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Full Length Research Paper

Cost and Energy evaluation of sultana grape growing in Turkey

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Turkey, located on the most suitable place on earth for vinegrowing, has a remarkably old and essential vinegrowing history as well as being the centre of grape-vine gene. Turkey's share in grape production area and world production in 2007 were 7 and 6%, respectively. The purpose of this study is to analyse the use of energy in sultana grape production in Manisa, a significant production area in Turkey and to determine the variable costs and gross margin of sultana grapes production. For this purpose, 48 farmers were selected and their 2008 growing season records examined. Winegrowing (viticulture and enology) is a global industry, representing a significant demand on the world's resources, including fossil fuels. Nowadays, energy use in agricultural production in Turkey is becoming more intensive due to the use of energy-intensive inputs. The total energy input necessary for sultana grape production was 37,488.00 MJ/ha. The research results indicated that the total energy input used for grape production was mainly dependent on non-renewable energy forms. The values of gross product and total variable costs were US$ 6,039.00 and US$ 2,847.23, respectively. Therefore, gross margin was calculated to be US$ 3,191.77.

Key words: Viticulture, grape, input usage, energy consumption, cost analysis, Turkey.

INTRODUCTION

Grape is one of the oldest known fruit kind in the world. It can be grown on a large scale of geographical area all over the world. Grape-vine is a plant of hot-mild climate, which Turkey is located in, and can be grown with ease between latitudes 34°N 49°S. After the 50th latitude, grapevine can be grown in greenhouses and such environments. World grape production is most commonly carried out in mediterenean countries because of the weather and climatic conditions. Traditional growing of grapes has been going on for centuries in these areas (Uysal, 2007) . According to 2007 FAO statistics, grape production in the world was realized in 7.5 million ha area. The most important share in production area belongs to Spain (16%), then comes respectively, France (11%), Italy (10%), Turkey and China (7%), USA (5%), and Iran (4%). In the same year, the grape production in the world was 63.3 million tonnes. The most important grape-growing countries in turn are Italy (13%), France (10%), China, USA and Spain (9%), and Turkey (6%) (FAO, 2007).

Turkey, located on the most convenient region for grape growing is the gene center of grape-vine as well as having quite an old and long standing vineyard culture. Vineyard culture has a long history in Anatolia. With the archeological excavations carried out in the region, it was determined that vineyard culture dates back to 3,500 BC. With respect to the fact that vinegrowing is carried out between latitudes 10°N and 52°S and Turkey is located between 36°N and 42°S latitudes and also with regards to natural conditions, Turkey has the ideal potentiality for vinegrowing (Oroman, 1965). About 7,500 years ago, cultured grape-vine has always had an important place in agricultural composition. Moreover, it had significant contribution to the economical and social life of our society (Ergenoglu and Tangolar, 2000).

Vine growing is one of the most important branches of agriculture in Turkey. At present, people are engaged in vine growing at 2% of the total agriculture area and this amount covers 17% of the areas allowed for garden plant agriculturing. According to the 2007 statistics of the Turkish Statistical Institute, grape production makes up

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14.27 % of Turkey's total fruit production (TUIK, 2007). In Turkey, 44% of grape production and 23% of the grape-vine areas are met from the Aegean region (Altindisli, 2003). The value of the raisins exported to the world from Turkey especially from the Aegean region reached US$ 289 million in 2006 and the value of the grapes has risen to US$ 89 million (UNSD, 2006).

Agriculture, energy, and global warming are closely related issues. First, the agricultural sector is an important user of fosil energy and it may reduce energy consumption through energy efficiency improvement. Second, it is a producer of biomass and the need for energy in agriculture, increase in population, fertilizer, chemicals, irrigation and energy need for mechanization production has made it compulsory for handling of non-renewable energy sources. Nevertheless, deterioration of agricultural areas, soil erosion and contamination of fresh water sources have brought about interrogating energy-intensive agriculture systems in terms of sustainability (Pimentel et al., 1999). By expanding the production of biomass, the agricultural sector offers scope for offsetting greenhouse gas emissions of fosil fuels. Third, changes in land management may increase the carbon content of soil through carbon sequestration (Ierland and Lansink, 2003).

