

Effect of Organic Manure with or Without Chemical Fertilizers on Growth, Yield and Quality of Some Varieties of Broccoli Plants

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Abstract: Two field experiments were conducted at El-Kassasein, Ismailia Governorate, Egypt. during the two successive seasons of 2003/2004 and 2004/2005 to study the response of vegetative growth and yield of some broccoli varieties (Southern star, Perennium crop, Prominence, Atlantic F1 and Monotop) to apply organic manures (Cattle and poultry manures) compared with mineral fertilization. Results indicated that the highest vegetative growth of broccoli plants was recorded by Atlantic F1 cvs in the two seasons. Moreover, the highest total yield of broccoli was obtained by Perennium crop and Southern star cvs varieties. in the first and second seasons, respectively. The highest vegetative growth of broccoli plants was recorded by plants which was supplied with 100% cattle manure. However, the highest total yield and quality of broccoli were recorded by adding poultry manure in the two seasons. Using poultry manure with Southern star cv. gave the highest total yield and quality of broccoli .

Key words: Broccoli, varieties, cattle manure, poultry manure, mineral fertilizer, growth, yield

INTRODUCTION

Broccoli (*Brassica oleracea L. var. italica*) belongs to family Brassicacea and considers a number of cole vegetable crops; which includes cabbage, cauliflower, chinese cabbage, broccoli, brussels sprouts and kohlrabi . It well known that, broccoli has enormous nutritional and medicinal values due to its high contents of vitamins (A, B1, B2, B5, B6 and E) , minerals (Ca, Mg, Zn and Fe) and antioxidant substances which prevent the formation of cancer causing agents^[1].

Broccoli is widely, cultivated in many European and American countries. In Egypt, broccoli still a grown in a very limited scattered areas and the total cultivated area is not exactly known.

Organic manures such as cattle manure and poultry manure improve the soil structure, aeration, slow release nutrient which support root development leading to higher yield and better quality of broccoli plants^[2].

Moreover, organic matter plays an important role in the chemical behavior of several metals in soils throughout its active groups (flavonic and humic acids) which have the ability to retain the metals in complex and chelate forms.

Organic manure play a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, improving the physical and physiological properties of soils.

Mineral fertilizer improves growth and yield of broccoli due to the role of nitrogen, phosphorus and potassium on the meristematic activity. Many

investigators found that using mineral fertilizer (N P K) increased vegetative growth^[3-9], yield and quality^[9-12,4,6].

The aim of this investigation is to evaluate, improve the productivity and head quality of five cultivars of broccoli under three organic manuring and mineral fertilizing.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons of 2003-2004 and 2004-2005 on an area of newly reclaimed land at El-Kassasein, Ismailia Governorate, Egypt to study the response of vegetative growth and yield of some broccoli cultivars to apply organic fertilizers compared with mineral fertilization.

Seeds of broccoli (*Brassica oleracea L. var. italica*) were drilled in foam trays of 209 holes in a media consisting of pure sand and vermiculite 1:1. Trays were wetted and warmed under plastic sheets for three days, then kept under plastic tunnel. Normal nursery treatments were followed till transplants become suitable for transplanting. After 45 days, trays were brought and transplants were planted one besides every dripper through drip irrigation system.

The experiment included twenty treatments, which were the combination of five cultivars of broccoli and four nitrogen sources in a split plot system with three replicates. Varieties were allotted in the main plots and sources of nitrogen were arranged in sub plots. The plot area was 9 m² (75 cm. width and 12 meter long). The normal agricultural treatments of growing broccoli

Table 1: Physical properties and chemical analysis of the experimental soil.

Physical properties							
Sand	Clay	Silt	Texture	F.C.%	W.P.%	Bulk density g/cm	
1.44	5.65	16.77	Sandy	0.66	11.38	87.96	
Chemical analysis							
E.C. m/moh	PH	Meq./L					
		Ca	Mg	Na	K	HCO ₃	Cl
26.00	2.1	2.79	62.00	3.00	26.00	8.4	9.1

Table 2: Analysis of poultry and cattle manure.

