ISSN : 1302-7050

Namık Kemal Üniversitesi

Tekirdağ Ziraat Fakültesi Dergisi

Journal of Tekirdag Agricultural Faculty

An International Journal of all Subjects of Agriculture

Cilt */ Volume:* ***10*** ***Sayı*** */ Number:* ***3*** ***Yıl*** */ Year:* ***2013***

Sahibi / Owner

Namık Kemal Üniversitesi Ziraat Fakültesi Adına
On Behalf of Namık Kemal University Agricultural Faculty

Prof.Dr. Ahmet İSTANBULLUOĞLU
Dekan / Dean

İndeksler / Indexing and abstracting

CABI tarafından full-text olarak indekslenmektedir/ Included in **CABI**

DOAJ tarafından full-text olarak indekslenmektedir / Included in **DOAJ**

EBSCO tarafından full-text olarak indekslenmektedir / Included in **EBSCO**

FAO AGRIS Veri Tabanında İndekslenmektedir / Indexed by **FAO AGRIS Database**

INDEX COPERNICUS tarafından full-text olarak indekslenmektedir / Included in **INDEX COPERNICUS**

TUBİTAK-ULAKBİM Tarım, Veteriner ve Biyoloji Bilimleri Veri Tabanı (TVBBVT) Tarafından taranmaktadır / Indexed by **TUBİTAK-ULAKBİM** Agriculture, Veterinary and Biological Sciences Database

Yazışma Adresi / Corresponding Address

Tekirdağ Ziraat Fakültesi Dergisi NKÜ Ziraat Fakültesi 59030 TEKİRDAĞ

E-mail: ziraatdergi@nku.edu.tr
Web adresi: http://jotaf.nku.edu.tr
Tel: +90 282 250 20 07

ISSN: 1302–7050

Tekirdag Ziraat Fakültesi Dergisi / Journal of Tekirdag Agricultural Faculty 2013 10(3)

İ Ç İ N D E K İ L E R / C O N T E N T S

The Effect of Increasing Doses of Sulfur Application of Some Nutrient Elements, Vitamin C , Protein Contents And Biological Properties of Canola Plant (*Brassica Napus* L.)

S. Adiloğlu[1] **F. Eryılmaz Açıkgöz[2]** **Aydın Adiloğlu[1]**

[1] Namik Kemal University, Faculty of Agriculture, Soil Science and Plant Nutrition Department, Tekirdag,

[2] Namik Kemal University, Corlu Vocational College, Greenhouse Department, Corlu–Tekirdag

This study was conducted in order to determine the effect of increasing doses of sulfur (S) application on some macro and micro elements, vitamin C, protein contents and biological properties of canola plant. In the experiment four doses of S (S_0: 0 mg kg^{-1}, S_1: 20 mg kg^{-1}, S_2: 40 mg kg^{-1}, S_3: 60 mg kg^{-1}) were applied as NH_4SO_4 fertilizer in greenhouse conditions. The content of Vitamin C content of canola plant decreased with increasing doses application of S. Vitamin C content of canola plant was obtained for S_0 dose as 28.41 mg 100^{-1}g and decreased Vitamin C content of canola plant with increasing S application and 22.36 mg 100^{-1}g obtained for S_3 dose. Protein content of canola plant increased from S_0 dose to S_2 dose with S application and decreased for S_3 dose application. Protein content of canola plant was found 33.71 % for S_2 dose. On the other hand, Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe) and Copper (Cu) nutrient elements contents of canola plant increased with S application but these increases were not found statistically significant. The highest Nitrogen (N) (6.68 %), Phosphorus (P) (0.80 %) and Zinc (Zn) (47.4 mg kg^{-1}) contents were obtained with S_2 dose and the highest Mangan (Mn) (70.6 mg kg^{-1}) content were obtained with S_3 dose of canola plant. Some biological properties of canola plant increased with increasing sulfur application. Plant height was determined as 37.16 cm, plant weight as 101.87g and number of leaves a plant as 8.33 for S_3 dose application. Canola plant can be an alternative product rather for vegetables which have rapid growth periods such as lettuce, cress, rocket, fresh onion, garlic, and leek from the months of late fall to early spring even until the beginning of summer.

Key words: Canola, sulfur, macro element, micro element, Vitamin C, protein.

