J. Agric. Sci. Mansoura Univ., 33 (3): 2045 - 2060, 2008

EFFECT OF VARIOUS TYPES AND RATES OF ORGANIC MANURES ON VEGETATIVE GROWTH, PIGMENTS AND CHEMICAL COMPOSITION OF LEAVES, YIELD AND SPEAR PIGMENTS OF BROCCOLI.

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ABSTRACT

Two Field experiments were conducted at the Experimental Farm of the Faculty of Agriculture, Suez Canal university during the winter seasons of 2004-2005 and 2005-2006 to study the effect of three types of organic manures, i.e poultry manure, cattle manure and sheep manure in comparison with conventional fertilization (cattle manure + mineral NPK) on broccoli vegetative growth, leaves chemical composition, leaf pigments, yield and its components and spear pigments. The organic manures and conventional fertilization (cattle manure + mineral nitrogen fertilizer) were applied according to their content of nitrogen at three rates: 100, 140 and 180kg N/feddan.

The obtained results indicated that conventional fertilization gave the highest values of stem length; stem diameter; stem weight; number of leaves per plant; both fresh and dry weights of leaves; chlorophyll a and b, total chlorophyll and carotenoids contents of leaves, N, P and K contents of leaves; main spear diameter; main spear weight; main spear yield (Ton/Fed); average side spear diameter; number of side spear per plant; side spears yield per plant; side spears yield (Ton/Fed); total yield; chlorophyll a, chlorophyll b, total chlorophyll and carotenoids contents of main spear. The second fertilizer with positive increase in the previous parameters was poultry manure followed by cattle manure then sheep manure. The previous parameters except number of leaves per plant were increased with increasing the rate of manure application providing N-level from 100 to 180Kg/Fed. The conventional fertilization containing 180kg N/Fed recorded the highest values of stem length; stem diameter; stem weight; number of leaves per plant; both fresh and dry weights of leaves; chlorophyll a, chlorophyll b, total chlorophyll and carotenoid, contents of leaves; N, P, and K contents of leaves and chlorophyll a, chlorophyll b, total chlorophyll and carotenoids of main spear, while conventional fertilization containing 140kg N/Fed gave the highest values of yield and its components.

INTRODUCTION

Broccoli (*Brassica olerace* var. *italica*) is popular vegetable around the world especially in Europe and USA. It is grown in Egypt recently as a new vegetable crop in winter season, but in very limited areas. Broccoli spears is rich in vitamin c. vitamin a, calcium, iron, riboflavin, niacin and protein. Addition of organic manures in sandy soils can increase nutrients availability, cation exchange capacity and micro nutrients. They contain high organic matter, improve drought tolerance (Hotlink *et al*., 1991) and increases soil microbial activities (Meissner-Smejkal, 2000). Fisher and Richter (1984), Borin *et al*. (1987) and Browaldh (1992) reported that organic manure usage lead to produce clean plant product. Also, organic manures do not cause environmental pollution compared with chemical fertilizers. Moreover, the

increased demand for organic products has also been an incentive for producers in sub-tropical countries to start organic production for export. Some studies were conducted to compare effect of mineral or conventional fertilization with effect of organic manure on other vegetable crops. The results of Gliesman *et al*. (1996) on strawberry and Hossein (2002) on onion, showed that vegetative growth and yield was decreased in organic production as compared with under conventional system.

With concern to the effect of organic manure rate on growth and yield of vegetable crops El-Sheikh and Salam (1997) showed that increasing rate of chicken manure significantly increased vegetative growth, fruit number per plant, number of trusses per plant yield and fruit components of tomato. Furthermore Ali *et al*. (2001) reported that increasing the rate of chicken manure recorded an increase in plant height, number and area of leaves, fresh dry weight of whole plant, and its leaves and yield of garlic.

Previous investigations on the effects of organic manures in comparison with conventional fertilization on growth and yield of broccoli plants are limited. Therefore, this study was conducted to test the effects of different manures and conventional fertilization at three N levels on the growth and yield of broccoli.

MATERIALS AND METHODS

Two field experiments were carried out during the winter seasons of 2004–2005 and 2005–2006 at the Experimental Research Farm, Faculty of Agriculture, Suez Canal University, Ismailia Governorate to study the effect of various types of organic manures i.e. poultry manure, cattle manure and sheep manure, and conventional Fertilization at three N levels (100, 140 and 180kg N/Fed) on vegetative growth, leaves chemical composition, leaf pigments, yield and its components and spear pigments of broccoli cv. Southern Star. The fertilizers (organic manures or conventional Fertilization) were applied according to their contents of nitrogen. Seeds were sown in seedling trays containing peat moss and vermiculite (1: 1) (by volume) on 20 and 23 September in the first and second season, respectively. The transplants were raised in the trays for one month, then transplanted in the field.

