International Journal of Agriculture Innovations and Research
Volume 5, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 23/09/2016 | Accepted on : 04/10/2016 | Published : 18/10/2016

Effects of Genotype and Fertilization on Fruit Quality in Several Harvesting Periods of Organic Strawberry Plantation

Sevinç ŞENER[1*] **Nurgül Fethiye TÜREMİŞ[2]**

***Abstract* – This study was conducted in an open field under organic plantation conditions on Monterey, Albion, Aromas, Camarosa and Sweet Charlie strawberry cultivars, in Nevşehir city, between 2011 - 2012 and 2012 - 2013. Through the study, effects of Ekoflora, Mog, Bio-One, Ferbanat L and Natural Bioplasma fertilizers, which could be used in organic strawberry plantation, on fruit quality criteria, in three different harvest periods (Months July, August and September). For the purpose, average fruit diameter, fruit weight, fruit firmness, pH, total soluble solids (TSS), titrable acidity (TA) and fruit's external color L, a, b, C and Hue values of strawberry cultivars, on which organic fertilization was applied, were measured. According to results, highest values of optimum fruit diameter, fruit weight, TSS and acidity of physical and pomological characteristics, were obtained in August. The highest average pH value was obtained in July and the highest fruit diameter value was obtained in September. The highest average value of fruit's external color in terms of L and a value were obtained in July. It is also determined in the study that, effect of several cultivars and fertilizer applications of different harvest periods on fruit weight, fruit diameter, fruit firmness, TSS, acidity and pH parameters is statistically significant.**

***Keywords* – Strawberry, Organic Farming, Fertilizer, Fruit Quality.**

I. INTRODUCTION

Strawberry (Fragaria X ananassa Duch.), is one of the most preferably grown and the most profitable fruit cultivar in our country. Strawberry, as an important temperate climate fruit, is a member of berry fruits and it is prevalently marketed in winter and early spring (Özgüven and Yılmaz, 2009). Looking through the TÜİK (2016) data, it is reported that, strawberry production in our country has increased by leaps and bounds between 1988 - 2015; total production has increased to 375,000 tons from 42,000 tons and its average yield has increased to 2648 kg/da from 2000kg/da. In our country, strawberry production is mostly held in Mediterranean, Marmara and Aegean regions and Mersin, Aydın and Bursa cities of these regions (Özdemir et al., 2001). As an addition, relevance to strawberry production, which is carried through organic methods, increases and its market share, enlarges day by day (Atasay and Türemiş, 2008).

In Turkey, who ranks the third line of total strawberry production worldwide (FAO, 2014), 3.857,05 tons of strawberry production is carried through organic production. According to TÜİK (2014) data, there had been a 652 tons of strawberry production, which consisted 8,80 tons of organically grown strawberries, in a 316 da's field. Average yield is reported as 2,063/da tons.

Strawberry, which is a product to be grown improved, productivite and quality cultivars, has an increasing value in our country (Macit et al., 2006). Cultivar selection in strawberry plantation is important (Nacar, 2012). Criteria of earliness yield and quality is determinant for cultivar selection (Özkan, 1999; Üstün and Paydaş, 1995).

Fruit quality for strawberries are qualified with; sugar rate (sweetness), acidity, firmness, crispness, sourness, aroma, appearance, hardiness and nutritive value (Kader, 1991; Salame-Donoso et al., 2010). As an addition, fruit color, which is an important quality criterion for strawberry, holds the attraction and increases the demand for the fruit (Pilanalı and Kaplan, 2001).

Fertilizing is the top one factor to increase the yield in strawberry plantation (Kaşka et al., 1988). Along the studies conducted to increase the yield and fruit quality of strawberry, it is seen that, organic fertilizers provide results to compete with chemical fertilizers. It is reported by some researchers that, organic fertilizers have some effects on plant growth and development, yield and quality of strawberries (El-Shal et al., 2003; Tomic et al., 2015; Karlıdağ et al., 2006, Güneş et al., 2016).