The need for energy consumption in agriculture for different purposes (yield) and determining their usage levels is important in terms of determining precautions to be taken in future. In fact, there are numerous studies on different products in different countries (Singh et al., 2002; Mandal et al., 2002; Gezer et al., 2003; Ozkan et al., 2004; Hatirli et al., 2005; Acaroglu and Aksoy, 2005; Goktolga et al., 2006; Hatirli et al., 2006; Ozkan et al., 2007; Erdal et al., 2007; Shahin et al., 2008; Smyth and Russell, 2009).

Nowadays, energy use in agricultural production in Turkey is becoming more energy intensive due to the use of energy-intensive inputs. Efficient use of energy resourc-es is vital in terms of increasing production, productivity and competitiveness of agriculture (Ozkan et al., 2007). For this aim, input–output analysis was usually used to evaluate energy efficiency and environmental impacts of production systems. A recent study has indicated that the input–output ratio for overall energy use in Turkish agriculture was estimated as 2.23 in 1975 and 1.18 in 2000 (Ozkan et al., 2004). The share ratio of agriculture in total energy consumption was 3.84% between 1990- 2001 (Ozturk and Barut, 2009).

Energy consumption per unit area in agriculture is directly related to the development of the technology in farming and the level of production. The inputs such as fuel, electricity, machinery, seed, fertilizer and chemical take significant share of the energy supplies in the production system of modern agriculture. The use of intensive inputs in agriculture and access to plentiful fossil energy has provided an increase in food production and standard of living. Efficient use of the energy resources is vital in terms of increasing production, productivity, competitiveness of agriculture as well as sustainability of rural living. Energy auditing is one of the most common approaches to examining energy efficiency and environmental impact of the production system (Hatirli et al, 2006). There are a lot of previous studies on energy usage in grape production (Ozkan et al., 2007; Abbona et al., 2007; Hassanzadeh, 2008; Smyth and Russell, 2009). But, there is need for new studies, especially at the local level and under farmer's conditions. There is also a need to do an economic study and cost analysis in such studies.

The purpose of this study is to analyse the use of energy in sultana grape production in Manisa, a significant production area in Turkey and determine the variable costs and gross margin of its production.

MATERIALS AND METHODS

This study was conducted in Manisa province of Turkey. Manisa is situated in the western part of Turkey between 38°04 N and 27°08 E. Manisa is an important province in grape production of Turkey and it's share in Turkey's total grape production is 35% (MARA, 2006). Ala ehir is the most important county related to grape production in Manisa; hence it was selected for this study. But there are a lot of production villages. Six villages (Yesilyurt, Killik, Sobran, Cakircaali, Caberfakili and Gumuscay) were choosen for this study from Alasehir county. In this study, farmers who record data in a registering system were selected for obtaining correct and reliable data. For this aim, 48 farmers were selected and their records examined. Furthermore, a survey was also carried out on these selected farmers to collect socio-economic data. All data were collected for the 2008 growing season.

The inputs used in agricultural production practices and output are converted to forms of energy to evaluate the output–input analysis. In order to estimate output and input energy, energy equivalents of inputs and output were converted into equivalent energy units (Yaldiz et al., 1993; Hatirli et al., 2006). The energy equivalents of inputs used in the crop production are given in Table 1. Energy equivalents of inputs and outputs for sultana grape production were obtained from previous studies. These energy equivalents were also used in previous studies (Helsel, 1992; Yaldiz et al., 1993; Sing, 2002; Singh et al., 2002; Ozkan et al.,2004; Acaroglu and Aksoy, 2005; Ozkan et al., 2007). Mechanical energy was estimated from the total fuel used in different farm operations for grape production. Energy consumed was calculated using a conversion factor (1 diesel ¼ 56.31 MJ) and expressed in MJ/ha. In order to calculate machinery energy, the following formula (Ozkan et al.,2004; Ozkan et al., 2007) was used:

$$ME = \frac{[EG]}{T} \qquad (1)$$

where ME is the machinery energy (MJ/h), E the constant that is taken as 62.7 MJ/kg for tractor, G the weight of tractor (kg), and T the economic life of tractor (h).

The input energy is also classified into direct and indirect and renewable and non-renewable forms. The indirect energy consists of pesticide and fertilizer while the direct energy includes human and animal power, diesel and electricity energy used in the production process. On the other hand, non-renewable energy includes petrol, diesel, electricity, chemicals, fertilizers, machinery and renewable energy consists of human and animal (Mandal et al.,

Table 1. Energy equivalents of different input and output values used in different farming systems.

