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Evaluation of Some Wheat Cultivars as Roughage

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Abstract

This study was carried out during the growing season of 2015-2016 to determine the roughage value of some wheat cultivars. In the study, 3 bread wheat (Pehlivan, Aras, Cham-6) and 5 durum wheat (Eminbey, Bakrajo-1, Ovanto, Simito and Acsad-65) cultivars were used as plant material. Experiments were conducted in randomized complete blocks design with three replications. Plant height, green herbage yield, dry herbage yield, crude protein ratio, protein yield, acid detergent fiber, neutral detergent fiber, calcium, magnesium, phosphor and potassium ratios were investigated. Plant heights between 70.3 and 81.8 cm, green herbage yields between 694.0 and 2560.0 kg da^{-1}, dry herbage yields between 237.4 and 824.9 kg da^{-1}, crude protein ratios between 10.60 and 12.85%, protein yields between 29.6 and 98.5 kg da^{-1}, acid detergent fiber ratios between 30.78 and 34.92%, neutral detergent fiber ratios between 51.86 and 57.26%, calcium ratios between 0.36 and 0.47%, magnesium ratios between 0.11 and 0.17%, phosphor ratios between 0.35 and 0.38% and potassium ratios between 1.61 and 2.22% have changed. In the study, Aras and Acsad-65 cultivars for high green herbage, dry herbage and protein yields; Simito and Bakrajo-1 cultivars for low acid detergent fiber, neutral detergent fiber ratios and high calcium and magnesium contents were better results as roughage at wheat cultivars.

Keywords: ADF, herbage yield, NDF, nutrient content, wheat

INTRODUCTION

Our country has the deficit of roughage. Even if the rate of forage crops cultivation has reached to 8-9% among field crops in result of the supports in recent years, it is obvious that this level is not sufficient to meet the deficit. Therefore, new sources are required to meet the roughage deficit in Turkey.Small grain cereals such as wheat, barley, oat, rye and triticale can be harvested as herbage and utilized as roughage in addition to be cultivated for its grains and be used as human food. In our country like in the entire world, the utilization of cereals as fodder is widespread. The herbage derived from cereals is fed animals in green, dry and silage forms (Tan and Serin, 1997).

In dry regions, cereals can be cultivated for dry herbage production. Although all cereals can be used for that purpose, barley, oat, and wheat are preferred. The hays of cereals which are harvested in the proper period and dried are considered as good forage for ruminant animals. It is proposed to harvest cereals for herbage at the milk dough stage. Cereals should be harvested to produce good herbage at heading stage. Hays can be yielded from cereals

between 500 kg and 1500 kg per hectare depending on land fertility and maintenance (Acikgoz, 2013).

Cereals are so delicious and nutritious in the vegetative period for animals and include crude protein of 15-35%. Digestibility rate of nutrients is at 80%. It has a high carotin amount and low rate of cellulose, is rich in B vitamins and minerals. Cereals are quietly proper at the vegetative period for young animals and dairy cattles (Acikgoz, 2001). Cereals have a crucial potential to feed animals as a forage source with regards to yield, quality and mineral contents (Yolcu, 2008).

In Anatolia where cereal cultivation has been carried out throughout the history, it is considered that utilization of cereals as roughage source would contribute to meet the roughage deficit. For this reason, this study aims to unfold forage potential of certain wheat species by investigating yield and forage quality in the latter.

MATERIAL and METHODS

Material

This study has been conducted at the Bingol University Research and Practice Area during 2015-2016 growing season. The wheat cultivars used as study materials in the research and the institutions that have provided the cultivars are given in Table 1. The figures related to Bingol climate conditions are given in Table 2.

Table 1. The wheat cultivars used in the study and the providing institutions

No	Variety Name		Institutions and Organizations
1	Pehlivan	Bread wheat	GAP International Agricultural Research and Training Centre
2	Aras	Bread wheat	Sulaymaniyah Agricultural Research Institute / Iraq
3	Cham-6	Bread wheat	Sulaymaniyah Agricultural Research Institute / Iraq
4	Eminbey	Durum wheat	GAP International Agricultural Research and Training Centre
5	Bakrajo-1	Durum wheat	Sulaymaniyah Agricultural Research Institute / Iraq
6	Ovanto	Durum wheat	Sulaymaniyah Agricultural Research Institute / Iraq
7	Simito	Durum wheat	Sulaymaniyah Agricultural Research Institute / Iraq
8	Acsad-65	Durum wheat	Sulaymaniyah Agricultural Research Institute / Iraq

Table 2. Monthly average climate figures of Bingol for long years (2000-2015) and first half of 2016