The physical and chemical properties of the experimental soil were: 96.1 and 95.82 sand, 2.85 and 2.71 silt, 1.10 and 1.48 clay, 8.11 and 8.24 PH, 1.67 and 1.89 mm hose/cm, 0.73 and 0.73 OC, 3.87 and 3.99 available N, 3.00 and 3.11 P and 10.51 and 15.58 K. The experimental design was spilt- plot with three blocks. The main plots were presented as type of fertilizer, while N level, were distributed as sub-plots. The sub-plot area was $14m^3$ which contained 4 rows each 5m long and 0.7m wide. The distance between plants was 0.5m. The seedlings were transplanted on one side of row.

Chemical analysis of the used organic manure is shown in Table (1).

Table (1): Chemical analysis and the application rate of the organic manures used during 2004-2005 and 2005-2006 seasons.

Organic manure character	Poultry manure		Cattle manure		Sheep manure	
	2004-2005	2005-2006	2004-2005	2005-2006	2004-2005	2005-2006
Weight of m^3 (kg)	432	453	530	541	561	570
Moisture percentage	55	53	42	46	42	40
PH	6.2	6.3	7.3	7.0	6.5	6.6
Ec (mm hmose/cm)	4.8	4.6	13.9	13.8	7.1	7.1
Organic carbon %	35.5	29.1	27.3	29.2	14.4	15.6
Organic matter	70.2	64.9	26.4	28.2	65.4	61.9
Total nitrogen %	2.94	2.85	1.13	1.20	2.08	1.99
C/N ratio (%)	10.37: 1	10.21:1	24.15:1	24.33:1	6.29:1	7.84:1
Total phosphorus %	0.68	0.75	0.55	0.51	0.69	0.73
Total potassium %	2.1	1.9	1.7	1.9	1.74	1.64
Ferrous mg/kg	180	193	799	780	805	811
Manganese mg/kg	215	190	133	142	93	95
Copper mg/kg	40	43	20	24	50	52
Zinc mg/kg	105	111	80	79	100	104
Application rate (kg) =100kg N/Fed	5535	5636	13194	12774	7168	7386
Application rate (kg) =140kg N/Fed	7750	7891	17947	17133	10835	10341
Application rate (kg) =180kg N/Fed	8657	9018	21111	19466	11469	11819

In both seasons, the experiment included 12 treatments as follows:

Fertilizer	N level
Mineral N.P and K Fertilizers + cattle manure ($15m^3$ / Fed)	100 kg/Fed
Mineral N.P and K Fertilizers + cattle manure ($15m^3$ / Fed)	140 kg/Fed
Mineral N.P and K Fertilizers+ cattle manure ($15m^3$ / Fed)	180 kg/Fed
Poultry manure	100 kg/Fed
Poultry manure	140 kg/Fed
Poultry manure	180 kg/Fed
cattle manure	100 kg/Fed
cattle manure	140 kg/Fed
cattle manure	180 kg/Fed
Sheep manure	100 kg/Fed
Sheep manure	140 kg/Fed
Sheep manure	180 kg/Fed

Ammonium sulphate (20.5% N) was used as a source of mineral nitrogen and potassium sulphate was applied at the rate of 75kg/Feddan. Both ammonium sulphate and potassium sulphate were added after 2, 4, 6 and 8 weeks from transplanting. Phosphorus was added in the form of calcium superphosphate (15.5 P_2O_5) at the rate of 200 kg/Feddan. Calcium superphosphate and organic manures were added at the time of soil preparation. Furrow irrigation was applied every three days. The other normal agricultural treatments for broccoli plants were practiced.

Data Recorded:

The following data were recorded during the plant growth period and harvesting period.

1- Vegetative growth characters:

Five plants from each sub-plot were randomly taken at 100 days after transplanting and the following data were recorded. Stem length, stem diameter, stem weight, number of leaves per plant, fresh weight of leaves and dry weight of leaves after drying in an oven for 72hrs.

2- Leaf pigments

Disks sample from the third lower leaves were taken from each sub- plot at 80 days after transplanting to determine chlorophyll a, chlorophyll b and total chlorophyll as well as carotenoids according to the methods described by Wettestein (1957).

3- Leaves chemical composition

The dried leaves were finely ground and digested and total nitrogen was determined according to Bremner and Mulvaney (1992). Phosphorus was estimated colorimectrically according to Olesen and Sommers (1982). Potassium was also determined flame photometrically due to the methods described by Jackson (1970).

4- Yield and its components:

a- Main Spears Characters

Five main spears were cut from each sub-plot when main spears were judged to be mature then the following characters were determined:

a-1- Main spear diameter (cm).
a-2- Main spear weight.

b- Side spears characters

b-1- Average side spear diameter.
b-2- Number of side spear plant.
b-3- Side spears yield per plant.

c- Yield

c-1- Main spears yield.
c-2- Side spears yield.
c-3- Total yield.

5- Main spears pigments

Spears samples from each sub plot were taken during maturity stage to determine chlorophyll a, chlorophyll b and total chlorophyll as well as carotenoids according the methods described by Wettestein (1957).

