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Response of Two Celery Cultivars to Partial or Complete Organic Nitrogen Alternation Strategies

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Abstract: The study was carried out in *Boulaq* Experimental Station, Faculty of Agriculture, Cairo University during the two successive growing seasons from August 2006 to July 2008. The study aimed to investigate the response of two celery cultivars, i.e. local Egyptian Cv" *Balady*" and imported Cv "Utah Tall 52-70", to complete or partial organic nitrogen replacement. Five fertilizing strategies {100% mineral nitrogen "M" (ammonium nitrate), 100 % Organic nitrogen "O" (compost El-Nile), 75 % M + 25 % O, 50 % M + 50 % O and 25 % M + 75 O} were conducted on both cultivars. Plant height, leaves number, fresh & dry weights/ plant, fresh yield/Feddan, Vitamin C, carotenoides, essential oil content & composition and nitrate accumulation in leaves were determined in the vegetative marketing stage. Results indicated that replacement of 25 to 5o % of celery nitrogen requirement by organic sources may be efficiently carried out without any loose of celery yield. Moreover, alternating mineral nitrogen by organic sources resulted in some improvement of essential oil composition, flavor and reduced nitrate accumulation in celery fresh yield. Accordingly, it could be an eco-friendly recommendation to alternate up to half nitrogen nutrition by organic source, in order to reduce the environmental harmful residues, nitrate accumulation in the celery vegetative yield and also improve its flavor, nutrient value and health impacts.

Key words: Compost fertilization, 3-n-butyl phthalide, daily intake Vitamin A& C and ADI of nitrate.

INTRODUCTION

Celery (Apium graveolens) is a herbal member of the Apiaceae family. It is an annual or biennial plant native to Mediterranean, region. Celery is cultivated in Egypt as leafy vegetable crop or medicinal herb crop in both seasons, i.e. winter and summer. Total cultivated area in 2007 year was 37 feddan (4200m^2) with total production of 16 ton herb and 78 ton seeds but in 2008 year the total area was 52 feddan with total production of 184 ton herb and 87 ton seeds (MALR 2007- 2008). WHO (1997) stated that about 31% of adults consume about 4 sticks of celery/day, with average daily consumption rate of 118 g/per/day. Meanwhile, 7 % of children consume about 1.75 sticks of celery/day, with average daily consumption rate of 54 g/per/day.

Nitrogen nutrition is one of the most important factors that influences growth, quality and reproductive development of plant. Depending on mineral nitrogen fertilizer application almost associated with high accumulation of nitrate, especially in leafy vegetables. So nitrate residues in leafy vegetables became one of the most critical issues. Since, the nitrate reduction in human body results in nitrite which may cause methaemoglobinaemia or act as precursor in the endogenous formation of carcinogenic nitrosamines. The acceptable daily intake "ADI" of nitrate is between 0 and 3.65 mg kg^{-1} of body weight (WHO, 1995).

From the economical point of view, application of organic fertilization may reduce agricultural costs as well as environmental pollution (Fawzy *et al*., 2007), In addition, application of enough amount of organic manure to the soil is a successful practice for improving the physical and chemical properties as well as its long run productivity. (Salem, 1986 and Amara and Dahdoh, 1995). On the other hand, complete replacement of mineral nitrogen may cause wake plant growth rate and lower out yielding, due to lower nitrate concentrations in soil solution, which can lead to less lateral root number and also inhibit root hair elongation, which results in a weak root system (Mantelin and Touraine, 2004). Accordingly, replacement of mineral fertilization by organic should be partial rate or associated with root stimulant agents (Glala *et al*., 2010)

This investigation aim to find out the possibility of partial or complete alternation of nitrogen requirement in celery cultivation without any significant reduction in fresh yield and its effect on nitrate accumulation, Vitamin C, carotenoides, essential oil content and compounds.

