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THE ANALYSIS OF SUNFLOWERS YIELD AND WATER PRODUCTIVITY IN TRAKYA REGION

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Abstract

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Turkey exist among the top ten countries of world sunflower production that approximately 60% of sunflower areas is in Trakya Region which is European part of Turkey. The agricultural enterprises in Trakya Region have experienced due to intensive sunflower production, and this region is the main area of country's vegetable oil industry. Although the sunflower yield is above the world average in agricultural enterprises in Trakya Region where is selected as a field of research, irrigated sunflower areas is only 2.79% of cultivated areas. Sunflower exists at second rank (42%) after the wheat in the research area. The adoption rates of farmers to new sunflower varieties including herbicide resistant (IMI) and the genetically resistant ones to broomrape are over 90%. While the average sunflower yield as 1.794 ton / ha and water productivity as 345.15 g / m^3 were measured in the research area, as 1.929 ton / ha seed yield and as 369.14 g / m^3 water productivity was determined in genetically resistant varieties. On the other hand, the revenue of sunflower was calculated 834.55 US$ per ha in the research area and a positive relationship between the revenue from sunflower and the water efficiency of the varieties in the study. It is revealed in the research results that among provinces as well as per unit area yields of sunflower varieties and water productivity levels exhibited statistically differences even though they had the similar climate structure and production technologies. It is concluded in the study that sunflower production should be planted in irrigated conditions, use of the cultivars that have strong reactions to irrigation and high oil content will increase farmer income as well as will reduce the Turkey's current oil deficit.

Key words: sunflower, broomrape (*Orobanche cernua* L.), income, yield, IMI herbicide resistant, discriminant analysis, water productivity

Introduction

Although soybean exists at first rank as having 37.87% planting area and 32.13% production planting areas of among oil crops in the world, sunflower is the most important crop in Turkey which ranked 10th in worldwide with 2.04% planting area and 2.56% sunflower production (FAO, 2009). On the other hand, Turkey has oilseed deficit and supply this domestic need by import. In 2008,

Turkey's foreign trade in agricultural products was 24.504 billion US$. The share of exports were 11.466 billion US$, and the share of imports were 13.037 billion US$ in total foreign trade. Vegetable oil imports were doubled in 2008 compared with 2007 as 1.7 billion US$ reaching to 3 billion US$ in 2008 (sharing about 23% of total agricultural product imports) (TEAE, 2009). Trakya Region is the most important region of sunflower and the region has the largest area of oil seed production of Turkey. The five provinces of Trakya Region constitute the 59.51% of sunflower cultivation area and the 62.04% amount of production of Turkey (TUIK, 2009).

The drought and global warming have increased in recent years in the world then it needs necessary to adjust irrigation in agriculture and irrigation systems based on these changes. As is known, one way of increasing efficiency in agricultural production is also irrigation which is generally defined as giving water to land necessary for plant growth not could be met by natural means without creating environmental problems (Kanber, 1997). Due to droughts and severe climatic changes in Turkey in recent years, irrigation has become one of the increasingly important issues in recent years in Turkey. Manufacturers are encouraged to use pressurized irrigation systems (Drip and Sprinkler Irrigation Systems) infield according to agricultural irrigation with the application of support provided in 2010.

Since 2008, 62% of economically irrigable area (5.28 million ha) could be actually irrigated. However, according to 2006 data, only 27.8% of the planted areas of field crops were irrigated (TEAE, 2009). One of the most important factors in the low ratio of irrigation in Turkey is the sufficient rainfall or the thought of farmers as it is sufficient (DSI, 2010). However, this idea results not enough investments being made and also not being used effectively of current investments.

According to data of 2008, 3.95 billion US$ has spent to support agriculture in Turkey and more than 60% of this support was separated to subsidies on based on lands. However, there was no investment to improve irrigation infrastructure when it examined these recent investments (TEAE, 2009). On the other hand, researches indicated that it is possible to increase gross farm income 5-6 fold with irrigated farming practices in Turkey. According to the study by DSI, while average agricultural income was 500 US$ per ha before irrigating, it has reached 3000 US$ per ha after irrigation (DSI, 2010).

