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Lepidium sativum Cultivation in Organic Fertilizer Added Hazelnut Husk Compost

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Abstract
This study was carried out under Ordu ecological conditions in an unheated plastic tunnel type greenhouse between 2008-2009 production seasons. In this study, the effect of growth medium of natural hazelnut husk compost enriched with organic fertilizer at different ratio on cultivation of garden cress was researched. Organic fertilizer was added to hazelnut husk compost (adjusted to by volume 5%, 10%, 15% and 20%) in the manner that nitrogen would be 1%, 2%, 3% and 4% by using the nitrogen content of growth medium as a base. Natural hazelnut husk was accepted as a control application. In the study which was coordinated as a pot trial, each pot was examined as a replication and the study was carried out according to randomized parcels base design with three replications. In the study, seed plantings (2 g/m^2) were made in two different seasons; spring and autumn. Autumn planting was made in 10 September 2008 and spring planting was made in 28 April 2009. Plants were harvested two times for each two seasons. After harvest was finished, plant yield, leaf width, leaf length, vitamin C and leaf color (chroma, hue) values were determined. In the study, organic fertilizer applications statistically increased yield and leaf quality. In terms of yield value, 2% N application with 2052 g/m^2 gave the highest yield. Yield and leaf width values were higher in the first harvests. All fertilizer applications increased garden cress width and length. Amount of vitamin C increased 80% according to the control in 2% N application. Fertilizer addition created more green leaves on plants. Usage of organic fertilizer added natural hazelnut husk in the cultivation of garden cress is important in terms of both plant yield and quality improvement, and environmental sustainability.
Keywords: Color, hazelnut husk compost, *Lepidium sativum*, organic fertilizer, yield.

Organik Gübre Katkılı Fındık Zuruf Kompostunda Tere (*Lepidium sativum*) Yetiştiriciliği

Özet
Bu çalışma 2008-2009 üretim sezonunda Ordu ekolojik koşullarında ısıtmasız plastik tünel tipi serada yürütülmüştür. Çalışmada tere yetiştiriciliği üzerine farklı oranlarda organik gübre ile zenginleştirilmiş doğal fındık zuruf kompostu yetiştirme ortamının etkisi araştırılmıştır. Organik gübre yetiştirme ortamının azot içeriği baz alınarak %1, %2, %3 ve %4 azot olacak şekilde (%5, %10, %15 ve %20 hacimsel olarak ayarlanmıştır) fındık zuruf kompostuna ilave edilmiştir. Doğal fındık zurufu kontrol uygulaması olarak kabul edilmiştir. Saksı denemesi şeklinde düzenlenen çalışmada her saksı bir tekerrür olarak ele alınmış ve çalışma 3 tekerrürlü tesadüf parselleri temel deseninde kurulmuştur.
Çalışmada sonbahar ve ilkbahar olmak üzere iki dönemde tohum ekimi (2 g/m^2) yapılmıştır. Sonbahar ekimi 10 Eylül 2008 tarihinde, ilkbahar ekimi ise 28 Nisan 2009 tarihinde yapılmıştır. Bitkilerde her iki dönemde de ikişer kez hasat yapılmıştır. Hasat sonrası bitki verimi, yaprak eni, yaprak boyu, vitamin C ve yaprak rengi (kroma, hue) değerleri belirlenmiştir.
Çalışmada organik gübre uygulamaları verim ve yaprak kalitesi açısından istatistiksel anlamda artışlar sağlamıştır. Verim değerleri bakımından %2 N uygulaması 2052 g/m^2 ile en yüksek verimi vermiştir. İlk hasatlarda verim ve yaprak eni değerleri daha yüksek bulunmuştur. Gübre uygulamalarının tümü terede yaprak eni ve boyunu arttırmıştır. Vitamin C miktarı %2 N uygulamasında kontrole göre %80 artış göstermiştir. Gübre ilavesi bitkilerde daha yeşil yaprak oluşturmuştur. Tere yetiştiriciliğinde organik gübre katkısıyla doğal fındık zurufunun kullanımı hem bitkisel verim ve kalite artışı hem de çevresel sürdürülebilirlik açısından önem arz etmektedir.
Anahtar Kelimeler: Fındık zuruf kompostu, *Lepidium sativum*, organik gübre, renk, verim.