	Poultry manure	Cattle manure
Nitrogen %	2.64	1.22
Phosphorus %	1.80	0.30
Potassium %	2.37	2.90
Fe ppm	2300	1720
Mn ppm	226	446
Zn ppm	180	70
Cu ppm	36	52
Moisture %	16.48	17.6
C/N ratio	7.4	9.67
O.M. %	46.0	20.3
O.C. %	27	11.8

were practiced as usually followed in the commercial production. Physical and chemical properties of the experimental soil are presented in Table (1). Chemical analysis of cattle and poultry manures is presented in Table (2).

Treatments were as follows:

A-Broccoli cultivars:

- 1- Southern star.
- 2- Perennium crop.
- 3- Prominence.
- 4- Atlantic F1.
- 5- Monotop.

B-Nitrogen sources :

- 1- Cattle manure 50%. (40 N unit/fed.)
- 2- Cattle manure 100%. (80 N unit/fed.)
- 3- Poultry manure 100%. (80 N unit/fed.)
- 4- Mineral fertilizer.(80 N unit/fed.)

The quantity of cattle(30 m³) and poultry manures (20 m³) were added per feddan. In addition, mineral fertilization was added as ammoniumnitrate (80 N/fed.).

During the vegetative growth period, samples of five plants were taken at 90 days after transplanting and the following data were recorded:

Vegetative growth (plant height (cm), number of leaves/plant and dry weight of leaves), Samples of leaves were oven dried at 70 C°, then fine grounded and wet digested for chemical analysis.

At harvest time spears were harvested and the yield and quality were recorded: Spears weight. Total yield (ton/fed.) Spear diameter (cm.). Flowerstalk length (cm.). Flower stalks number. The nitrogen, phosphorus and

potassium contents were determined in dry leaves using the method by Jackson^[13], Troug and Mayers^[14] and Brown and Lilleland^[15], respectively.

Data of the two experiments were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez^[16].

RESULTS AND DISCUSSIONS

Vegetative growth characteristics:

Effect of cultivars: Vegetative growth was widely differed between the tested broccoli cultivars. Data in Table (3) show clearly that, the highest plant height and leaves number of broccoli plants were recorded by Atlantic F1. Meanwhile, the lowest plant height was recorded by Prominence cv. These results were true and similar in the two seasons of study. In addition, the lowest leaves number was recorded by Perennium crop in the first season and Southern star in the second season. These results might be correlated with the gene action of the tested cultivars. Many investigators dealt with broccoli cultivars^[17-21].

Effect of nitrogen sources: Results in Table (4) showed that, the highest plant height and leaves number of broccoli plants were recorded by plants which supplied with organic manure in the form of 100% cattle manure. These findings were similar and true in both seasons of study. The superiority over than the other treatments was great enough to reach the level of significance. On the contrary, the lowest values of plant height and leaf number were recorded by mineral fertilizer treatment. These results held good in the two experimental seasons. These results were coincided with those reported by Huieh-Ching Fong *et al*^[22] and Abou El- Magd *et al*^[2].

Effect of the interaction: The obtained data revealed that the interaction treatments (Table 5) significantly affected all growth parameters. These results held good in the two experimental seasons. Generally, it could be summarized that, the highest plant height was recorded with cultivar Atlantic F1 combined with mineral fertilization in the two seasons of study and the highest number of leaves was obtained by Prominence cv. with 100 % cattle manure in the first season and with Monotop cv. receiving 50 %

Table 3: Effect of varieties on growth , yield and quality of spears of broccoli (2003-2004) and (2004-2005) seasons.