The irrigation time is also important in sunflower. The sunflower crop uses only 20-25% of its total water needed during the first 30 days, but the peak demand is during reproductive stage. The most critical period of sunflower yield determinants is anthesis and post anthesis (Dar et al, 2009). In other studies conducted in Bursa conditions, Goksoy et al. (2004) and Demir et al. (2006) obtained the highest seed yield with 88% yield increase as 3.95 ton ha^{-1} and 4.1 ton ha^{-1} with irrigating at heading, flowering and milk ripening stages, respectively. They concluded that three irrigations was the best choice for maximum yield under the local conditions, but these irrigation schemes must be reconsidered in areas where water resources are more limited.

Karaata (1991) indicated that the highest grain yield (3900 kg ha^{-1}) was obtained from three irrigations in sunflower as receptacle formation (2100 mm), in flowering onset and milk existence period (each 1600 mm per ha) in Kirklareli conditions. He also emphasized that in the case of water restrictions the irrigation must be done in the flowering period. Similarly, Yakan and Kanburoglu (1989) suggested one irrigation at flowering stage (197 mm) in the case of insufficient water supply and they obtained 2963 kg ha^{-1} seed yield with only one irrigation in Kirklareli conditions.

In other studies conducted in the region (Tekirdag), sunflowers water consumption was determined to be 781 mm per ha with normal precipitation throughout the entire growing season. While 2657 kg ha^{-1} grain yield was obtained from sunflowers in no irrigation conditions, 5139 kg

ha^{-1} grain yield was obtained in all water needs of sunflower plants entirely met (Orta et al., 2002; Erdem and Delibas, 2003).

Tan et al. (2000) found that up to 31% yield increase could be obtained with three times irrigation at the beginning circuit of receptacle formation, flowering and milk existence in Izmir at Aegean Region. They also concluded that in the case of the scarce of water resources, implementing irrigation only once and at the beginning circuit of receptacle formation would be economical.

In another study conducted in 2002 and 2003 in Ankara conditions, Kolsarici (2004) found that with the irrigation applied on different growth stages influenced plant height, receptacle diameter, thousand grain weight and grain yield positively. Comparing the anhydrous growing (control), it was revealed that irrigation for four times at the stages of vegetative growth+receptacle formation+flowering onset and milk existence provided an increase 43.1% in 2002 and 77.2% in 2003. In the limited resources of irrigation and higher irrigation costs, the irrigation should be applied at the beginning of flowering.

The research was conducted to determine in differences between seed yield and water productivity among sunflower varieties planted in the Trakya Region and also among sunflower provinces as well as between water productivity and revenue of sunflower.

Material and Method

Trakya Region which determined as research areas is located between 26^0-29^0 eastern longitudes and 40^0-42^0 northern latitudes in Turkey. The average annual rainfall in the region vary according to season and years, but it is generally between 500-800 mm annually and average temperature varies between the 13.0-14.6^{0}C (Istanbulluoglu et al., 2006). The research data were collected from agricultural businesses based on stratified random sampling method located in Edirne, Kirklareli, Tekirdag, Istanbul and Canakkale as provinces of Trakya Region. The data based on the sampling the settlements were obtained from provincial directorates of agriculture and the Ministry of Agriculture and Rural Affairs Agricultural General Directorate of Agricultural Production and Development. The data belongs to the sampling of sunflower cultivation area were obtained from "Prime subsidies of Sunflower to Producer" lists of 2007.

Sampling Method

The Research data were prepared utilizing from "The Determination of Efficiency of Subsidizing Policies, and Productivity in Sunflower Production (TAGEM - 08/AR- GE / 06)" which supported by Ministry of Agriculture and Rural Affairs. The formula of Stratified Random Sampling Method which is used in research is given below (Yamane, 1967).

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

In formula;

n: sample volume

N_h: the number of units in the layer (frekans)

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.)

The total 571 surveys were conducted with sunflower producers in the content of research; 175 enterprises in 16 villages in 9 districts in Edirne province; 116 enterprises in 11 villages in 11 districts Kirklareli province, 233 enterprises in 21 villages in 9 district in Tekirdag province, 26 enterprises in 3 villages in 2 districts in Istanbul province and 21 enterprises in 2 villages in 2 district in Canakkale province. However, the survey data compiled from production cross-sectional data of 2009. In identification of residential units for the

survey, confidence interval of 95% and deviation from mean 4% were taken. In determination of the survey applied, the confidence interval 95% and deviation from mean 1% were taken (Erkan and Cicek, 1996).