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INTRODUCTION

Supplying the soil with the highly required organic matter helps better its health so that less and less soil gets emaciated. In agriculture, the capacity and area of activity of recycling some resources is tub according to whichever standards. The process of recycling wastes may introduce many advantages to farming and land management when considered over the long run. Besides, a lot of advantages of a less polluted environment, a better habitat and a wise usage of usable recyclable resources can be seen before immediately judging them as garbage. With

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this design, provided with the deficiency of organic nutrient source, soil mixture of urban solid waste can function as a worthful organic matter source (Prakash et al. 2007).

Misuse of agricultural lands and excessive usage of chemical fertilizer in agricultural production disturb the natural balance and agricultural lands are eroded and gradually destroyed. As a consequence, lands lose their fertility. Especially in greenhouse productions, excessive and insensible usage of chemical fertilizer causes fatigue and desertification in hotbeds (Tuzel et al. 2005). This situation brings alternative productions in greenhouse productions into the agenda. Soilless agriculture is on the top of these alternatives. Soilless agriculture is made in two different methods as solid and liquid medium systems. It is seen in solid medium systems that peat, pearlite, rockwool, sand, zeolite, pumice, coco peat, processed clay, vermiculite, volcanic tuff and various plant waste are used as an agricultural medium. Rice and peanut husk, various barks, straws of grains such as wheat and barley, and corn and mushroom compost can be regarded as a plant growth medium in soilless cultures.

For some time Sphagnum peat has been the most widely used growing media constituent for the production of vegetables seedling and ornamental potted plants. Increasing demand and rising costs for peat as growing medium in horticulture have led to searches for alternative high quality but low cost substrates (Zeytin and Baran 2003). Moreover, in an effort to recycle and reclaim solid wastes, various organic residues generated by agriculture, livestock farming, forestry, industries and city centers are being successfully used as container media for plant production. Lots of current studies have showed that direct addition of many materials regarded as a waste can be organic material and plant nutrient sources or can be used as a growth medium with mixing in specific ratios (Benito et al. 2005, Hernandez-Apaolaza et al. 2005, Grigatti et al. 2007, Akyüz and Kirbağ 2009, Pekşen and Günay 2009, Akyüz and Kirbağ 2010). Another alternative medium that can be used as a growth medium is hazelnut husk compost. Hazelnut husk is a plant tissue that externally surrounds hazelnut and is initially green. After harvest, hazelnut husk separates from hazelnut with sorting machine in threshing. Albeit the change depending on the years, approximately 500-600 thousand tone hazelnuts are produced in Turkey. Amount of husks gained from hazelnut production is approximately 400-500 thousand tone. Husks are generally burned or leaved on lands (Zeytin and Baran 2003, Dede et al. 2012). Burning agricultural residues also causes environmental problems such as air pollution, soil erosion, and a decrease in soil biological activity (Copur et al. 2007).

Hazelnut husks can be evaluated as an organic material because of their chemical and physical properties. Hazelnut husk is a significant material with its 93.65% organic matter content. Moreover this husk has suitable values in terms of pH and salinity. Also in terms of its nutritional elements, it was reported that while nitrogen and phosphorus were inadequate as limit values, potassium and micro elements were great and adequate (Kacar and Katkat 1998). Husk is a hard to decompose material as having high C/N ratio (33/1) depending on low nitrogen and high carbon level. After a good composting, C/N ratio can be lowered to 10-15/1. Hazelnut husk compost being in this condition can be used as a plant growth medium because of its physical and chemical properties (Caliskan et al. 1996, Ozenc and Caliskan 2001, Zeytin and Baran 2003, Bender Ozenc 2005).

Lepidium sativum L. (garden cress) is widely cultivated in temperate climates throughout the world for various culinary and medicinal uses (Gokavi et al. 2004). Advantages to garden cress include relatively high oil contents, tolerance of fallow lands, minimal agricultural inputs (pesticides, fertilizer, water) and capability to serve in rotational crop cycles (Moser et al. 2009).

There is a wide range of wastes that have been studied as peat substitutes and no information concerning by adding organic fertilizer to hazelnut husk compost for growing media. In this study, the effect of hazelnut husk compost enriched with organic fertilizer at different ratio on some yield and quality properties of garden cress plant was researched.

MATERIAL AND METHODS

Materials

This study was carried out under Ordu (40° 96'N, 37° 96'E) ecological conditions in an unheated greenhouse between 2008-2009 production seasons. Hazelnut husk that was composted in a natural medium was used in trial. Husk compost was pressed after it was cleaned from coarse waste and sifted with 0.5 cm sieve. Plastic balcony pots being in size of 75x16x14 cm were used as a seed planting place. Pots were filled with hazelnut husks and organic fertilizers were added in the manner that there would be 1% (Application I), 2% (Application II), 3% (Application III), and 4% (Application IV) over dry weight. The content of organic fertilizer that was used was given in Table 1. Natural hazelnut husk compost was accepted as a control.