Fertilizer	Plant height(cm)	Leaves No.	Head Diameter (cm)	Flower stalk length (cm)	Leaf dry weight (%)	Total yield (ton/fed.)
2003-2004						
Southern star	43.25	14.83	10.75	17.00	16.69	9.46
Prenium crop	42.00	13.67	11.17	13.13	16.49	9.70
Prominence	37.50	17.75	10.92	14.08	13.95	7.06
Atlantic F1	48.83	17.50	9.92	12.50	14.08	6.31
Monotop	39.67	15.92	10.17	14.25	15.69	6.28
L.S.D at 0.05	2.48	1.21	NS	1.17	0.86	1.26
2004-2005						
Southern star	41.92	13.33	10.50	14.42	16.27	9.55
Prenium crop	41.75	15.75	11.13	14.08	16.08	9.09
Prominence	35.67	14.83	10.25	15.33	14.51	6.82
Atlantic F1	46.67	16.33	9.17	13.08	14.73	6.40
Monotop	41.50	15.50	10.71	14.17	14.51	7.33
L.S.D at 0.05	2.93	2.71	0.96	1.07	0.92	2.04

Table 4: Effect of organic manure on growth , yield and quality of spears of broccoli (2003- 2004) and (2004-2005) seasons.

Organic manure	Plant height(cm)	Leaves No.	Head Diameter (cm)	Flower stalk length (cm)	Leaf dry weight (%)	Total yield (ton/fed.)
2003-2004						
50% cattle manure	38.53	16.07	8.47	11.23	16.76	4.78
100% cattle manure	46.20	17.27	10.20	14.93	16.22	7.07
Poultry manure	40.67	14.73	12.93	17.07	14.47	10.86
Mineral fertilizer	31.60	12.07	9.73	12.80	11.54	7.11
L.S.D at 0.05	3.08	0.71	0.32	1.20	0.87	1.37
2004-2005						
50% cattle manure	38.27	14.73	9.23	13.40	16.04	6.73
100% cattle manure	45.73	15.60	10.13	14.00	14.86	7.17
Poultry manure	38.60	14.20	11.63	15.40	15.06	9.63
Mineral fertilizer	29.73	11.60	9.03	11.93	11.78	6.57
L.S.D at 0.05	3.01	3.35	0.80	NS	NS	2.05

cattle manure in the second season. On the contrary, the lowest plant height was recorded by Prominence cv. and Southern star with 50 % cattle manure in the first and second season, respectively. Moreover, the lowest number of leaves of broccoli plants was recorded by Prenium crop cv. with mineral fertilizer in the first season and by Southern star with 100 % cattle manure in the second one.

Total yield and quality:

Effect of cultivars: Results in Table (3) showed that there were significant differences in the total yield and quality between the different varieties of broccoli in the

two seasons of study except for spear diameter in the first season only. However, the highest total yield of broccoli was produced by Southern star and Perennium crop cvs. in the two seasons without significant differences between the two cvs. On the contrary, the lowest total yield of broccoli plants was produced by Monotop cv. in the first season and by Atlantic F1 cv. in the second season. Moreover, the highest values of spear diameter was recorded by Prenium crop and the lowest spear diameter was found by Atlantic F1 cv. These findings held good in both experimental seasons. However, the highest flower stalk length was recorded by Southern star cv. in the first season and by Prominence cv. in the second one. On the other hand, the lowest flower stalk length was

Table 5: Effect of interaction of sowing date and varieties on growth, yield and quality of spears of broccoli (2003-2004) and (2004-2005) seasons.

