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: **13** **Sayı** / Number: **1** **Yıl** / Year: **2016

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 00

ISSN: 1302–7050

Tekirdag Ziraat Fakültesi Dergisi / Journal of Tekirdag Agricultural Faculty 2016 13(1)

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

An Evaluation on Strawberry Production in Terms of Plant Nutrition and Farmer Applications: Evidences from Gediz River Basin, Turkey

S. Erdoğan Bayram[1,*] Ö. L. Elmacı[2] B. Miran[3]

[1] Central Laboratory , Faculty of Agriculture Ege University, 35100-Bornova, İzmir, Turkey

[2] Department of Soil Science and Plant Nutrition, Faculty of Agriculture Ege University, Bornova, İzmir, Turkey

[3] Department of Agricultural Economics, Faculty of Agriculture Ege University, Bornova, İzmir, Turkey

[*] Corresponding author: E-mail: seda.erdogan@ege.edu.tr

Emiralem located in the Gediz River basin which is having a significant agricultural potential is a county familiar with strawberry production. The fact that production style in the basis of yield associated with careless fertilizer use gave rise to soil, water and air pollution has become a threat to the environment. This study aims at describing the current circumstances on probable jeopardies toward human health and environmental pollution and examines the producer behaviors in order to increase the production potential of the region. For this purpose a survey of 67 producers covering 150 structured questions was carried out in the area. The data was analyzed via some descriptive statistical analysis techniques and particularly Analytical Hierarchy Process (AHP). The analysis depicted that the producers were seeking both quality and quantity during the strawberry production. It is also deduced that the farmers should be trained for sensitive production applications to environment via extension services.

Key words: Strawberry, fertilization practices, producer behaviours, producer pool

Bitki Besleme ve Çiftçi Uygulamaları Açısından Çilek Üretimi Üzerine Bir Değerlendirme: Gediz Havzası Örneği, Türkiye

Gediz Havzası'nda yer alan Emiralem beldesi, Türkiye çilek üretimi açısından yüksek tarımsal potansiyele sahip bir beldedir. Verim odaklı üretime yönelik yapılan bilinçsiz gübreleme uygulamaları nedeniyle meydana gelen toprak, su ve hava kirliliği çevre için bir tehdit oluşturmaktadır. Bu çalışma insan sağlığı ve çevre kirlenmesi hakkındaki olası tehditler ile ilgili mevcut durumu tanımlamayı ve bölgenin üretim potansiyelini artırmak için üretici davranışlarını incelemeyi amaçlamaktadır. Bu amaçla 150 yapılandırılmış soru içeren bir anket bölgedeki 67 üreticiye uygulanmıştır. Veriler Analitik Hiyerarşi Prosesi (AHP) gibi bazı tanımlayıcı istatistiksel analiz teknikleri ile analiz edilmiştir. Analiz sonuçları üreticilerin çilek üretiminde hem miktar hem de kalite arayışında olduklarını göstermiştir. Ayrıca üreticilere çevre konusunda hassas üretim uygulamaları eğitiminin verilmesi gerektiği de vurgulanmıştır.

Anahtar kelimeler: Çilek, gübreleme uygulamaları, üretici davranışları, üretici havuzu

Introduction

Strawberries (*Fragaria* sp.) have an important place among vine fruits and can be grown in many places in the world. The strawberry plant is a perennial herbaceous plant which lives for many years. With its delicious taste and its high vitamin and mineral contents, it forms part of the diet of millions of people around the world. Ripening in the spring when no other fruits are available, it has the attractiveness and high vitamin C content which customers seek, and thus can maintain a high market value until other fruits come into season. With these characteristics, strawberries are very popular in countries with a high level of health and nutrition awareness such as the USA, Canada, Europe and Japan, and can command high prices, giving them high economic value on the world market. Strawberries crop reliably each year and are easy to grow, making them an important supplementary crop for farmers and an ideal crop for small family producers.

