PRODUCTIVITY ANALYSIS OF SUNFLOWER CULTIVATIONS IN TURKEY

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Abstract

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The objective of this research is to determine the resource use efficiency in three different types of sunflower production with respect to orobanche resistance in the agricultural enterprises in Thrace Region, Turkey. The data used in this research have been obtained through questionnaire technique from 571 agricultural enterprises which were determined by ''Stratified Random Sampling Method'' in 2009. In this research, the production elasticity of coefficient (PEC), the marginal income (MI), and the marginal efficiency of coefficients (MEC) of inputs used in 3 types sunflower productions have been made and economically interpreted.

In this study, it has been reached to the highest yield by 189.30 kg da^{-1} in the production of sunflower, resistant to orobanche. In the estimating equations of 3 different types of sunflower, which have been obtained by Cobb-Douglas function type, it has been concluded that there is a decreasing return to scale.

Key words: Efficiency, Production Function, Orobanche (*Orobanche cernua* L.).

Introduction

Turkey ranks among the top 10 country in the world sunflower production by 580000 ha cultivation area and by its production amount which is more than 1050000 ton (FAO, 2010). The sunflower is one of the important sources of income for the producers in Thrace Region, which meets almost 60% of country production (TURKSTAT, 2010). The most important difficulty in sunflower, which has 60-year history in Turkey, is orobanche (*Orobanche cernua*). The orobanche is one of the factors that affect the sunflower yield negatively in Thrace Region, which is located at European continent of Turkey along with Spain and East European countries (Kaya et al., 2010). In the areas of Thrace where the orobanche is intensively infected, the cultivars which are genetically resistant to orobanche and IMI (Imidazolinone) are produced beside slightly non-orobanche-resistant cultivars (Demirci and Kaya 2009; Semerci et al., 2010).

The improvement studies form the important part of the researches conducted about this issue. However, there are studies in limited numbers about determining the resource use efficiency (Pirinccioglu, 1973; Safak, 1981; Tuna, 1993; Aksoy and Gaytancioglu, 1996; Altintas and Oguz, 2002). On the other hand in the literature examines, it has been concluded that there has not been any socio-economic study on sunflower production so far which has been conducted by considering the condition of sunflower resistance to orobanche.

The research, which has been conducted, is a first for both research area and Turkey in terms of analyzing the input use efficiency of three different sunflower cultivars, which have different characters about resistance to orobanche. In the research, the production elasticity of inputs used in different types of sunflower produc-

tion and factor use efficiency have been proved with the help of marginal income and marginal efficiency of coefficients.

Materials and Methods

Turkey exists among the top ten countries of world sunflower production that approximately 60% of sunflower areas is in Thrace Region, which is European part of Turkey. In the region sunflower exists at second rank (42%) after the wheat in the research area. The agricultural enterprises in Thrace Region have experienced due to intensive sunflower production, and this region is the main area of country's vegetable oil industry (Semerci et al., 2011).

In the research the data acquired from the project named ''The Determination of Efficiency of Subsidizing Policies, and Productivity in Sunflower Production (TAGEM - 08/AR- GE / 06)'' which has been supported in the extent of R&D studies by Ministry of Food Agriculture and Livestock of Turkey have been used.

The data in this research have been obtained from agricultural enterprises in the provinces of the Trakya Region such as Edirne, Kirklareli, Tekirdag, Istanbul, and Canakkale by using "Stratified Random Sampling Method". The formula of "Neyman Method- Stratified Random Sampling Method" which has been used to determine the sample size is given below (Yamane, 1967).

$$n = \frac{\Sigma \ (Nh \ Sh)^2}{N^2 \, D^2 + \ \Sigma \, Nh \, (Sh)^2} \qquad (1)$$

In formula: n: sample volume, N_h: the number of units in the layer (frequency), S_h: standard deviation of layer h, N: total unit number, D: d/z, d: average of a certain percentage (1% - 5% - 10%, etc.) deviation, z: degrees of freedom in t-distribution scale (N-1) and expresses "t value" belongs to a certain confidence limit (90% - 95% - 99% etc.).