Artan Miktarlarda Kükürt Uygulamasinin Kanola (*Brassica Napus* L.) Bitkisinin Bazı Besin Elementi, Vitamin C, Protein Kapsami Ve Biyolojik Özellikleri Üzerine Etkisi

Özet: Bu araştırmada kanola bitkisine artan miktarlarda kükürt uygulamasının bitkinin bazı makro ve mikro besin elementi, vitamin C, protein kapsamı ve biyolojik özellikleri üzerindeki etkileri incelenmiştir. Bu amaçla sera koşullarında yapılan sakı denemesinde kanola bitkisine dört doz kükürt (S_0: 0 mg kg^{-1}, S_1: 20 mg kg^{-1}, S_2: 40 mg kg^{-1}, S_3: 60 mg kg^{-1}) ile NH_4SO_4 formunda azot uygulaması yapılmıştır. Araştırmanın sonunda artan kükürt dozları bitkinin C vitamini kapsamını azaltmıştır. S_0 kükürt dozunda C vitamini 28.41 mg 100^{-1}g iken S_3 dozunda ise 22.36 mg 100^{-1}g olarak ölçülmüştür. Bitkinin protein içeriği S_2 dozuna kadar artmış ve daha sonra ise azalmıştır. Bitkinin protein içeriği S_2 dozu için % 33.71 olarak belirlenmiştir. Diğer taraftan bitkinin K, Ca, Mg, Fe ve Cu içerikleri de kükürt uygulaması ile birlikte artmıştır. Bitkinin en yüksek N (% 6.68), P (% 0.80) ve Zn (47.4 mg kg^{-1}) kapsamı S_2 dozunda ve Mn (70.6 mg kg^{-1}) ise S_3 dozunda belirlenmiştir. Bitkinin bazı biyolojik özellikleri de kükürt uygulaması ile birlikte artmıştır. Bitki gövde yüksekliği 37.16 cm, bitki ağırlığı 101.87 g ve bitkide yaprak sayısı 8.33 olarak S_3 dozunda belirlenmiştir. Bu araştırmada kanola bitkisinin sebze olarak tüketilmesi lahana, tere, roka, yeşik soğan, sarmısak ve pırasa gibi yeşil sebzeler için erken ilkbahardan yaz mevsimi başlangıcına kadar alternative bir bitki olabileceği ortaya konulmuştur.

Anahtar kelimeler: kanola, kükürt, makro element, mikro element, C vitamin, protein.

Introduction

Canola is a member of the *Brassicaceae* family and has become one of the most important sources of vegetable oil in the world. Its oil also has potential in the developing biodiesel market. In addition to oil production, the leaves and stems of canola provide high quality forage because of its low fiber and high protein content (Wiedenhoeft and Bharton, 1994).

Many studies state that consuming vegetables of dark green leaves; especially *brassica* vegetables with their antioxidant vitamins, mineral materials, flavonoids and glycosides content; may decrease some cancer risks, defend against cardiovascular diseases and prevent chronic illnesses (Kuhnlein, 1990; Verhoeven et al., 1996; Van Duyn and Pivonka, 2000; Kristal and Lampe, 2002; Barillari et al., 2006; Dixon, 2006; Podsedek, 2007; Jing et al., 2009).

Vegetables contain low amount of fat and calories, nevertheless they are high in fibre, vitamins and minerals (Giannaukourou and Taoukis, 2003). A report by the World Cancer Research Fund and the American Institute for Cancer Research (Steinmetz and Potter, 1996) confirms that diets rich in fruit and vegetables (more than 400 g day^{-1}) may diminish the risk of neoplasms by minimum 20 %. A diet rich in broccoli, Brussels sprouts, cabbage and kale or i.e. *Brassica* vegetables may considerably condense the risk of neoplasm (Kohlmeier and Su, 1997; Korus, 2010).

Many varieties of *Brassica* family are used as vegetables in many places of the world (Nieuwhof, 1969; Bhardwaj et al., 2003; Kawashima and Soares, 2003; Front et al., 2005; Thomson et al., 2007; Ahmad et al., 2007).

GRAS (Generally Recognized As Safe) status was granted to canola in 1985 (Shanidi, 1990). Canola is consumed as a vegetable in some of the African countries (Miller-Cebert, et al. (2009), however, it is just produced for its oil in Turkey.

As a leafy greenery canola plant may also offer nutritional benefits similar to those of some traditional leafy greens (Bhardwaj et al., 2003; Miller-Cebert, et al., 2009).

Sulfur deficiency of canola is a major concern in many parts of the world as canola requires higher levels of S for optimum yield than do most other agronomic crops. Management of S fertilizer sources should consider both the short- and long-term impacts on crop yield, seed quality and economics of production (Grant et al., 2012).

