INFRASTRUKTURA I EKOLOGIA TERENÓW WIEJSKICH
INFRASTRUCTURE AND ECOLOGY OF RURAL AREAS

Nr II/2/2017, POLSKA AKADEMIA NAUK, Oddział w Krakowie, s. 757–766
Komisja Technicznej Infrastruktury Wsi

DOI: http://dx.medra.org/10.14597/infraeco.2017.2.2.058

ECONOMIC ANALYSIS OF DIFFERENT APPLICATIONS OF COMPOSTS OBTAINED FROM SOLID WASTES OF ROSE OIL PROCESSING IN ORGANIC APPLE PRODUCTION

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Abstract

In this study, it was aimed to compare the economic aspect of different applications of composts obtained from solid wastes of rose oil processing (RC) applications in organic apple production. The data used in the study were obtained from the experiments carried out in Egirdir Fruit Research Institute of Food, Agriculture and Livestock Ministry, Turkey. The trial was carried out with a total of 6 applications consisting of 5 different nutritional applications (RC, ERC (50%) (half dosage of the enriched RC, ERC (100%) (full dosage of the enriched RC, AB (azotobacter), and ST (standard application: 50% commercial solid organic manure +50% commercial liquid manure)) and 1 control (no nutrients applications). According to the results of the research, it was determined that apple production in all treatments was higher than control application. The result showed that the highest yield was determined for ERC (100%). The production costs per decare of the organic production in all treatments were found to be higher than the control application. Production cost was 854.97 USD da^{-1} in control application, while it varied between 914.61 USD da^{-1} and 984.79 USD da^{-1} in all treatments. When a comparison was made in terms of net profit, it was determined that the most advantageous application was ERC (100%). The net profit per decare for the ERC (100%) application was determined as 214.35 USD. In the control application, net profit per decare was determined as 130.42 USD.

Key words: Compost, rose oil processing wastes, organic apple, cost, profitability.

INTODUCTION

Turkey has an ecology, due to its great variety in geomorphology, topography and climate, where many fruit species can be grown due to the advantages of the climate zone. The apple, which is a mild climate fruit, can be cultivated in many parts of Turkey (Aras, 2015). Turkey is one of the most important apple producers in the world. With 2.9 million tons of apple production, Turkey ranks third in the world after China and the USA (TUIK, 2016). Although Turkey is a country with a high potential for apple production, it is not enough for apple exports. Turkey exports about 4% of its production. The fact that exports are so low reveals that production cannot be adequately assessed. For this, the development of export-oriented production strategies will provide significant contributions to the sustainability of the sector (Aras, 2015). Apple, one of the most grown fruit species in Turkey, is encouraged to consume the fact that its benefits in terms of health and nutrition. Apple is also used in the production of many products such as dried apples, fruit juice, vinegar, marmalade, wine, essence, cosmetics (Özçatalbaş, 2009).

Organic agriculture is a form of controlled and certified agricultural production in every stage from production to consumption without using chemical inputs in production. The purpose of organic agriculture is to protect the environment, plants, animals and human health without polluting the air, the soil and water resources (Er and Başalma, 2008). Organic agriculture in Turkey began in an unscheduled manner due to the development of organic agriculture in the world in the period of 1985-1986, and the demand for organic products from abroad, developed in parallel with changes in the world regarding „The Organic Farming Law" and the consumption of healthy foods. In 2014, the number of organic farming producers, production area, the number of product varieties, and the annual production amount reached 71 472, 842 216 hectares (350 239 hectares natural collection area), 208, and 1 642 235 tons (GTHB, 2017a, GTHB, 2017b), respectively. Despite Turkey's growing exports of organic agricultural products, its share in the world's organic agriculture and food markets is very low. According to data from the year 2014, Turkey's exports of organic agricultural products are about 79 million dolars (GTHB, 2017a). Supply of organic agriculture and food products, especially in North America and European countries, can not meet the demand increase in these markets. As such, these markets potentially offer a good opportunity for developing countries, such as Turkey, where ecology and infrastructure, are suitable for organic agricultural production and export (Demiryürek, 2011).