Özkan (2012) reported that, in the Fern strawberry cultivar, TSS, total sugar and vitamin C content is higher in Macro crop, Stym 25, Biofarm and Mol liquid organic fertilizer applications compared to NPK chemical application. Gülbağ (2010), reported that, Camarosa and Elsanta strawberry cultivars, which were grown with organic fertilizer applications, provide the same yield and quality compared to cultivars grown under classical conditions. Erenoğlu et al., (2010), in their study they researched some plant nutrition materials and effects of genotype, reported that effect of genotype is important. Karlıdağ et al., (2006), reported that, in Fern strawberry cultivar, humic acid application done over leaves 3 or 4 times, increases the fruit quality in organic strawberry plantation. Polat (2005), noted that, the fertilizer application consists of green fertilizer, farm fertilizer and humic acid improves the yield and some quality criteria in Camarosa and Fern strawberry cultivar. El-Shal et al., (2003) reported that, an organic fertilizer type named Halex-2 improves the plant productivity and fruit quality of Camarosa cultivar. Tomic et al., (2015) reported that, effect of several fertilizer applications containing various bacteria and genotype differences on strawberry's fruit quality is significant.

There are very few studies about organic fertilizers to be used in organic strawberry plantation and adaptation of Central Anatolia. Through this study, it is aimed to determine suitable strawberry cultivars and organic fertilizing materials to be used in the region. Effects of strawberry cultivars and fertilizing materials on strawberry

fruit quality in different months in organic strawberry plantation system are revealed.

II. Materials and Methods

The study was conducted in Göre town of Nevşehir city, which is at 1150 m altitude, in and 4000 m2 ‘s open field and under organic growth conditions. Before the study, soil samples were collected and analyzed in the working area. Monterey, Albion, Aromas, Camarosa and Sweet Charlie strawberry cultivars were used as plant materials Ekoflora, Mog, Bio-One, Ferbanat L ve Natural Bioplasma fertilizers were used in the working area for fertilization. Ekoflora is an organic fertilizing material, which is obtained by biologically fermenting cattle manure with vegetal organic remains. Mog is an organic fertilizer, which consists of enzymes, amino acid and dissolved humic acid and fulvic acid. Bio-One is a microbial fertilizer. Ferbanat L is a fertilizer produced with organic materials, which were obtained due to soil microorganisms. Natural Bioplasma is a fertilizer that contains Chlorella alg. The treatments were arranged in a randomized block design (RBD) using a 5 X 5 factorial arrangement with 4 repetitions and 30 plants per parcel. During the seeding preparation, clinoptilolite fertilizer application was held in 100 kg/da recommended dosage to enlarge the water retention capacity of soil and improve physical characteristics of the soil. Afterwards, banks were prepared and systems of drip irrigation and rain irrigation were settled. Watering was held by drip irrigation and sprinkling irrigation during the trial. Prepared banks were planted out between 19.05.2012 - 22.05.2012. Fertilizer applications, application dosages, timing and methods are listed in Table 1.

Table 1. Ways of fertilizer use and dosages

Fertilizer	Application Dosage	Application Time	Way of Application
Ekoflora	250 kg/da	Before Planting	Integrating into soil
Mog	0.5-1 lt/da	4 application	Soil application and spraying
Bio-One	0.3 lt/da	1 application	Soil application
Ferbanat L	0.5-0.7 lt/da	4 application	Spraying
Natural Bioplasma	1 lt/da	4 application	Spraying

Along the trial, bordeaux mixture was applied twice time a year in recommended doses against fungal diseases. Any contention program was not conducted as any harmful side effects on plants were not faced.

Measurements and analyzes were held in 15 days periods along the trial. Fruit diameter was measured with a digital pachymeter, fruit weight was measured with a 0.01 g’s precision scales and fruit firmness was measured using a penetrometer with 5/16ıı (0,79 wide) surface needles and two punctures from opposite sites per fruit (Kaşka et al., 1986). TA, expressed in citric acid percentage, was determined by titrating 1 mL of juice in 50 mL distilled water with 0.1 N NaOH solutions to pH 8.1. The pH was measured, and then the solution was titrated with NaOH 0.1 N up to pH 8.1 using a pH meter. The TA was expressed as percent citric acid equivalent, according to the volume of NaOH added during titration (Özdemir et al., 2001; Adak et al., 2003). TSS was measured with hand-held refractometer.