Along with these characteristics, strawberries can be grown in different climatic and soil conditions

and on marginal hillside land, giving strawberry production a potential of increasing importance in Turkey. The USA is the most important strawberry producing country, with about 29.2% of world production. According to FAO data, Turkey was third in the World strawberry production (FAO, 2015), and demand for strawberry production has been steadily increasing. According to TUİK data, 42.000 tonnes of strawberries were produced on 46.000 da of land, while by 2012 this had increased eightfold to 376.070 tonnes on 127.928 da (TUİK, 2015).

In this production, the 140 hectare production area with a production potential of 4.821 tonnes in the town of Emiralem, in the district of Menemen in Izmir Province and situated in the Gediz River basin, is of vital importance for the Aegean Region as it supplies 10% of Turkey's total agricultural output, and is an important centre of strawberry production (Anon., 2013). The ecological advantages of strawberry production have been developed over many years in this area, and recently drip irrigation/fertilizer application, production in covered areas, soilless cultivation, and other new agricultural techniques have started to be used. Strawberries are generally produced in the open in today's conditions, and varieties which have a high yield in Mediterranean conditions are rapidly being developed in this region, as well as drip irrigation and fertilizer application techniques. However, wrong practices, particularly uninformed use of fertilizers, is causing pollution of the ground and surface water and the atmosphere, and is leading to a decrease in crop yield and quality. The Gediz Basin is very wide and the people there are farmers, raising the importance of the river in the area. Recently, one of the most important reasons for the fall in productivity of the land which is farmed using water from the Gediz River has been shown to be water pollution (Öner and Çelik, 2011). It has been stated that this river is under the threat of pollution from industrial activity in the area, from domestic waste, from agricultural chemicals and from commercial fertilizers (Üstün, 2011).

Strawberries are classed as a vine fruit but are more like a vegetable in terms of production, and like other vegetables need a higher level of fertilizer application than plants in other categories because of their higher nutritional content. For this reason, fertilizer application has a special importance in vegetable/fruit production. However, a fertilizer application program applied in an uninformed way creates many problems. Plant nutritional material taken up from the soil along with the crop or extracted in one way or another may cause shortages which affect crop quality and yield. Inadequately replenishing nutrients which are removed from the soil by the crop or in other ways, or applying them haphazardly, has a negative effect on yield and quality. In addition, fertilizers used in an uncontrolled way find their way into surface flow from irrigation and rainfall as soil pollution and mix with water sources, contributing to pollution of groundwater, surface water and thereby of the atmosphere (Anon., 2008). Intensive application of fertilizers causes many problems in the soil, the principal one of which is salinity. In this way, uptake by plants of water and thus of nutrients is hindered.

The rapidly increasing world population and numbers of well-informed consumers necessitates a more efficient use of available nutritional resources, and in this way crop yield and quality both gain in importance. However, in this process of developing environmentally friendly technologies and production methods for a sustainable life, more environmentally sensitive production and consumption choices must be made. In agricultural production, one of the most important inputs is fertilizer. Success in agricultural production is attained by the correct use of cultivation techniques and fertilizer application, improving the crop yield per unit of land, along with the quantity and quality of the crop. As is known; many errors were encountered in production conditions and fertilizer application practices that had been used for many years by the producers. As a result, it was concluded that this region, which is eminently suitable for strawberry production, did not reach its true potential because of production errors, and that with correct assessment and management, production could be raised to higher levels.

The aim of this study was to show the widespread trends in production and fertilizer use by strawberry growers in the town of Emiralem in Izmir Province using the AHP, which is a method which efficiently solves multi-decision problems, and thus to determine the mistakes being made in

this regard, and to direct growers to correct practices. Taking into account the potential of the region, we aimed to determine the current situation in strawberry production and fertilizer application and growing under production conditions by economic analyses of the current situation.

On this basis, proposals were made with regard to improving the yield and quality of strawberries, with their increasing value on the local and world markets and their potential for the Emiralem area and the country in general, by spotlighting technical and economic errors in growing and fertilizer application. In the light of these proposals, the measure of success of this research will be an increase of amount and quality per unit of land in an economic way, as well as a contribution to the national and global economy, and preservation of the natural cycle by guiding producers in correct fertilizer use and growing methods, and preventing environmental problems which could occur from the uninformed use of water and fertilizer.

