Babu, S.S. (1999). Biofertilizer for cereal production in India. Indian J. Agric. Res., 69(2):73-83.

Jacobs, M.B. (1951). The Chemical Analysis of Foods and Food Products. 1st Ed., PP. 724-732. D. Van Nostrand Comp., New York, USA.

Kalayani, D.P.; Sankar, C.R. and Prasad, D.M. (1996). Studies on the effect of nitrogen and *Azospirillum* on growth and yield of cauliflower. South Indian Hort., 44:147-149.

Kaloosh, A.A. and Koreish, E.A. (1995). Nitrobin, ammonium nitrate and chicken manure effects on wheat growth, soil nitrate, soil microbial biomass and carbon dioxide evolution. J. Agric. Sci. Mansoura Univ., 20(8):3943-3949.

Khafagy, E.E.E. (1999). Reducing the potential for adverse environmental impacts of inorganic nitrogen in agro-ecosystem. M.Sc. Thesis, Soil Dept., Fac. of Agric., Mansoura Univ., Egypt.

Klute, A. (1986). Methods of Soil Analysis. 2nd Ed., Part 1, Soil Sci. Amer., Madison, Wisc., USA.

Kundu, B.S. and Gaur, A.C. (1980). Establishment of nitrogen-fixing and phosphate solubilizing bacteria in rhizosphere and their effect on yield and nutrient uptake of wheat crop. Plant and Soil, 57:223-230.

Page, A.L. (1982). Methods of Soil Analysis. 2nd Ed., Part 1, Soil Sci. Soc. Amer., Madison, Wisc., USA.

Premuzic, Z.; Garate, A. and Bonilla, I. (2002). Production of lettuce under different fertilization treatments, yield and quality. Acta Hort., 571:65-72.

Saber, M.S.M. and Gomaa, A.M.H. (1993). Associative action of a multistrain biofertilizer on tomato plants grown in a newly reclaimed soil. The Sixth International Symposium on Biological Nitrogen Fixation with Non-Legumes. 6-10 Sept., Ismailia, Egypt, PP. 493-497.

Serna, M.D.; Borras, R.; Legaz, F. and Primo-Millo, E. (1992). The influence of nitrogen concentration and ammonium / nitrate ratio on N-uptake, mineral composition and yield of citrus. Plant and Soil, 147:13-23.

Sharma, K.C. and Arya, P.S. (2001). Effect of nitrogen and farmyard manure on cabbage (*Brassica oleracea* var. *capitata*) in dry zone of Himachal Pradesh. Indian J. Agric. Sci., 71(1):60-61.

Sharma, S.K. (2002). Effect of *Azospirillum, Azotobacter* and nitrogen on growth and yield of cabbage (*Brassica oleracea* var. *capitata*). Indian J. Agric. Sci., 72(9):555-557.

Snedecor, G.W. and Cochran, W.G. (1982). Statistical Methods. 7th Ed., 2nd Printing, Iowa State Univ. Press, Ame., USA, 507 PP.

Steel, R.G.D. and Torrie, J.H. (1980). Principles and Procedures of Statistics. A Biometrical Approach. 2nd Ed. McGraw-Hill Publishing Co., New York, USA.

Szwonek, E. and Michalik, H. (1991). Effect of nitrogen fertilization on nitrates and vitamin C content in cauliflower. Biuletyn Wazyniczy, 37:161-169. (Cited after Hort. Abst., 64(4):2748, 1994).

Thakur, O.P.; Sharma, P.P. and Singh, K.K. (1991). Effect of nitrogen and phosphorus with and without boron on curd yield and stalk rot incidence in cauliflower. Veget. Sci., 18(2):115-121.

Tisdale, S.L.; Nelson, W.L. and Beaton, J.D. (1985). Soil Fertility and Fertilizers. 4th Ed. MacMillan Publ., New York.

Wild, A. (1993). Soils and the Environment, An Introduction. 1st Ed., PP. 80-81. Cambridge Univ. Press, UK.

إستجابة القنبيط للأسمدة العضوية والحيوية ولمستويات النتروجين

إيهاب عوض الله إبراهيم ، محمد السعيد أبو النصر ، رضا عبد الخالق الشبراوى
قسم بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة – مصر

عوملت نباتات القنبيط (صنف سنوبول واى محسن) بسبع معاملات هى: ٨٠ كجم ن / فدان ، ٦٠ كجم ن / فدان + ٢ كجم نتروبين / فدان ، ٦٠ كجم ن / فدان + ١٠ م^3 سماد دواجن / فدان ، ٦٠ كجم ن / فدان + ٢ كجم نتروبين + ١٠ م^3 سماد دواجن / فدان ، ٤٠ كجم ن / فدان + ٢ كجم نتروبين / فدان ، ٤٠ كجم ن / فدان + ٢٠ م^3 سماد دواجن / فدان ، ٤٠ كجم ن / فدان + ٢ كجم نتروبين + ٢٠ م^3 سماد دواجن / فدان. وذلك بإجراء تجربتان حقليتان فى المزرعة البحثية بالبرامون ، بمحافظة الدقهلية خلال الموسمين ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ . أثرت المعاملات المستخدمة معنويا على مختلف الصفات المدروسة ، فأعطت المعاملتان ٦٠ كجم ن / فدان + ٢ كجم نتروبين + ١٠ م^3 سماد دواجن / فدان و ٤٠ كجم ن / فدان + ٢ كجم نتروبين + ٢٠ م^3 سماد دواجن / فدان أعلى القيم لمتوسطات وزن الأوراق / نبات ووزن وقطر القرص والنسبة المئوية للبروتين والمادة الجافة فى القرص وكذلك لتراكم النتروجين والفوسفور والبوتاسيوم فى الأوراق والقرص معاً ، وفى نفس الوقت خفضت محتوى القرص من فيتامين ج والمادة الجافة. أعطت المعاملة ٤٠ كجم ن / فدان + ٢ كجم نتروبين / فدان أعلى القيم لفيتامين ج والمادة الجافة فى القرص ، بينما أعطت المعاملة ٨٠ كجم / فدان أعلى القيم للنترات المتراكمة فى القرص ومتوسط الوقت من الشتل حتى الحصاد. وعلى ذلك يمكن التوصية بإستخدام المعاملتين ٦٠ كجم ن / فدان + ٢ كجم نتروبين + ١٠ م^3 سماد دواجن / فدان و ٤٠ كجم ن / فدان + ٢ كجم نتروبين + ٢٠ م^3 سماد دواجن / فدان للحصول على أعلى إنتاجية وجودة.