A mutual two sided measurement of fruits’ external middle parts was done with a Minolta CHROMAMETER CR 300 to determine the external color of the fruit. Measurements are provided in means of L, a, b, C and Hue. L is the amount of brightness and 0 refers to black and 100 refer to white. a value’s negative values show green color and positive values show red color. b value’s negative values show blue color while positive values show yellow color (Wang et al., 1998). Obtained data was analyzed in random blocks trial test pattern according to factorial order. Data was analyzed with SPSS software version 22 program. Application averages were compared with Duncan test after variance test was completed. Significance level for all statistical analysis is $p \leq 0.05$. Significance level of differences between applications and different groups are provided in tables.

III. Results and Discussion

According to results of trial soil analysis, it is determined that, trial soil is loam, low acidity reaction molding, not salty, containing very little organic materials, containing lots of calcareous content, containing very little azote, containing lots of phosphor, sufficient in means of calcium, copper, zinc, potassium and magnesium, rich in iron, slightly containing boron and containing very low manganese.

In the Table 2. below, fruit weight (g/fruit), fruit diameter (mm) and fruit firmness (kg) values of different strawberry cultivars and fertilizer applications according to months, are given. Monterey and Albion are reported to be the largest cultivars in terms of fruit weight and fruit diameter. Analyzing the obtained data, harvests, done in different months, have an effect on fruit bigness. The highest values of fruit weight (15.61 g/fruit) and fruit diameter (33.09 mm) were obtained in August and highest firmness value (0.83 kg/fruit) was obtained in September. Monterey cultivar was found to be the superior in firmness in all months, comparing to all other cultivars. A difference was found among fertilizer applications in August and September in terms of firmness. It is also determined that, cultivars and fertilizers’ effect on parameters given in Table 2 is significant. Statistical analysis results are in accordance with this data (Table 2). Results obtained from the study in various cultivars and applications varies in a range of fruit weight; 11.59-18.83 g/fruit, fruit diameter; 24.52 - 39.78 g/fruit and fruit

firmness; 0.57-0.92 kg/fruit. These values are in accordance with various adaptation and fertilizer application studies' values in terms of fruit weight (Rahman et al., 2014; Çekiç and Aksu, 2012; Cabilovski et al., 2011; Geçer and Yılmaz, 2011; Gündüz and Özdemir 2008), fruit diameter (Kepenek et al., 2002; Pesakovic et al., 2013) and fruit firmness (Kaleci and Günay, 2006; Serçe et al., 2008). Considering effects of different harvest periods on fruits' physical characteristics, it is seen that, values of criteria about fruits' bigness such as fruit diameter and weight increases in August, mid-season while firmness values increase in September with the effect of passing season and temperature decrease. Zaldivar et. al., (2005) have reported that, fruit firmness values of 'Diamante' strawberry cultivar increases through the harvesting period.

Table 2. Effects of strawberry cultivars and fertilizer applications on fruit weight and fruit diameter by months.

Cultivars**	Fruit Weight (g/meyve) Months*			Fruit Diameter (mm) Months*			Fruit Firmness (kg) Months*		
	1	2	3	1	2	3	1	2	3
1	17.54 a	18.83 a	18.82 a	35.33 a	39.78 a	36.04 a	0.81 a	0.66 a	0.92 a
2	17.56 a	18.61 a	17.91 b	33.39 b	36.61 b	33.06 b	0.76 b	0.70 a	0.90 ab
3	13.96 b	15.95 b	14.67 c	29.07 c	29.84 d	27.61 d	0.74 b	0.67 a	0.86 b
4	11.59 c	12.43 c	11.95 d	26.85 d	31.15 c	29.44 c	0.63 c	0.68 a	0.78 c
5	11.92 c	12.25 c	11.90 d	25.63 e	28.06 e	24.52 e	0.61 c	0.57 b	0.68 d
Fertilizers ***									
1	14.23 ab	15.33 b	15.21	29.91 b	32.84 bc	29.86 b	0.70	0.62 c	0.92 a
2	14.60 ab	15.31 b	14.87	29.69 b	32.54 c	29.73 b	0.72	0.65 abc	0.91 a
3	14.76 ab	15.60 b	15.16	31.05 a	34.12 a	30.99 a	0.71	0.64 bc	0.75 c
4	14.08 b	15.55 b	14.93	30.01 b	32.63 c	29.96 b	0.71	0.69 ab	0.77 bc
5	14.91 a	16.27 a	15.09	29.61 b	33.30 b	30.14 b	0.71	0.69 a	0.80 b
Mean	14.52 c	15.61 a	15.05 b	30.05 b	33.09 a	30.14 b	0.71 b	0.66 c	0.83 a