MATERIALS AND METHODS

Present study was carried out in sandy loam soil at *Boulaq* Experimental Station, Faculty of Agriculture,

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Cairo University, Giza, during two growing seasons of 2006/2007 and 2007/2008. Seeds of two celery cultivars i.e. local Egyptian Cv "*Balady*" and imported Cv "Utah Tall 52-70", were sown on 1st August in the nursery trays in both seasons. Seedlings were transplanted into the field on 15th October in both seasons in plots of 2.00 m × 2.40 m (4.80 m^2). The plot was divided into 4 rows 60 cm apart and 25 cm between plants (32 plant/ plot). Nitrogen fertilization of all treatments were adjusted to be 100 Kg N/feddan (4200m^2). Ammonium nitrate (33.5% N) was used as a mineral source of nitrogen, meanwhile compost El-Nile (1.9 % N, 0.6 % P_2O_5 and 1% K_2O) was used as organic source of nitrogen in the two seasons. Ten treatments represented the combination between two cultivars and five fertilizer treatments (100 % mineral nitrogen “M”, 100 % Organic nitrogen “O”, 75% M + 25% O, 50% M + 50 % O and , 25 % M + 75 % O). During soil preparation a mixture of 1.5 kg calcium superphosphate (15.5% P_2O_5) plus 5 kg potassium sulphate (48% K_2O) were applied for each 150 m^2 of the trials soils as basic fertilizers. Those plots which assigned for organic treatments complet compost dose was applied before furrow holding. Meanwhile only 10% of mineral N quantity for 100% and 75% mineral fertilizer was mixed with the soil during furrow holding. An equivalent amount of organic manure content of potassium and phosphorus were substacted from the application of the mineral source of both elements from those plots received organic fertilization. Generally, the potassium application rate was adjusted to 100 Kg K_2O /fed and the phosphorus at 47 kg P_2O_5 /fed in all treatments. The rest of mineral potassium and nitrogen were divided into five equal portions during the growing season at two weeks intervals starting one month from transplanting. The split plot design with three replicates was adapted in this study. Cultivars occupied the main plots; while the fertilization treatments were applied to sub plots.

A random sample of three plants was taken from each plot after 105 days from transplanting (marketing stage), plant height, number of leaves per plant, plant fresh and dry weights (gm/plant), fresh and dry yields per feddan, essential oil analysis, carotenoides, vitamin C (mg/100g) and nitrate content were recorded in both growing seasons. Statistical analysis was carried out by SAS programs, the Duncan multiple comparative ranges were used to applied among treatments means. As reported by Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Vegetative Growth:

Data in Table (1) represent the effect of partial or complete organic replacement of mineral nitrogen fertilization on celery plant height, number of leaves, fresh and dry weights in vegetative marketing stage of two celery cultivars, Local Egyptian cv. (Balady) and Utah Tall 52-70) during two growing seasons (2006/2007 and 2007/ 2008). The results showed that Local Egyptian cv. recorded the higher values of plant height and leaf numbers in vegetative marketing stage within each fertilizer treatment comparing with cv. Utah Tall 52-70. On the other hand, Utah Tall 52-70 cv. recorded higher value of plant fresh and dry weight in vegetative marketing stage within each fertilizers treatment comparing with Local Egyptian cv. The differences between the two cultivars were highly significant in both investigation seasons.

Results in Table (1) revealed that the highest values of plant height, leaf number fresh and dry weight were recorded with 100% mineral fertilization and 50% mineral fertilizer + 50% organic fertilizer treatment in both seasons followed by 75% mineral fertilizer + 25% organic fertilizer treatment. Meanwhile the lowest growth values were obtained with 100% organic fertilizer treatment. These results are in the same trend with Dufault (1987) and Li-HuiHe *et al*. (2003) on celery, and were in agreement with those of Mantelin and Touraine (2004) and Glala *et al*.; (2010)

Yield:

Data in table (2) showed the effect of partial or complete organic replacement of mineral nitrogen fertilization on vegetative and dry yield in vegetative marketing stage of two celery cultivars during two growing seasons. Utah Tall 52-70 cv. recorded the higher values of fresh and dry yield comparing with Local Egyptian cv. The differences between the two cultivars were highly significant in both seasons.