Methods

Trial was established two times during the fall and spring. Garden cress seeds sowing as it would be 2 g/m^2 was made in 10 September 2008 and 28 April 2009. After seeds sowing, peat with 1 cm thickness (Klasmann, Potgrond H) was used as a cover material. In the study each pot was accepted as an application replication and carried out according to randomized block trial design with three replications. All agricultural practices are made timely and complete to the harvest. Plants were harvested with a sharp knife, 2 cm over the soil level without giving harm to the plant growth zones. Regrowth of plants were provided after the first harvest. After plant growth, second harvest was done. In autumn after the seeds were planted, 30th and 60th days were the days when plants were harvested and in spring, plants were harvested in 23rd and 45th days after the planting.

Plants that were harvested were weighted with 0.01 g precision scale and yield was determined as g/m^2. In each application, randomly selected wholly grown 10 leaves length and width were measured in mm with a ruler. Color reading in leaves' samples were determined in the manner that 20 readings in each application as L, a*, b* with Konica Minolta CR-400 colorimeter. Chroma and hue values calculated from L, a* and b* coordinates. (Chroma= $\sqrt{a^2+b^2}$, Hue^o= $\tan^{-1}(b/a)$). Vitamin C (L-ascorbic acid) values in leaves were determined in filtrate as mg/100 g sap by reading in spectrophotometer in 518 nm wavelength with the indicator of 2.6 dichloroindophenol dyes (Pearson, 2005).

Statistical evaluation of yield and analysis results was made with the help of SPSS statistical package program.

RESULTS AND DISCUSSION

Additional organic fertilizer applications in hazelnut husk compost caused statistical differences over plant properties of garden cress (Table 2).

Table 1. Nutritional element of organic fertilizer.

Features	Amounts
N (%)	4.98
C (%)	26.78
P_2O_5 (%)	4.97
K_2O (%)	5.76
Fe (ppm)	112
S (ppm)	3190
Zn (ppm)	490
Mo (ppm)	18.4
Ca (ppm)	796
Mg (ppm)	306
Moisture (%)	20
pH	7.5

Examining average values of both harvests in yield, it was recognized that there was an increase up to application II according to control. Yield amount was determined as 526.86 g/m^2 in control application and values up to 2052.97 g/m^2 were estimated in organic fertilizer applications and application II. First harvest among the harvest periods gave the highest yield. After the first harvest, because of stresses that plant were faced with due to especially tissue loss, and low temperature (≤8.0^{o}C) in autumn where as excess temperature in spring (≥32.0^{o}C), the decrease in yields was occurred in second harvests. Air temperature and light also affect N uptake by salad greens (Gent 2002). Because of environment affects the release of nutrients from soil and the availability of nitrate. Cool soil limits the rate of nitrification via microbial transformation (Jarvis et al. 1996). The best temperature for cultivation of garden cress was stated as 20.0^{o}C (Munro and Small 1997). Literature findings stating that organic fertilizer applications increased the yield values of rocket matched with our results (Akcay Shakernagad 2000, Elgin 2003, Esiyok et al. 2007). Tuncay et al. (2011) reported that yield values in garden cress changed between 1711-3299 g/m2. Total values of fertilizer applications and first and second harvests gave the similar results with this study. A further increase after Application II doses the fertilizer rates did not result in significant changes of yield. Fertilizer leads to an increase in the carbohydrate accumulation in the plants thus enhancing leaf fresh weight and is essential for protein synthesis and also chloroplast development (Salisbury and Ross 1986). The control gave the lowest yield due to depletion of nutrients in the medium. Depending on the doses of fertilizer increased yield per plant.

Organic fertilizer addition statistically affected the leaves' length, width and colors of garden cresses that were cultivated in hazelnut husk compost. According to control, all applications increased to leaves width values (Table 3). Leaf width value in control application increased up to 15.56 to 28.18 mm in application III. First harvest had the highest leaf width value among the harvest periods. In spring, application activities in terms of leaf width values were more significant in first harvest. Leaves' width of rockets (6.35 cm) were found a little bit more than our findings in a study that was carried out by Esiyok et al. (2010) under Izmir (38° 26′N, 27° 09′E) conditions. The results of this study might be caused by that rockets had wider leaves than garden cresses and hours of sunshine in the ecology where the study was carried out was longer than our region.