Broomrape *(Orobanche cernua)* which directly affects the seed yield is one of the biggest problems in sunflower production in Trakya Region (Kaya et al., 2009). Genetically resistant to broomrape sunflower hybrids and also IMI (*Imidazolinone*) herbicide which control effectively both broomrape and key weeds with IMI herbicide resistant hybrids use commonly in sunflower production in broomrape infested areas in Trakya region (Demirci and Kaya, 2009). Farmers decide firstly which variety would plant depending on the broomrape infestation of their fields. Therefore, genetically resistant varieties of sunflowers to broomrapes, IMI herbicide resistant varieties and non resistant varieties to broomrapes are used in the research. In this context, research investigates whether there are differences for the yield obtained per unit area and water productivity in between "Genetic Resistant Varieties to Broomrape", "Herbicide Resistant Varieties to IMI groups" and "non resistant varieties to Broomrape" types. Therefore, with utilizing from "ANOVA Test", the yield and water productivity differences were determined among the provinces in the research and as well as these three sunflower groups (Cakici et al., 2003) and "Turkey HSD Test" was used to determine in the differences among variables (Ural and Kilic, 2006; Altunisik et al., 2007; Green et al., 2000). Standard errors, the significance level of difference, lower and upper limits were calculated according to confidence interval of 95% in the multiple comparisons.

Adoption Indicators

The adoption rates, degree of adoption and intensity of adoption were determined among sunflower groups based on the resistance to broomrape. ***Adoption rate***; shows the ratio of the number of farmers who adopt the each sunflower groups in the research area to the total number of sunflower producers. ***Degree of adoption****;* represents the ratio of current sunflower varieties to total sown areas of sunflowers. ***Intensity of adoption*****;** It is calculated by multiplying the adoption rate with degree of adoption an represents the intensity of sunflower groups on cultivated areas (Mazid et al., 2009).

Water Productivity

As a not being agreed concept mainly in agriculture, "productivity" described and perceived as the amount of product obtained per unit area or agricultural production obtained from per unit area (MPM, 2002). Another important factor is "input productivity". On the other hand, water productivity is defined as the product amount or value due to per amount of water (m^3) used (rainfall amount and the amount of water used for irrigation) in production (Shideed et al., 2005). Each settlement where survey was carried out were evaluated based on the data obtained from General Directorate of Meteorology in terms of precipitation falling during sunflower production. Therefore, sunflower yields in each residential unit (ton/ha) and water productivity (g/m^3) was calculated separately. Between the groups which were generated according to provinces in research area and sunflower varieties resistant to broomrape, the statistical differences were determined by utilizing "ANOVA" and "Turkey HSD Test" on seed yield and water productivity. The correlation analysis was also performed between the revenue obtained from sunflower and water productivity.

Results and Discussion

According to EU typological classification, businesses are assessed according to their standard gross profit, and they are accepted to be specialized in the branches where the ratio of profit is over 2/3(TEAE, 2009). According to this definition 25.7% of companies in Turkey are specialized in the field of agricultural crops. With the examination of the businesses in the area of research, it is

Table 1
Irrigated areas and rate in sunflower production in the research area

Parameters	Provinces					Total area,ha
	Edirne	Kirklareli	Tekirdag	Istanbul	Canakkale	
Cultivated area of sunflower, ha	1176.00	1308.40	2430.55	295.30	139.50	5349.75
Irrigated area of sunflower, ha	57.80	53.20	15.30	0.00	23.00	149.30
Irrigation rate of sunflower, %	4.91	4.07	0.63	0.00	16.49	2.49

Table 2
ANOVA table of rainfall of provinces in the research area

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	254521.089	4	63630.272	34.482	0.000
Within groups	1044460.528	566	1845.337		
Total	1298981.617	570			

Table 3
Precipitation in the provinces in the research area

Provinces (I)	Provinces (J)	Mean difference (I-J)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
Canakkale	Istanbul	-86.369*	12.603	0.000	-120.860	-51 879
	Kirklareli	107.496*	9.321	0.000	81.988	133.004
Istanbul	Edirne	97.973*	9.029	0.000	73.265	122.681
	Tekirdag	93.367*	8.882	0.000	69.060	117.674
Kirklareli	Tekirdag	-14.129*	4.881	0.032	-27.488	-0.771

(*). The mean difference is significant at the 0.05 level

found that wheat-sunflower alternation is applied on closely 90% of the production pattern and producers' revenues are based on these products.