According to the data in Table (2) it is clearly noticed that the highest fresh and dry yield was recorded with 100% mineral nitrogen fertilization treatment in both seasons followed by 50% mineral fertilizer + 50% organic fertilizer and 75% mineral fertilizer + 25% organic fertilizer treatment. Meanwhile, the lowest fresh and dry yield was obtained with 100% organic fertilizer treatment preceded by 25% mineral nitrogen + 75% organic nitrogen treatment. The lower vegetative growth and out yielding was recorded with 100% organic nitrogen and 25% mineral nitrogen + 75% organic nitrogen fertilizer treatment, may due to lower nitrate concentrations in soil solution, which lead to less lateral root number and also inhibit root hair elongation**,** (Mantelin and Touraine, 2004).

Table 1: The effect of partial or complete organic replacement of mineral nitrogen fertilization on plant height, number of leaves and fresh and dry weights of two celery cultivars, in vegetative marketing stage, during two growing seasons.

Cultivars	Nitrogen sources	First season (2006-2007)				Second season (2007-2008)			
		Plant height (cm)	Number of leaves /plant	Fresh weight (g/plant)	Dry weight (g/plant)	Plant height (cm)	Number of leaves /plant	Fresh weight (g/plant)	Dry weight (g/plant)
Local Egyptian Balady	(S1)100 % O	53.7 a	127.9a	584.5 e	57.4 d	64.7 a	132.1 a	846.9 de	91.3 cd
	(S2)25 % M+75% O	50.1b	120.0b	508.3 e	53.9 d	61.0 bc	126.7b	781.1 e	83.7 d
	(S3)50 % M+50% O	50.9 b	126.4b	528.3 e	56.4 d	62.3 b	131.1a	791.0 e	88.9 cd
	(S4)75 % M+25% O	46.0 c	107.8c	366.7 f	43.1e	58.0 de	116.0c	623.3 g	74.8 e
	(S5)100 % M	42.0 d	65.4 d	283.0 g	34.7 f	56.3 e	92.7 d	533.3 g	66.1 f
Mean		48.6 a	109.5 a	454.2 b	49.1 b	60.5 a	119.7 b	715.3 b	81.0 b
Utah Tall 52-70	S1	42.7 d	55.2 e	1163.6a	91.0a	59.3 cd	48.0 e	1433.3 a	114.6a
	S2	40.9 de	49.0 f	1033.3 b	80.3 b	56.6 e	43.7 f	1343.3 b	106.6 b
	S3	40.6 de	54.3 ef	1083.3 b	97.6a	57.6 de	46.3 e	1333.3 b	115.6a
	S4	39.1e	41.0 g	796.7 c	81.4 b	53.8f	38.4 g	1016.7c	105.0 b
	S5	35.3 f	34.3 h	689.9 d	70.3 c	49.3 g	29.9 h	889.7 d	96.4 c
Mean		39.7 b	46.8 b	953.3 a	84.1 a	55.3 b	41.3 a	1203.3 a	107.8 b
Means of nitrogen fertilization treatments									
(S1) 100 % M		48.2 a	91.5 a	874.0a	74.2 a	62.0 a	90.1 a	1140.1a	101.0 a
(S2)75 % M+25% O		45.5 b	84.5 b	770.8b	67.1 b	58.8 b	85.2 b	1062.0b	95.6b
(S3)50 % M+50% O		45.8 b	90.3 a	805.8b	76.9 a	59.9 b	88.7 a	1063.2 b	102.9 a
(S4)25 % M+75% O		42.5 c	74.4 c	581.7 c	62.2b	55.8 c	77.2 c	820.0c	89.9b
(S5)100 % O		38.6 d	49.9 d	486.2d	52.4c	52.7 d	61.3 d	711.5 d	81.2 c
Significant levels									
Cultivars		**	**	**	**	**	**	**	**
Treatments		**	**	**	*	**	**	**	*
Interaction		*	**	*	*	*	**	*	*