Method

Data collection

The base material for the study consisted of data obtained by means of a questionnaire in 2012 in order to determine the habits and techniques with regard to the growing and fertilizer application of strawberry producers selected so as to be representative of the area of Emiralem in the district of Menemen in Izmir province in Turkey (Figure 1). The number of producers chosen to represent the area was determined by the following formula (Miran, 2002).

$$n = \frac{Np(1-p)}{(N-1)\sigma^2_{\hat{p}_x} + p(1-p)}$$

N = 150

n = 67

p: potential (taken as 0.50)

σ^2 : standard error

The study was carried out between October 2011 and January 2012 in six villages chosen to represent the area, and a total of 67 questionnaires were given to the producers. The main population of the research consisted of the total number of all strawberry farmers in the district of Emiralem. Distribution of the sampling by villages was determined on a percentage basis from producers who were registered on the FRS (Farmer Registration System) system of Menemen District Agriculture Directorate. Distribution of samples by village is shown in Table 1. The 67 producers who formed the basic data source were chosen by the random sampling method. The questionnaire forms were filled in by face-to-face interviews.

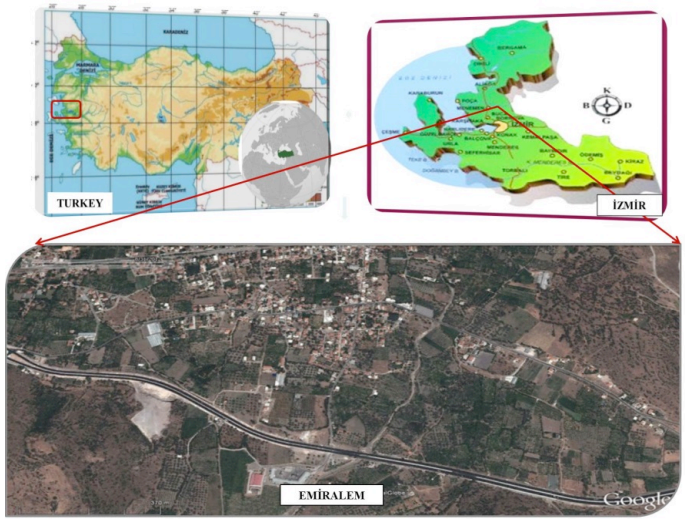

Figure 1. Location of research area in Turkey

Table 1. Sampling distribution of villages

Village	No of questionnaires	%
Alaniçi	3	4.48
Bozalan	21	31.34
Göktepe	9	13.43
Görece	15	22.39
İğnedere	9	13.43
Süleymanlı	10	14.93
TOTAL	67	100

They contained questions on personal information, soil preparation, fertilizer application practices and marketing preferences, and obtained information on yield, quality and management relating to growing, fertilizer application and marketing.

Field work was carried out by a team of researchers who had undergone a process of training relating to questions encountered on fertilizer application during a survey on strawberry growing in the region.

Data obtained from the producers was evaluated under main headings taking into account the percentage levels of producers.

Various demographic characteristics of the producers who took part in the survey are given in Table 2. This shows that 70.1% of producers were educated to primary school level and 17.9% to middle school level, while 9% had attended high school and 3% university.

Table 2. Some demographic characteristic of producers

Educational level	n*	%
Illiterate	-	-
Primary school	47	70.1
Middle school	12	17.9
High school	6	9
University	2	3
TOTAL	67	100

n*: number of producers who responded

Table 3 shows that various characteristics of the respondents with regard to their businesses: parameters of experience in growing strawberries, average annual income from agriculture and average annual income from strawberry growing alone. The average length of time spent growing strawberries for growers in the region was 16.96 years; 23.9% had spent 16-20 years growing strawberries, and 19.4% 6-10 years. Producers with 1-5 years, 11-15 years and over 25 years of experience were found to constitute 13.5% of each group.