Data Statistical Analysis:

All obtained data were subjected to analysis of variance according to Sendecor and Cochran (1980) and the least significant difference (LSD) was calculated as mentioned by Gomez and Gomez (1984) at 5% level.

RESULTS AND DISCUSSION

1- Vegetative Growth Characters:

a) Main effect of fertilizer type

Data in Tables (2 and 4) show that conventional fertilization significantly recorded the highest values of stem length, stem diameter, stem

weight, number of leaves per plant and both fresh and dry weight of leaves in both growing seasons. The second fertilizer with positive increase in the previous parameters was poultry manure, followed by cattle manure then sheep manure. The obtained results are in harmony with those of Gliesman *et al*. (1996) on strawberry, and Hossein (2002) on onion, where they reported that plant vegetative growth was decreases in the organic production compared with under conventional system. Moreover, the obtained results are in harmony with those of Abde El-Mouty *et al*. (2000) on squash and El-Mansi *et al*. (2004) on pea, where they found that chicken manure gave better plant growth expressed as length of plant and number of leaves per plant than cattle manure.

The observed enhancement effect on plant growth with conventional fertilization compared with organic manures may be due to rapid availability of nutrients from mineral fertilizers, for broccoli plant growth. The improvement of vegetative growth with poultry manure as compared with the other organic manure may be inputed to rapid decomposition of poultry manure throughout broccoli growth period.

b- Main effect of N level

Data in Tables (2 and 4) indicated that all vegetative growth parameters except number of leaves per plant were significantly increased with increasing N level from 100 to 180 kg/Feddan in both seasons.

Table (2): Main effect of fertilizer type and N level on broccoli vegetative growth during 2004 – 2005 season.

Character / Treatment	Stem length (cm)	Stem diameter (cm)	Stem weight (g)	No. of leaves per plant	Fresh weight of leaves (g)	Dry weight of leaves (g)
Fertilizer						
Mineral NPK + cattle manure	13.03	3.55	119.15	17.05	488.28	76.317
Poultry manure	12.01	2.86	96.14	13.92	245.50	45.353
Cattle manure	8.71	2.58	55.10	11.73	160.24	29.29
Sheep manure	6.94	1.69	46.64	9.77	97.03	16.81
LSD 5%	0.77	0.19	6.78	1.64	23.27	4.22
N level (kg/Fed)						
100	8.913	2.23	69.77	12.18	213.91	37.27
140	10.21	2.65	81.53	13.20	243.00	40.42
180	11.39	3.13	86.47	13.95	286.38	48.14
LSD 5%	0.99	0.29	10.08	NS	31.43	5.60

The obtained results are in harmony with those of Thakur *et al*. (1999) on cauliflower and Brahmo *et al*. (2000) on Broccoli. Moreover, similar results were obtained by Singh and Akhilesh-Singh (2002) on broccoli, Jana and Mukhopadhyay (2007) on cauliflower and Sharma *et al*. (2002) on broccoli concerning plant height.

The increasing in all vegetative growth parameters of broccoli plants with increasing N level may be due to nitrogen element being required to form amino acids, amides, peptide and high molecular-weight peptides such as

protein (Marschner, 1988). An increase in protein content of vegetables is often positively correlated with increase in content of vitamins such as riboflavin, thiamin and nicotine acid (Dressel and Jung, 1979). Also, nitrogen is necessary for formation of treptophan, a precursor for indole acetic acid (Skoog, 1979).

c- Effect of interaction between fertilizer type and N level

Data in Tables (3 and 5) illustrate that conventional fertilization containing 180kg N/Feddan gave significantly the highest values of stem length, stem diameter, stem weight, number of leaves per plant and both fresh and dry weights of leaves in both seasons.

Table (3): Effect of interaction between fertilizer type and N level on broccoli vegetative growth during 2004-2005 season.

Character / Treatment		Stem length (cm)	Stem diameter (cm)	Stem weight (g)	No. of leaves per plant	Fresh weight of leaves (g)	Dry weight of leaves (g)
Mineral NPK +cattle manure	100	11.17	3.09	109.49	15.37	399.10	68.62
	140	12.55	3.75	119.31	17.62	480.79	78.77
	180	15.38	4.17	128.64	18.15	578.28	81.56
Poultry manure	100	10.00	2.15	72.14	13.07	214.40	41.13
	140	12.62	2.85	105.07	14.11	236.11	37.82
	180	13.40	3.57	110.53	14.58	286.00	57.11
Cattle manure	100	8.13	2.11	51.18	11.31	150.83	25.83
	140	8.77	2.66	55.63	11.82	159.74	28.62
	180	9.23	2.95	58.48	12.06	170.15	33.42
Sheep manure	100	6.35	1.58	45.60	8.97	84.66	13.50
	140	6.91	1.66	46.11	9.56	95.34	16.46
	180	7.55	1.84	48.22	11.00	111.08	20.47
LSD 5%		1.20	0.57	20.16	3.88	62.84	11.20

Table (4): Main effect of fertilizer type and N level on broccoli vegetative growth during 2005 – 2006 season