M= Ammonium nitrate O = Nile Compost * = significant at 5 % ** = significant at 1%

Results in Table (2) also showed that there were significant increase for the interaction between celery cultivars and fertilization treatments. The highest fresh and dry yield was obtained with Utah Tall 52-70 cv. plants fertilized with 100% mineral nitrogen and/or 50% mineral nitrogen + 50% organic nitrogen treatment , followed by Utah Tall 52-70 cv. plants fertilized by 75% mineral fertilizer + 25% organic fertilizer. Meanwhile, the lowest fresh and dry yield was obtained with Local Egyptian cv. plant fertilized with 100% organic fertilizer, preceded by Local Egyptian cv. plant fertilized with 25% mineral fertilizer + 75% organic fertilizer for both two investigation seasons. Similar trends have been reported by Feigin *et al*., (1982), Stark *et al*., (1982), Abdallah *et al*., (1984), Masson *et al.*, (1991), Evers *et al*., (1997), Titulaer and Kanters (2000), Xiong-You Sheng *et al*., (2005) and Koota *et al*., (2007) on celery.

Essential Oil In Celery Leaves:

Data in Table (3) showed the essential oil percent and its main compounds relative percentages in two celery cultivars leaves as affected by different fertilization treatments in the second season. the percentage of essential oil in celery leaves varied from 0.02 to 0.033 %, with average value of 0.029 and 0.034 % in the leaves of Utah Tall 52-70 and Balady cultivar, respectively. However, there was no significant effect for cultivar, organic fertilization or their interaction on essential oil percentage in celery leaves.

The effect of different fertilizer treatments on the main compounds of the essential oil in the two celery cultivars' leaves is shown in Table (3). The major compound was identified as limonene in all treatments but slightly varied according to the proportion of organic and mineral fertilizer. The maximum limonene content in the essential oil of Utah Tall 52-70 cv leaves (70.6%) was found in 100% mineral fertilizer treatment, while the minimum value of the essential oil (65.3%) was observed in the same cultivar, with 25% mineral fertilizer + 75% organic fertilizer treatment. The sesqueterpene, selinene showed the opposite trend of limonene and tended to increase with the increase of the ratio of organic fertilizer. The maximum percentage of selinene (6.4%) was determined in 25% mineral fertilizer + 75% organic fertilizer treatment, while the minimum content (4.3%) was observed with 100% mineral fertilizer treatment. Sedanolide (the major phthalides) increased gradually with increasing the portion of organic fertilizer mixture. Sedanolide content ranged from 3% in essential oil of Utah Tall 52-70' plants fertilized with 100% mineral fertilizer to 9.75% with 100% organic fertilizer treatment. The other phthalides (sedanenolide and 3-n- putyl phthalide) also tended to increase with increasing organic fertilization.

Table 2: The effect of partial or complete organic replacement of mineral nitrogen fertilization on vegetative and dry yield in vegetative marketing stage of two celery cultivars during two growing seasons.