*1: July, 2: August, 3:September. **1:Monterey, 2:Albion, 3:Aromas, 4:Camarosa, 5: Sweet Charlie. ***1:Ekoflora, 2:Mog, 3:Bio-One, 4:Ferbanat L, 5:Natural Bioplasma

In the Table 3, effects of various strawberry cultivars and fertilizer applications on TSS, acidity and pH content by months. Analyzing the data, it is seen that, cultivar variances and fertilizer applications' effects on TSS, acidity and pH values is statistically significant and values vary in a range of 7,87-9.53% for TSS values; 1.05-1.51% for acidity values and 3.53-3.92% for pH values. As an addition, TSS, acidity and pH values' differences are important and the highest TSS (8.80%) and acidity (1.37%) values were obtained in August while the highest pH value (3.75%) was obtained in July. The reason for the matter is thought to be the seasonal temperature raise and its increasing effect on TSS content (Kaşka et al., 1986). It is reported in some studies of the literature that, harvesting period's effect on pomological characteristics of TSS, acidity and pH values is significant (Wold and Opstad, 2007; Özdemir et al., 2001).

Table 3. Effects of strawberry cultivars and fertilizer applications on TSS (%), acidity (%) and pH content (%) by months

Cultivars**	TSS (%) Months*			Acidity (%) Months*			pH (%) Months*		
	1	2	3	1	2	3	1	2	3
1	8.08 c	8.57 c	8.39 b	1.35 a	1.47 b	1.30 b	3.61 e	3.60 c	3.57 bc
2	8.86 a	9.53 a	8.75 a	1.33 a	1.51 a	1.37 a	3.74 c	3.69 b	3.53 c
3	7.87 d	8.44 c	7.97 d	1.14 b	1.29 c	1.15 c	3.70 d	3.74 b	3.60 b
4	8.50 b	8.87 b	8.28 cb	1.10 c	1.31 c	1.17 c	3.92 a	3.87 a	3.70 a
5	8.54 b	8.60 c	8.10 cd	1.05 d	1.24 d	1.06 d	3.80 b	3.69 b	3.58 bc
Fertilizers* **									
1	8.19 c	8.82 ab	8.12 b	1.19 ab	1.39 ab	1.22	3.78 a	3.68	3.56 b
2	8.33 bc	8.80 ab	8.31 ab	1.21 ab	1.36 bc	1.23	3.71 b	3.73	3.62 ab
3	8.29 bc	8.96 a	8.31 ab	1.17 b	1.36 abc	1.20	3.76 a	3.73	3.59 ab
4	8.43 ab	8.66 b	8.42 a	1.22 a	1.33 c	1.19	3.74 ab	3.74	3.63 a
5	8.59 a	8.77 b	8.33 ab	1.18 ab	1.40 a	1.22	3.78 a	3.72	3.58 ab
Mean	8.37 b	8.80 a	8.30 b	1.19 b	1.37 a	1.21 b	3.75 a	3.72 b	3.60 c

*1: July, 2: August, 3:September. **1:Monterey, 2:Albion, 3:Aromas, 4:Camarosa, 5: Sweet Charlie. ***1:Ekoflora, 2:Mog, 3:Bio-One, 4:Ferbanat L, 5:Natural Bioplasma.

Monthly effects of study cultivars and applications on fruits' external color are listed in Table 4. It is defined that cultivars' effect on fruit's external color L, a, b, C and Hue values is significant, however, fertilizer applications do not have a significant effect on fruit's external color a and C values. It is confirmed that, harvests done in different months do not have a significant effect, excluding L and a values. The highest average value of fruit's external color L (30.46) and a value (63.44) was obtained in July.

In the study, effects of five different fertilizer types (Ekoflora, Mog, Bio-One, Ferbanat L and Natural Bioplasma) on fruit quality criteria of two short day cultivars (Camarosa and Sweet Charlie) and three day-neutral cultivars (Monterey, Albion and Aromas) in three different harvest periods (June, July and August) were analyzed. According to the results, the highest physical and pomological characteristics of fruit diameter, fruit weight, TSS, and acidity values were obtained in August. The highest average pH value was obtained in July and the highest fruit stiffness value was obtained in September. Determination of the correlation between the physical and pomological values obtained from this study and inspected factors will make a significant contribution into future studies.