A total of 571 surveys have been conducted with sunflower producers in the extent of the research; 175 of them have been obtained from the enterprises in Edirne province, 116 of them have been obtained from enterprises in Kirklareli province, 233 of them from the enterprises in Tekirdag province, 26 of them from enterprises in Istanbul province and lastly 21 of them from the enterprises in Canakkale province. The data used in the research belong to cross sectional data of the year 2009. Upon determining the sample residential area, 95% confidence interval and 4% deviation from mean have been considered. Also for determining the number of enterprises where the questionnaire technique applied, 95% confidence interval and 1% deviation from mean have been taken into account (Erkan and Cicek, 1996).

The methods used in functional analysis

One of the functions, which uses extensively in agricultural production is "Cobb-Douglas Production Function" (Kip and Isyar, 1976). Cobb-Douglas production function is defined by double logarithmic pattern prevalently. In the model, coefficient of every X variable equals to partial elasticity of Y dependent variable (Gujarati, 2009). In Cobb-Douglas function, by the both sided logarithms the linear form appears as below:

$$\log Y = \log \alpha + \beta_1 \log x_1 + \beta_2 \log x_2 + \beta_3 \log x_3 + ... + \beta_k \log x_k \qquad (2)$$

Cobb-Douglas function is defined between the production quantity of sunflower and production factors (X) in the study. The variables included in the model are as follows:

Log Y (Sunflower Production Quantity-kg-): It is defined as sunflower production quantity obtained because of production activity in regression equation.

Log X_1 (Hoeing cost –US$),

Log X_2 (Seed cost -US$),

Log X_3 (Fertilizer -kg),

Log X_4 (Pesticide cost-US$),

Log X_5 (Precipitate-mm); precipitation quantity in the sunflower production period,

Log X_6 (Land rent cost-US$).

In this research, the production elasticity of coefficient (PEC), the marginal income (MI), and the marginal efficiency of coefficients (MEC) of inputs used in sunflower production have been made and economically interpreted.

In Cobb-Douglas type production function, the total production elasticity ($\sum \beta j$) indicates the relation among enterprises scale, production quantity and level of income. Due to the features of Cobb-Douglas type production function, geometric mean has been used in-

stead of arithmetic mean. The marginal income (MI) of any production input (X_i) has been calculated with the help of formula (Karagolge, 1973):

$$M_j R_{xj} = \beta_j \ \frac{\overline{Y_G}}{\overline{X_{jG}}} \ * F_y \qquad (3)$$

To which extent a factor has been used efficiently in production branch is determined by efficiency coefficient. The formula of the marginal efficiency coefficient is given below (Karkacier, 2001):

$$MEC = \frac{\text{Marginal Income of Factors}}{\text{Factor Price (Opportunity Cost)}} \qquad (4)$$

The fact that the marginal efficiency of coefficient is equal one-to-one means that for every 1 unit input, 1 unit output will be obtained. That is the point when the marginal revenue is equal to the marginal cost. The fact that marginal efficiency coefficient is lower than 1 means that for every 1 unit input, output lower than 1 is obtained and also marginal income is lower than marginal cost. In that case, input use is required to be reduced. When the marginal efficiency coefficient is higher than 1, it indicates the deficiency in input use and signs that it is required to make an increase in input use.

In determining regression coefficient (R^2), which is the best expression of the relation between dependent and independent variables, "Stepwise Selection" method has been used (Duzgunes et al., 1987).

Results

In the enterprises, where the questionnaire has been conducted, 9295.82 ton sunflower has been produced in 5260.2 ha. In return for about 176.7 kg da^{-1} sunflower yield per unit area, 104.43 US\$ da^{-1} income have been obtained. When the sunflower cultivation area has been considered on parcel basis, the sunflower production has been made in 666 parcels in the enterprises where the questionnaire has been conducted. As a result of the survey, it has been proved that in 49% of total parcel number (327 piece and 2219.9 ha) the orobanche resistant cultivars have been used, in 41.14% (274 piece and 2652.95 ha) IMI resistant cultivars have been used and in 9.76% of the rest parcel (65 piece and 387.3 ha) sunflower cultivars which are non-resistant-to-orobanche have been used.