Cultivars	Nitrogen sources	First season (2006-2007)		Second season (2007-2008)	
		Vegetative yield (ton/fed.)	Dry yield (Kg/fed.)	Vegetative yield (ton/fed.)	Dry yield (Kg/fed.)
Local Egyptian Balady	(S1) 100 % O	5.5 ^{e}	535.3 ^{d}	7.9 ^{de}	851.7 ^{cd}
	(S2) 25 % M+75% O	4.7 ^{e}	502.8 ^{d}	7.3 ^{e}	781.3 ^{d}
	(S3) 50 % M+50% O	4.9 ^{e}	526.3 ^{d}	7.4 ^{e}	829.5 ^{cd}
	(S4) 75 % M+25% O	3.4 ^{f}	402.3 ^{e}	5.8 ^{f}	698.4 ^{e}
	(S5) 100 % M	2.6 ^{g}	323.6 ^{f}	5.0 ^{g}	610.8 ^{f}
Mean		4.2 ^{b}	458.0 ^{b}	6.7 ^{b}	755.6 ^{b}
Utah Tall 52-70	S1	10.9 ^{a}	849.5 ^{a}	13.4 ^{a}	1069 ^{a}
	S2	9.6 ^{b}	759.3 ^{b}	12.4 ^{b}	1003 ^{ab}
	S3	10.1 ^{b}	910.6 ^{a}	12.6 ^{b}	1078 ^{a}
	S4	7.4 ^{c}	749.6 ^{b}	9.5 ^{c}	980.8 ^{b}
	S5	6.4 ^{d}	654.3 ^{c}	8.3 ^{d}	899.7 ^{c}
Mean		8.9 ^{a}	784.7 ^{a}	11.3 ^{a}	1006 ^{a}
Means of nitrogen fertilization treatments					
100 % M (S1)		8.2 ^{a}	692.4 ^{a}	10.6 ^{a}	954.0 ^{a}
75 % M+25% O(S2)		7.2 ^{b}	626.2 ^{b}	10.0 ^{b}	891.1 ^{b}
50 % M+50% O(S3)		7.5 ^{b}	718.4 ^{a}	9.9 ^{b}	960.4 ^{a}
25 % M+75% O(S4)		5.4 ^{c}	580.8 ^{b}	7.6 ^{c}	839.6 ^{b}
100 % O (S5)		4.6 ^{d}	488.9 ^{c}	6.6 ^{d}	750.3 ^{c}
Significant levels					
Cultivars		**	**	**	**
Treatments		**	*	**	*
Interaction		*	*	*	*

M= Ammonium nitrate   O = Nile Compost   * = Significant 5%   ** = Significant at 1%

Generally, the oxygenated compounds were increased from 12.5% in 100% mineral fertilizer treatment to 20.6% in 100% organic fertilizer treatment as a result of increasing organic fertilization.

On the other hand, the non oxygenated compounds decreased from 84.8% in 100% mineral fertilizer treatment to 76.4% in 100% organic fertilizer treatment. In other words, increasing organic fertilizer gradually decreased the content of non oxygenated compounds and increased oxygenated compounds content of Utah Tall 52-70' essential oil.

Concerning the main essential oil compounds in local Egyptian cv "*Balady"* leaves. It was affected by different nitrogen fertilizer treatments as shown in Table (3). The major compound was identified as limonene in all treatments and the maximum limonene content (72.9%) was found in 100% mineral fertilizer treatment, while the minimum value (64.2%) was observed in the leaves of 100% organic fertilizer treatment. The main sesqueterpene selinene tended to increase with increasing the portion of organic fertilizer. The maximum content of selinene (6.58%) was detected in the leaves' of 100% organic fertilizer treatment, while the minimum value (2.72%) was observed with 100% mineral fertilizer treatment. This trend was opposite to limonene trend. Sedanolide (the major phthalides) ranged from 2.1% in 100% mineral fertilizer to 7.81% in 100% organic fertilizer treatment and was increased with the increase of the portion of organic fertilizer mixture.

The other phthalides (3-n-butyl phthalide) also tended to increase with increasing organic fertilization. Generally, the oxygenated compounds in local Egyptian cv "*Balady"* leaves' essential oil, increased from 5.08% in 100% mineral fertilizer treatment to 12.3% in 100% organic fertilizer treatment as a result of increasing organic fertilization. On the other hand, non oxygenated compounds were decreased from 91.6% in 100% mineral fertilizer treatment to 82.6% in 100% organic fertilizer treatment. In other words, increasing organic fertilizer gradually decreased the content of non oxygenated compounds and increased the oxygenated compounds. Data also indicated that phthalides contents in celery leaves' essential oil were gradually increased with increasing organic fertilization portion, which may explain the better aroma and flavor of the organic produced celery. Our results on phthalide agree with those of Gijbels *et al*., (1985), Mc Leod *et al*., (1988) who mentioned that phthalides have been recognized as compounds responsible for the characteristic celery flavor and their higher contents, therefore, represent a positive quality aspect. From the consumer health point of view, Carol (1992) reported that 3-n-butyl phthalide in fresh celery leaves' oil, relaxes the smooth-muscle lining of blood vessels much better than most used antihypertensive agents, without any troubling side effect. Since phthalide works on lowering the concentration of catecholamines "stress hormones" in the blood, through blocking the action tyrosine hydroxylase enzyme, which involved in producing catecholamines. He added that a dose of the phthalide compound equivalent to four stalks of celery in humans lowered about 13 % of blood pressure. The same dose also decreased the cholesterol' levels by 7 percent.