Input		Energy equivalent (MJ/unit)	Reference
Human labour (h)		1.96	Sing et al. (2002).
Machinery (h)		13.06	Ozkan et al. (2004).
Chemicals (fertilizers [kg])	Nitrogen	60.60	Sing et al. (2002).
	Phosphorus	11.10	Sing et al. (2002).
	Potassium	6.70	Sing et al. (2002).
Chemicals (Pesticide [kg])	Insecticide	199.00	Helsel (1992).
	Fungicides	92.00	Helsel (1992).
	Herbicides	238.00	Helsel (1992)
Diesel-oil (l)		56.31	Sing et al. (2002).
Electricity (kwh)		10.59	Acaroglu and Aksoy (2005).
Water for irrigation (m^3)		0.63	Yaldiz et al. (1993).
Output (Grape-kg)		11.80	Sing (2002).

2002; Singh et al., 2003). In this study, output–input ratio, specific energy and energy productivity for sultana production were also calculated using the following equations in addition to exploring output–input energy and different forms of energy (Hatirli et al., 2006; Shahin et al., 2008; Bayramoglu and Gundogmus, 2009).

$$\text{Energy (output-input) ratio} = \frac{\text{Energy output (MJ/ha)}}{\text{Energy input (MJ/ha)}} \quad (2)$$

$$\text{Energy productivity} = \frac{\text{Sultana output (kg/ha)}}{\text{Energy input (MJ/ha)}} \quad (3)$$

$$\text{Specific energy} = \frac{\text{Energy input (MJ/ha)}}{\text{Sultana output (kg/ha)}} \quad (4)$$

In this study, variable costs of Sultana production was also determined. Variable costs included labour, machinary and material costs. These costs were payed by farmers as directly. For calculating of total gross production value of Sultana production, the sale price of Sultana recived by farmers was multiplicated with total Sultana amount. In the calculation of the gross margin of Sultana, total variable costs were subtracted from total gross production value.

RESULTS AND DISCUSSION

Grape production area and yield

Grape production area of farmers varied between 0.30 and 9.00 ha. Average production area was 2.60 ha. Yield varied from year to year in Manisa. Average fresh yield varied between 25 and 35 tons in different years. However, for this study, average fresh sultana was 27,450 kg/ha.

In a similar study done in Antalya, Turkey, yield of grapes was estimated to be 10,220 kg/ha (Ozkan et al., 2007). In Berrisso Region, Argentina, the yield was differed between 10,880 and 51,000 kg/ha (Abbona et al., 2007).

Energy use for sultana grape production

The inputs used for Sultana production and their energy equivalents, percentages in the total energy input and energy output-input ratio presented in Table 2. The results revealed that diesel used in Sultana production had a significant share with 33.04%. Chemical fertilizer energy used in Sultana production ranked in the second place with 24.20% in the total energy input. Chemical fertilizer was followed by electricity (21.86%), and machinery (10.52%), respectively. The consumption of chemical (pesticide), electricity and human labour was 5.04%, 3.02%, and 2.97%, respectively, of the total energy input used for Sultana production. The energy (output-input) ratio, energy productivity, and specific energy for Sultana production were calculated to be 8.29 MJ, 0.73 kg/MJ and 1365.68 MJ/t, respectively.

The total energy input necessary for Sultana production was 37,488.00 MJ/ha. Out of all 57.20% of the total energy, input use in Sultana production was in the form of direct energy. The remaining part of energy input use (42.80%) was in the form of indirect energy. The research results indicate that the total energy input used for Sultana production was mainly dependent on non-renewable energy forms (Table 3). As can be seen from the table, the non-renewable form of energy input was 97.03% in the total energy input.

In previous studies, different results were obtained for energy consumption depending on the grapes kinds. For the data obtained from some grape kinds grown in the field or in greenhouses in Antalya, Turkey, the total energy input necessary for greenhouse grape production was 24,513 MJ/ha. Out of all 60.76% of the total energy, input use in greenhouse grape production was in the form of direct energy. The remaining part of energy input use (37.57%) was in the form of indirect energy. For open-field grape production, a total of 23640.9 MJ/ha energy was consumed of which 61.97% was direct and 36.88% was in indirect energy form. The non-renewable form of

Table 2. Energy consumption and output for Sultana grape production.