It was found that the average annual income of producers from agriculture varied from a maximum of 200.000TL to a minimum of 6.000TL, with an average of 60.430 TL. The highest proportion in this distribution was 31.3% between 51.000 and 100.000 TL. 26.9% with an income distribution of 36.000 to 50.000TL followed this. Annual income derived from strawberry production varied on a scale from 5.000 to 100.000TL, and the highest distribution was 37.4% at an income level of 11.000 to 20.000TL. The lowest proportion on the distribution was 4.5% at an income level of 81.000 to 100.000TL.

Method used in data collection analytic hierarchy process analysis

In the study AHP was used to take the number of priority numbers of the criteria and options which are the parts of AHP regarding strawbery production. The AHP, which was developed by Saaty (1980), is one of the most commonly applied multi-criteria decisions making techniques. The AHP is a decision-support tool to cope with complex multi-criteria problems. The method helps to structure and analyze decision problems by breaking down the complex problem in a hierarchic order and by employing pair-wise comparisons of its elements to determine the preferences among the set of alternatives. The first stage of AHP is problem structuring. The AHP decision problem is structured hierarchically at different levels, each level consisting of a finite number of decision elements. A basic hierarchical model consists of a goal, criteria and alternatives. The top level of the hierarchy represents the overall goal, while the lowest level is composed of criteria and all possible alternatives**.** The second stage is assessment of local priorities. The relative importance of the decision elements is assessed indirectly from comparison judgments during the second step of the decision process. The third stage is calculation of global priorities. The last step of the AHP aggregates all local priorities from the decision table by a simple weighted sum.

Research Findings

Findings on soil characteristics and preparation

The soil texture in the production areas of participants was found to be 52.24% sandy, 8.96% loamy, and 5.97% sandy-loamy. Well-aerated light textured soil that was suitable for strawberry production was found at a proportion of about 67.17% of the area, which clearly shows the potential of the region. Clayey and stony soils were each found in proportions of 7.46% in the region (Table 4). It was established that 88.06% of producers in the area did not have soil analysis carried out before beginning production, 4.47% of them did, and 7.47% sometimes had this done. The trend for producers to have plant analysis carried out was in parallel with this but at a much lower level. Before the beginning of the growing season (before planting) or in the production period, the tendency not to have plant analysis performed was 98.5%, so that the tendency to have it performed was only 1.5% (Table 4). The basic reason why the full existing potential of the region is not exploited, or in other words why yield is poorer and quality is lower than that expected in the feedback from producers despite the advantageous ecological conditions, is that fertilizer is applied in traditional ways without soil or crop analysis.

Soil disinfection was not performed by 68.66% of producers in the area, and was performed by 19.4%. A proportion of 11.94% performed soil disinfection occasionally or irregularly. Soil washing was not performed by 92.5% of the producers in the area, but was performed by 7.5% (Table 4). According to this, the fact that most of the producers did not wash the soil for salinity was appropriate.

Table 3. Various characteristics of producers relating to their businesses

Business characteristic	n*	Average	Standard Deviation	Minimum	Maximum	No	%
Yrs of experience growing strawberries	67	16.96	9.33	1	40		
1-5						9	13.4
6-10						13	19.4
11-15						9	13.4
16-20						16	23.9
21-25						11	16.4
26-40						9	13.4
Average annual agricultural income (1.000 TL/yr)	67	60.34	41.05	6	200		
6-20						11	16.4
21-35						10	14.9
36-50						18	26.9
51-100						21	31.3
101-150						5	7.5
151-200						2	3.0
Average annual income from strawberries (1.000 TL/yr)	67	30,52	23,16	5	100		
5-10						9	13.4
11-20						25	37.4
21-40						19	28.4
41-80						11	16.5
81-100						3	4.5