Organic manure	Varieties	Plant height (cm)	Leaves No.	Head Diameter (cm)	Flower stalk length (cm)	Leaf dry weight (%)	Total yield (ton/fed.)
2003-2004							
50% cattle manure	Southern star	36.33	12.67	7.67	12.67	19.27	4.94
	Prenium crop	42.00	13.00	9.33	10.17	15.71	6.08
	Prominence	34.67	17.00	8.67	11.00	16.21	4.54
	Atlantic F1	42.67	18.67	8.67	11.00	15.72	5.09
	Monotop	37.00	19.00	8.00	11.33	16.91	3.26
100% cattle manure	Southern star	46.67	18.00	10.00	20.67	17.50	8.60
	Prenium crop	44.33	15.67	11.00	14.33	17.05	7.44
	Prominence	42.67	20.00	9.67	11.33	15.06	5.17
	Atlantic F1	51.00	16.67	10.00	13.33	15.77	5.70
	Monotop	46.33	16.00	10.33	15.00	15.71	8.44
Poultry manure	Southern star	45.33	13.33	16.00	21.33	14.67	18.74
	Prenium crop	37.00	13.67	13.00	15.00	16.19	14.43
	Prominence	36.00	16.00	15.00	19.67	14.60	10.32
	Atlantic F1	46.33	18.00	9.00	11.00	13.56	4.49
	Monotop	38.67	12.67	11.67	18.33	13.34	6.32
Mineral fertilizer	Southern star	44.67	15.33	9.33	13.33	15.33	5.54
	Prenium crop	44.67	12.33	11.33	13.00	17.00	10.84
	Prominence	36.67	18.00	10.33	14.33	9.94	8.20
	Atlantic F1	55.33	16.67	12.00	14.67	11.27	9.95
	Monotop	36.67	16.00	10.67	12.33	16.81	7.12
L.S.D at	0.05	4.96	2.42	2.01	2.34	1.72	2.53
2004-2005							
50% cattle manure	Southern star	30.67	12.00	11.00	12.00	20.06	8.72
	Prenium crop	43.00	16.00	10.00	14.33	15.55	7.21
	Prominence	34.00	12.67	11.33	17.00	13.42	6.91
	Atlantic F1	40.33	15.00	5.67	10.67	16.55	5.08
	Monotop	43.33	18.00	8.17	13.00	14.63	5.70
100% cattle manure	Southern star	45.67	11.33	8.00	14.00	14.60	8.05
	Prenium crop	48.00	17.00	10.00	14.00	15.05	7.51
	Prominence	39.67	16.67	10.33	14.67	15.66	6.66
	Atlantic F1	51.33	16.33	11.00	14.33	14.76	6.11
	Monotop	44.00	16.67	11.33	13.00	14.25	7.53
Poultry manure	Southern star	44.33	13.00	13.00	17.33	16.38	15.29
	Prenium crop	37.00	14.00	13.17	15.00	16.13	12.28

Table 5: Continued.

	Prominence	31.67	14.67	10.67	15.00	13.85	8.53
	Atlantic F1	44.33	17.00	9.33	12.33	15.09	5.53
	Monotop	35.67	12.33	12.00	17.33	13.85	6.51
Mineral fertilizer	Southern star	47.00	17.00	10.00	14.33	14.04	6.14
	Perennium crop	39.00	16.00	11.33	13.00	17.60	9.35
	Prominence	37.33	15.33	8.67	14.67	15.13	5.17
	Atlantic F1	50.67	17.00	10.67	15.00	12.52	8.87
	Monotop	43.00	15.00	11.33	13.33	15.30	9.57
L.S.D at 0.05		4.86	2.24	1.93	2.14	1.85	4.08

recorded by Atlantic F1 cv. in the two seasons of study. The results are in accordance with those obtained by Real-Rosas *et al*^[21].

Effect of nitrogen sources: Data presented in Table (4) indicated that application of poultry manure increased the total yield of broccoli. However, the highest total yield and quality of broccoli were recorded by poultry manure in the two seasons of study. On the contrary, the lowest total yield of broccoli was recorded by 50% cattle manure and mineral fertilizer in the first and second seasons, respectively. Increases in the total yield were significant in the two seasons. The increase in the total yield resulting by organic manuring may be attributed to that organic manuring enhanced soil aggregation, soil aeration and increasing water holding capacity and offers good environmental conditions for the root system of broccoli plants^[2]. In addition, organic manures are slow release nutrients all over the growth season. Poultry manure is rich in its nitrogen and nutrients content. These favourable conditions create better nutrient absorption and favour the growth and development of root system which in turn reflects better vegetative growth, photosynthetic activity and dry matter accumulation. Consequently higher total yield would be obtained by poultry manure. The reports recorded by other investigators such as Huieh-Ching Fong *et al.*^[22] and Abo El- Magd *et al*^[2] on broccoli plants.