The functional analysis of IMI group sunflower production

Cobb-Douglas function type is one of the production functions, which are used extensively in determining the resource use efficiency in agricultural production. In the study, by using Cobb-Douglas production function, the estimating equation, which belongs to the production of IMI resistant sunflower, is given below:

$$LogY_{IMI} = 3.379 + 0.069 LogX_1 + 0.342 LogX_2 + 0.129 LogX_3 + 0.072 \, Log \, X_4 - 0.084 \, Log \, X_5 + 0.399 \, Log \, X_6$$

The determination coefficient (R^2) of the equation has been determined as 0.928 and the "$F_{calculation}$" value of the equation is different from '0' at 1% significance level ($F_{calc.571.27} > F_{table\,2.21}$). All of the independent variables in the equation of IMI group sunflower production may explain 92.8% piece of the variation in the production quantity (Table 1).

In the research "DW (d) Test" has been used for analyzing autocorrelation. The value of "DW (d) Sta-

Table 1
The parameters and related test values of IMI group sunflower production activity

Variables	(β_i) Coefficients	Partial Correlation	"t- value"	Significance Level
Hoeing cost (X_1)	0.069	0.108	1 769	0.078
Seed cost (X_2)	0.342	0.278	4 726	0.000 (*)
Fertilizer quantity (X_3)	0.129	0.138	2 269	0.024 (*)
Pesticide cost (X_4)	0.072	0.193	3 219	0.001 (*)
Precipitate (X_5)	- 0.084	-0.274	-4 656	0.000 (*)
Land rent value (X_6)	0.399	0.279	4 755	0.000 (*)

R^2: 0.928, Fcalculation =571.27, DW: 1.858
(*): Significant at 0.05 level.

tistics" has been calculated as 1.858 (k=5, n=274). In the study, the calculation value of "DW (d) Statistics" has been compared to the table value and it has been concluded that there is not any autocorrelation in a negative or positive way at 1% significance level in the equation ($d_{table\ L}$ 1.623 – $d_{table\ U}$ 1.725).

In the equation of the sunflower production, all of the other factors except for hoeing cost (X_1) are significant at 1% level. When the elasticity coefficients of the estimating function have been analyzed, it has been understood that the land rent value (X_6) and seed cost (X_2) have the highest effect on the production quantities. The only variable having negative effect on production is rainfall factor (X_5).

Elasticity coefficient of rainfall factor has been determined as negative for all kinds of sunflowers in the aspect of resistant to orobanche and found 1% as significant in explaining production amount statistically for the function regarding only IMI group sunflower cultivars. Rise in rainfall factor will cause reduce in production amount of sunflower according to estimating equation. Upon analyzing rainfall data in research area, it has been observed that there was a rainfall, which was mostly as equal as the average of many years in May period in 2009, under 14.84% in June period, over 271.14% in July period and under 65.57% in August period. This shows that rainfalls were at extreme levels according to the average of many years in 2009 in the aspect of agricultural production. The fact that the elasticity coefficients for rainfall variable in regression equation regarding function analysis were negatively characterized could be considered due to the fluctuations in precipitation during the production period of sunflower and it can be said that this situation has a negative effect on sunflower production.

When analyzing the variables in Table 1, it has been concluded in the study that multicorrelation has not existed among variables because of singinificance level of explanatory variables has been under 5% and coefficients of part correlation have been low (Gujarati, 2009).

Marginal production elasticity of coefficients of factors

Elasticity coefficient of rainfall factor (X_5) has been negatively characterized among variables in equation.

The sum of production elasticity coefficients of factors in estimating equation for sunflower production has been determined as ($\sum\beta_i$) 0.927. This value shows that a 1% rise in input costs can cause a 0.927% rise in sunflower production amount on condition that the combination of independent variables is stable. In other words, the calculated value implies the diminishing returns to scale in sunflower production.

A 1% rise in the factor of ground rent cost (X_6) for sunflower production function will cause a 0.399% rise in production amount. A 1% rise in seed cost (X_2) will constitute a 0.342% rise in production. Precipitation during sunflower production period in 2009 (X_5) effected the production in a negative manner because it was over average value of many years. This situation can be easily seen in estimating equation obtained. Then, a 1% rise in precipitation can cause a 0.084% decrease in sunflower production.