n*: Number of responding producers

Table 4. Characteristics of local soils and production practices

Parameters	n*	No	%
Soil texture	67		
Sandy		35	52.24
Loamy		6	8.96
Clayey		5	7.46
Stony		5	7.46
Sandy - Loamy		4	5.97
Sandy-Stony		4	5.97
Other (mixed)		8	11.94
Soil analysis	67		
performed		3	4.47
not performed		59	88.06
sometimes		5	7.47
Crop analysis	67		
performed		1	1.5
not performed		66	98.5
sometimes		-	-
Soil disinfection	67		
performed		13	19.4
not performed		46	68.66
sometimes		8	11.94
Soil washing	67		
performed		5	7.5
not performed		62	92.5
sometimes		-	-

n*: No of producers not responding

Findings Relating to Application of Fertilizer

When considering the habits of the area's producers concerning fertilizer use, all producers who took part in the survey were found to use animal manure from sheep, goats, cows, chickens or pigeons before the beginning of production. It was found that 38.81% of the producers in the area used these manures mixed and at different times. The level of this widespread use was followed by 32.84% use of chicken and pigeon manure. Cow manure was used at a level of 17.91%, and the level of use of sheep and goat manure was 5.97% (Table 5).

It was found that 97.01% of producers taking part in the survey were not accustomed to using organic fertilizer which was not of animal origin. The amounts of chemical fertilizer used over the season in the production of strawberries in the region varied over a wide range from 15 to 6.250 kg (Table 6). This wide variation confirms the idea that producers in the area apply fertilizers entirely according to habit and tradition, without carrying out regular soil or crop analysis. One problem with the area's soils is a high lime content, and in soils with a pH of up to 8.5, Ca^{++} ions become dominant. The rising concentration of Ca^{++} ions in the soil changes micro elements such as available phosphorus and iron into the form of insoluble compounds, and prevents their uptake by plants. Yellowing known as chlorosis occurs in the leaves of strawberries in relation to a shortage of these elements (Ağaoğlu 1986, Özden and Ayanoğlu 2002, Çakıcı and Aydın 2005). Under these conditions, fertilizer application through the leaves gains in importance. It was found that 98.5% of the area's producers who took part in the survey were accustomed to applying leaf fertilizer (Table 5). The number of applications of leaf fertilizer in a season was found to be between 1 and 15, with an average of 5.20 times (Table 6).

Table 5. Tendencies in fertilizer use by producers and amounts applied

	n*	No	%
Use of farmyard manure	67		
Sheep and goat		4	5.97
Cattle		12	17.91
Chickens and pigeons		22	32.84
Mixed		26	38.81
Not used		3	4.48
Use of artificial fertilizer (kg/season)	67		
15 – 250		14	20.89
251 – 1.000		37	55.22
1001 – 2.500		11	16.72
2501 – 6.250		5	7.46
Use of organic fertilizer other than animal manure	67		
Yes		2	2.99
No		65	97.01
Use of leaf fertilizer			
Used		66	98.5
Not used		1	1.5
Amount of leaf fertilizer applied (times/season)	67		
1 – 5		43	65.16
6 – 10		20	30.30
11 – 15		3	4.54

Table 6. Fertilizer applications by producers in strawberry production and amounts used

	n*	Average	Standard deviation	Minimum	Maximum
Total fertilizer use (kg/season)	67	650	1.11	15	6.250
Number of leaf fertilizer applications (times/season)	66	5.197	2.66	1	15

n*: Number of producers not responding

Evaluation according to criteria expected before applying fertilizer

Considering the expectations of strawberry producers in the area before applying fertilizer and the priorities of these expectations, it was found that the yield and quality parameter expectations were equal (Table 7, Figure 2).

In the same evaluation, the culture operations affecting crop yield and quality of soil preparation, soil analysis, crop analysis, soil disinfection, soil washing and fertilizer application were considered. It was established that the effect of these parameters on yield and quality was about equal (Table 8). The highest effect, applying fertilizer, was followed by soil preparation, soil analysis, soil disinfection, crop analysis and soil washing (Table 8, Figure 3).

