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Research Article

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Gross Margin Analysis of Alfalfa (*Medicago sativa* L.) Genotypes As Influenced By Sowing Dates

Abstract

In this study the economic performance of different sowing times of alfalfa cultivars were examined. Plots were established in 2015-2017 period, in the area of Siirt University, Faculty of Agriculture, Department of Field Crops, in Turkey. The randomized split block experimental design with three replications was applied in the study. Main plots were consisted from the genotypes and the subplots were consisted from the sowing times. The experimental material comprised of four alfalfa genotypes, three different planting times. The gross margin analysis were used to analyse the data for the study. Gross margin, indicator per unit area was used to evaluate of production success level and compare economic efficiency of different dates of planting for alfalfa genotypes. Kolmogorov-Smirnov test used for data normality test and analysis of variance used to analyze the differences between group means. As a result, maximum gross margin was obtanied at Magnum V planted on 5th April (D2) in 2017, while Nimet planted on 30th April (D3) in 2015 have the minimum gross margin (-13.61).

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INTRODUCTION

Alfalfa (*Medicago sativa* L.) that is often called "Queen of forages" is the most important forage crop species in the world. In addition to being an excellent source of protein, vitamins and minerals, alfalfa is important for improving the soil. Good quality alfalfa hay contains digestible fibers and a useful range of minerals and vitamins (Wu, 2005). Alfalfa originated in Vavilov's Near Eastern Center Asia Minor, Transcaucasia, Iran and Turkistan (Bolton et al., 1972). Parts of Iran around of Caspian Sea and east of Anatolian plateau are centers of origin of primitive or diploid forms of M. sativa (Lesins, 1976; Abbasi et al., 2007). Alfalfa can be cut up to ten times per year, depending on the regions. This performance cannot be seen in other forage crops. In addition, alfalfa high adaptability to different climatic conditions. Alfalfa is the main legume used for livestock feed in Turkey. Also, it is one of the most commonly used legumes for both hay and pasture because of its high yield, high nutritional quality, ability to fix nitrogen and vigorous fall regrowth (Acikgoz, 2001). The land area under alfalfa production in Turkey is about 635.105 ha which produces 17.544.946 ton of alfalfa in 2018. Igdir province is one of the major alfalfa producing provinces in which about 10.48% of alfalfa production in Turkey is provided from this province and it is followed by Van (8.34%), Aksaray (7.72%), Muş (7.66%), Konya (7.37%), Aydın (4.36%), respectively (TURKSTAT, 2018). Many studies have conducted in Turkey on agronomic studies of alfalfa genotypes (Kir and Soya, 2008; Geren et al., 2009; Turan, 2010; Altınok and Karakaya, 2015; Acıkbas et al. 2017; Turan et al., 2017; Karakoy and Sarac, 2018; Cacan et al. 2020). But there isn't any study on economic analysis of agronomic studies of alfalfa cultivars. The objective of present study was to examine the economic performance of different sowing times of alfalfa cultivars. Gross margin, indicator per unit area was used to evaluate of production success level and compare economic efficiency of different dates of planting for alfalfa genotypes.

MATERIALS and METHODS

This research was carried out in the area of Siirt University, Faculty of Agriculture, Department of Field Crops during the year 2015-2017. The experimental site is located at 37˚58' N latitude and 41˚50' E longitude with prevailing terrestrial climate type. Therefore, the experimental site is irrigated after each cutting. Weather data were presented at Table 1.

Table 1. Temperature, precipitation and relative humidity values of the research area*

Months	Temperature (^{0}C)				Precipitation (mm)				Relative humidity (%)			
	LYA**	2015	2016	2017	LYA**	2015	2016	2017	LYA**	2015	2016	2017
January	2.60	3.86	1.69	2.95	96.80	60.80	162.40	48.80	73.30	73.98	76.04	66.11
February	4.20	6.04	8.06	2.74	97.50	92.00	63.80	26.60	68.50	70.72	68.39	64.49
March	8.30	9.14	10.07	9.54	111.10	125.00	135.60	126.60	60.4	63.19	62.35	64.16
April	13.70	13.72	16.70	14.00	104.70	53.20	66.80	124.60	50.40	55.48	47.45	59.18
May	19.30	20.42	19.90	19.55	62.00	26.80	64.60	74.60	41.50	42.99	48.92	51.62
June	26.00	26.87	26.52	26.94	8.70	3.60	20.40	0.0	24.10	27.79	32.63	29.44
July	30.60	32.09	31.37	32.28	1.60	0.00	2.40	0.0	18.10	19.56	24.48	18.99
August	30.10	31.37	32.28	31.94	0.90	2.40	0.20	0.40	17.20	22.55	20.55	18.99
September	25.10	28.13	24.86	28.31	4.90	1.60	18.80	0.0	24.00	23.14	29.82	19.22
October	17.90	18.54	19.49	18.35	49.10	188.00	40.20	18.40	45.30	59.23	37.10	35.15
November	10.40	10.56	10.33	11.13	81.40	56.80	51.80	73.40	57.10	64.76	49.82	64.44
December	4.80	5.00	3.35	7.95	94.40	57.80	104.2	47.40	56.9	61.75	72.92	65.29
Total/Average	16.08	17.15	17.05	17.14	713.10	668.00	731.20	540.80	44.73	48.76	47.54	46.42