Marginal efficiency of production factors

Table 2 shows geometric mean, standard deviation and marginal income values regarding the factors in sunflower production where IMI group cultivars are preferred. According to the marginal income values of variables in production, agrochemical causes US$ 2.86 rise, hoeing cost US$ 1.40, factor of land rent value US$ 1.27 and fertilizer variable US$ 0.66 in respectively while one unit rise in seed cost (X_2) causes US$ 5.29 rise in sunflower income.

Although the signs of elasticity coefficients regarding production factor give some information about usage case of the relevant factor, it can be said that the elasticity coefficients give more specific and clear information about usage cases of factors. Because it makes itself no sense the fact that marginal product values of production factors are high or low. At this stage, the use of efficieny of coefficients can explain whether the amount or cost of a production factor should be reduced or increased according to current usage case (Akcay and Uzunoz, 1999). Table 3 shows marginal income, factor prices and marginal efficieny of coefficients of the factors in the equation regarding the production of IMI group sunflower.

When analyzing the marginal efficiency of coefficients of factors in production function, it is under-

stood that just the factor of fertilizer cost (X_3) is the closest input for the economic optimum level (1.138). As all of the other factors are under the optimum input combination and overused, it is required to make limitations in use of those inputs.

Functional analysis of orobanche resistant sunflower production

The estimating equation regarding sunflower production where orobanche resistant sunflower cultivars are used is given below.

Table 2
Geometric mean and marginal income values regarding variables in production of IMI group sunflower

Variables	Geometric Mean (US$)	Standard Deviation	Marginal Income (US$)
Production Quantity (Y)	9043.36	0.423	-
Hoeing cost (X_1)	263.28	0.412	1.40
Seed cost (X_2)	345.01	0.411	5.29
Fertilizer quantity (X_3)	1046.02	0.416	0.66
Pesticide cost (X_4)	134.14	0.555	2.86
Precipitate (X_5)	531.63	0.041	-
Land rent value (X_6)	1673.98	0.401	1.27

Table 3
Marginal income, factor price and marginal efficiency coefficients regarding the variables in the IMI group sunflower production

Variables	Marginal Income (US$)	Factor Price (US$)	Marginal Efficiency Coefficient (MI/ MC or FP)
Hoeing cost (X_1)	1.40	4.75	0.295
Seed cost (X_2)	5.29	17.61	0.300
Fertilizer quantity (X_3)	0.66	0.58	1,138
Pesticide cost (X_4)	2.86	23.41	0.122
Land rent value (X_6)	1.27	31.10	0.041

$$\text{Log } Y_R = 1.530 + 0.001 \text{ Log } X_1 + 0.401 \text{ Log } X_2 + 0.242 \text{ Log } X_3 + 0.037 \text{ Log } X_4 - 0.014 \text{ Log } X_5 + 0.287 \text{ Log } X_6$$

The coefficient of determination for the equation obtained has been calculated as (R^2) 0.895. The value "$F_{calculation}$" regarding function is different from "0" at 1% significance level ($F_{calc.453.06} > F_{table\ 2.21}$). The coefficient of determination for estimating equation (R^2) is able to explain the 89.50% of variations in sunflower production (Table 4).

The value "DW (d) Statistics" has been calculated as 1.919 (k=5, n=327) in the study. As the value "DW (d) Statistics calculation" has been determined higher than the table upper value, it has been understood that negative or positive autocorrelation has not existed among the variables in equation ($d_{table\ L}$ 1.623 − $d_{table\ U}$ 1.725).

Table 4
Parameters and test values regarding orobanche resistant sunflower production

Variables	($β_i$) Coefficients	Partial Correlation	"t- value"	Significance Level
Hoeing cost (X_1)	0.001	0.002	0.033	0.003(*)
Seed cost (X_2)	0.401	0.277	5,163	0.974
Fertilizer quantity (X_3)	0.242	0.242	4,457	0.000(*)
Pesticide cost (X_4)	0.037	0.058	1,035	0.000(*)
Precipitate (X_5)	-0.014	-0.041	-0.741	0.302
Land rent value (X_6)	0.287	0.207	3 776	0.459

R^2: 0.895, $F_{calculation}$ =453.06, DW: 1.919
(*): Significant at 0.05 level.