After the effects of applications were examined in terms of leaves' length value, it was recognized that all factors caused statistically significant differences (Table 4). Organic fertilizer applications increased leaves' length of garden cresses (40-58%). While the leaves' length values were similar between harvests in autumn as leaves'width values, first harvest gave higher values than second harvest in spring.

All applications in term of hue value in leaves' color parameters gave higher values than control (Table 5). Especially brown color formation that was seen in control application decreased the hue value. In our study it was recognized that hue value increased with organic fertilizer application and there was a transition from yellow-green color to green color. On the other hand when examined through chroma values, brown color formation seen in autumn in control application affected the presence of application activities (Table 6). Hueo values increased in depending on increasing rates of nitrogen (Bakker et al. 2009).

Difference in the amount of vitamin C in plants was reflected on average values (Table 7). Amount of vitamin C being 33.33 mg/100 g in control application changed among 44.38-60.10 mg/100 g according to the fertilizer application. Application activities did not cause statistical differences because of the variation that was possible in terms of harvest and cultivation season. Tuncay et al. (2011) reported that amount of vitamin C was average 68.8-70.5 mg/100 g in autumn whereas our results were changed between 76.3-77.8 mg/100 g in spring. It was seen that these results were a little bit higher than ours. Vitamin C amount was decreased in high

Table 2. Yield values in *L. sativum* (g/m^2).

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	834.86	218.86	526.86
	1 % (Application I)	2039.70	1068.53	1554.11
	2 % (Application II)	1961.11	2144.83	2052.97
	3 % (Application III)	1438.07	2303.46	1870.77
	4 % (Application IV)	646.80	2936.30	1791.55
	LSD	548.24***		387.66***
Harvest Seasons	1st Harvest	1625.36	2466.17	2045.76
	2nd Harvest	1142.86	1002.62	1072.74
	LSD	346.74***		245.19***
Cultivation Seasons	Average	1384.11	1734.39	
	LSD	245.19**		
	ns.: non significant; *p <0.05; ** p<0.01; *** p<0.001			

Table 3. Leaves width values (mm) of *L. sativum*.

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	24.41	6.71	15.56
	1 % (Application I)	32.00	18.24	25.12
	2 % (Application II)	29.57	22.02	25.79
	3 % (Application III)	24.67	31.70	28.18
	4 % (Application IV)	23.68	30.18	26.93
	LSD	3.73***		2.64***
Harvest Seasons	1st Harvest	26.70	26.97	26.84
	2nd Harvest	27.03	16.57	21.80
	LSD	2.36***		1.67***
Cultivation Seasons	Average	26.87	21.77	
	LSD	1.67***		
	ns.: non significant ,; * p<0.05; ** p<0.01; *** p<0.001			

Table 4. Leaves length values (mm) of *L. sativum*.

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	119.19	44.83	82.01
	1 % (Application I)	163.97	86.68	125.33
	2 % (Application II)	144.47	116.07	130.27
	3 % (Application III)	104.40	152.23	128.32
	4 % (Application IV)	90.68	139.56	115.12
	LSD	15.42***		10.90***
Harvest Seasons	1st Harvest	124.28	123.28	123.78
	2nd Harvest	124.81	92.47	108.64
	LSD	9.75***		6.90***
Cultivation Seasons	Average	124.54	107.87	
	LSD	6.90***		
	ns.: non significant; * p<0.05; ** p<0.01; *** p<0.001			

Table 5. Hue° values of *L. sativum*.

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	146.67	94.25	120.46
	1 % (Application I)	147.67	158.17	152.92
	2 % (Application II)	148.17	146.67	147.42
	3 % (Application III)	149.67	147.50	148.58
	4 % (Application IV)	149.67	147.54	148.60
	LSD	24.07**		17.02**
Harvest Seasons	1st Harvest	148.07	150.62	149.34
	2nd Harvest	148.67	127.03	137.85
	LSD	15.22*		10.76*
Cultivation Seasons	Average	148.37	138.82	
	LSD	ns.		
	ns.: non significant; * p<0.05; ** p<0.01; *** p<0.001			

Table 6. Chroma values of *L. sativum*.