Table 7. Statistical evaluation of the yield and quality preferences of the area's producers

Criteria	Mean	Maximum	Minimum	Median	St. Dev
Yield	0.510	0.900	0.125	0.500	0.214
Quality	0.490	0.875	0.100	0.500	0.214

	Q	p-value
Friedman	3.84146	0.807
	Alternatives are not different	

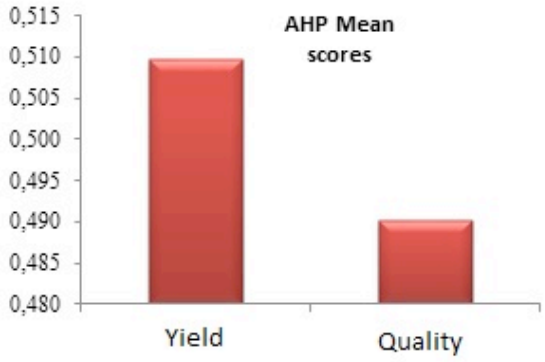

Figure 2. Importance levels according to strawberry yield and quality by producer

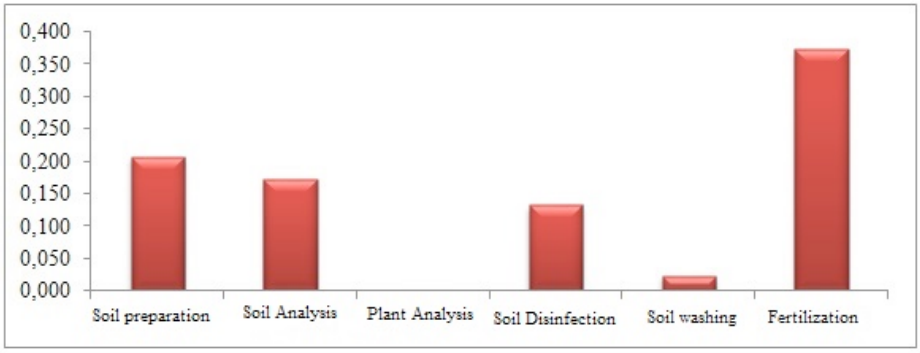

Figure 3. Producer's importance levels for various culture practices

Table 8. Importance accorded to various growing and fertilizer application parameters by producers

Parameter	Mean	Maximum	Minimum	Median	Standard Deviation
Fertilizer application	0.373	0.503	0.136	0.379	0.086
Soil preparation	0.207	0.361	0.063	0.203	0.064
Soil analysis	0.173	0.377	0.081	0.169	0.061
Soil disinfection	0.133	0.297	0.022	0.125	0.072
Soil washing	0.024	0.047	0.015	0.022	0.006
Crop analysis	0.000	0.000	0.000	0.000	0.000

	Q	p-value
Friedman	248.51	1.1E-51
	Alternatives differ by 0.01	

Table 9. Levels of effect on strawberry yield and quality of various culture practices by producers

Means of alternatives by criteria	Criteria	
Alternatives	*Yield*	*Quality*
Fertilizer application	0.340	0.409
Soil preparation	0.220	0.196
Soil analysis	0.186	0.153
Soil disinfection	0.145	0.123
Crop analysis	0.085	0.096
Soil washing	0.024	0.023

When the levels of importance given to the yield and quality of various culture procedures applied to the growing and nutrition of strawberries was considered from the point of view of the producers who participated in the survey, it was found that the factor most affecting both parameters was fertilizer application. This was followed by soil preparation, soil analysis, soil disinfection, crop analysis and soil washing (Table 9, Figure 3).

It was found that the most important factors affecting yield were soil preparation, soil analysis, soil disinfection and soil washing, those most affecting quality were crop analysis and fertilizer application (Table 9, Figure 4).