The factors such as seed cost (X_2), fertilizer cost (X_3) and land rent cost (X_6) have been found significant at 5% level in the study. Rainfall (X_5) is the only factor, which has negative valence in the equation. The sum of production elasticity coefficients of the factors in the equation has been calculated as ($\sum \beta_i$) 0.954. In other words, it has been concluded that the decreasing returns to scale have been in question in the orobanche resistant sunflower production like in the production of IMI group pesticide resistant sunflower cultivars.

Marginal efficiency of production factors

Geometric Mean, Standard Deviation and Marginal Income values are given at Table 5 for the production of orobanche resistant sunflower cultivars. According to the marginal income values of the inputs in production, one unit rise in agrochemical (X_4) constitutes US\$ 6.132 rise in sunflower income and one unit rise in seed cost (X_2) constitutes US\$ 5.64 rise in sunflower income. Respectively, fertilizer variable (X_3) cause US\$ 1.40, the factor of land rent value (X_6) US\$ 1.01 and hoeing factor (X_1) US\$ 0.02 rise in sunflower income.

Table 6 shows Marginal Income, Factor Prices and Marginal Efficiency Coefficients of the factors in the estimating equation regarding the sunflower production where orobanche resistant seeds are used.

When analyzing the marginal efficiency coefficients of the factors in function, it is understood that agrochemical (X_4) is the closest input for economic optimum level. The use of fertilizer variable (X_3) should be increased according to the equation. Overuse is in question for the other factors and some reductions should be applied for those inputs.

Functional analysis of sunflower cultivars non-resistant to orobanche

The equation regarding the production of sunflower where the sunflower species which are non-resistant to orobanche are used is given below.

$$\text{Log } Y_{NR} = 3.379 - 0.105 \text{ Log } X_1 + 0.662 \text{ Log } X_2 + 0.453 \text{ Log } X_3 + 0.035 \text{ Log } X_4 - 0.037 \text{ Log } X_5 - 0.083 \text{ Log } X_6$$

The coefficient of determination for the estimating equation has been calculated as (R^2) 0.908. The value

Table 5
Geometric mean and marginal income values regarding the variables in the production of orobanche resistant sunflower

Variables	Geometric Mean (US$)	Standard Deviation	Marginal Income (US$)
Production Quantity (Y)	8900.82	0.356	-
Hoeing cost (X_1)	311.88	0.387	0.02
Seed cost (X_2)	373.45	0.347	5.64
Fertilizer quantity (X_3)	903.15	0.348	1.40
Pesticide cost (X_4)	31.71	0.412	6.13
Land rent value (X_6)	1486.42	0.340	1.01

Table 6
Marginal income, factor price and marginal efficiency coefficients regarding the variables in the production of orobanche resistant sunflower

Variables	Marginal Income (US$)	Factor Price (US$)	Marginal Efficiency Coefficient (MR/MC or FP)
Hoeing cost (X_1)	0.02	7.32	0.003
Seed cost (X_2)	5.64	21.61	0.261
Fertilizer quantity (X_3)	1.40	0.54	2.593
Pesticide cost (X_4)	6.13	5.89	1.041
Land rent value (X_6)	1.01	30.98	0.033

"F$_{calculation}$" is different from "0" at 1% significance level (F$_{calc.95.249}$ > F$_{table 2.29}$). The coefficient of determination for the equation is able to explain the 90.8% of variations in sunflower production (Table 7).

The value "DW (d) Statistics" has been calculated as 1.698 (k=5, n=65) in the study. As the value "DW (d) Statistics" has been determined higher than the upper level of the table value, negative or positive autocorrelation has not existed among the variables at 1% significance level (d$_{table L}$ 1.283 – d$_{table U}$ 1.604).

The variables of seed cost (X$_2$) and fertilizer quantity (X$_3$) in the equation are significant at 5% level. The rainfall factor (X$_5$) has been the negatively characterized factor in the equation like in the production of IMI group and orobanche resistant sunflower. The sum of production elasticity coefficients of variables in the estimating equation has been calculated as ($\sum\beta_i$) 0.925. This value shows that the diminishing returns to scale are in question in the production type where sunflower cultivars, which are non-resistant to orobanche, are used like in the other two production types.