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	35.17	20.88	28.03
	1 % (Application I)	33.67	33.67	33.67
	2 % (Application II)	31.17	33.00	32.08
	3 % (Application III)	26.17	33.50	29.83
	4 % (Application IV)	26.50	33.38	29.94
	LSD	5.64***		ns.
Harvest Seasons	1st Harvest	30.60	32.35	31.48
	2nd Harvest	30.47	29.42	29.94
	LSD	ns.		ns.
Cultivation Seasons	Average	30.53	30.89	
	LSD	ns.		
	ns.: non significant; * p<0.05; ** p<0.01; *** p<0.001			

Table 7. Vitamin C values (mg/100 g) of *L. sativum*.

		Autumn	Spring	Average
Organic Fertilizer Dosages	Control	30.45	36.20	33.33
	1 % (Application I)	59.75	54.90	57.33
	2 % (Application II)	60.05	60.10	60.08
	3 % (Application III)	58.80	51.80	55.30
	4 % (Application IV)	49.15	44.38	46.76
	LSD	ns.		12.76**
Harvest Seasons	1st Harvest	43.22	48.41	45.82
	2nd Harvest	60.06	50.54	55.30
	LSD	ns.		8.07*
Cultivation Seasons	Average	51.64	49.48	
	LSD	ns.		
	ns.: non significant; * p<0.05; ** p<0.01; *** p<0.001			

rates of fertilizer. This decrease is due to the decrease in the amount of dry matter more (Bakker et al. 2009). Results of whole plant visual quality and growth measurements indicated all fertilizer treatments produced marketable leaf quality exception of control.

CONCLUSION

Enriching hazelnut husk compost with organic fertilizer gave positive results in terms of plant yield and quality in the cultivation of garden cress. Especially yield values highly increased. Yellow-brown color formation in control plants that occurred because of poor nutrition especially depending on low nitrogen content made the interpretation of leaves' color parameters difficult. The decreases in quality and yield were occurred in second harvest because of stresses in plants. Although it was not stated in here numerically, organic fertilizer applications increased nitrogen, phosphorus and potassium values of garden cresses' leaves. Organic fertilizer applications to media should be allowed to garden cress plants, their chemical characterizations.

In terms of agricultural products supply into the market it can be more suitable to use gradual planting in planting instead of second harvest or different harvest periods while putting applications into practice. Composting hazelnut husk under more controlled conditions, making fertilizer additions during compost and trying hazelnut husk compost on other leafy plants can create different perspectives about the subject.

Among the important problems in the world arises the act of disposal of the continually mounting quantity of urban and agricultural wastes. It has become a requisite to create new methods in order to be able to benefit from wastes at a maximum level through suitable technology to increase the amount of fertilizers and soil fertility, because of the inadequate purchasing potential of small farmers, energy crisis and overcharge of fertilizers. The remainders of regional cultivations and agricultural industries generate raw materials which are likely to be utilized for higher quality.

Reuse of waste husks by composting in hotbeds in which organic matter contents drop and soiled especially because of excessive chemical usage is vital for yield and sustainability in agricultural production. Plant waste compost can use as a soil amendment in open air and greenhouse cultivation. The use of compost materials in greenhouse and the other branch of agriculture can result in substantial savings in fertilizers. Utilizing agricultural residues not only prevents air pollution due to residual burn which adversely affect air quality and human and environmental health, but also economically profitable for farmers.

It is highly anticipated that the process of composting of hazelnut shells will be an environmentally safe substitute which alters the biodegradable wastes into a very beneficial compost product. The farmers would probably utilize on-site composting at a much lower price. The farmers would also benefit from this completed product-compost as an extra income; so it might as well serve as a developing means complement in greenhouse vegetable productions.

REFERENCES

Akcay Shakernagad B (2000) Effect of some natural and artificial fertilizers on the yield and quality characteristics of rocket plant. Master of Science Thesis, Ege University Natural and Applied Sciences Institute Department of Horticulture. Izmir.

Akyüz M, Kırbağ S (2009) Bazı tarımsal ve endüstriyel atıkların *Pleurotus* spp. üretiminde kompost olarak değerlendirilmesi. Ekoloji 18(70): 27-31.

Akyüz M, Kırbağ S (2010) Element contents of *Pleurotus eryngii* (DC. ex Fr.) Quel. var. eryngii grown on some various agro-wastes. Ekoloji 19(74): 10-14.

Bakker CJ, Swanton CJ, Mckeown AW (2009) Broccoli growth in response to increasing rates of pre-plant nitrogen. I Yield and quality. Canadian Journal of Plant Science 89: 527-537.