Character / Treatment	Stem length (cm)	Stem diameter (cm)	Stem weight (g)	No. of leaves per plant	Fresh weight of leaves (g)	Dry weight of leaves (g)
Fertilizer						
Mineral NPK + cattle manure	11.08	3.93	92.69	13.39	378.95	58.83
Poultry manure	10.82	2.67	76.63	12.55	290.68	56.67
Cattle manure	8.51	2.41	57.87	11.75	165.39	30.31
Sheep manure	6.49	1.81	37.83	10.20	20.31	12.18
LSD 5%	0.77	0.15	6.50	1.54	27.75	2.60
N level (kg/Fed)						
100	8.25	3.25	58.93	10.76	197.69	35.82
140	9.18	2.84	65.43	12.08	216.81	38.89
180	10.25	2.80	74.41	13.08	264.50	44.59
LSD 5%	0.99	2.00	7.71	NS	32.07	5.35

Table (5): Effect of interaction between fertilizer type and N level on broccoli vegetative growth during 2005-2006 season

Character / Treatment		Stem length (cm)	Stem diameter (cm)	Stem weight (g)	No. of leaves per plant	Fresh weight of leaves (g)	Dry weight of leaves (g)
Mineral	100	9.41	2.89	76.65	12.21	324.05	55.08
NPK + cattle	140	10.53	3.2	89.17	13.46	350.12	56.84
manure	180	13.30	3.6	112.25	14.49	462.67	64.91
Poultry	100	9.45	2.44	69.33	11.16	257.88	49.42
manure	140	11.23	2.61	77.06	12.82	291.50	58.20
	180	11.78	2.95	83.51	13.66	319.34	62.39
Cattle	100	8.14	2.00	54.78	1017	143.12	24.78
manure	140	8.52	2.51	58.73	12.23	154.49	28.41
	180	8.88	2.73	60.11	12.86	198.55	37.74
Sheep	100	6.01	1.65	35.03	9.48	65.69	10.81
manure	140	6.42	1.84	36.75	9.81	71.14	12.09
	180	7.03	1.93	42.10	11.30	74.09	13.64
LSD 5%		1.99	0.39	15.41	4.90	64.12	10.69

2- Leaf pigments

a- Main effect of fertilizer type

Obtained data in Table (6) reveal that conventional fertilization gave significantly the highest values of chlorophyll a, chlorophyll b, total chlorophyll and carotenoids contents. The second fertilizer recorded positive increase in the previous characters was poultry manure followed by cattle manure then sheep manure in both seasons.

Table (6): Main effect of fertilizer type and N level on broccoli leaf pigments (mg/100mg dry matter) during 2004-2005 and 2005-2006 seasons.

Character / Treatment	Chl. a	Chl. b	Total Chl.	Carote-noids	Chl. a	Chl. b	Total Chl.	Carote-noids
	2004-2005				2005-2006			
Fertilizer								
Mineral								
NPK + cattle manure	2.71	1.35	4.07	0.616	2.75	1.45	4.43	0.64
Poultry manure	1.83	1.08	2.92	0.493	2.29	1.15	3.44	0.52
Cattle Manure	1.63	0.83	2.46	0.43	1.68	0.89	2.63	0.43
Sheep manure	1.5	0.67	2.28	0.3	1.59	0.71	2.57	0.31
LSD 5%	0.07	0.08	0.39	0.07	0.53	0.079	0.22	0.08
N level (kg/Fed)								
100	1.92	0.82	2.24	0.37	1.57	0.87	2.85	0.39
140	2.03	1.01	3.12	0.48	2.19	1.08	3.27	0.50
180	2.30	1.13	3.43	0.51	2.47	1.22	3.66	0.54
LSD 5%	0.09	0.09	0.30	0.09	0.45	0.09	0.29	0.09

b- Main effect of N level

Data recorded in Table (6) show that chlorophyll a, chlorophyll b, total chlorophyll and carotenoids contents of leaves were significantly increased with increasing the level of nitrogen from 100 to 180kg/Feddan in both growing seasons.

The obtained results are in harmony with those of Arjona and Greig (1984) on broccoli, Tarata (1995) on cauliflower and Ampressh–Sharma and Atul-Chandral (2006) on cauliflower.

The favourable effect of nitrogen on leaf pigments formation may be due to nitrogen element being necessary for formation of lipids and chloroplast constituents such as chlorophyll and carotene (Schulze, 1957).

c- Effect of interaction between fertilizer type and N level

Data in Table (7) show that traditional fertilization containing 180kg N/Feddan gave significantly the highest leaf contents of chlorophyll a, chlorophyll b, total chlorophyll and carotenoids in both seasons.

Table (7): Effect of interaction between fertilizer type and N level on broccoli leaf pigments (mg/100mg dry matter) during 2004-2005 and 2005-2006 seasons.