Many of the areas where canola is grown are subject to sulfur deficiencies. In Europe, S deficiencies have been noted in canola crops since the mid-eighties, related to the reduction in atmospheric S deposition that previously provided a significant source of plant-available S (Halstead et al., 2008).

Sulfur is an essential constituent of many proteins. Sulfur helps develop enzymes and vitamins, promotes nodule formation on legumes and is necessary for chlorophyll formation (Tirasoglu et al., 2005).

There are some studies conducted on the usability of canola plant (Bhardwaj et al., 2003; Miller-Cebert, et al. 2009). In this study, an alternative plant of canola for the production of oil in a vegetable salad with fresh greens and the effect of increasing sulfur doses application of some macro and micro element contents and some biological properties of canola plant was investigated.

Material and Methods

Experimental Design And Location

The experiment was carried out during successive crop seasons: late winter-early spring, UV consisting of PE greenhouse in Corlu, Turkey (41°11' N, 27°49' E) in 2011. The experiment was conducted according to random blocks experimental design with four replications. Canola seeds of cv. ES Hydromel (Euralis, Semences) were sown in February for late winter-early spring growing period in PE filled with peat (Klasmann-Deilmann, potground H, Germany). Four doses of sulfur fertilizer as $(NH_4)_2SO_4$ form (S_0: 0 mg kg^{-1}, S_1: 20 mg kg^{-1}, S_2: 40 mg kg^{-1}, S_3: 60 mg kg^{-1}) were applied to canola plant. These fertilizers were applied as a single dose 48 days after sowing of the seed plants. Each pot with 250 ml measuring cylinder is given by measuring the fertilizer. Plants were harvested after 63 days of seed sowing and these plants were harvested before generative maturity. When measurements were made without losing the biological characteristics of post-harvest plants and then passed two times the pure water 65^{0}C until it locks in an oven-dried weight, ground and is ready for the required. Some chemical properties of peat material are given in Table 1. Average climate data in unheated greenhouse during the months of the experiment are given in Table 2.

Data Collection And Analytical Methods

At the conclusion of the experiment the following characteristics were studied: Ascorbic acid (vitamin C) in fresh samples (mg 100 g-1), protein

(%) and some macro and micro element contents (%, mg kg-1).

The plant samples used for analysis collected from plants planted in the central of each parcel. Collected samples washed and dried in a ventilated oven at 65°C for ascorbic acid and some macro and micro element contents. Ascorbic acid content of fresh samples was determined with titrimetric method. The plant samples were analyzed for protein contents based on nitrogen analysis utilizing the Kjeldahl system according to the Association of Official Analytical Chemists International (AOAC). The protein was calculated using a nitrogen conversion factor of 6.25 (AOAC, 1990). Nitrogen content of the plant was determined by Kjeldahl method and P, K, Ca, Mg, Cu, Zn, Mn and Fe contents were determined by ICP- OES (Varian-Vista Model Axial Simultaneous) method. Individual plant weight (g), height of leaves (cm) and leaf number of a plant after harvesting without loss of time were obtained (Kacar and İnal, 2010).

Cultivation And Irrigation Practices

Neither extra fertilization nor pesticide application of any kind was carried out during the experiment. Pests and disease incidences were not observed and weeding was carried out when needs arises during the growing period.

Statistical Analysis

All data obtained from this experiment was statistically analyzed by using the MSTAT-C packet computer program. The statistical significance of differences among the mean values was determined by least significant difference (LSD) test at 5 % and 1 % probability (Düzgünes et al., 1987).

Table1. Some chemical properties of the peat material.

Parameter	Value	Unit
pH	6	%
Organic Matter	70	%
C	35	%
Total N	160-260	Mg L^{-1}
P_2O_5	180-280	Mg L^{-1}
K_2O	200-350	Mg L^{-1}
Mg	80-150	Mg L^{-1}

Table 2. Average climate data in unheated greenhouse during the months of experiment*

Month	Average Temperature (^{0}C)	Max. Temperature (^{0}C)	Min. Temperature (^{0}C)	Average Humidity (%)
February	10,0	21,0	4,0	87
March	10,0	22,1	4,1	90
April	12,9	23,7	6,5	84,7

*Data obtained from Turkish State Meteorological Service (TSMS)

Table 3. The effect of increasing doses of sulfur on the Vitamin C and protein contents of canola plant.