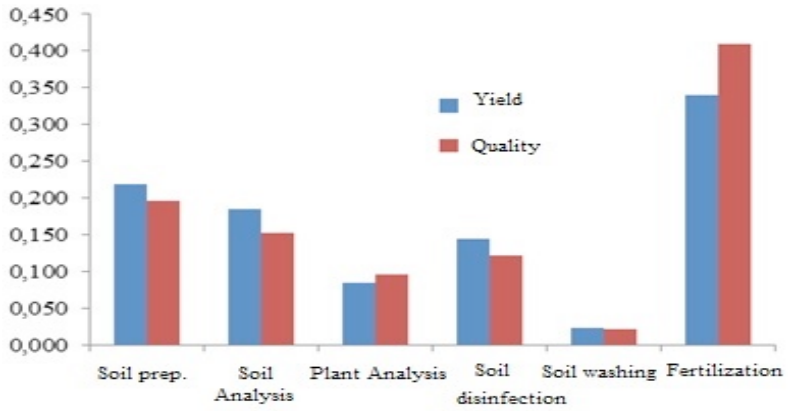

Figure 4. Levels of effect on strawberry yield and quality of various culture practices by producers

In yield and quality obtained, and the ranking of technical and culture practices, the placing of the parameters of soil preparation (application of fertilizer under the soil, application of organic fertilizer before planting, fallow, solarization, etc.), and soil and crop analysis in the front rank shows that the area's producers are guided by correct techniques to guidance to informed production.

Results and Recommendations

In this study, conducted in villages of Emiralem in the district of Menemen in the Gediz Basin, the evaluations carried out on production and nutrition techniques in strawberry production can be summarized as follows:

- Strawberry production, which has been carried out for over 40 years in the district, is performed mainly by producers with a primary school level of education using habits handed down through the generations.
- Animal manure is used intensively. There are no criteria regarding its origins or maturation.
- The use of chemical fertilizer varies from 15 to 6.250 kg/season. 55% of producers use it at normal levels for strawberry production (250-1.000 kg/season).

However, according to soil and crop analysis, economic production can be secured in the area by a fertilizer application program.

In strawberry production, priorities of expectations of yield and quality of the product are equal. Producers are aware of the importance of plant nutrition for crops. However, it is necessary to inform them as to how they can obtain optimum yield and quality of products by a fertilizer program based on soil and crop analysis. In this regard, it would be of benefit to inform producers by means of seminars, workshops and meetings with the support of cooperatives and private and government organizations in the area.

References

Ağaoğlu, Y.S. 1986. Berry Fruits, Ankara Univ. Faculty of Agriculture, Publication No: 984, (Üzümsü Meyveler, Ankara Üniv. Ziraat Fakültesi, Yayın No: 984) Ankara.

Anonymous, 2008. Governorship of İzmir, Provincial Environmental and Forest Directorate. Studies of Gediz Basin.

Anonymous, 2013. Turkish Statistical Institute, Crop Production Statistics Database, Republic of Turkey Ministry of Food, Agriculture and Livestock (Date accessed: 25.04.2013).

Çakıcı, H., Aydın, Ş. 2005. Nutritional Status of Strawberry Plantations in Emiralem- Ege Univ. Faculty of Agriculture - Electronic Journal, 42(1): 155-166.

FAO (2015) Statistical database. http://faostat.fao.org/site/339/default.aspx. Accessed 26 April, 2015.

Miran, B. 2002. Basic Statistics (Temel İstataistik). Ege Univ. Faculty of Agriculture, Bornova, İzmir, 106, p.

Öner, Ö., Çelik, A. 2011. Investigation of Some Pollution Parameters in Water and Sediment Samples Collected From the Lower Gediz River Basin, Ekoloji, 20(78): 48-52 .

Özden, A., Ayanoğlu, H. 2002. Nutritional Status of Strawberry Plantings Near Silifke in Turkey. Acta Hort. (ISHS) 567: 443-446.

Saaty, T.L. 1980. The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. McGraw-Hill, New York.

TUİK, 2015. tuik.gov.tr (Date accessed: 14.10.2015).

Üstün, G.E. 2011. The Assessment of Heavy Metal Contamination in the Waters of the Nilüfer Stream in Bursa. Ekoloji, 20(81): 61-66.