*Meteorology Regional Directorate, Siirt **LYA: Long years' average (1960-2017)

Table 2. Soil analysis results of the research area*

										Soil (%)		
pH	Salt ds/m	Lime ($CaCO_3$)	Organic matter	P (P_2O_5) kg da^{-1}	K (K_2O) ppm	Fe ppm	Cu ppm	Zn ppm	Mn ppm	Sand	Clay	Silt
7.21	1.47	16.30	1.96	2.44	620	14.07	5.89	1.13	22.71	36	44	20

*Soil analysis were conducted at the Siirt University Science and Technology Application and Research Center Directorate (2015)

The experimental material comprised of four alfalfa genotypes (Gea, Magnum V, Kayseri, Nimet), three different planting times (10 March 2015, 05 April 2015, 30 April 2015). The randomized split block experimental design with three replications was applied in the study. Main plots were consisted from the genotypes and the subplots were consisted from the sowing times. The experiment details presented at Table 3.

Table 3. Experiment details

Genotypes	Symbol
Kayseri	V_1
Magnum V	V_2
Gea	V_3
Nimet	V_4
Sowing Dates	
10 March 2015	D_1
05 April 2015	D_2
30 April 2015	D_3

Alfalfa genotypes were sown at 25 cm row spacing with a planting density of 3 kg da^{-1} of seeds. Plots were fertilized uniformly at the planting with 15 kg da^{-1} DAP (18% N and 46% P). The size of each unit plot was 2m × 5 m. The distance between blocks and

plots were 2.0 m and 1.0 m, respectively. The harvest time was based on the 10-15% flowering stage of alfalfa. From each plot, six rows in the middle were harvested. To eliminate side-row effects, 0.5 m at both sides of these rows was discarded. Plots were harvested 5 times for the first and second sowing date while 4 times for the third sowing date in the year of establishment. In 2016-2017 plots were harvested 5 times for each sowing date. The gross margin analysis was employed to analyze the data for the study. Gross margins, however, should only be compared with figures from farms with similar characteristics and production systems. With this reservation in mind, the comparisons can give a useful indication of the production and economic efficiency of an enterprise (Firth, 2002). Gross margin analysis is an ideal approach in terms of the comparison of variable factors (Aras, 1988). This method was applied in most of the previous studies (Aydin et al., 2016; Baran et al., 2014; Baran, 2017; Kumar et al., 2019). Gross Margin were estimated as Eq.1 (Erkus et al., 1995). Gross margin = Total Value of Production – Total Variable Cost (1) Variable costs include land cultivation, utilized temporary labour costs, fertilization, material costs (seed, fertilizer, fuel) and harvest costs (Erkus et al., 1995; İnan, 2001). The costs for the materials used were calculated by taking the market prices into consideration. Daily wages paid to workers in the region were taken into consideration when calculating the labor costs. The calculation of machine power costs was based on local unit machine rental prices. The revolving fund interest was calculated by applying half of the interest rate applied by TR. Ziraat Bank to agricultural production credits (Acil, 2001). Kolmogorov-Smirnov test used for testing normality of the distribution. Economic outcome was analyzed using the analysis of variance (ANOVA). Significances were declared at the probability level of 0.05, unless otherwise stated.

RESULTS and DISCUSSION

The average data on gross production value as influenced by varying planting dates and genotypes are presented in Table 4.