Sunflower Irrigation

The ratio of irrigated land to total land is 2.79% in the research area. Among the provinces the highest rate 16.49% was observed in Canakkale (Table 1). Although the ratio of farmers growing sunflower in irrigated conditions to total farmers have irrigation conditions is 57.32%, the ratio of sunflowers in total irrigated area is so low (14.61%).

The Amount of Precipitation

The statistical differences were observed on precipitation among the provinces of Trakya Region in 2008-2009 (Table 2). Based on Multiple Comparative Variance Analysis, the rainfall amount between Canakkale-Istanbul, Istanbul-Kirklareli, Istanbul-Edirne, Istanbul-Tekirdag and Kirklareli-Tekirdag provinces is determined as statistically different in significance level of 5% (Table 3). The rainfall varied between 514.67 mm and 622.17 mm among the provinces in the research area. The average rainfalls in the provinces of research area are 535.8 mm in Canakkale, 622.17 mm in

Table 4

General variance table of sunflower yield between the provinces of research area

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	11,717	4	2,929	14,436	0.000
Within groups	114,843	566	0,203		
Total	126,560	570			

Table 5

Sunflower yields of provinces in the research area

Provinces (I)	Provinces (J)	Mean difference (I-J)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
Canakkale	Istanbul	0.815*	0.132	0.000	0.453	1.176
	Kirklareli	0.425*	0.107	0.001	0.133	0.717
	Edirne	0.315*	0.104	0.022	0.030	0.599
	Tekirdag	0.514*	0.103	0.000	0.233	0.795
Istanbul	Kirklareli	-0.389*	0.098	0.001	-0.657	-0.122
	Edirne	-0.500*	0.095	0.000	-0.759	-0.241
	Tekirdag	-0.300*	0.093	0.012	-0.555	-0.045
Kirklareli	Edirne	-0.110	0.054	0.244	-0.258	0.037
	Tekirdag	0.089	0.051	0.408	-0.051	0.229
Edirne	Tekirdag	0.200*	0.045	0.000	0.076	0.323

(*). The mean difference is significant at the 0.05 level

Istanbul, 514.67 mm in Kirklareli, 524.20 mm in Edirne and 528.80 mm in Tekirdag.

Sunflower Yield

Statistical differences were found at 1% significance level for the average sunflower yield obtained from per unit area among the provinces in the research area (Table 4). Based on Multiple Comparisons Analysis, the sunflower yield which was obtained from per unit area were statistically different in significance level of 5% in among the provinces, except the difference among Kirklareli-Edirne-Tekirdag (Table 5).

The average sunflower yield was calculated as 1.807 ton ha^{-1} in the study. The average sunflower yields of provinces in the research area were; 1.423 ton/ha in Istanbul, 1.723 ton ha^{-1} in Tekirdag, 1.812 ton ha^{-1} in Kirklareli, 1.923 ton ha^{-1} in Edirne and 2.237 ton ha^{-1} in Canakkale. The average sunflower yields of Istanbul and Canakkale exhibited the deviations from the average yield value both in negative and positive directions as 0.450 ton ha^{-1} approximately.

Water Productivity in Sunflower

Statistical difference was calculated in the water productivity of sunflower among the provinces at the significance level of 5% (Table 6). Based on Multiple Comparative Variance Analysis, the productivity of water obtained from per unit area was statistically different at the 5% significance level among the provinces of research area except among Canakkale-Edirne, Kirklareli-Edirne and Kirklareli-Tekirdag (Table 7).

Table 6
ANOVA table of water productivity of sunflower among groups

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	617189.489	4	154297.372	18.332	0.000
Within groups	4763981.754	566	8416.929		
Total	5381171.243	570			

Table 7
Comparative analysis table of water productivity of sunflower between provinces

Provinces (I)	Provinces (J)	Mean difference (I-J)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
Canakkale	Istanbul	188.356*	26.917	0.000	114.695	262.018
	Kirklareli	60.996*	21.757	0.042	1.456	120.535
	Edirne	50.403	21.187	0.123	-7.578	108.384
	Tekirdag	88.144*	20.903	0.000	30.942	145.347
Istanbul	Kirklareli	-127.361*	19.907	0.000	-181.838	-72.884
	Edirne	-137.953*	19.283	0.000	-190.722	-85.184
	Tekirdag	-100.212*	18.970	0.000	-152.125	-48.300
Kirklareli	Edirne	-10.592	10.984	0.871	-40.652	19.467
	Tekirdag	27.149	10.425	0.071	-1.381	55.678
Edirne	Tekirdag	37.741*	9.177	0.000	12.627	62.855

(*). The mean difference is significant at the 0.05 level.