Table 4. Effects of strawberry cultivars and fertilizer applications on fruits' extarnal color L, a, b, C and Hue values by months.

	Fruit Skin Color														
Cultivars*	**L Values Months***			**a Values Months***			**b Values Months***			**C Values Months***			**Hue Values Months***		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	31.60 a	30.32	29.44	62.19 c	62.19 b	60.45 c	37.09 a	36.91 a	37.15 a	72.12 b	71.81 b	71.79	31.02 c	30.52 a	30.62 a
2	30.39 ab	29.24	28.63	63.76 b	63.55 a	63.49 a	35.75 b	35.26 b	34.87 b	72.97 ab	73.27 a	71.98	29.34 b	29.10 bc	28.01 b
3	31.06 a	30.69	29.60	65.33 a	64.06 a	63.19 ab	33.78 c	34.71 b	35.12 b	73.36 a	72.73 ab	72.40	27.62 c	28.19 c	27.91 b
4	31.10 a	31.68	30.53	62.85 bc	63.76 a	62.08 b	36.23 ab	35.60 b	37.26 a	72.75 ab	72.63 ab	72.71	29.83 b	29.17 b	30.81 a
5	28.13 b	29.16	28.41	63.08 bc	62.12 b	62.62 ab	36.42 ab	37.47 a	36.33 a	72.73 ab	72.14 ab	72.87	30.04 b	31.01 a	30.32 a
Fertilizers**															
1	30.91	30.37	30.42 a	63.81	62.89	62.65	35.56	36.42 a	36.17	72.44	72.46	72.58	29.30	29.78 ab	29.01
2	30.17	30.46	28.33 ab	63.52	63.50	63.06	35.84	35.80 ab	35.71	72.35	72.30	72.87	29.58	29.62 ab	29.12
3	30.77	29.98	30.08 a	63.40	63.05	62.29	36.11	36.18 ab	36.42	73.13	73.01	71.77	29.72	30.00 a	29.90
4	29.66	31.20	30.31 a	62.92	62.75	61.90	36.00	36.16 ab	36.04	72.85	72.47	72.47	29.75	29.71 ab	29.60
5	30.77	29.07	27.48 b	63.56	63.50	61.93	35.77	35.39 b	36.40	73.15	72.33	72.06	29.50	28.88 b	30.03
Mean	30.46 a	30.22 ab	29.32 b	63.44 a	63.14 a	62.37 b	35.86	35.99	36.15	72.79	72.52	72.35	29.57	29.60	29.53

*1: July, 2:August, 3:September. **1:Monterey, 2:Albion, 3:Aromas, 4:Camarosa, 5: Sweet Charlie. ***1:Ekoflora, 2:Mog, 3:Bio-One, 4:Ferbanat L, 5:Natural Bioplasma

ACKNOWLEDGMENT

This study was supported by Çukurova University Scientific Research Project Intuitional Unit (Project no: ZF2011D17). I would like to thank Assoc. Prof. Dr. Nilda ERSOY and Assoc. Prof. Dr. Şahlan ÖZTÜRK. This article is a part of doctoral dissertation by Sevinç ATEŞ..

REFERENCES

[1] N. Adak, H. Gübbük and M. Pekmezci (2003). Investigations on the growing possibilities of some strawberry cultivars grown under protected cultivation in Antalya conditions. In: 'IV. Turkey National Horticultural Plant Congress'. Publisher Hasad Press, Turkey. P 313-315.

[2] A. Atasay and N. Türemiş (2008). An investigation on the application of organic strawberry production in Egirdir (Isparta) conditions. Çukurova Univ. Inst. of Nat. and App. Sci. J., 18(3), 72-81. http://orgprints.org/19122

[3] R. Cabilovski, M. Manojlovic, D. Bogdanovic, N. Magazin, Z. Keserovic and B.K. Sitaula. (2014). Mulch type and application of manure and composts in strawberry (Fragaria×ananassa Duch.) production: impact on soil fertility and yield. Zemdirbyste-Agriculture, 101(1): 67-74.

[4] Ç. Çekiç and H.D. Aksu (2012). The performance of some strawberry cultivars in Niksar ecology (Valley of Kelkit) In: IV. National Berry Fruit Symposium. Publisher Akdeniz University, Turkey. P 340-341.