Inputs		Quantity per unit area (ha)	Total energy equilavent (MJ)	%
	Land preparation	13.30	26.10	0.07
Human labour	Cultural practises	386.00	756.60	2.02
	Harvesting	168.80	330.80	0.88
	Total	568.10	1,113.50	2.97
	Land preparation	12.00	156.70	0.42
	Cultural practises	240.00	3,134.40	8.36
Machinery (ha)	Transportation	50.00	653.00	1.74
	Total	302.00	3,944.10	10.52
	Nitrogen	123.00	7,453.80	19.88
	Phosphorus	95.00	1,050.50	2.80
Chemical	Potassium	85.00	569.50	1.52
fertilizers (kg)	**Total**	303.00	9073.80	24.20
	Insecticide	6.00	1,194.00	3.18
	Fungicides	5.00	460.00	1.23
Chemicals	Herbicides	1.00	238.00	0.63
(Pesticide-kg)	**Total**	12.00	1,892.00	5.04
Diesel-oil (l)		220.00	12,388.20	33.04
Electricity (kwh)		750.00	7,942.50	21.86
Water for irrigation (m^3)		1,800.00	1,134.00	3.02
Total energy input (MJ)		-	37,488.00	100.00
Yield (kg)		27,450.00	323,910.00	-
Energy output-input ratio		-	8.64	-
Specific Energy (MJ/t)		-	1365.68	-
Energy productivity (kg/MJ)		-	0.73	-

Table 3. Total energy input in the form of direct, and direct renewable and non-renewable energy for Sultana grape production.

Sultana grape production		Total energy input (MJ/ha)	%
	Direct energy[a]	21,444.20	57.20
Energy forms (MJ/ha)	Indirect energy[b]	16,038.80	42.80
	Total	37,488.00	100.00
	Renewable energy[c]	1,113.50	2.97
	Non-renewable energy[d]	36,374.50	97.03
Energy forms (MJ/ha)	**Total**	37,488.00	100.00

[a]Includes human, animal, diesel, and electricity; [b]Includes fertilizers, manure, chemicals, and machinery; [c]Includes human, animal and manure; [d]Includes diesel, electricity, chemical, fertilizers, and machinery.

total energy in greenhouse grapes and open-field grapes were 81.30% and 93.16%, respectively (Ozkan et al., 2007). In a study carried out in Iran related with grapes, fertilizer rank first in energy usage (Hassanzadeh, 2008). In another study brought about in Berisso Region, Argentina, energy efficiency (energy-output- input ratio) was determined in vineyard system which was planted in a different way depending on the old and new system. Total energy use in old and new vineyard systems varied between 2,740.43 and 6,133.26 MJ/ha (Abbona et al., 2007).

Vineyard energy efficiency was similar in the two analyzed systems, ranging from 4 to 8.3, with no clear pattern of energy efficiency observed between old and new systems. Fuel was found to make up the largest portion of the energy input, ranging from 65 to 86% of total energy input. Approximately 80% of fuel was used to mow spontaneous vegetation. The portion of energy input made up of fungicides was higher than that for insecticides and herbicides. Compared to old systems, new ones applied more synthetic fungicides,which implies a higher energy cost than traditional fungicides such as Bordeaux mixture (Lime).

In a study carried out in Iran related with grapes, fer-.

Table 4. Variable costs and gross margin of sultana grape production (US$/ha).

Operations	Numbers and time of opertaion	Total costs (US$/ha)	% of costs
Plowing (labour and machine)	December - July (5 times)	270.76	9.51
Pruning (labour)	December - June (4 times)	289.28	10.16
Fertilization (labour and machine)	November - July (3 times)	78.75	2.77
Fertilizer (1,050 kg)		600.53	21.09
Pesticide application (labour and machine)	February - July (12 times)	217.99	7.66
Pesticides (12 kg)		241.65	8.49
Irrigation (labour) (labour and machine)	February - July (3 times)	96.64	3.39
Electricity (for irrigation) (750 kwh)		421.82	14.82
Gibberellic acid application (labour and machine)	May - July (3 times)	24.88	0.87
Gibberellic acid (10.15 kg)		158.88	5.58
Harvest (labour and machine)	July - September	330.05	11.59
Others		116.00	4.07
Total variable costs (A)		2,847.23	100.00
Average yield of sultana grape (kg/ha)		27,450.00	-
Average price of sultana grape (US$/kg)		0.22	-
Gross production value (B)		6,039.00	-
Gross margin (B-A)		3,191.77	-

tilizer rank first in energy usage energy value of used factors and input in grape gardens of Urmia and Sardasht were 6,417,773 and 862,570 kcal/ha, respectively Energy efficiency values (output/input ratio) were 3.99 and 11.7 respectively (Hassanzadeh, 2008).