The aim of this study is to compare economically different applications of composts obtained from solid wastes of rose oil processing (RC) in the production of organic apples. For this purpose, the inputs, costs and incomes used for organic apples production using different compost applications were determined for which application was more profitable. It is expected that this study will provide information to policy makers, producers of organic apples, and institutions that conduct agricultural publishing work in this regard.

MATERIALS AND METHODS

The study was carried out in Fruit Research Institute located in Eğirdir District of Isparta province. In the experiment, Granny Smith apples grafted on the M9 clone rootstock was used in at full efficiency. There were 250 trees in one decare. The average age of trees was 11 years. The characteristics of the plant nutrient materials used in the experiment are given in Table 1. Azadirachtin (Neem Azale) and Sulfur (Microthiol Disperss), which is chemicals for pesticide application, were used. The plant nutrients and chemicals for plant protection are in compliance with the Regulation on the Principles of Organic Agriculture and its Implementation (Anonymous, 2010). The experiment was carried out with a total of 6 applications consisting of 5 different nutritional applications and 1 control as specified in Table 2 in organic agriculture.

In economic analysis; production costs and indicators of profitability were calculated for apple production using five different applications and control in one decare. The data used in the study covered the sum of two years (2015 and 2016) and the production costs were calculated taking into account the physical and monetary amounts of inputs. Cost elements are grouped into the fixed and variable costs. The variable costs are the costs that depend on the production volume. It emerges as production takes place. Fixed costs do not depend on the amount of production. Such costs arise regardless of the production. Hereby study takes into account local leasing cost for calculation of machinery expenses used in operations such as ploughing, hoeing, fertilizer and pesticide application. Wages paid to workers in the region have been taken into account in the calculation of labor costs such as fertilization, pesticide application, irrigation, and hoeing. Market values were taken in the calculation of materials such as farmyard manure, drip irrigation material, irrigation water and agrochemicals. Interest rate was assumed to be half of the rate employed by Agricultural Bank of the Republic of Turkey for plant cultivation credits (10%). 3% of the total variable costs are considered as general administrative expenses. 5% of net land value was considered as land rent. The interest expense was calculated by taking 1.65% (real interest rate) of the value of irrigation machinery/equipment, which is among the fixed cost elements. As for annual amortization, the rates of 10% and 6.66% were employed for drip irrigation facility and motopump, respectively (MF, 2014). By means of this calculation, the cost of organic apple production, which were cultivated on area of one decare for two years, was determined per decare.

Table 1. Properties of plant nutrients used in the trial

	Solid organic manure – (Biofarm)	Solid organic manure (Ferbio)	Liquid manure--(Botanica)	Liquid manure (AKC)	Azotobacter (AB)	Enriched RC (solid)	RC (solid)	Solid Organic fertilizer (Karden)	Phosphate rock
pH	6.4-8.5	8.0	3.5-5.5	4.5-6.5	-	9.10	9.10	6-8	-
Organic matter (%)	50	85.8	50	35	-	72.03	72.03	5	-
Total nitrogen (%)	2	2.1	5	4	-	2.52	2.52	-	
Total P_2O_5 (%)	2	0.68	0.1	2	-	1.22	1.22	-	30-32
Water-soluble K_2O (%)	2	1.1	2.3	3	-	2.31	2.31	25	-
The number of Azotobacter sp (number/g)	-	-	-	-	$1x10^{10}$	$1x10^{10}$	-	-	-
$ZnSO_4$ (%)	-	-	-	-	-	0.2	-		-
$FeSO_4$ (%)	-	-	-	-	-	0.2	-	-	-

Table 2. Treatments in the trial

1. AB: Azotobacter application (the whole nitrogen requirement of the plant was planned to be met by a diluted mixture containing $1x10^{10}$/g of azobacter. The missing phosphor was met by phosphofat and the potassium was supplied by organic certified solid organic fertilizer – Karden.
2. ERC (%50): Half dosage of ERC. (It should be noted that RC was enriched with azotobacter, Cu and Fe to obtain ERC). (Half of the nitrogen requirement of the plant was targeted to meet from ERC. The missing phosphor was met by phosphofat and the potassium was supplied by organic certified solid organic fertilizer – Karden.
3. ERC (%100): Full dosage of ERC. (It should be noted that RC was enriched with azotobacter, Cu and Fe to obtain ERC). The requirement of the plant's nitrogen and other nutrients were targeted to meet from the ERC.