Efficiency of production factors

Geometric mean, standard deviation and marginal income values are given at Table 8 for the production of sunflower cultivars, which are non-resistant to orobanche. According to the marginal income values of the factors in the estimating equation, one unit rise in fertilizer factor (X$_3$) constitutes US$ 4.71 rise in sunflower income while agrochemical factor (X$_4$) causes US$ 3.77 rise and seed factor (X$_2$) causes US$ 2.40 rise in sunflower income.

Table 9 shows marginal income, factor prices and marginal efficiency of coefficients for the production factor in the estimating equation regarding the production of orobanche non-resistant sunflower cultivars.

When analyzing the marginal efficiency coefficients of the factors in the estimating equation, it has been concluded that agrochemical (X$_4$) and seed cost (X$_2$) have been overused and they should be reduced and the variable regarding fertilizer quantity (X$_3$) should be increased.

Table 7
Parameters and test values regarding the production of sunflowers which are non-resistant to orobanche

Variables	(β_i) Coefficients	Partial Correlation	"t- value"	Significance Level
Hoeing cost (X$_1$)	-0.105	-0.142	-1.093	0.279
Seed cost (X$_2$)	0.662	0.372	3.050	0.003(*)
Fertilizer quantity (X$_3$)	0.453	0.490	4.286	0.000(*)
Pesticide cost (X$_4$)	0.035	0.062	0.476	0.636
Precipitate (X$_5$)	-0.037	-0.106	-0.809	0.422
Land rent value (X$_6$)	-0.083	-0.053	-0.407	0.685

R^2: 0.908, F$_{calculation}$ =95.249, DW: 1.698
(*): Significant at 0.05 level.

Table 8
Geometric mean and marginal income values regarding the variables in orobanche non-resistant sunflower production

Variables	Geometric Mean (US$)	Standard Deviation	Marginal Income (US$)
Production Quantity (Y)	6702.86	0.369	-
Seed cost (X$_2$)	267.01	0.336	2.40
Fertilizer quantity (X$_3$)	380.44	0.381	4.71
Pesticide cost (X$_4$)	36.74	0.397	3.77

Table 9
Marginal income, factor price and marginal efficiency coefficients regarding the variables in the production of orobanche non-resistant sunflower

Variables	Marginal Income (US$)	Factor Price (US$)	Marginal Efficiency Coefficient (MI/MC or FP)
Seed cost (X_2)	2.40	15.84	0.152
Fertilizer quantity (X_3)	4.71	0.56	8.411
Pesticide cost (X_4)	3.77	7.06	0.534

Stepwise analyses

The function has been formed as:

$Y = 0.713\, X_6^{0.955}$ (R^2: 0.912, F: 2804.04)

in the sunflower production where IMI group cultivars have been used according to the analysis which has been applied for determining the most effective variable on sunflower production amount among the production factors.

The land rent value factor (X_6) has been determined as the variable, which has had the highest effect on the sunflower production in the new equation. The equation for the orobanche resistant species is given below:

$Y = 1.473\, X_2^{0.936}$ (R^2: 0.877, F: 2309.31)

The factor (X_2) regarding the seed cost has been the most important variable in the sunflower production according to the equation. The new equation has been obtained as:

$Y = 1.331\, X_2^{0.934}$ (R^2: 0.872, F: 431.06)

in the production of orobanche non-resistant sunflower cultivars. It has been concluded that the seed input (X_2) has been the most important factor in the sunflower production in the function like in the production of orobanche resistant sunflower cultivars.

According to the study on the functional analysis of sunflower in the research area by Pirinccioglu (1973), the coefficient of determination has been calculated as (R^2) 0.92 as well as the sum of elasticity coefficients as ($\sum\beta_i$) 0.906. The fertilizer factor (β_i: 0.48) and land variable (β_i: 0.377) have been determined as the most effective factors on the sunflower production in the examined enterprises.

As with the study of Gungor and Semerci (1999), the coefficient of determination regarding the obtained function has been determined as (R^2) 0.936 as well as the sum of elasticity coefficients as ($\sum\beta_i$) 1.025. The seed factor (β_i: 0.585) and fertilizer factor (β_i: 0.352)

have been concluded as the most important factors for the sunflower production.

