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HERBAGE YIELDS AND QUALITY TRAITS OF DIFFERENT SAINFOIN GENOTYPES

Isa Tepe [1], Mahmut Kaplan [1,*]

[1] Erciyes University, Faculty of Agriculture, Department of Field Crops, Kayseri, Turkey

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Abstract
This study was conducted to determine green herbage yield, dry herbage yield, crude protein yield, ADF, NDF ratios, crude protein ratio, crude oil, crude ash and tannin ratios of 26 sainfoin genotypes and to identify superior genotypes in terms of yield and quality traits. Experiments were conducted in randomized blocks design with tree replications in 2017-2018 growing season. Significant differences were observed in investigated traits of the genotypes. Green herbage yields varied between 765.36 - 2737.25 kg/da, dry herbage yields between 281.01 - 693.42 kg/da, crude protein yields between 48.96 - 133.34 kg/da, crude protein ratios between 11.81 - 23.78%, crude ash ratios between 4.42 - 8.02%, ADF ratios between 37.12 - 56.76%, NDF ratios between 42.12 - 67.01%, crude oil ratios between 0.81 - 1.73% and condensed tannin contents 1.35 - 5.78%. Therefore, it was recommended for Kayseri province and the regions with similar climate and soil conditions.

Keywords: chemical composition, herbage yield, sainfoin.

1. INTRODUCTION

Ever-increasing stress exerted by global warming and resultant droughts on agricultural practices clearly revealed the significance of feed crops in unirrigated lands. Feed crops have various positive impacts on soil physical and chemical characteristics, yield and quality of subsequent crops. They also provide significant source of roughage and feed in livestock industry (Aksay et al., 2005; Yolcu and Tan, 2008).

Sainfoin (*Onobrychis viciifolia* Scop.) belongs to legumes (*Fabaceae*) family. It is a perennial feed crop with high quality roughage able to be grown under different ecological conditions (Elci, 2005). Sainfoin is highly resistant to low temperatures and droughts, thus could successfully be grown in barren lands. It is rich in protein, minerals and vitamins (Avci et al., 2014). Sainfoin cultivars exhibit a great variation in yield and quality traits. Therefore, it is quite significant that genotypes and cultivars should be experimented for yield and quality traits under different climate and soil conditions (Harmanlioglu, 2019). Animal feeding behaviors, feed consumptions, digestibility and conversion into animal products are directly related to feed quality. Feed quality is determined through measurements for physical, chemical and biological traits of the feeds (Ulger and Kaplan, 2016). Previous studies mostly focused on chemical composition, metabolic energy and digestibility of different sainfoin cultivars, but the number of studies investigating yield and quality traits of sainfoin genotypes is quite limited.

*Corresponding author, E-mail address: mahmutkaplan5@hotmail.com

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This study was conducted to determine green and dry herbage yield, crude protein yield, ADF, NDF, crude protein, crude oil, crude ash and tannin ratios of 26 sainfoin genotypes and to identify superior genotypes in terms of yield and quality traits.

2. MATERIALS AND METHODS

In this study, 26 sainfoin genotypes supplied from Field Crops Department of Erciyes University Agricultural faculty were used as the plant material of the experiments. Experiments were conducted in randomized blocks design with 3 replications over the experimental fields of Agricultural Research Center of Erciyes University. Seeds were sown in April 2017. Measurements were not able to be performed in the first year of the experiments. Experimental plots were 5.0 x 3.0 m. Row spacing was 50 cm. Fertilization was practiced at sowing as to have 3 kg/da N and 6 kg/da P_2O_5. Throughout the growing season, manual weeding was practiced for weed control. Plants were grown without irrigation. Harvest was practiced at 50% flowering stage. At harvest, side rows and 0.5 m sections from the top and bottom of the plots were omitted as to consider side effects and harvested plants were weighed to get green herbage yields. Plant samples were dried at 70 °C until a constant mass and weighed to get dry herbage yields.

Kayseri province has a temperate climate with hot and dry summers and cold and snowy winters. Monthly total precipitations were lower than the long-term averages in 2017 and greater in 2018. Monthly average temperatures were similar with the long-term averages in both years. Experimental soils were loamy in texture, slightly alkaline and unsaline. Soils were insufficient in available phosphorus, moderate in organic matter, high in available potassium and low in lime.

Dry samples were ground to pass through 1 mm sieve. For crude ash content, samples were dried in an ash oven at 550 ^oC for 8 hours. Ether extraction method was used to determine crude oil contents with the use of a Soxhlet collector device. Sample nitrogen (N) contents were determined with Kjeldahl method and crude protein contents were determined with the use of Nx0.6 formula (AOAC, 1990). NDF analysis was conducted with the use of Van Soest and Wine (1967) and ADF analysis with Van Soest (1963) methods. Condensed tannin contents were determined with the use of Buthanol-HCl method (Makkar et al., 1995).

Experimental data on herbage yields and quality traits of different sainfoin genotypes were subjected to analysis of variance with the use of SAS (Statistical Analysis Software) software. Significant means were compared with the use of LSD test (SAS Institute, 1999).