Character / Treatment		Chl. a	Chl. b	Total Chl.	Carote-noids	Chl. a	Chl. b	Total Chl.	Carote-noids
		2004-2005				2005-2006			
Mineral	100	2.31	1.14	3.45	0.49	2.56	1.23	3.79	0.51
NPK +	140	2.75	1.39	4.14	0.67	3.02	1.49	4.51	0.69
cattle manure	180	3.09	1.52	4.61	0.69	3.35	1.64	4.99	0.73
Poultry	100	0.94	0.96	1.91	0.40	1.93	1.01	2.94	0.42
Manure	140	2.15	1.08	3.23	0.52	2.30	1.14	3.44	0.55
	180	2.42	1.22	3.64	0.56	2.64	1.31	3.95	0.59
Cattle	100	1.31	0.67	1.98	0.39	1.41	0.71	2.12	0.40
manure	140	1.69	0.88	2.57	0.41	1.81	0.94	2.75	0.43
	180	1.89	0.94	2.83	0.44	2.01	1.00	3.01	0.47
Sheep	100	1.15	0.49	1.64	0.22	1.23	0.51	2.52	0.23
manure	140	1.54	0.68	2.22	0.32	1.64	0.73	2.37	0.34
	180	1.81	0.83	2.64	0.36	1.91	0.88	2.79	0.37
LSD 5%		0.19	0.20	0.60	0.19	0.90	0.19	0.59	0.19

3- Leaves mineral composition

a- Main effect of fertilizer type

In general, conventional fertilization recorded significantly higher N, P and K contents of leaves than organic manures. Poultry manure gave significantly the highest values of N, P and K contents. The second organic manure with positive increase in the previous parameters was cattle manure followed by sheep manure in both seasons (Table 8). Similar results were obtained on onion by Lallangoud *et al*. (1999) and Mahmoud (2006), where they reported that plant from plots treated with the recommended rates of N, P and K exhibited higher uptake of N, P and K than those grown under organic production. Furthermore, El-Mansi *et al*. (2004) indicated that application of chicken manure increased pea leaves N, P and K contents compared with application of cattle manure.

b- Main effect of N level

Data in Table (8) reveal that N, P and K contents were significantly increased with increasing N level from 100 to 180kg/Feddan except P content in both seasons and K content in the second season.

c- Effect of interaction between fertilizer type and N level

Traditional fertilization containing 180kg N/Feddan gave significantly the highest N, P and K contents of leaves in both seasons (Table 9).

Table (8): Main effect of fertilizer type and N level on chemical composition of broccoli leaves during 2004-2005 and 2005-2006 seasons.

Character / Treatment	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
	2044-2005			2005-2006		
Fertilizer						
Mineral NPK + cattle manure	2.61	0.508	1.791	2.75	0.544	1.81
Poultry manure	2.08	0.367	1.613	2.21	0.39	1.71
Cattle Manure	1.94	0.229	1.57	1.84	0.307	1.65
Sheep manure	1.20	0.267	1.34	1.27	0.262	1.44
LSD 5%	0.154	0.076	0.08	0.15	0.078	0.15
N level (kg/Fed.)						
100	1.76	0.319	1.46	1.84	0.342	1.56
140	2.03	0.353	1.62	2.01	0.362	1.67
180	2.89	0.396	1.66	2.21	0.424	1.73
LSD 5%	0.19	NS	0.06	0.19	NS	NS

Table (9): Effect of interaction between fertilizer type and N level on chemical composition of broccoli leaves during 2004-2005 and 2005-2006 seasons.

Character / Treatment		N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
		2044-2005			2005-2006		
Mineral NPK + cattle manure	100	2.41	0.444	1.78	2.53	0.484	1.71
	140	2.68	0.512	1.90	2.85	0.544	1.84
	180	2.75	0.569	1.96	2.85	0.604	1.88
Poultry manure	100	1.81	0.309	1.66	1.89	0.339	1.61
	140	2.18	0.357	1.75	2.34	0.376	1.72
	180	2.25	0.438	1.83	2.39	0.455	1.79
Cattle Manure	100	1.72	0.289	1.63	1.78	0.289	1.61
	140	2.01	0.274	1.70	1.55	0.292	1.65
	180	2.09	0.299	1.79	2.19	0.327	1.69
Sheep manure	100	1.08	0.254	1.33	1.14	0.274	1.31
	140	1.23	0.268	1.51	1.31	0.234	1.48
	180	1.30	0.281	1.58	1.36	0.296	1.54
LSD 5%		0.39	0.197	0.11	0.40	0.197	0.40

4- Yield and its components

a- Main effect of fertilizer type

Data in table (10 and 12) show that conventional fertilization gave the highest values of main spear yield, average side spear diameter, number of side spear per plant, side spear yield and total yield. The second treatment with positive increase in the previous parameters was poultry manure, followed by cattle manure then sheep manure, in both seasons. Application of 180kg N/Fed increased total yield by 17.07% and 65.53%, while 140kg N/Fed increased total yield by 14.38% and 58.77% over 100kg N/Fed in the

first and second seasons, respectively. Concerning total yield, similar results were obtained by Mallanagouda *et al*. (1995) on garlic, where they reported that plants from plots treated with mineral N, P and K fertilizers exhibited higher total yield than farmyard manure. Furthermore, the obtained results agree with those of Arenfalk and Hogelskjoor (1995) on leek, Mohamed and Gamie (1999) and Hossein (2000) and Mahmoud (2006) on onion. Respecting the effect of different organic manures on total yield, the obtained results agree with those of Abd El-Mouty *et al*. (2000) on squash where they reported that poultry manure gave higher yield than cattle manure.