The tabulated data (Table 4) show clearly that, the best quality of broccoli plants (spear diameter and flower stalk length) was recorded by using poultry manure in the two seasons of study.

On the contrary, the lowest spear diameter and lowest flower stalk length were found by application of 50% cattle manure in the first season and by mineral fertilizer in the second one.

Effect of interaction: The interaction effect within varieties of broccoli and sources of nitrogen on yield of broccoli is shown in Table (5). The obtained data reveals that, the interaction treatments significantly affected total

yield of broccoli. These results held good in the two experimental seasons. Generally, it could be concluded that, the highest total yield of broccoli plants was recorded by the combined effect of Southern star cv. and poultry manure in the two seasons of study. On the contrary, the lowest total yield of broccoli plants was recorded by Monotop cv. receiving 50% cattle manure in the second one.

These results show clearly that the treatments of organic manure and varieties of broccoli plants act in co-operating pattern.

Data in Table (5) show that the highest spear diameter of broccoli was recorded by Prominence cv. receiving poultry manure in the first season and by Perennium crop with poultry manure in the second season. On the contrary, the lowest values of spear diameter of broccoli were recorded by Southern star cv. and Atlantic F1 cv. with 50% cattle manure in the first and second seasons, respectively. The same data in Table (5) show that, the highest flower stalk length of broccoli was recorded by Southern star cv. receiving poultry manure in the two seasons of study. On the contrary, the lowest flower stalk length was recorded by Perennium crop and by Southern star cv. receiving 50% cattle manure in the first and second seasons, respectively.

Chemical composition in the spears of broccoli:

Effect of cultivars: Results given in Table (6) reflected significant differences in the amount of N % of the different varieties. On the other hand, the amount of P and K % did not reflect significant differences in the two seasons of study except for K% in the second season only. However, the highest amount of N % was recorded by Monotop cv. in the two seasons of study. The highest amount of P% was recorded in the head of Monotop cv. in the first season and Prominence in the second one. Moreover, the highest values of K % were recorded by Atlantic F1 cv. On the other hand, the lowest amount of N % and P% were recorded by Prominence cv. in the

Table 6: Effect of organic manure and varieties on nitrogen, phosphorus and potassium of spears of broccoli (2003-2004) and (2004-2005) seasons.

Organic manure						
Fertilizer	N %	P %	K %	N %	P %	K %
2003-2004			2004-2005			
50% cattle manure	1.79	0.26	2.41	1.73	0.26	2.55
100% cattle manure	1.64	0.25	2.58	1.86	0.27	2.48
Poultry manure	1.91	0.30	2.79	2.01	0.30	2.82
Mineral fertilizer	1.54	0.26	2.37	1.57	0.26	2.61
L.S.D at 0.05	0.16	0.02	0.23	0.12	0.02	0.09
Varieties						
2003-2004			2004-2005			
Southern star	1.67	0.25	2.43	1.68	0.27	2.47
Prenium crop	1.65	0.28	2.49	1.72	0.26	2.44
Prominence	1.57	0.24	2.49	1.74	0.28	2.61
Atlantic F1	1.83	0.27	2.70	1.90	0.27	2.80
Monotop	1.88	0.30	2.59	1.91	0.27	2.77
L.S.D at 0.05	0.13	NS	NS	0.08	NS	0.12

Table 7: Effect of interaction of sowing date and varieties on growth , yield and quality of spears of broccoli(2003-2004) and (2004-2005) seasons.