Table 4. Gross production value of different sowing times of alfalfa cultivars

Years		V1	V2	V3	V4
Dry Herbage Yield (kg ha^{-1})					
2015	D1	106.90	80.07	106.14	110.64
	D2	84.69	92.74	118.92	120.82
	D3	53.23	59.92	59.50	42.73
2016	D1	145.36	156.14	156.96	151.73
	D2	151.55	175.23	170.06	172.40
	D3	155.12	134.01	144.07	154.25
2017	D1	170.51	159.76	180.59	155.94
	D2	144.71	190.61	178.91	150.06
	D3	168.19	132.33	168.53	160.04
Gross Production Value (TL ha^{-1})					
2015	D1	85.52	64.05	84.91	88.51
	D2	67.76	74.19	95.13	96.65
	D3	42.59	47.94	47.60	34.18
2016	D1	116.29	124.91	125.57	121.39
	D2	121.24	140.18	136.05	137.92
	D3	124.10	107.21	115.26	123.40
2017	D1	153.46	143.78	162.53	140.34
	D2	130.24	171.55	161.01	135.05
	D3	151.37	119.10	151.68	144.04

As regarding the gross production value of genotypes by varying planting dates and years, the maximum gross production value was recorded with the Magnum V planted on 5th April (D_2) in 2017. While, it was observed that genotype Nimet recorded the minimum gross production value planted on 30th April (D_3) in 2015 (Table 4). In the calculation of the gross production value, sale price of alfalfa was 0.80 TL kg^{-1} in 2015 and 2016, while 0.90 TL kg^{-1} in 2017. The reason for this is the low gross production value of alfalfa in 2015, the initial year (2015) is the establishment year. Further, genotypes were harvested 4 times for the third sowing date in the year of establishment. Data analysis indicated the normality of the values of gross production ($p>0.10$). According to ANOVA results, in 2015 there was no significance between genotypes for gross production value ($p:0.662$, $p>0.05$). In contrasts, there was a significant effect of sowing date on gross production value ($p:0.00$, $p<0.05$). In 2016, there was no significant effect of genotypes on gross production value ($p:0.882$, $p>0.05$) Similarly, the effect of the sowing dates on gross production value was no statistically significant ($p:0.076$, $p>0.05$). In 2017, statistical results are same with 2016. There was no significant effect of genotypes and sowing dates on gross production value ($p:0.172$ and $p:0.469$, respectively, $p>0.05$). In the ANOVA, there was no significant effect of genotypes on gross production value ($p:0.216$, $p>0.05$) whereas the effect of the years was statistically significant ($p:0.00$, $p<0.05$). Furthermore, the effect of

the sowing dates on gross production value was statistically significant (p:0.00, p<0.05) The most profitable genotype was Magnum V planted on 5th April (D_2) in 2017 according to gross margin results. The minimum gross margin (-13.61) was recorded for the Nimet planted on 30th April (D_3) in 2015 based on average data mean (Table 5).

Table 5. Gross margin of different sowing times of alfalfa cultivars.

Years		V_1	V_2	V_3	V_4
Variable Costs (TL ha^{-1})					
2015	D_1	52.37	55.49	56.12	51.44
	D_2	52.37	55.49	56.12	51.44
	D_3	48.73	51.85	52.48	47.80
2016	D_1	42.10	42.10	42.10	42.10
	D_2	42.10	42.10	42.10	42.10
	D_3	37.94	37.94	37.94	37.94
2017	D_1	50.85	50.85	50.85	50.85
	D_2	50.85	50.85	50.85	50.85
	D_3	46.16	46.16	46.16	46.16
Gross Margin (TL ha^{-1})					
2015	D_1	33.15	8.56	28.80	37.07
	D_2	15.38	18.70	39.02	45.22
	D_3	-6.15	-3.92	-4.87	-13.61
2016	D_1	74.19	82.80	83.47	79.28
	D_2	79.14	98.08	93.95	95.82
	D_3	86.16	69.27	77.31	85.46
2017	D_1	102.61	92.93	111.67	89.49
	D_2	79.39	120.70	110.16	84.20
	D_3	105.21	72.93	105.51	97.88

Data analysis indicated the normality of the values of gross margin (p>0.10). In 2015 there was no significance between genotypes for gross margin (p:0.578, p>0.05). However, there was a significant effect of sowing date on gross margin (p:0.00, p<0.05). In 2016, there was no significant effect of genotypes on gross production value (p:0.875, p>0.05). In addition, the effect of the sowing dates on gross production value was no statistically significant (p:0.169, p>0.05). In 2017, there was no significant effect of genotypes and sowing dates on gross production value (p:0.158 and p:0.866, respectively, p>0.05). According to ANOVA results, there was no significant effect of genotypes on gross margin, whereas the effect of the years was statistically significant. Further, the effect of the sowing dates on gross margin was not statistically significant.

CONCLUSION

Estimated profitability were useful in agronomic studies, matter agronomic

characteristics and yield alone. In the study, maximum gross margin was obtanied at Magnum V planted on 5th April (D2) in 2017, while Nimet planted on 30th April (D3) in 2015 have the minimum gross margin (-13.61). As a result, it was determined that genotype of Magnum V had more profit able than other genotypes. In addition, data revealad that the crops planted in 5th April had higher gross margin than other sowing dates.

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