The observed enhancement on broccoli yield with application of conventional fertilization as compared with organic manure may be attributed to the increase in vegetative growth (Tables 2, 4), in leaf pigments (Table 6) and in leaves chemical composition (Table 8).

Table (10): Main effect of fertilizer type and N level on broccoli yield and its components during 2004-2005 season.

Character / Treatment	Main spear diameter (cm)	Main spear weight (g)	Main spears yield (Ton/ Fed)	Average side spear diameter (cm)	No. of side spear per plant	Side spears yield per plant (g)	Side spears yield (Ton/ Fed)	Total yield (Ton/ Fed)
Fertilizer								
Mineral NPK + cattle manure	11.70	468.24	4.265	5.132	6.69	130.53	1.083	5.352
Poultry manure	11.30	440.54	4.057	4.746	5.08	91.28	0.861	4.907
Cattle Manure	10.34	289.04	2.801	3.864	4.36	77.29	0.679	3.183
Sheep manure	9.08	240.23	2.225	2.554	3.12	45.99	0.411	2.635
LSD 5%	0.77	41.63	0.654	0.335	0.32	7.39	0.08	0.38
N level (kg/Fed.)								
100	9.58	334.95	2.975	3.712	4.33	76.06	0.667	3.638
140	10.86	365.04	3.420	4.132	4.87	88.34	0.791	4.161
180	11.38	378.55	3.616	4.378	5.24	100.43	0.819	4.259
LSD 5%	0.99	NS	0.413	0.368	0.43	12.33	0.09	0.499

b- Main effect of N level

Data in Tables (10 and 12) reveal that the parameters of yield and its components were significantly increased with increasing N level from 100-180kg/Feddan, except main spear weight in both seasons and main spear yield and side spears weight per plant in the second season. Also, data showed that respecting total yield, the obtained results are in accordance with those of Arjana and Greig (1984) on broccoli, Yadav and Paliwal (1990) on cauliflower, Zebarth *et al*. (1995) on broccoli, Balyan *et al*. (1994) on cauliflower, Abdul Baki *et al*. (1997) on broccoli, Kaniszewsk and Willigen (1998) on cauliflower, Fueraarts and Willigen (1999) on broccoli, Babik and El-Kner (2002) on broccoli, Jana and Mukheredhyay (2002) on cauliflower, Brahama *et al.* (2002) on broccoli and Kuldeep-Singh *et al.* (2004) on cauliflower. Increasing total yield with increasing N level may be explained through the significant role of N element in enhancing plant growth (Tables 2 and 4). In addition, it has an indispensable role in photosynthetic pigments

formation (Table 6). This in turn, stimulate the net assimilation rate and increased total yield.

c- Effect of interaction between fertilize type and N level

Obtained data in Tables (11 and 13) show that conventional fertilization containing 140kg N/Feddan gave significantly the highest values of main spear diameter, main spear weight, main spears yield, average side spear diameter, side spears yield per plant, weight of side spears per plant, side spear yield and total yield in both seasons.

Table (11): Effect of interaction between fertilizer type and N level on broccoli yield and its components during 2004-2005 season.

Character / Treatment		Main spear diameter (cm)	Main spear weight (g)	Main spears yield (Ton/ Fed)	Average side spear diameter (cm)	No. of side spear Per plant	Side spears yield Per plant (g)	Side spears yield (Ton/ Fed)	Total yield (Ton/ Fed)
Mineral NPK + cattle manure	100	11.09	459.80	4.418	4.720	5.88	112.85	0.984	5.702
	140	14.32	516.45	4.598	5.369	7.42	185.71	1.236	5.834
	180	9.703	428.46	3.791	5.317	6.78	117.21	1.030	4.821
Poultry manure	100	10.07	418.90	3.478	3.808	4.81	86.36	0.751	4.229
	140	11.19	443.03	4.272	4.594	4.59	94.82	0.840	5.112
	180	12.63	459.70	4.388	5.170	5.84	92.66	0.991	5.379
Cattle Manure	100	9.16	258.77	2.127	3.441	3.98	68.31	0.596	2.723
	140	10.58	269.01	2.374	4.005	4.38	74.92	0.672	3.046
	180	11.29	339.34	3.009	4.148	4.72	88.64	0.770	3.779
Sheep manure	100	7.98	212.35	1.864	2.215	2.66	36.71	0.335	2.199
	140	9.44	231.67	2.236	2.570	3.09	46.44	0.414	2.650
	180	9.83	286.69	2.574	2.878	3.62	54.83	0.483	3.057
LSD 5%		1.99	102.16	0.827	0.737	0.85	24.66	0.193	0.99

Table (12): Main effect of fertilizer type and N level on broccoli yield and its components during 2005-2006 season.