Organic manure	Varieties	N %	P %	K %	N %	P %	K %
		2003-2004			2004-2005		
50% cattle manure	Southern star	1.68	0.24	2.12	1.71	0.25	2.33
	Prenium crop	1.73	0.27	2.43	1.65	0.23	2.35
	Prominence	1.55	0.23	2.35	1.72	0.26	2.63
	Atlantic F1	1.93	0.26	2.63	1.82	0.29	2.75
	Monotop	2.05	0.32	2.52	1.75	0.25	2.68
100% cattle manure	Southern star	1.48	0.27	2.62	1.85	0.30	2.36
	Prenium crop	1.62	0.25	2.55	1.72	0.25	2.32
	Prominence	1.63	0.23	2.23	1.75	0.26	2.47
	Atlantic F1	1.72	0.24	2.85	1.99	0.26	2.65
	Monotop	1.75	0.27	2.67	1.97	0.27	2.61
Poultry manure	Southern star	1.77	0.25	2.75	1.82	0.28	2.81
	Prenium crop	1.82	0.31	2.82	1.85	0.27	2.73
	Prominence	1.73	0.28	2.63	1.98	0.31	2.68
	Atlantic F1	2.12	0.32	2.88	2.15	0.32	2.97
	Monotop	2.09	0.33	2.87	2.24	0.30	2.92
Mineral fertilizer	Southern star	1.76	0.25	2.24	1.35	0.26	2.37
	Prenium crop	1.42	0.27	2.16	1.66	0.27	2.35
	Prominence	1.37	0.23	2.73	1.52	0.30	2.66

Table 7: Continued:

Atlantic F1	1.54	0.26	2.44	1.63	0.23	2.83
Monotop	1.61	0.29	2.30	1.67	0.24	2.86
L.S.D at 0.05	0.32	NS	0.35	0.19	NS	0.22

first season and Southern star and Premium crop cvs. ,respectively in the second season. Moreover, the lowest K% was recorded by Southern star in the first season and Prominence cv. in the second one. The obtained results are in good agreement with that obtained by Sanchez *et al*^[18].

Effect of nitrogen sources: Results in Table (6) show that there were significant differences in N,P and K % by using different organic manure treatments in the two seasons of study. However, the highest N,P and K% in heads of broccoli were produced by poultry manure in the two seasons of study. On the contrary, the lowest amount of N, P and K% in heads of broccoli were found by mineral fertilizer treatment in the two seasons except for P% in the first season and K% in the second one.

Concerning to the superiority in elemental values in tissues of heads of broccoli by increasing the poultry manure, may be attributed to high content of N,P and K. The high availability of macro and micro elements in poultry manure are found in an enough quantity which required for agood plant growth, consequentlyt higher yield and more better quality. The results are accordance with those obtained by Real Rosas^[21].

Effect of the interaction: Results in Table (7) revealed that the interaction between different organic manure and broccoli varieties had a significant effect on N and K % in the two seasons of study but P % was without significant differences in the different treatments. The highest values of N, P and K percentages of heads of broccoli were recorded when plants of Atlantic F1 and/or Monotop cvs. received poultry manure in the two seasons of study.

Conclusion: Using Southern star or Perennium crop cvs. of broccoli with poultry manure at the rate of 20 m³/fed. level could be followed for producing high yield of broccoli with high quality of heads.

REFERENCES

1. Beecher, C., 1994. Cancer preventive properties of varieties of Brassica oleracea: a review *Amer. J. Clin. Nutri.*, 59: 1166-1170.
2. Abou El- Magd, M.M, Hoda, A. Mohamed and Z.F. Fawzy, 2005. Relationship growth, yield of broccoli with increasing N,P or K ratio in a mixture of NPK fertilizers (*Brassico oleracea* var *italica* plenck). *Annals of Agriculture Science, Moshtohor.* vol. 43(2): 791-805.