4. RC: RC application (The plant's nitrogen and other nutrients were targeted to meet the non-enriched RC	
5. ST: Standard application (50% Solid organic manure (the mixture of Biofarm and Ferbio)+50% Liquid manure (the mixture of Botanica and AKC). This was taken into account in the study because it was identified as the most advantageous application in the previous study (Demircan *et al.* 2016).	
6. Control: No nutrient application	

Gross Production Value (GPV) was found by the multiplication of amount of apple production by market price. Gross profit per decare was calculated by deduction of variable costs from gross production value, while net profit per decare was calculated though subtraction of cultivation costs from GPV.

RESULTS AND DISCUSSIONS

Organic apple yields for the years of 2015 and 2016 based on different treatments are given in Table 3. According to the average of two years, the yields of all treatments were determined to be higher than control applications. Results showed that the highest yield was determined for ERC (100%) application. Apple yields for ERC (100%) and control treatment were calculated as 2250 kg and 1965 kg per decare, respectively. It can be concluded that RC or ERC treatments was effective on yield.

Table 3. Apple yields based on different treatments with control in the years of 2015 and 2016

Treatments	Yield in 2015 (kg da^{-1})	Yield in 2016 (kg da^{-1})	Average
AB	1970	1968	1969
ERC (50%)	2010	2054	2032
ERC (100%)	2310	2196	2250
RC	2260	2088	2174
ST	2290	2185	2238
Control	1990	1939	1965

The classification of fruit according to classes is important for economic analysis since fruit sales prices differ according to class values. This difference affects profitability. The apple classification values according to different treatments are given in Table 4. In the study, apples were classified as extra (>75mm), I. Class (68-75mm), II. Class (60-68mm) and scrap (Karamürsel *et al.,* 2012). Based on the research results, the extra class apple ratio in all treatments in 2015 and 2016 were higher than control. When a comparison was made in terms of the ratio of the I. Class apples, it was determined that the control application had a higher rate in 2015 and 2016 than all treatments. It was estimated that the control application in terms of scrap apple ratio was generally slightly higher than other treatments.

Table 4. Classification of apple (diameter of apple (mm)) according to classes for different treatments with control in the years of 2015 and 2016

Treatments	Extra (>75 mm)		I. Class (68-75mm)		II. Class (60-68 mm)		Scrap	
	2015	2016	2015	2016	2015	2016	2015	2016
AB	53.94	48.72	29.05	26.43	9.50	10.83	7.51	14.03
ERC (50%)	44.65	52.10	36.95	24.99	12.67	6.87	5.73	16.04
ERC (100%)	56.66	53.88	28.40	21.09	9.45	7.69	5.49	17.35
RC	57.04	53.37	28.52	26.11	9.51	7.76	4.93	12.77
ST	56.78	55.86	25.15	19.99	13.85	6.54	4.22	17.62
Control	42.45	41.77	41.40	30.87	9.31	8.48	6.84	18.88

Production cost was calculated as 854.97 USD da^{-1} in the control application and 1094.91 UDS da^{-1} in the ST application. The production costs of RC, ER (50%), ER (50%) and AB treatments varied between 914.61 USD da^{-1} and 984.79 USD da^{-1}. It can be shown that the cost of plant nutrients used in organic applications was high as a result of lower apple production cost in control application than in other organic applications. The reason why the cost of apple production per decare in the control application was lower than the other treatments was the higher cost of nutrients supplied to the other treatments.

The profitability indicators of organic apple production in the study are given in Table 6. GPV was calculated based on multiplication apple yield per decare by the apple prices per kg. Apples were classified as extra, I. Class, II. Class and scrap. Market prices of extra, I. Class, II. Class, and scrap were considered as 0.66, 0.46, 0.33 and 0.20 USD kg^{-1}. The amount of organic apple production in extra, I. Class, II. Class and scrap class based different treatments was different. It has been determined that the GPV of the apples produced in all treatments was higher than the control application. The GPV per decare was the highest for ERC (100%) application and the lowest was obtained in control application. The GPV's per decare for ERC (100%) and control application were 1199.14 and 985.39 USD, respectively. When a comparison was made in terms of net profit, it was determined that the most advantageous application was ERC (100%). As a matter of fact, the net profit for the ERC (100%) application was determined as 214.35 USD. In the control application, net profit per decare was determined as 130.42 USD. In study conducted by Karamürsel et al. (2012), it was found that organic apple cultivation was more profitable, although the total cost and unit product cost in organic applications was higher than in conventional application. Similarly, Swezey et al. (1998) reported that the certified organic apples, comparative cost accounting showed greater net return per hectare for the organic apple production system. On the other hand, Mon and Holland (2006) found that net return (2149.12 $ per acre) conventional apple production was greater than that of organic production (1179.72 $ per acre).