[5] M.A. El-Shal, S.M. El-Araby, I.M. Ghoneim and H. Anter (2003). Effects of biofertilization under varying npk levels on growth, yield and fruit quality of strawberry plants. J. Agric. & Env. Sci. Alex. Univ., Egypt. 2(2): 106-129.

[6] B. Erenoğlu, E. Yalçınkaya, S. Soyergin, E. Uysal, G. Beşirli, C. Hantaş and M. Öztürk (2010). Using of the some plant nutrition applications at the organic fruit growing in The Marmara Region (strawberry) Results of Organic Farming Reviews 2005-2010. Republic of Turkey Ministry Of Food, Agriculture and Livestock. Ankara. Turkey.

[7] FAOSTAT (2015). (Food and Agriculture Organization of the United Nations Cropping database) FAOSTAT Database. Production of Strawberry 2013. Agricultural Statistic. In: http://faostat3.fao.org/download/Q/QC/E. [accessed: 2016-15-03].

[8] M.K. Geçer and H. Yılmaz (2011). Determination of fruit yield characteristics of strawberry runner plants produced in van ecological conditions. Iğdır Univ. Inst. of Nat. and App. Sci. J. 1(2): 15-22

[9] A. Gunes, M. Turan, N. Kitir, M.S. Tufenkci, K.M. Cimrin, E. Yildirim and S. Ercisli (2016). Effects of Bio-Bor fertilizer applications on fruit yield, antioxidant enzyme activity and freeze injury of strawberry. Erwerbs-Obstbau, 1-8.

[10] F. Gülbağ (2010). Determination of the effects of different organic preparates on the yield, fruit quality and plant growth in some strawberry cultivars (Camarossa and Elsanta). Master Thesis, University of Sutcu Imam, K.Maras.

[11] K. Gündüz and E. Özdemir (2008). The effect of some strawberry cultivars cultivated in field and high tunnel in Amik Plain conditions to yield, quality and earliness. MKU Journal of Agricultural Faculty. 13(1-2): 35-42

[12] A.A. Kader (1991). Quality and its maintenance in relation to the postharvest physiology of strawberry. Timber press, Portland, pp.152.

[13] N. Kaleci and S. Günay (2006). Determining phenological, pomological and yield characteristics of some strawberry cultivars grown in Çanakkale ecological conditions. Bahçe. 35 (1-2): 47-54.

[14] H. Karlıdağ, M. Pehluvan and S. Bilen (2006). Yapraktan humik asit uygulamasının organik çilek yetiştiriciliğinde verim, meyve kalitesi ve yaprak besin elementi kapsamı üzerine etkisi. In: Turkey III. Organic Agriculture Symposium. Publisher Atatürk Horticultural Central Research Institute, Turkey. P 489-496.

[15] N. Kaşka, E. Özdemir, S. Paydaş and İ. Doran (1988). Çileklerde yavaş çözünen ve kimyasal gübrelerin Eskibe kumlarında verim, kalite ve erkencilik üzerine etkileri. Bahçe. 17(1-2): 77-91.

[16] N. Kaşka, A.I. Yıldız, S. Paydaş, M. Biçici, N. Türemiş and A. Küden (1986). Türkiye için yeni bazı çilek çeşitlerinin adana'da yaz ve kış dikim sistemleriyle örtü altında yetiştiriciliğinin verim, kalite ve erkencilik üzerine etkileri. Doğa Bilim Dergisi. 10(1): 84-102.