Table 8
ANOVA table of sunflower revenue among provinces

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	12,680	2	6,340	32,037	0.000
Within groups	133,182	673	0,198		
Total	145,861	675			

The water productivity of sunflower was deviated between 229.18 g/m^3 and 417 g/m^3 among the provinces in the research area. The water productivity of sunflower in provinces was; Canakkale 417.53 g/m^3, Istanbul 229.18 g/m^3, Kirklareli 356.54 g/m^3, Edirne 367.130 g/m^3 and Tekirdag 329.38 g/m^3.

Sunflower Revenue

Based on variance analysis, statistical difference at 5% significance level of was found for sunflower revenue obtained per unit area (US$ ha^{-1}) among the provinces (Table 8). The average revenue obtained from per unit area was statistically different at significance level of 5% among

Table 9

Comparative analysis table of income of sunflower between the provinces

Provinces (I)	Provinces (J)	Mean difference (I-J)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
Canakkale	Istanbul	357.673*	62.128	0.000	187.656	527.691
	Kirklareli	168.774*	50.217	0.007	31.349	306.198
	Edirne	103.240	48.902	0.217	-30.586	237.066
	Tekirdag	194.887*	48.246	0.001	62.858	326.917
Istanbul	Kirklareli	-188.900*	45.947	0.000	-314.639	-63.161
	Edirne	-254.433*	44.507	0.000	-376.300	-132.637
	Tekirdag	-162.786*	43.784	0.002	-282.605	-42.967
Kirklareli	Edirne	-65.534	25.353	0.075	-134.914	3.847
	Tekirdag	26.114	24.062	0.814	-39.735	91.962
Edirne	Tekirdag	91.647*	21.182	0.000	33.681	149.613

(*). The mean difference is significant at the 0.05 level

the provinces except between Canakkale-Edirne, Kirklareli-Tekirdag and Kirklareli-Edirne (Table 9).

Average revenue of sunflower is determined as 834.55US$ ha^{-1} in the study. The average revenue of sunflower of provinces were; 638.62 US$ ha^{-1} in Istanbul, 801.40 US$ ha^{-1} in Tekirdag, 827.52US$ha^{-1} in Kirklareli, 893.05 US$ ha^{-1} in Edirne and 996.29 US$ ha^{-1} in Canakkale. Based on correlation analysis; positive correlations was found between the income of sunflower and water productivity of sunflower varieties at 1% significance level.

Adoption Situation of Sunflower Cultivars based on Variety Groups

Adoption Degree

IMI herbicide resistant varieties had the highest rate as 51.01% under total area of sunflower cultivation 5349.75 ha in the research area. The genetically resistant hybrids to broomrape existed at 2nd rank sharing of 41.58%, and non resistant hybrids took only 7.41% in the sunflower planting area. Based on provinces, IMI resistant varieties are more common in Tekirdag and Kirklareli, genetically resistant ones are growing more in Edirne province.

Adoption Rate

Genetically resistant hybrids had the highest adoption rate (49.46%) in research area and it was followed by IMI resistant varieties as 40.88% and non resistant hybrids as 9.65% respectively. Genetically broomrape resistant and IMI herbicide resistant hybrids planted intensively in sunflower area which infested by broomrape. These infested areas reached about approximately 90% of culti-

Table 10

The relationship between the sunflower revenue and water productivity

		Revenue, US$ ha^{-1}
Water productivity, g / m^3	Pearson Correlation	0.935*
	Sig. (2-tailed)	0.000
	N	571

(*). Correlation is significant at the 0.01 level (2-tailed).

Table 11
ANOVA table of sunflower yield between the groups of sunflower varieties

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	12,680	2	6,340	32,037	0.000
Within groups	133,182	673	0.198		
Total	145,861	675			

Table 12
Comparative yield analysis table of sunflower through groups of sunflower varieties

Groups (I)	Groups (J)	Mean difference (I-J)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
GRH	IMIH	0.235*	0.036	0.000	0.150	0.319
	NRH	0.380*	0.060	0.000	0.238	0.522
IMIH	NRH	0.145*	0.061	0.047	0.001	0.289

(*). The mean difference is significant at the 0.05 level.