Character / Treatment	Main spear diameter (cm)	Main spear weight (g)	Main spears yield (Ton/ Fed)	Average side spear diameter (cm)	No. of side spear per plant	Side spears yield per plant (g)	Side spears yield (Ton/ Fed)	Total yield (Ton/ Fed)
Fertilizer								
Mineral NPK + cattle manure	10.97	412.84	3.666	4.51	5.83	113.17	1.002	4.657
Poultry manure	9.99	391.31	3.472	3.96	4.56	8.646	0.797	4.269
Cattle Manure	9.96	241.29	2.157	3.39	8.84	70.73	0.633	2.789
Sheep manure	8.26	210.59	1.867	2.43	2.78	44.01	0.391	2.258
LSD %	0.99	37.53	0.231	0.23	0.38	8.08	0.767	0.281
N level (kg/Fed.)								
100	8.70	291.52	2.594	3.16	3.79	72.27	0.641	2.234
140	9.89	317.57	2.824	3.68	4.38	81.49	0.724	3.547
180	10.77	332.93	2.954	3.88	4.59	82.01	0.753	3.698
LSD 5%	1.13	NS	NS	0.29	0.43	NS	0.099	0.356

Table (13): Effect of interaction between fertilizer type and N level on broccoli yield and its components during 2005-2006 season.

Character / Treatment		Main spear diameter (cm)	Main spear weight (g)	Main spears yield (Ton/ Fed)	Average side spear diameter (cm)	No. of side spear per plant	Side spears yield per plant (g)	Side spears yield (Ton/ Fed)	Total yield (Ton/ Fed)
Mineral NPK + cattle manure	100	10.08	418.05	3.714	4.14	5.15	108.57	0.950	4.664
	140	13.02	434.35	3.856	4.75	6.47	119.73	1.060	4.916
	180	9.73	386.12	3.429	4.63	5.87	111.96	0.995	4.424
Poultry manure	100	9.15	355.77	3.150	3.38	4.18	81.92	0.720	3.870
	140	9.26	402.75	3.578	4.03	4.44	90.22	0.80	4.378
	180	11.48	415.42	3.688	4.48	5.07	87.25	0.870	4.558
Cattle Manure	100	8.33	217.50	1.930	3.00	3.52	64.87	0.576	2.506
	140	8.71	225.63	1.999	3.53	3.89	71.83	0.640	2.63
	180	10.25	287.06	2.550	3.65	4.09	76.81	0.683	3.233
Sheep manure	100	7.25	178.11	1.582	2.11	2.30	35.65	0.317	1.897
	140	8.58	210.54	1.874	2.42	2.76	44.36	0.394	8.264
	180	8.94	243.13	2.157	2.76	3.14	52.02	0.462	2.612
LSD 5%		2.25	99.34	0.599	0.599	0.85	21.99	0.199	0.712

5- Spear pigments

a- Main effect of fertilizer type

Data in Table (14) illustrate that conventional fertilizers gave significantly the highest chlorophyll a, chlorophyll b, total chlorophyll and carotenoids contents of spear followed by poultry manure then cattle manure, while sheep manure recorded the lowest values of the previous parameters in both seasons.

Table (14): Main effect of fertilizer type and N level on spear pigments (mg/g fresh matter) of broccoli during 2004-2005 and 2005-2006 seasons.

Character / Treatment	Chl. a	Chl. b	Total Chl.	Carot-enoids	Chl. a	Chl. b	Total Chl.	Carot-enoids
	2004-2005				2005-2006			
Fertilizer								
Mineral NPK + cattle manure	0.494	0.313	0.806	0.293	0.545	0.339	0.885	0.319
Poultry manure	0.466	0.274	0.738	0.233	0.512	0.300	0.812	0.250
Cattle Manure	0.414	0.261	0.694	0.210	0.461	0.285	0.246	0.222
Sheep manure	0.387	0.234	0.615	0.159	0.415	0.257	0.678	0.174
LSD %	0.063	0.022	0.069	0.027	0.052	0.019	0.073	0.019
N level (kg/Fed)								
100	0.384	0.211	0.594	0.184	0.422	0.229	0.651	0.198
140	0.449	0.273	0.718	0.231	0.495	0.299	0.795	0.247
180	0.488	0.328	0.827	0.257	0.533	0.358	0.896	0.279
LSD 5%	0.488	0.030	0.088	0.099	0.067	0.026	0.094	0.026

b- Main effect of N level

Data in Table (14) show that chlorophyll a, chlorophyll b, total chlorophyll and carotenoids contents were significantly increased with increasing N level in the fertilizer from 100 to 180kg/Feddan.

c- Effect of interaction between fertilizer type and N level

Data in Table (15) show that the conventional fertilization containing 180kg/Feddan gave significantly the highest values of the previous characters in both seasons.