Table 3: The essential oil percent and its main compounds relative percentages in two celery cultivars leaves as affected by different fertilization treatments in the second season.

	Utah Tall 52-70					Local Egyptian *"Balady"*				
Compound / Treatments	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Total oil percent	0.033	0.032	0.032	0.032	0.032	0.020	0.04	0.03	0.03	0.02
	Main compounds relative percentages									
β-Pinene R	0.02	0.02	0.03	0.04	0.06	0.01	0.01	0.03	0.04	0.05
Myrcene	4.7	3.6	3.3	3.2	2.5	7.01	6.84	6.10	6.07	5.65
Limonene	70.6	69.73	69.3	65.3	68.15	72.9	71.3	70.5	66.0	64.2
Ocimene	1.9	1.6	2.4	2.8	2.9	4.58	3.08	1.76	0.74	0.15
Terpenene	0.6	-	0.44	-	-	2.4	2.09	3.01	3.02	3.32
α - Terpenene	0.79	-	0.89	-	0.77	-	-	-	-	-
pentyl cyclohexadiene	2.15	5.77	3.98	3.3	3.01	-	-	-	-	-
β -Methoxy acetophene	2.36	1.97	2.84	2.9	1.30	-	-	-	-	-
Caryophyllene	0.50	-	0.69	-	-	-	-	-	-	-
Hamleline	0.55	-	0.78	-	-	-	-	-	-	-
Farnesene	-	-	-	-	-	2.01	2.31	2.17	2.60	2.64
Apiol	-	-	-	-	-	1.5	2.54	1.98	3.02	1.65
Selinene	4.30	5.7	5.4	6.4	5.3	2.72	3.02	5.65	5.95	6.58
3-n-Butyl hexahydrophthlide	-	-	-	-	-	1.37	1.47	2.08	2.93	2.84
Caryophyllene oxide	0.55	-	0.45	-	-	-	-	-	-	-
3- Butyl hexahydrophathlide	1.37	1.30	2.01	3.06	3.46	-	-	-	-	-
α –eudesmol	0.78	0.55	0.78	0.94	-	-	-	-	-	-
Sedanolide	3.00	4.36	5.47	7.5	9.75	7.81	5.42	3.96	2.95	2.1
Total of Identified compounds	97.3	97.1	95.6	97.9	97.0	94.9	95.8	97.2	95.5	96.7
Oxygenated compounds	12.5	16.5	16.8	20.9	20.6	12.3	11.4	8.05	6.9	5.08
Non- Oxygenated compounds	84.8	80.6	78.8	77.0	76.4	82.6	84.4	89.2	88.5	91.6

S1= 100% mineral fertilizer (M) S2 = 75% (M) + 25% organic fertilizer (O) S3 = 50% (M) +50% (O)
S4 = 25% (M) +75% (O) S5 = 100% (O)

Carotenoides:

Data in Table (4) showed the effect of partial or complete organic replacement or mineral nitrogen fertilization on vitamin C content, carotenoides and NO_3–N of two celery cultivars during two growing seasons. The differences in Carotenoides contents between the two cultivars were significant for both seasons as shown in Table (4), Balady recorded the highest value of plant content of carotenoides within each fertilizers treatment comparing with Utah Tall 52-70.