As far as the study on the sunflower production by Altıntas and Oguz (2002) is concerned, the coefficient of determination regarding the estimating equation has been determined as (R^2) 0.88 and the sum of elasticity coefficients as ($\sum\beta_i$) 1.148. The production land (β_i: 0.96) has been determined as the most effective factor on the production.

According to a study by Semerci et al. (2007), the coefficient of determination regarding the function for the functional analysis of the sunflower production has been calculated as (R^2) 0.918 and the sum of elasticity coefficients as ($\sum\beta_i$: 0.989). The cultivation area (β_i: 0.806) has been determined as the most effective variable on the production amount.

The efficiency of coefficients of the factors used in the sunflower production has showed differences in accordance with the studies carried out in the region. Gungor and Semerci (1999) have made inferences about the fact that pesticide and seed inputs and fertilizer variable have been overused in their studies. Altıntas and Oguz (2002) have determined that the factors regarding land and seed costs have been underused and soil preparation costs have been overused in the sunflower production.

The inputs regarding the land rent value, seed cost, fertilizer cost, pesticide cost and hoeing costs have been concluded as being overused according to a study by Semerci et al. (2007).

Discussion

In estimating functions of all three seed types, it has been concluded that precipitation factor has a negative effect on production quantity in sunflower. It has been

considered that precipitation quantity and precipitation regime in the period June- August 2009, which are rather higher than average values for long years may have an important role in negative effect of precipitation factor in sunflower production.

In this study, determination coefficients (R^2) of estimating equations of sunflower cultivars in the aspect of resistance to orobanche have shown close similarity with other research findings. In this research, it has been concluded that especially seed cost factor has a significant effect on production quantity in production of IMI group, orobanche resistant and non-resistant to orobanche sunflower cultivars. When the marginal efficiency coefficients of the functions are analyzed, it has been determined that the factors in IMI group sunflower production such as seed cost, pesticide cost, hoeing cost and land rent factors have been used insufficiently and these factors must be increased. It has also been determined that the variable related to fertilizer quantity is a bit more than economic optimum level. The factors that are required to be increased in the production of orobanche resistant varieties are hoeing cost, seed cost and land rent value. It has been concluded in the study that seed cost and pesticide cost factors need to be increased while the amount of the fertilizer used in production must be limited in the production of varieties that are non resistant to orobache.

Sum of the production elasticity coefficients ($\sum \beta_i$) of the factors in sunflower production estimating equation have shown that there is decreasing return to scale in sunflower production. It has been understood that the calculated values are similar with the findings obtained from other researches made on sunflower production.

Turkey is one of the countries that fail to meet the supply in response to demand in oily seeds production. When the agricultural importation values of the country in 2008 are analyzed, it is understood that Turkey has imported oily seeds for 3.2 billion US$ (TEAE, 2009). Oily seeds production in Turkey has been supported since 2000 in order to be able to meet the current supply deficit. The effective use of production factors has great importance in decreasing the production cost and contributing to the producer prosperity besides the granted subsidies in order to able to make increase in oily seeds production.

Conclusions

Turkey is one of the most important countries in sunflower production in the world and this research has been conducted in Thrace Region where the sunflower production is densely made. In this study, input use efficiency among 3 different varieties have been shown in the aspect of resistance to orobanche in sunflower production and the relations between the production factors and production quantity have been analyzed.

This research has proved that orobanche resistant cultivars have higher yield value when compared to other varieties in sunflower production.It is possible to envisage that the rate of orobanche resistant cultivars in sunflower production areas that are more important than the other varieties in the aspect of yield will increase in future in agricultural areas.

References

Akcay, Y. and M. Uzunoz, 1999. A research on the resource use efficiency in agricultural enterprises: Niksar Plain Sample, *Agriculture and Engineering Journal,* **59:** 831- 841.

Aksoy, S. and O. Gaytancioglu, 1996. Reseaching about the effects of the increase in agricultural input price on production price. I. Agricultural Economics Congress of Turkey. Vol. No: II. Izmir.