In conclusion, the present investigation demonstrated that conventional fertilization containing 140kg N/Feddan gave the highest growth and yield and that poultry manure containing 180kg N/Feddan gave higher growth and yield than the other organic manures.

Table (15): Effect of interaction between fertilizer type and N level on spear pigments (mg/g fresh matter) of broccoli during 2004-2005 and 2005-2006 seasons.

Character		Chl. a	Chl. b	Total Chl.	Carot-enoids	Chl. a	Chl. b	Total Chl.	Carot-enoids
Treatment		2004-2005				2005-2006			
Mineral	100	0.450	0.251	0.701	0.241	0.497	0.271	0.768	0.259
NPK +	140	0.495	0.311	0.806	0.293	0.551	0.342	0.893	0.319
cattle manure	180	0.537	0.375	0.912	0.344	0.587	0.406	0.993	0.378
Poultry	100	0.424	0.224	0.648	0.201	0.461	0.245	0.706	0.216
Manure	140	0.468	0.271	0.739	0.228	0.517	0.299	0.816	0.246
	180	0.500	0.328	0.828	0.271	0.557	0.357	0.914	0.289
Cattle	100	0.346	0.205	0.551	0.194	0.384	0.221	0.605	0.210
manure	140	0.427	0.263	0.690	0.207	0.464	0.287	0.751	0.225
	180	0.491	0.319	0.810	0.211	0.535	0.348	0.883	0.232
Sheep	100	0.313	0.165	0.478	0.098	0.344	0.179	0.523	0.108
manure	140	0.407	0.248	0.655	0.178	0.448	0.271	0.719	0.196
	180	0.439	0.290	0.729	0.200	0.471	0.322	0.793	0.217
LSD 5%		0.088	0.059	0.173	0.139	0.134	0.052	0.189	0.052

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تأثير معدلات مختلفة من الأسمدة العضوية والتسميد التقليدى على النمو الخضرى ومحتوى الأوراق من الصبغات ومحتواها الكيماوى والمحصول ومحتوى الأقراص من الصبغات في البروكلي

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أجريت هذه التجربة على نباتات البروكلى خلال موسمى 2004 – 2005, 2005 – 2006 بالمزرعة البحثية لكلية الزراعة بجامعة قناة السويس – الإسماعيلية لدراسة تأثير ثلاثة أنواع من المخلفات العضوية (سماد الطيور- السماد البلدى- سماد الأغنام) بالإضافة إلى التسميد التقليدى (سماد نيتروجين معدنى بالإضافة إلى السماد البلدى) كلاً عند ثلاث مستويات من النيتروجين (100 – 140 – 180 كيلو جرام للفدان) على النمو الخضرى والتركيب الكيماوى للأوراق وصبغات الأوراق والمحصول ومكوناته وصبغات الأقراص الرئيسية. وتم إضافة الأسمدة العضوية وكذلك السماد النيتروجينى المعدنى على أساس كمية النيتروجين الموجودة بالسماد.

أوضحت الدراسة أن التسميد التقليدى أعطى أعلى القيم من طول الساق وقطر الساق ووزن الساق والوزن الجاف والطازج للأوراق وكذلك محتوى الأوراق من كلورفيل أ وكلورفيل ب والكاروتينات ونسبة النيتروجين والفوسفور والبوتاسيوم بالأوراق وقطر القرص الرئيسى ووزن القطر الرئيسى ومحصول الفدان من الأقراص الرئيسية ومتوسط قطر القرص الجانبى وعدد الأقراص الجانبية للنبات ومحصول النبات من الأقراص الجانبية والمحصول الكلى (أقراص رئيسية وأقراص جانبية) ومحتوى الأقراص الرئيسية من كلورفيل أ وكلورفيل ب والكاوتينات. يأتى سماد الطيور فى المرتبة الثانية لكل الصفات السابقة. السماد الثالث هو السماد البلدى ثم سماد الأغنام كما أوضحت الدراسة انه بزيادة مستوى النيتروجين بالسماد ذادت كل الصفات السابقة ماعدا عدد الأوراق / نبات. وكان تأثير التفاعل بين نوع السماد ومحتواه من النيتروجين معنوى لكل الصفات السابقة. كما أوضحت الدراسة أن الأسمدة التقليدية المحتوية على 180 كجم نيتروجين/ فدان قد أعطت أعلى القيم لصفات النمو الخضرى ومحتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم وكلورفيل أ وكلورفيل والكاوتينات ومحتوى الأقراص الرئيسية من كلورفيل أ وكلورفيل ب والكاوتينات بينما أعطى التسميد التقليدى المحتوى على 140 كجم نيتروجين / فدان أعلى القيم المحصول ومكوناته.

ABSTRACT **INTRODUCTION** **MATERIALS AND METHODS** **RESULTS AND DISCUSSION** **REFERENCES**	**الملخص** **المقدمة** **الأسلوب البحثى** **النتائج ومناقشتها** **المراجع**
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