Data in Table (4) illustrated that the effects of fertilization treatments on celery carotenoides contents were significant in both two seasons. There were significant differences between 75% mineral fertilizer + 25% organic fertilizer, 100% mineral fertilization treatment; which, recorded the highest carotenoides contents value (0.34 and 0.32 mg/g of fresh weight, respectively), however 25% mineral fertilizer + 75% organic fertilizer treatment, recorded the lowest carotenoides contents value (0.19 mg/g of fresh weight) in the first season.

Results in Table (4) clearly showed that there was no significant effect of the interaction between celery cultivars and fertilization treatments on celery carotenoides contents.

These results agreed with those Dufault (1987), Evers *et al*., (1997) on celery.

From the consumer health point of view, The recommended daily intake for adults of Vitamin A " carotenoides " is 600 µg /per/day (FAO 1999). With consideration that, the daily consumption rate of adult from celery leaves is 118 g/per/day (WHO, 1997). That means the adult's daily celery consumption could supplement

84.5- 90.5% of Vitamin A requirements. Since it contain 507or 543 µg vitamin a, if it was 50% or 100 % mineral nitrogen fertilized, respectively.

Table 4: The effect of partial or complete organic replacement or mineral nitrogen fertilization on vitamin C content, carotenoides and NO_3–N of two celery cultivars during two growing seasons.

Cultivars	Nitrogen Sources (s)	vitamine content (mg/100 gm)	carotenoides (mg/g)	NO_3 –N ppm	vitamine content (mg/100 gm)	carotenoides (mg/g)	NO_3 –N ppm
		First Season 2006 – 2007			Second season 2007- 2008		
Local Egyptian	S1	6.1 ^{e}	0.32^{abc}	483.3 ^{a}	6.1 ^{e}	0.44^{abc}	483.3 ^{a}
	S2	7.5 ^{b}	0.37^{a}	433.3 ^{b}	7.5 ^{b}	0.48^{a}	433.3 ^{b}
	S3	7.0 ^{c}	0.31^{abc}	303.3 ^{c}	7.0 ^{c}	0.43^{abc}	303.3 ^{c}
	S4	8.0 ^{a}	0.33^{abc}	200.0 ^{d}	8.0 ^{a}	0.45^{abc}	200.0 ^{d}
	S5	6.5 ^{d}	0.35^{ab}	116.67 ^{f}	6.5 ^{d}	0.47^{ab}	116.67^{f}
Mean		7.03^{a}	0.34^{a}	307.3^{a}	7.03^{a}	0.46^{a}	307.3^{a}
Utah Tall 52-70	S1	4.9 ^{f}	0.33^{abc}	306.7 ^{c}	4.9 ^{f}	0.45^{abc}	306.7 ^{c}
	S2	5.1 ^{f}	0.31^{abc}	156.7 ^{e}	5.1 ^{f}	0.43^{abc}	156.7 ^{e}
	S3	6.4 ^{d}	0.31^{abc}	100.0 ^{f}	6.4 ^{d}	0.44^{abc}	100.0 ^{f}
	S4	4.5 ^{g}	0.23^{bc}	53.3 ^{g}	4.5 ^{g}	0.35^{c}	53.3 ^{g}
	S5	4.5 ^{g}	0.22^{c}	25.00 ^{h}	4.5 ^{g}	0.36^{bc}	25.00 ^{h}
Mean		5.09^{b}	0.28^{b}	128.3^{b}	5.09^{b}	0.40^{b}	128.3^{b}
Means of nitrogen fertilization treatments							
(S1) 100 % M		5.6 ^{c}	0.32^{a}	395.0 ^{a}	5.6 ^{c}	0.46^{a}	395.0 ^{a}
(S2) 75 % M+25% O		6.3 ^{b}	0.34^{a}	295.0 ^{b}	6.3 ^{b}	0.44^{a}	295.0 ^{b}
(S3) 50 % M+50% O		6.7 ^{a}	0.25 ^{ab}	201.0 ^{d}	6.7 ^{a}	0.43^{a}	201.0 ^{d}
(S4) 25 % M+75% O		6.3 ^{b}	0.19 ^{b}	126.0 ^{d}	6.3 ^{b}	0.37^{b}	126.0 ^{d}
(S5) 100 % O		5.5 ^{c}	0.26 ^{ab}	70.8 ^{e}	5.5 ^{c}	0.40^{ab}	70.8 ^{e}
Significant levels							
Cultivars		**	**	**	**	**	**
Treatments		**	*	**	**	*	**
Interaction		**	NS	**	**	NS	**