3. Singh, A.K. and Akhilesh- Singh, 2000. Influence of nitrogen and potassium on growth and head yield of broccoli (*Brassica oleracea* L .var *italica*) under low hills subtropical condition of H.P. *Vegetable-Science*, 27(1) : 99 - 100.
4. Nkoa-R., Coulombe - J.Y. Desjardins and N. Tremblay. 2001. Towards optimization of growth via nutrient supply phasing: nitrogen supply phasing increases broccoli (*Brassica oleracea* var. *italica*) growth and yield . *J. of Experimental - Botany*, 52: 821-827.
5. Yang-Xian and Li- Deming, 2001. The effect of nitrogen on nuclic acid and calmodulin during the growth and development of curd in broccoli (*Brassica oleracea* L. var *italica* planch). *Acta Horticulturae. Sinica*, 28 (4): 312-316.
6. Nkoa, R., J. Coulombe, Y., Desjardins, J. Owen and N.Tremblay. 2002. Nitrogen supply phasing increases broccoli (*Brassica oleracea* var. *italica*) growth and yield. *Acta- Horticulturae* (571): 163-170.
7. Sharma, S.K., Rajender - Sharma and B.N. Korla, 2002. Effect of nitrogen and phosphorus on the growth and seed yield of sprouting broccoli cv. Green Head. *Horticultural J.*, 15(2) : 87-90.
8. Vagen. I., M., Skjelvag and H. Bonesmo, 2004. Growth analysis of broccoli in relation to fertilizer nitrogen application. *J. of Hort. Sci. and Biotechnology*, 79 (3) : 484- 492.
9. Tolba, M.S., 2005. Influence of different nitrogenous and potassic fertilization levels on vegetative growth, heads yield and chemical composition of broccoli (*Brassica oleracea* var. *italica*). Ph.D Thesis. Fac. Agric., El Fayoum, Cairo Univ, Egypt.
10. Everaarts, A.P., and P. de Willigen, 1999. The effect of nitrogen and the method of application on yield and quality of broccoli. *Netherlands. J. of Agric. Sci.*, 47 (2) : 123- 133.
11. Rydz. Z., 2001. The effect of foliar nutrition with urea on yiled quality of broccoli cv. lord F1. *Vegetable- Crops - Research - Bulletin* 54 (1): 61-64.
12. Babik, J. and K. Elkner. 2002. The effect of nitrogen fertilization and irrigation on yield and quality of broccoli. *Acta. Horticulturae.* (572) : 33-43.
13. Jackson, M.L. 1958. *Soil chemical analysis* prentice. Hall. Inc. enelewood cliffs, N.J. Library of Congress. U.S.A.
14. Troug. E. and A.H. Mayer, 1939. Improvement in the deiness colorimetric mrthod for phosphrus and arseni. *Indian Engineering chemical annaual* Ed., 1: 136-139.

15. Brown, J.D and O. Lilleland, 1946. Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry Proc. Amer. Soc. Hort. Sci., 38:341-364.
16. Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for Agricultural Research. Second ed. Willey Inter Science Publ., pp. 357- 423.
17. Liu, L. and B.J. Shelp, 1993. Broccoli yield and nitrogen composition in response to different management regimes. Communications in Soil Science and Plant Analysis, 24: (1-2) 61-84.
18. Sanchez, C.A., R.L., Roth. B.R Gardner and H. Ayer, 1996. Economic responses of broccoli and cauliflower to water and nitrogen in the desert . HortScience, 31: 2, 201-205.
19. McCall, D.L., Srensen and B.D Jensen, 1996. Broccoli varieties spp. Rapport- Statens-Planteavlsfors, (8) :32.
20. Rekowska, E., 1999. The influence of varieties and planting density on the yield quantity and quality of italian broccoli. Folia- Universitatis- Agriculturae-Stetinensis- Agricultura, (78): 269-275. (c.a CAB Abst. 2003).
21. Real Rosas, M.A, A; Lucera. Arce; M. Toyota; R, Lopez. Aguilar and B. Murillo. Amador. 2002. Precocious varieties of broccoli for agricultural dirersification in arid zones. Interciencia 27(5) : 247-251. (c.a. CAB Abst. 2003)
22. Huieh ChingFang, Hsu. KuoNan, C.F. Hsieh and K.N.Hsu. 1996. An experiment on the organic farming of broccoli. Bulletin of Taichung District Agricultural Improvement Station, No. 53, 35-40.