Increasing dose of sulfur	Vitamin C (mg 100 g^{-1})	Protein (%)
S_0	28,41	14,13c
S_1	27,38	27,40b
S_2	25,21	33,71a
S_3	22,36	27,21ab
Mean	25,84	25,61
$LSD_{0.05}$	ns	4,2

Results And Discussion

The effect of increasing sulfur application on vitamin C and protein content of canola plant are given in Table 3. Protein content of canola plant increased from S0 dose to S2 dose but decreased with S3 dose application (Table 3). These increases and decreases were found significant statistically at the level of 5 %. The highest protein contents of plant were determined with S2 dose. This results show that, excess S application to the plants were caused low protein content in plants (Table 3).

Vitamin C contents of canola plant decreased with increasing S application but these decreases were not found statistically significant with increasing S application (Table 3). Same results were determined some earlier researchers for different vegetables (Elwan and Abd El-Hamed, 2011).

Vitamin C content plants are effected many different biotic and abiotic factors (plant genotype, light, temperature, fertilization, irrigation prior to harvest) (Lee and Kader, 2000; Hancock and Viola, 2005, Abd El-Hamed and Elwan, 2010). Kurilich et al., (1999) determined Vitamin C content of five different fresh weight of cabbage between 32.9 and 22.6 mg 100-1g.

Effect of increasing sulfur application on some macro and micro elements contents of canola plant are given in Table 4. Nitrogen content of canola plant increased with increasing S application (Table 4) and statistically significant at the level of 1 %. Phosporus content of canola increased with S application (Table 4) and statistically significant at the level of 5 %. Same way, K, Ca, Mg, Fe and Cu content of plant increased with S application, but these increases were not found statistically significant. However, Zn and Mn contents of canola increased with S application (Table 4) and these results were found statistically significant at the level of 5 %.

Effects of increasing sulfur application on some biological properties of canola plant are given in Table 5. The highest plant weight and number of leaves in a plant were determined with S2 dose as 101,87 g and 37,16 cm, respectively. On the other hand plant height increased with increasing sulfur application and the highest plant height was determined with S3 dose application and this value as 8,33. Consequently, sulfur application to canola plant very important for plant qulaity. Because, excess or insufficient S application to canola may be decreasing of quality and quantity in canola plant.

Table 4. The effect of increasing doses of sulfur on the some macro and micro element contents of canola plant.

Increasing sulfur	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Cu (ppm)	Zn (ppm)	Mn (ppm)
S0	4,21c	0,60b	5,50	1,73	0,31	598	6,72	33,6b	54,4c
S1	6,20b	0,69b	5,52	1,41	0,26	451	8,10	41,8ab	63,2b
S2	6,68a	0,80a	5,75	1,40	0,25	530	8,40	47,4a	70,6b
S3	6,47ab	0,71ab	5,72	1,75	0,30	458	9,21	40,1ab	85,3a
Mean	5,89	0,7	5,12	1,56	0,28	509,25	8,10	40,72	68,37
LSD	4,12*	0,13**	ns	ns	ns	ns	ns	8,3**	21,06**

*p=0,01; **p=0,05; ns=not significant

Table 5. Some biological properties of canola plant grown in increasing doses of sulfur

Increasing dose of sulfur	Plant weight (g)	Plant height (cm)	Number of leaves in a plant
S_0	57,78d	29,00c	7,83
S_1	76,11c	32,50b	8,16
S_2	89,82b	34,16ab	8,33
S_3	101,87a	37,16a	8,33
Mean	81,39	33,20	8,29
$LSD_{0.05}$	11,21	8,3	ns

ns=not significant

References

Abd El-Hamed, K.E., Elwan, M.W.M., (2010). Genotype by environment interaction and henotypic stability of yield and quality in broccoli (Barassica oleracea var. italica). J. Agric. Sci. Mansoura Univ. 1 (6), 819–835.

Ahmad G, Jan A, Arif M, Jan MT and Khattak RA (2007). Influence of nitrogen and sulfur fertilization on quality of canola (Brassica napus L.) under rainfed conditions. Journal of Zhejiang University Science. 8(10):731-737.

Barillari J, Cervellati R, Costa S, Guerra MC, Speroni E, Utan A and Lori R (2006). Antioxidant and choleretic properties of Raphanus sativus L sprout (Kaiware Daikon) extract. Journal of Agricultural and Food Chemistry. 54 (26):9773-9778.

Bhardwaj HL, Hamama AA and Rangappa M (2003). Characteristics of nutritional quality of canola greens. HortScience. 38(6): 1156-1158.

Dixon G (2006). Vegetable brassica and related crucifers. CABI publishing. ISBN-9780851993959.

Düzgünes O, Kavuncu O, Kesici T and Gürbüz F (1987). Arastirma ve deneme metodlari. A.Ü. Ziraat Fakültesi Yayinlari, No:1021, Ankara.