The variable costs and gross margin of sultana grape production

The variable costs and gross production value of sultana grape production is given in Table 4. The results reveal that the variable cost of production per hectare for grape production is 2,847.23 US$/ha. The biggest share for variable costs are labour and machine (45.95 %), fertilizer (21.09 %), irrigation (14.82 %), and pesticide (8.49 %). However, these figures can change depending on the climatic conditions and variation in input prices each year.

Multiplying the sultana grape price received by the producer by grape production amount, the value of the gross production was figured out. The approximate price received by the producer is 0.22 US$/kg and approximate yield for hectare is 27,450 kg/ha. Therefore, gross production value from grape production is 6,039.00 US$/ha. Then by subtracting variable cost from gross production value, gross margin from grape production was calculated. Gross margin from grape production was determined to be 3,191.77 US$/ha.

Costs of grape production and gross production values were put forward with a number of preceding studies. For example, a study done in Antalya, Turkey, showed that the total cost for grape production was 3,368.60 US$/ha. Variable costs make up 41.82% of the total cost. In the same survey, gross production value from grape production was found out to be 7,460.60 US$/ha (Özkan et al., 2007). In another survey in Izmir and Manisa, Turkey, total cost for grape production was 879.30 US$/ha (Bayramoglu and Gundogmus, 2008).

Conclusion

In this study, energy use for sultana grape production and cost analysis have been carried out. When the issue is evaluated in terms of energy consumption amount, fuel oil ranks first with 12,388.20 MJ/ha value and 33.04 % within the total usage of 37,488.0 energy consumption amount. The reason for this is that the meaning of mechanical usage in agriculture is quite common and particularly in certain years; increase in pesticiding boosts the fuel use. Chemical fertilizer energy used in sultana grape production ranked second with 24.20% in the total energy input. Chemical fertilizer was followed by electricity (21.86%) and machinery (10.52%), respectively. The total energy input necessary for sultana grape production was 37488.00 MJ/ha. Out of 57.20% of total energy, input use in grape production was in the form of direct energy. The non-renewable form of energy input was 97.03% of total energy input. Further, gross production value, total variable costs and gross margin were determined to be US$ 6,039.00, US$ 2,847.23, and US$ 3,191,77, respectively. When evaluated by and large, gross margin of grape production in Manisa when compared with other crops is higher. It is particularly considered that Turkey which is first in rank in sultana grape production, where there is excess supply, should head for wine-making and table grapes in terms of using the country's resources more efficiently for the growers.

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REFERENCES

Acaroglu M, Aksoy AS (2005). The cultivation and energy balance of Miscanthus-giganteus production in Turkey. Biomass Bioenerg. 29: 42-48.

Abbona EA, Sarandon SJ, Marasas, ME, Astier M (2007). Ecological sustainability evaluation of traditional management in different vineyard systems in Berisso, Argentina. Agric. Ecosyst. Environ. 119: 335-345.

Altindisli A (2003). An overview on Turkish sultana production and recent developments. International Dried Grapes Production Countries Conference, 23-24 October , Izmir, Turkey.

Canakci M, Topakci, M, Akinci I, Ozmerci, A (2005). Energy use pattern of some field crops and vegetable production: Case study for Antalya Region, Turkey. Energy Conversion Manage. 46: 655-666.

Erdal G, Esengün K, Erdal H, Gündüz O (2007). Energy use and economical analysis of sugar beet production in Tokat province of Turkey. Energy. 32: 35-41.

Ergenoglu F, Tangolar S (2000). Practical Information for Vinegrowing (Turkish).The Scientific and Technological Research Council of Turkey, Publications of Project. Ankara. 33 p.

FAO (2007). Production statistics. http://faostat.fao.org/. (15 March 2009).

Gezer I, Acaroglu M, Haciseferogullari H (2003). Use of energy and labour in apricot agriculture in Turkey. Biomass Bioenergy. 24: 215-219.

Göktolga ZG, Gözener B, Karkacier O (2006), Energy use in peach production: case of Tokat province (Turkish), Gaziosmanpasa Univ. J. Agric. Fac. 23:39-44.