M= Ammonium nitrate O = Compost El-Nile NS = not significant at 5 % * = significant at 5% **= significant at 1%

Vitamin C Content:

The results in Table (4) showed that Local Egyptian "Balady", recorded the highest value of vitamin C content within each fertilizers treatment comparing with Utah Tall 52-70. The differences between the two cultivars were highly significant in both investigation seasons.

Data in Table (4) showed that the highest content of vitamin C was recorded with 50% mineral fertilizer + 50% organic fertilizer treatment. Meanwhile the lowest content was obtained with 100% organic fertilizer treatment and 100% mineral fertilizer treatment. Even the effects of fertilization treatments on celery plant content of vitamin C were highly significant for both growing' seasons, there were no significant differences between the two treatments of 75% mineral fertilizer + 25% organic fertilizer and 25% mineral fertilizer + 75% organic fertilizer treatment on celery plant content of vitamin C.

Results in Table (4) also revealed that there were significant effect for the interaction between celery cultivars and fertilization treatments. These results agree with those of Evers *et al.,* (1997), Elkner and Kaniszewski (2001), Li-HuiHe *et al.* (2003), Szwejkowska (2003) and Xiong-YouSheng *et al*. (2005) on celery.

From the consumer health point of view, the recommended daily intake of adults of Vitamin C is 75 mg/per/day (Gershoff, 1993 and FAO 1999). Moreover CAC/GL 55, 2005) recommended that at least 15% from each vitamin's requirement should be supplemented from food daily portion of consumption. With consideration that, the daily consumption rate of adult from celery leaves is 118 g/per/day (WHO, 1997). That means the adult's daily celery consumption contribute by more than the half of minimum value needed from food "11.25", since it contain 6.61 mg vitamin C, if it was mineral fertilized, that amount increased to 7.91 mg if the consumed celery was fertilized by 50% organic nitrogen.

Nitrate Content:

The results in Table (4) showed that, nitrate contents in celery leaves, highly significant affected by cultivars, organic fertilization treatments and were their interaction. Nitrate content in celery leaves varied from 25.00 to 483.3 ppm. Utah Tall 52-70 recorded the lowest value of plant content of NO_3-N within each fertilizers treatment "in average of 128.3 ppm", compared with Balady cultivar "307.3 ppm in average".

Data in Table (4) revealed that the lowest content of NO_3-N was recorded with 100% organic fertilizer treatment "70.8 ppm in average". Meanwhile the highest content of NO_3-N was obtained with 100% mineral fertilizer treatment "395.0 ppm in average".

This result agree with those obtained by Vulsteke (1979), Welch *et al*. (1985), Malakouti *et al*., (1999), Lin-Bao *et al*., (2000), Chen-Song *et al.,* (2005), Xiong-YouSheng *et al*., (2005), Koota *et al*., (2007), on celery.

From the consumer health point of view, the acceptable daily intake "ADI" of nitrate is between 0 and 3.65 mg kg^{-1} of body weight (WHO, 1995). That means the save ADI for adult person with average weight of 60 kg, reached 219 mg. The daily consumption rate of adult from celery leaves, 118 g/per/day (WHO, 1997). That means the adult's daily celery consumption contribute by 46.61 mg NO_3-N, if it was mineral fertilized, that reduced to 23.72, 8.35 mg if the consumed celery was fertilized by 50% organic or 100% organic nitrogen respectively.

Recommendation:

From the health value, better flavor and yield points of view, we may recommend the cultivation of celery with fertilizer treatment of 50% mineral +50% organic fertilizer.

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