Elwan MWM. and KE Abd El-Hamed, (2011). Influence of nitrogen form, growing season and sulfur fertilization on yield and the content of nitrate and vitamin C of broccoli Scientia Horticulturae 127: 181–187.

Front R, Rio-Celestino M, Cartea E and Haro-Bailon A (2005). Quantification of glucosinolates in leaves of leaf rape (Brassica napus ssp. Pabularia) by nearinfrared spectroscopy. Phytochemistry 66:175-185.

Grant CA, Mahli SS and Karamanos RE (2012). Sulfur management for rapeseed. Field Crops Research. 128: 119–128

Giannaukourou MC and Taoukis PS (2003). Kinetic modeling of vitamin C loss in frozen green vegetables under variable storage conditions. Food Chemistry 83: 33-41.

Halstead,S, Bloem E, Schung E (2008). History of sulfur deficiency in crops. In: Jez, J. (Ed.), Sulfur: A Missing Link Between Soils, Crops, and Nutrition. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Madison, WI, pp. 45–58.

Jing J, Koroleva OA, Gibson J, Swanston T, Magan J, Hang Y, Rowland IR and Wagstaff C (2009). Analysis of Phytochemical Composition and Chemoprotective Capacity of Rocket (Eruca sativa and Diplotaxis tenuifolia) Leafy Salad Following Cultivation in Different Environments. J. Agric. Food Chem. 57(12): 5227–5234.

Kacar B. and İnal A. (2010). Plant Analysis (2nd ed). Nobel Publ. No: 1241, Ankara.

Kawashima LM and Soares LM (2003). Mineral profile of raw and cooked vegetables consumed in southern Brazil. Journal of Food Composition and Analysis. 16:605-611.

Kristal AR and Lampe JW (2002). Brassica vegetables and prostate cancer risk: A review of the epidemiological evidence. Nutrient and Cancer, 42(1): 1–9.

Kohlmeier L and Su L (1997). Cruciferous vegetable consumption and colorectal cancer risk: Meta-analysis of the epidemiological evidence. Journal of the Federation of American Societies for Experimental Biology. (11): 369.

Korus A (2010). Level of vitamin C, polyphenols and antioxidant and enzymatic Activity in three varieties of kale (Brassica Oleracea L. var. Acephala) at different stages of maturity. International Journal of Food Properties, 14: 1069-1080.

Kuhnlein HV (1990). Nutrient values in indigenous wild plant greens and roots used by Naxalk people of Bella Coole, British Colombia. Journal of Food Composition and Analysis. 2: 38–46.

Miller-Cebert RL, Sistani NA and Cebert E (2009). Comparative mineral composition among canola cultivars and other cruciferous leafy greens. Journal of Food Composition and Analysis (22): 112–116.

Nieuwhof M (1969). Cole Crops, Leonard Hill, London, p. 102-104.

Podsedek A (2007). Natural antioxidant and antioxidant capacity of Brassica vegetables. Food Science and Technology, 40(1): 1-11.

Shanidi F (1990). Canola and rapeseed, production, chemistry, nutrition and processing technology, AVI Book. ISBN-0-442-00295-5.

Steinmetz KA and Potter JD (1996). Vegetables, fruits, and cereal fiber intake and risk of coronary heart disease among men. The Journal of the American Medical Association. 96:1027-1039.

Thomson CA, Newton TR, Graver EJ, Jackson KA, Reid PM, Hartz VL, Cussler EC and Hakim LA (2007). Cruciferous vegetable intake questionnaire improved cruciferous vegetable intake estimates. Journal of the American Dietetic Association. 107: 631-643.

Tirasoglu E, Cevik U, Ertugral B, Apaydin G, Baltas H and Ertugrul M (2005). Determination of trace elements in cole (Brassica oleraceae var. acephale) at Trabzon region in Turkey Journal of Quantitative Spectroscopy & Radiative Transfer. 94: 181–187

Wiedenhoeft M, Bharton, BA (1994). Management and environment effects on Brassica forage quality. Agron. J. 86: 227–237.

Van Duyn MA and Pivonka E (2000). Overview of health benefits of fruit and vegetable consumption for the dietetics professional; selective literature. Journal of American Dietetic Association. 100: 1511–1521.

Verhoeven DTH, Goldbohm RA, Van Poppel G, Verhagen H and Van Den B (1996). PA: Epidemiological studies on Brassica vegetables and cancer risk. Cancer Epidemiol. Biomarkers Prev. 5: 733–748.