Table 13
ANOVA table of water productivity according to groups of sunflower hybrids

	Sum of squares	Degree of freedom	Mean square	F	Significance
Between groups	596797.213	2	298398.607	35.838	0.000
Within groups	5603635.254	673	8326.353		
Total	6200432.467	675			

vated areas of sunflower in Trakya Region (Kaya et al., 2009) and IMI herbicide application and planting genetically resistant hybrids are only solutions to overwhelm this problem. Research results indicated that farmers were aware of this problem and they perceived how to solve it truly.

Adoption Intensity

IMI resistant varieties had the highest adoption intensity rate (20.86%) in the research and Genetically Resistant ones followed it very closely (20.57%). However, non resistant hybrids to broomrape had very lower rate (0.71%).

Sunflower Yield in Variety Groups

As the result of variance analysis it is determined that there is statistical difference in the significance level of 1% between the groups of sunflower varieties in respect to average yield (Table 11).

According to analysis, it is understood that all the groups of sunflower varieties have statistically difference at the 5% significance level (Table 12). In the groups of sunflower hybrids, the average yield was calculated as 1.794 ton ha^{-1}.

The average sunflower yield value of the group was found as follows: Hybrids non resistant to broomrape was 1.549 ton/ha, IMI herbicide resistant hybrids was 1.694 ton ha^{-1}, Hybrids genetically resistant to broomrape was 1.929 ton ha^{-1}. The yield of genetically resistant hybrids was higher than the other hybrids of sunflower.

Table 14
Comparative analysis of water productivity of sunflower based on hybrid groups

Groups (I)	Groups (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
Genetically resistant hybrids	IMI Resistant	46.666*	7,401	0.000	29.28	64.05
	Non Resistant	88.953*	12,392	0.000	59.85	118.06
IMI Herbicide Resistant	Non Resistant	42.286*	12,547	0.002	12.82	71.76

(*). The mean difference is significant at the 0.05 level.

Water Productivity Based on Sunflower Hybrid Groups

Study results indicated that there was a statistical difference between water productivity of sunflower hybrids (Table 13) and also among hybrids groups at 5% significance level (Table 14). Water productivity varied between 280.19 g/m^3 and 369.14 g/m^3 in sunflower hybrids. Among the sunflower hybrids the water productivities were measured: 369.14 g/m^3 for genetically resistant hybrids, 322.47g/m^3 for IMI herbicide resistant ones, and 280.19 g/m^3 for non resistant ones. Research results implied that genetically resistant hybrids got benefit from water more efficiently than other hybrids.

Subsidies of Turkish Government to Irrigation Systems

Turkish Ministry of Agriculture and Rural Affairs supports irrigation systems within the frame of a public notice as" Conducted to Support of Rural Development Program, Notification Relative to Support of Purchasing Machine and Equipment (Notification no: 2010/5)". Modern pressurized irrigation systems (Drip and Sprinkler Irrigation Systems) are intended to be build up and disseminated for infield with the application of support on agriculture.

Based on this supporting system, 50% cost of irrigation products which purchased by producers are subsidizing by government (Official Gazette, 2010). This policy has contributed recently to accelerate the use of modern irrigation system in the agricultural production and irrigation rates in Turkey.

Conclusion

The research results indicated that the water efficiency differed by sunflower hybrids in Turkey. Irrigation is the main contributing factor affected mainly sunflower revenue obtained per ha at least one time at the beginning of flowering stage which increases more than 25% of the seed yield.

Genetically resistant hybrids to broomrape should prefer in irrigated conditions because of having higher water productivity than other hybrids.

The study results revealed that Turkish farmers understood entirely how to struggle with broomrape which is the main problem in sunflower production in Trakya region with observing higher adoption rates on genetically broomrape resistant and IMI herbicide resistant hybrids. However, due to higher adoption rates, the study results indicated that IMI herbicide resistant hybrids preferred more than genetically resistance ones because of controlling both broomrape and also key weeds efficiently in sunflower production.

To reduce Turkish vegetable oil deficit and to increase sunflower production which is the main oil crops in Turkey, irrigating of sunflower should consider primarily in Turkey especially with preferring hybrids having higher oil contents.

Due to highly positive effects to increase irrigating rate and improving quality of irrigation in

recent years, Turkish government should continue to subsidize to irrigation systems.

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