Table 5. Cost of organic apple production based on different treatments

Cost items (USD da^{-1})	Treatments					
	ERC (50%)	ERC (100%)	ST	RC	AB	Control
Pruning	49.67	49.67	49.67	49.67	49.67	49.67
Fertilizer	77.32	111.75	213.58	100.58	46.87	0.00
Fertilization labor	8.28	8.28	8.28	8.28	8.28	0.00
Hoeing by hand (for weed)	69.54	69.54	69.54	69.54	69.54	69.54
Hoeing by machine (for weed)	46.36	46.36	46.36	46.36	46.36	46.36
Pheromone cost (Pheromone +labor)	28.97	28.97	28.97	28.97	28.97	28.97
Pesticide (7 times)	186.75	186.75	186.75	186.75	186.75	186.75
Pesticide application labor	32.45	32.45	32.45	32.45	32.45	32.45
Calcium cost (Ca) (4 times)	2.38	2.38	2.38	2.38	2.38	2.38
Calcium application cost	18.54	18.54	18.54	18.54	18.54	18.54
Water	27.81	27.81	27.81	27.81	27.81	27.81
Irrigation	39.74	39.74	39.74	39.74	39.74	39.74
Electric	19.07	19.07	19.07	19.07	19.07	19.07
Harvest	29.80	29.80	29.80	29.80	29.80	29.80
Revolving fund interest	31.83	33.56	38.65	33.00	30.31	27.55
A. Total variable costs	668.52	704.68	811.59	692.95	636.55	578.65
Administrative costs	20.06	21.14	24.35	20.79	19.10	17.36
Land rent	127.48	127.48	127.48	127.48	127.48	127.48
The interest of irrigation machines	4.10	4.10	4.10	4.10	4.10	4.10
Depreciation of irrigation machines	30.70	30.70	30.70	30.70	30.70	30.70
Depreciation ratio of establishment cost	96.69	96.69	96.69	96.69	96.69	96.69
B. Total fixed costs	279.02	280.10	283.31	279.75	278.06	276.32
C.Total production costs(A+B) USD da^{-1}	947.54	984.79	1094.91	972.70	914.61	854.97

Table 6. Profitability indicators of organic apple production based on different treatments

Profitability indicators (USD da^{-1})	Treatments					
	ERC (50%)	ERC (100%)	ST	RC	AB	Control
Yield (kg da^{-1})	2032	2253	2238	2174	1969	1965
Gross production value (USD da^{-1})	1052.34	1199.14	1193.45	1171.58	1030.96	985.39
Total variable costs (USD da^{-1})	668.52	704.68	811.59	692.95	636.55	578.65
Total production costs (USD da^{-1})	947.54	984.79	1094.91	972.70	914.61	854.97
Gross profit (USD da^{-1})	383.82	494.46	381.86	478.63	394.40	406.74
Net profit (USD da^{-1})	104.80	214.35	98.55	198.88	116.34	130.42

CONCLUSIONS

As a result, it was determined that organic apple yield in all treatments was higher than control application. It was found that the highest yield was determined for ERC (100%). According to the research results, the extra class apple ratio in all treatments in 2015 and 2016 was higher than control. It was estimated that the control application in terms of scrap apple ratio was generally slightly higher than other treatments. In the study, it was determined that the production costs per decare in all treatments were higher than the control application. When a comparison was made in terms of net profit, it was determined that the most advantageous application was ERC (100%).

ACKNOWLEDGEMENT

The authors thank to the Scientific and Technological Research Council of Turkey (TÜBİTAK) for supporting the research project KAMAG-111G055 under which this work was financed.

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Received: 30.03.2017
Accepted: 30.05.2017