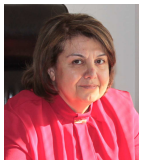
[17] K. Kepenek, M.A. Koyuncu and F. Koyuncu (2002). Adaptation of some strawberry varieties to isparta ecological conditions. Bahçe. 31(1-2): 17-22.
[18] İ. Macit, A. Koç and M. Akbulut (2006). Determination of yield and quality of strawberry cultivars in samsun coastal condition. In: II National Berry Fruit Symposium. Publisher Nobel Academic Press, Turkey. P 70-74
[19] Ç. Nacar (2012). Strawberry Plantion. General Directorate of Agricultural Research and Policies, Alata Horticultural Research Institute. Mersin. Turkey.
[20] E. Özdemir, K. Gündüz and S. Bayazit (2001). Determination of yield, quality and precocity of some strawberry cultivars grown under high tunnel by using fresh runners rooted in pots in Amik plain. Bahçe. 30(1): 65-70
[21] A.I. Özgüven and C. Yılmaz (2009). Pomological and morphological traits of some strawberry cultivars under Adana ecological conditions. Alatarım, 8(2): 17-21.
[22] G. Özkan (2012). An investigation on organic strawberry growing facilities in Erzurum conditions. Ph.D. dissertation, University of Ataturk, Erzurum.
[23] Y. Özkan (1999). Bazı çilek çeşitlerinin Tokat ekolojik koşullarındaki verim ve kalite kriterleri üzerinde araştırmalar. In: III. Turkish National Horticultural Plant Congress. Publisher Ankara University, Turkey. P 787-791.
[24] M. Pešakovıć, Ž. Karaklajıć-Stajıć, S. Mılenkovıć and O. Mıtrovıć (2013). Biofertilizer affecting yield related characteristics of strawberry (Fragaria×ananassa Duch.) and soil micro-organisms. Scientia Hortic. 150: 238-243.
[25] N. Pilanalı and M. Kaplan (2001). Determination of relationship between some plant nutrient contents of soil and humic acid applied different forms with fruit colour of strawberry. YYÜ, ZFD, J. Agric. Sci. 12(1), 1-5.
[26] Polat M. 2005. Researches on possibilities of organic strawberry growing in Ankara (Ayaş). Ph.D. dissertation, University of Ankara, Ankara.
[27] M.M. Rahman, M.M. Rahman, M.M. Hossain, Q.A. Khaliq and M. Moniruzzaman (2014). Effect of planting time and genotypes growth, yield and quality of strawberry (Fragaria×ananassa Duch.). Scientia Hortic. 167: 56-62.
[28] T.P. Salame-Donoso, B.M. Santos, C.K. Chandler and S.A. Sargent (2010). Effect of high tunnels on the growth, yields, and soluble solids of strawberry cultivars in Florida. Int. J. Fruit Sci. 10(3): 249-263.
[29] S. Serçe, K. Gündüz, E. Özdemir, Y. Kıyga, E. Orhan and S. Ercişli (2008). Relationships among the firmness measurements of strawberries (Fragaria×Ananassa Duch.) Grown On Different Systems. Bahçe. 37(1): 9-16.
[30] J.M. Tomic, J.M. Milivojevic and M.I. Pesakovic (2015). The response to bacterial inoculation is cultivar-related in strawberries. Turkish J. of Agric. and Forestry. 39(2): 332-341.
[31] TÜİK (Turkish Statistical Institute), Main Statics, Organic Crop Production, 2013. In: http://www.turkstat.gov.tr/UstMenu.do?metod=temelist (20.03.2016).
[32] P. Üstün and S. Paydas (1995). Bazı melez çilek çeşit adaylarının verim ve meyve kalitesi üzerinde araştırmalar. In: II. Turkish National Horticultural Plant Congress. Publisher Cukurova University. P 301-305.
[33] S. Wang, G.J. Galetta and M.J. Camp (1998). Mulch types affect fruit quality and composition of two strawberry genotypes. Hort Science. 33(4): 636-640.
[34] A.B. Wold and N. Opstad (2007). Fruit quality in strawberry (Fragariaxananassa Duch. cv. Korona) at three times during the season and with two fertilizer strategies. J. of App. Bot. and Food Quality. 81: 36-40.
[35] C.P. Zaldivar, S.E. Ebeler and A.A. Kader (2005). Cultivar and harvest date effects on flavor and other quality attributes of California strawberries. J. of Food Quality. 28: 78-97.

AUTHORS' PROFILES

First A. Author

Sevinc SENER. She is a Assistant Prof, Organic Agriculture Programme, Vocational School of Technical Science at Akdeniz University. She completed her PhD degree from department of Horticulture in Çukurova University. She researches on Organic agriculture and berries.
She is correspondence author of this manuscript.
Her email: svncsener@gmail.com

Second B. Author



Nurgul F. TUREMIS. She is a Professor at Department of Horticulture, Faculty of Agriculture, Çukurova University.
Currently she is teaching and conducting researches on organic farming, berries and fruits.
Email:nturemis@gmail.com