Bender Ozenc D (2005) Usage of hazelnut husk compost as growing medium. Proceedings of The Sixth International Congress on Hazelnut. Acta Horticulturae 686: 309-319.

Benito M, Masaguer A, De Antonio R, Moliner A (2005) Use of pruning waste compost as a component in soilless growing media. Bioresource Technology 96: 597-603.

Caliskan N, Koc N, Kaya A, Senses T (1996) Composting hazelnut husk. Hazelnut Research Institute, Research Final Report, Giresun.

Copur Y, Guler C, Akgul M, Tascioglu C (2007) Some chemical properties of hazelnut husk and its suitability for particleboard production. Building and Environment 42(7): 2568–2572.

Dede OH, Dede G, Ozdemir S (2012) The use of hazelnut husk and biosolid in substrate preparation for ornamental plants. African Journal of Agricultural Research 7(43): 5837-5841.

Elgin C (2003) Effects of organic fertilizer on yield and quality in rocket. Master of Science Thesis, Ege University Natural and Applied Sciences Institute Department of Horticulture, Izmir.

Esiyok D, Bozokalfa MK, Yagmur B, Kaygisiz Asciogul T (2010) Nutrional value and economic plant properties of *Eruca sativa* L. accessions. Cruciferae Newsletter 29: 42-45.

Esiyok D, Okur B, Tuncay O, Yagmur B, Ugur A (2007) Research on determination of the amount of change in sowing time and fertilizer forms of total glucosinolate of garden rocket and cress. Tubitak Project Final Report TOGTAG-2709, Ankara.

Gent MPN (2002) Growth and composition of salad greens as affected by organic compared to nitrate fertilizer and by environment in high tunnels. Journal of Plant Nutrition 25(5): 981-998.

Gokavi SS, Malleshi NG, Guo M (2004) Chemical composition of garden cress (*Lepidium sativum*) seeds and its fractions and use of bran as a functional ingredient. Plant Foods for Human Nutrition 59:105-111.

Grigatti M, Giorgioni ME, Ciavatta C (2007) Compost-based growing media: Influence on growth and nutrient use of bedding plants. Bioresource Technology 98: 3526-3534.

Hernandez-Apaolaza L, Gasco AM, Gasco JM, Guerrero F (2005) Reuse of waste materials as growing media for ornamental plants. Bioresource Technology 96: 125-131.

Jarvis SC, Stockdale EA, Shepard MA, Powlson DS (1996) Nitrogen mineralization in temperate agricultural soils: processes and measurement. Advances in Agronomy 57: 187-235.

Kacar B, Katkat AV (1998) Plant Nutrition. Uludag University Press, Bursa.

Moser BR, Shah SN, Winkler-Moser JK, Vaughn SF, Evangelista RL (2009) Composition and physical properties of cress (*Lepidium sativum* L.) and field pennycress (*Thlaspi arvense* L.) oils. Industrial Crops and Products 30: 199-205.

Munro DB, Small E (1997) Vegetables of Canada. NRC Research Press Scientific Publishing, Canada.

Ozenc N, Caliskan N (2001) Effect of husk compost on hazelnut yield and quality. Proceedings of the Fifth International Congress on Hazelnut, Acta Horticulturae 556: 559-566.

Pearson D (2005) The chemical analysis of foods. J&A Churchill, London.

Pekşen A, Günay A (2009) Use of Substrates Prepared by the Mixture of Tea Waste and Wheat Straw in *Agaricus bisporus* (L.) Sing. Cultivation. Ekoloji 19(73): 48-54.

Prakash UHB, Bhargavi MV, Parama VRR, Preethu DC (2007) Bioremedial recycling of solid waste. In: Proceeding of the International Conference on Sustainable Solid Waste Management, 5-7 September 2007, Chennai, 289-295.

Salisbury FB, Ross CW (1986) Plant physiology. CBS Publishers and Distributors, New Delhi.

Tuncay O, Esiyok D, Yagmur B, Okur B (2011) Yield and quality of garden cress affected by different nitrogen sources and growing period. African Journal of Agricultural Research 6(3): 608-617.

Tuzel Y, Gul A, Dasgan HY, Ozgur M, Celik N, Boyaci HF, Ersoy A (2005) Developments in protected cultivation. In: Proceedings of the Turkey Agricultural Engineering VI. Technical Congress, 3-7 January 2005, Ankara, 551-563.

Zeytin S, Baran A (2003) Influences of composted hazelnut husk on some physical properties of soils. Bioresource Technology 88: 241-244.