Altintas, O. and C. Oguz, 2002. Cost and Functional Analysis of Sunflower Production for Nut and Oil in Kirikkale Province. Agricultural Faculty of Selcuk University. *Selcuk Agriculture and Food Science Journal,* **16** (29): 39-47.

Demirci, M. and Y. Kaya, 2009. Status of *Orobanche cernua* Loefl. and weeds in sunflower production in Turkey. *Helia,* **32 (**51): 153-160.

Duzgunes, O., T. Kesici, M. Kavuncu and F. Gurbuz, 1987. Research and testing method (Statistics Methods II). Agricultural Faculty Publishing of Ankara University. No: 1021. Ankara. p. 344.

Erkan, O. and A. Cicek, 1996. Research and sampling methods in agricultural economics GOP University. Agricultural Faculty Publishing. 12 (6). Tokat. Turkey.

FAO, 2010. Statistical database. Available at: http:// www. fao.org.

Gujarati, D. N., 2009.Basic Econometrics. Literature publishing (6. print). Publication No: 33; 215. Istanbul.

Gungor, H. and A. Semerci, 1999. The productivity analy-

sis of sunflower production in Tekirdag province. *Productivity Journal.* MPM Publishing 1999/3. Ankara. pp.193-202.

Karagolge, C., 1973. The econometric analysis of agricultural enterprises in Erzurum Province according to their land saving ways. Ankara University Publication. No:312. Agricultural Faculty Publication. No: 153. Res. Serial No: 90. Ankara. pp. 8-24.

Karkacier, O., 2001. The functional analysis of agricultural economics area and some quantitative findings that could be inferred from these analyses. Agricultural Faculty of Gaziosmanpasa University Publication No: 49. Tokat, Turkey.

Kaya, Y., G. Evci, V. Pekcan, T. Gucer and M. I. Yilmaz, 2010. The current situation of broomrape problem in sunflower production, the solutions and future directions in Turkey. 8th European Sunflower Biotechnology Conference. 59. March 1-3 2010. Antalya, Turkey, p. 59.

Kip, E. and Y. Isyar, 1976. The application of simple and multi regression analyses to the agricultural economics problems. Ankara University Publication No: 460, Agricultural Faculty Publication No: 217. YDK No: 14. Erzurum,Turkey.

Pirinccioglu, N., 1973**.** The productivity analyses of sunflower production in Turkey and comparisons among the enterprises. *Productivity Journal* MPM Publication. No: TA-A (3) 165. Ankara.

Safak, A., 1981.   A research about the production costs of enterprises in Edirne, Bursa and Tekirdag where the production of sunflower is made intensively and the evaluation of production technique economically and marketing

.TKB, TAGEM, Agricultural Economics Researches and Training Territorial Project', Application Project Code No.: 7-059/060-1/2-342. Directorate of the Garden Culture Research Institute.Yalova.

Semerci, A. and Y. Kaya, 2007.The input use of the sunflower enterprises in Thrace and researching the efficieny of support policy. Ministry of Agricultural and Rural Affairs. The General Directorate of Agricultural Research (Project No: TAGEM/TA/05/2/01/002).Thrace Agricultural Research Institute Publication. Edirne.

Semerci, A., Y. Kaya, I. Sahin and N. Citak, 2010.The determination of the performances and the adoption level of sunflower cultivars based on the resistance to broomrape at farmer conditions in Thrace Region. 8th European Sunflower Biotechnology Conference. 1-3 March. Antalya,Turkey.

Semerci, A., Y. Kaya, K. Peker, I. Sahin and N. Citak, 2011.The analysis of sunflowers yield and water productivity in Trakya region. *Bulg. J. Agric. Sci.,* **17**: 207-217.

TEAE, 2009. The agriculture in Turkey with economic indicators. Ministry of Agriculture and Rural Affairs. Agricultural Economics Research Institute Publication No: 176.Ankara.p.95.

Tuna, Y., 1993. The economical results of the productivity growth in the agriculture: an evaluation about Turkey. *Productivity Journal.* MPM Publication No: 487, Ankara, pp. 26-41.

TURKSTAT, 2010. Statistical database. Available at: *http://www.turkstat.gov.tr*

Yamane, T., 1967. Elementory Sampling Theory. Prentice-Hall Inc. Englowood Cliffs. N. Jersey. USA.