Bayramoglu Z, Gundogmus E (2008). Cost efficiency on organic farming: a comparison between organic and conventional raisin-producing households in Turkey. Spanish. J. Agric. Res. 6: 3-11.

Bayramoglu Z, Gundogmus E (2009) The effect of EurepGAP standards on energy input use: a comparative analysis between certified and uncertified greenhouse tomato producers in Turkey. Energy Conversion and Management. 50:52-56.

Hassanzadeh AG, Nemati NO, Faghenaby F, Talat F, Mojarrad M, Amirnia R, Salhzadeh H (2008). Evaluation and compared energy efficiency on grape in West Azerbaijan province. J. Biol. Sci. 3: 1090-1093.

Hatirli SA, Ozkan B, Fert C (2005). An econometric analysis of energy input–output in Turkish agriculture. Renewable. Sustain. Energy. Rev. 9: 608-623.

Hatirli SA, Ozkan B, Fert C (2006). Energy inputs and crop yield relationship in greenhouse tomato production. Renewable Energy. 31: 427-438.

Helsel ZR (1992). Energy in world agriculture. In: Energy and alternatives for fertilizer and pesticide use (Edit: RC Fluck). Vol. 6. Elsevier Science Publishing, pp: 177-210.

Ierland E, Lansink AQ (2003). Economics of sustainable energy in agriculture, Springer Publishers, Economy and Environment Series. Vol.24. Hardcover, 256 p.

Mandal KG, Saha KP, Ghosh PK, Hati KM, Bandyopadhyay KK (2002). Bioenergy and economic analysis of soybean based crop production systems in central India. Biomass Bioenergy. 23:337-45.

MARA (Turkish Ministry of Agriculture and Rural Affairs) (2006). The master of agriculture in Aegean region (Turkish). www.tarim.gov.tr. (10 March 2009).

Oroman MN (1965). New methods in vineyard (Turkish), Ankara University, Faculty of Agriculture. Publication Number: 253. Ankara.Turkey. 343 p.

Ozkan B, Akcaoz H, Fert C (2004). Energy input output analysis in Turkish agriculture. Renewable Energy. 29:39-51.

Ozkan B, Kuklu A, Akcaoz H (2007). Energy and cost analysis for greenhouse and open field grape production. Energy. 32:1500-1504.

Oztürk HH, Barut ZB (2009). Energy use in Turkish agriculture (Turkish). Cukurova University Faculty of Agriculture Department of Agricultural Machinery. Adana. 14 p.

Pimentel D, Pimentel M, Machan MK (1999). Energy use in agriculture: an overview. Agric. Eng. Int. CIGR E-J. 1: 1-32.

Shahin S, Jafari A, Mobli H, Rafiee S, Karimi M (2008). Effect of farm size on energy ratio for wheat production: a case study from Ardabil province of Iran, Am-Eurasian. J. Agric. Environ. Sci. 3: 604-608.

Singh JM (2002). On farm energy use pattern in different cropping systems in Haryana, India. Master of Science Thesis, International Institute of Management, University of Flensburg, Germany. 106 p.

Singh H, Mishra D, Nahar NM (2002). Energy use pattern in production agriculture of a typical village in Arid Zone India (Part I). Energy. Conversion. Manage. 43: 2275–2286.

Singh H, Mishra D, Nahar NM, Ranjan, M (2003). Energy use pattern in production agriculture of a typical village in Arid Zone India (Part II). Energy Conversion and Management. 44:1053–1067.

Smyth M, Russell J (2009). From graft to bottle-Analysis of energy use in viticulture and wine production and the potential for solar renewable Technologies. Renewable and Sustainable Energy Reviews (in Press). http://www.sciencedirect.com. (12 March 2009).

TUIK (Turkish Statistical Institute) (2007). Agricultural production statistics. www.tuik.gov.tr. (12 March 2009).

UNSD (United Nations Statistics Division) (2006). Agricultural statistics. http://comtrade.un.org/db/dqBasicQuery.aspx. (6 March 2009).

Uysal H (2007). A research on the improvement of possibilities for table grape production and marketing oriented to Agean region. PhD Thesis. Faculty of Agriculture Ege University, Izmir. 287 p.

Yaldiz O, Ozturk HH, Zeren Y, Bascetincelik A (1993). Energy use in field crops of Turkey (Turkish). V. International Congress of Agricultural Machinery and Energy. 12–14 October. Kusadası-Turkey.