3. RESULTS AND DISCUSSIONS

The lowest green herbage yield (683.46 kg/da) was obtained from EUOS9 genotype and the greatest green herbage yield (2737.25 kg/da) was obtained from EUOS1 genotype. The average green herbage yield of sainfoin genotypes was calculated as 1328.39 kg/da. The lowest dry herbage yield (281.01 kg/da) was obtained from EUOS2 genotype and the greatest dry herbage yield (693.42 kg/da) was obtained from EUOS1 genotype. The average dry herbage yield of the sainfoin genotypes was calculated as 405.48 kg/da. The lowest crude protein yield (48.96 kg/da) was obtained from EUOS2 genotype and the greatest crude protein yield (133.34 kg/da) was obtained from EUOS1 genotype. The average crude protein yield of the sainfoin genotypes was calculated as 76.53 kg/da.

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Table 1. Green and dry herbage and crude protein yields of sainfoin genotypes

Genotypes	Green Herbage Yield (kg/da)	Dry Herbage Yield (kg/da)	Crude Protein Yield (kg/da)
EUOS1	2737.25 a	693.42 a	133.34 a
EUOS2	843.12 qp	281.01 m	48.96 m
EUOS3	1546.46 h	556.55 c	77.81 gh
EUOS4	1829.45 ef	549.00 c	107.50 cd
EUOS5	964.10 mn	322.56 j	49.78 lm
EUOS6	1465.97 i	502.11 e	88.88 ef
EUOS7	1005.09 lm	320.07 j	61.06 ijkl
EUOS8	765.36 r	314.34 jk	55.76 jklm
EUOS9	683.46 s	292.62 lm	56.25 ijklm
EUOS10	1740.67 g	399.07 g	82.43 fg
EUOS11	892.46 nop	295.70 klm	49.93 lm
EUOS12	2222.86 b	547.17 c	100.15 de
EUOS13	941.91 mn	346.13 i	75.11 gh
EUOS14	895.71 nop	298.33 klm	62.00 ijk
EUOS15	1775.64 fg	498.04 e	118.46 bc
EUOS16	962.24 mn	314.39 jk	53.02 klm
EUOS17	1046.52 l	344.71 i	76.67 gh
EUOS18	920.64 no	348.06 i	67.44 hij
EUOS19	780.89 qr	303.59 jkl	52.51 klm
EUOS20	1215.27 j	369.38 h	80.05 fg
EUOS21	1130.40 k	347.12 i	66.90 hij
EUOS22	857.61 op	314.07 jk	67.70 hi
EUOS23	1245.75 j	384.75 gh	74.47 gh
EUOS24	2145.94 c	526.82 d	62.11 ijk
EUOS25	2060.94 d	598.51 b	123.43 ab
EUOS26	1862.41 e	475.08 f	98.00 de
Means	1328.39	405.48	76.53
LSD	76.36	19.12	11.79

The lowest crude protein ratio (11.81%) was obtained from EUOS24 genotype and the greatest crude protein ratio (23.78%) was obtained from EUOS15 genotype. The average crude protein ratio of the sainfoin genotypes was calculated as 18.93%. The lowest crude ash content (4.45%) was obtained from EUOS12 genotype and the greatest crude ash content (8.02%) was obtained from EUOS15 genotype. The average crude ash content of the sainfoin genotypes was calculated as 6.04%. The lowest crude oil content (0.63%) was obtained from EUOS17genotype and the greatest crude oil content (1.73%) was obtained from EUOS21 genotype. The average crude oil content of the sainfoin genotypes was calculated as 1.13%. ADF ratios of sainfoin genotypes varied between 37.12 - 56.76% with an average value of 45.67%. The lowest ADF ratio was obtained from EUOS14 genotype and the greatest from EUOS26 genotype. NDF ratios of sainfoin genotypes

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varied between 42.12 - 67.01% with an average value of 53.95%. The lowest NDF ratio was obtained from EUOS14 genotype and the greatest from EUOS3 genotype. Condensed tannin contents of sainfoin genotypes varied between 1.35 - 5.78% with an average value of 3.22%. The lowest condensed tannin content was obtained from EUOS3 genotype and the greatest from EUOS19 genotype (Table 2).

Table 2. Biochemical properties of sainfoin genotypes

Genotypes	Crude Protein (%)	Crude Ash (%)	Crude Oil (%)	ADF (%)	NDF (%)	Condense Tannin (%)
EUOS1	19.25 bcdef	5.65 ijkl	0.88 def	48.46 bcd	54.26 def	3.74 cdefg
EUOS2	17.43 efg	5.93 ghij	1.20 abcde	44.96 cdefgh	55.14 cdef	3.72 cdefg
EUOS3	14.00 hi	4.79 op	0.81 ef	56.21 a	67.01 a	1.35 k
EUOS4	19.57 bcdef	5.46 jklmn	1.27 abcde	46.28 bcdefg	52.97 defg	3.35 fgh
EUOS5	15.41 gh	6.25 fgh	1.51 abc	44.21 defghi	53.53 def	3.56 defgh
EUOS6	17.71 defg	5.56 ijklm	1.57 ab	46.40 bcdef	53.18 def	3.08 fghi
EUOS7	19.07 bcdef	5.33 klmn	1.27 abcde	47.49 bcde	57.80 bcd	4.42 bcde
EUOS8	17.74 defg	5.75 hijk	0.92 def	42.56 efghij	51.37 efgh	5.13 ab
EUOS9	19.25 bcdef	5.16 lmno	1.14 bcdef	48.09 bcd	53.13 def	3.88 cdef
EUOS10	20.67 abcde	5.09 mno	0.99 cdef	49.63 bc	58.60 bcd	1.72 jk
EUOS11	16.81 fgh	7.08 cd	1.19 abcdef	46.29 bcdefg	55.98 cde	2.19 ijk
EUOS12	18.30 cdefg	4.45 p	0.86 ef	50.83 b	62.65 ab	1.87 jk
EUOS13	21.69 ab	7.01 cd	1.08 bcdef	46.33 bcdef	56.40 cde	1.81 jk
EUOS14	20.78 abcd	6.92 cde	1.20 abcde	37.12 k	42.12 i	3.42 efgh
EUOS15	23.78 a	8.02 a	0.89 def	46.56 bcde	60.73 bc	2.11 ijk
EUOS16	16.86 fgh	6.18 gh	1.16 bcdef	44.12 defghi	55.49 cde	4.68 bc
EUOS17	22.25 ab	7.28 bc	0.63 f	41.28 fghijk	49.56 fgh	4.52 bcd
EUOS18	19.39 bcdef	6.75 def	0.87 ef	46.20 bcdefg	53.88 def	2.62 hij
EUOS19	17.26 fgh	5.33 klmn	1.33 abcde	41.11 ghijk	51.41 efgh	5.78 a
EUOS20	21.66 ab	6.22 gh	1.30 abcde	42.60 efgij	51.78 efgh	3.40 efgh
EUOS21	19.36 bcdef	6.19 gh	1.73 a	39.66 ijk	47.08 ghi	3.10 fghi
EUOS22	21.58 abc	7.69 ab	1.21 abcde	38.67 jk	45.99 hi	2.74 ghij
EUOS23	19.35 bcdef	5.98 ghi	1.42 abcd	40.02 hijk	46.40 hi	1.98 jk
EUOS24	11.81 i	5.00 no	0.82 ef	50.98 b	57.09 bcde	1.98 jk
EUOS25	20.63 abcde	5.52 ijklm	1.15 bcdef	44.64 cdefghi	55.25 cdef	3.74 cdefg
EUOS26	20.63 abcde	6.43 efg	1.03 bcdef	56.76 a	54.00 def	3.74 cdefg
Means	**18.93**	**6.04**	**1.13**	**45.67**	**53.95**	**3.22**
LSD	**3.34**	**0.51**	**0.55**	**5.19**	**5.92**	**1.05**

The ADF, NDF, crude protein, crude oil, crude ash and tannin ratios of 16 sainfoin genotypes were investigated in this study and significant differences were observed in herbage yield and quality traits of the genotypes.

It was reported that herbage yields were significantly influenced by plant genetics, sowing dates, climate and soil conditions (Dumlu et al., 2017; Engin and Mut, 2017). Crude protein ratio of the

*Corresponding author, E-mail address: mahmutkaplan5@hotmail.com

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feeds and cell membrane components (ADF and NDF) are among the most significant quality criteria (Assefa and Ledin, 2001; Parlak et al., 2014). The differences in dry biomass and protein ratios of the present genotypes were attributed to differences in plant genetics, plant leaf, spike and stem ratios, ripening stages, climate factors and fertilization practice (Ball et al., 2001). Increasing ADF and NDF ratios reduce animal feed consumptions. It was also reported that high ADF and NDF ratios decreased digestible energy. Just because of significant effects on feed digestibility, low ADF and NDF ratios are desired in quality feeds (Van Soest, 1994; Bozkurt, 2011; Canbolat and Karaman 2009). High condensed tannin ratios also reduce digestion of feed proteins, thus have negative impacts on feed digestibility (Kumar and Singh, 1984). However, low condensed tannin ratios (2-3%) prevent excessive protein degradation in rumen, thus have positive impacts on feed digestibility (Barry, 1987). Plant oil contents are not constant and vary with the plant genetics, morphology, physiology, ecological conditions and cultural practices (Baydar, 2000). Crude ash is composed of unburnt portion of the dry biomass and is used as an indicator of mineral content of the feed (Gençtan, 1998). Minerals are not synthesized in animal body, so they should be supplied externally. Mineral contents up to 5% is accepted as complying with the standards, but upper limit of the minerals may vary from feed to feed (Anonymous, 2011).

4. CONCLUSIONS

Present findings revealed that EUOS1 genotype was prominent for yield components. Therefore, it is recommended for Kayseri province and the regions with similar climate and soil conditions. Further research is recommended for potential use of this genotype in sainfoin breeding programs.

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