Months	Average Temperature (°C)			Total Precipitation (mm)			Relative Humidity (%)		
	Long Years	2015	2016	Long Years	2015	2016	Long Years	2015	2016
January	-2.5	1.8	-2.8	154.0	147.2	257.8	73.3	75.1	75.4
February	-0.9	1.9	2.5	137.7	119.8	95.3	72.2	74.4	73.3
March	4.9	5.5	7.0	124.1	155.3	131.0	64.2	66.9	60.2
April	10.9	10.7	14.0	103.8	66.7	46.8	61.2	60.1	43.4
May	16.2	16.4	16.3	66.8	21.2	66.2	55.8	53.9	57.4
June	22.6	22.6	22.3	18.4	8.1	34.4	42.5	38.4	43.5
July	27.0	27.4	26.9	7.3	0.1	7.0	36.7	28.1	43.3
August	26.8	27.1	-	5.4	0.6	-	36.8	30.8	-
September	21.3	23.6	-	16.4	0.4	-	42.2	30.0	-
October	14.2	14.4	-	70.3	18.9	-	58.9	68.6	-
November	6.5	14.4	-	91.8	46.2	-	64.7	56.4	-
December	0.2	1.3	-	121.8	219.1	-	70.7	58.6	-
Total/Ave.	12.3	13.9	12.3	917.8	803.6	638.5	56.6	53.4	56.6

Source: General Directorate of Meteorology (Bingol)

As seen in the table, the long year's temperature average of Bingol is 12.3 °C. Accordingly in 2015, when the study was conducted, the annual average temperature was 13.9 °C. We can say that 2015 was a warm year for Bingol compared to previous years. Until the month of July, when the harvest took place, 2016 average temperature was 12.3 °C. During the first half of 2016 the figures were similar to those of long years' averages.

It has been determined that 2015 total precipitation level is lower than the total precipitation level of previous years. But during the first half of 2016, the amount of precipitation was higher than the previous years. In terms of relative humidity values, the average figure for the long years was 56.6% but in 2015 this figure became 53.4% and during the first half of 2016 it was 56.6%. It has been observed that the figures acquired for relative humidity were close to the previous year's average.

In conclusion, we can say that in Bingol, 2015 and the first half of 2016 was warmer, with less precipitation and similar moisture levels when compared to long years'.Soil samples have been taken from ten different points of the study area, from a depth of 0-30 cm, and then the samples were mixed. The analysis of the resulting sample took place at the Bingol University Faculty of Agriculture Department of Soil Science and Plant Nutrition Laboratories. Results of the analysis have been assessed by taking the limit values defined by Sezen (1995) and Karaman (2012) as a basis. Results of the analysis are given in Table 3.

Table 3. Soil texture, saturation, pH, salinity, lime content, organic matter content, phosphor and potassium amounts of the study area

Texture	Saturation (%)	pH	Salinity (%)	$CaCO_3$ (%)	Organic Matter (%)	P_2O_5 (kg da^{-1})	K (kg da^{-1})
Loamy	43.31	6.37	0.0066	0.15	1.26	7.91	24.45

As seen in Table 3, the soil texture of the study area was "loamy", with "mildly acidic" pH, no "salinity", "low" levels of lime, organic matter ratio was "low", phosphor ratio was "average" and potassium ratio was "sufficient".

Method

The trial has been established on 16 October 2015 over a randomized complete block experimental design with 3 repetitions. Planting was made where parcels lengths were 5 m, row spacing was 20 cm and each parcel had 6 rows. 500 seeds have been used per square meter during planting. Right before planting, 4 kg nitrogen (N), 8 kg phosphor (P_2O_5) fertilizer was applied over pure matter per decare. Then during the bolting period of the plans, 4 kg nitrogen (N) fertilizer was applied over pure matter per decare to increase the nitrogen (N) quantity to 8 kg da^{-1}. The trial was conducted under dry conditions. Harvesting of the plants took place on 12 May 2016.

Plant height, randomly selected from each parcel, 10 plants have been measured from soil surface to the top, including the awn, in cm and the average has been taken. The harvested herbage from each plot was weighed to get green herbage yields. Then, plot herbage yields were converted into yields per decare. From each green herbage harvest, 0.5 kg was dried at 70 ^{0}C for 48 hours (Anonymous, 2016). Dried samples were weighed to get dry herbage yields of the plots. Then, these values were also converted into dry herbage yields per decare.

Crude protein, ADF (Acid Detergent Fiber), NDF (Neutral Detergent Fiber), calcium, magnesium, phosphor and potassium analyses were performed at laboratories of Dicle University Scientific and Technological Research Center with NIRS (Near Infrared Spectroscopy - Foss Model 6500) analysis device.

Statistical Model and Assessment Method

The gathered data has been analysed by the help of JUMP statistics package program (software of SAS program) in accordance with randomized complete block experimental design with three repetitions. The factor averages that were statistically significant according to the variance analysis results have been compared to LSD test (Kalayci, 2005).

RESULTS and DISCUSSION

The plant height, green herbage yield and dry herbage yield averages observed in wheat cultivars are given in Table 4.

Table 4. Plant height, green herbage yield and dry herbage yield averages determined in wheat cultivars

		Plant Height (cm)	Green Herbage Yield (kg da^{-1})	Dry Herbage Yield (kg da^{-1})
1	Pehlivan	70.8 bc*	2237.1 b**	671.0 b**
2	Aras	78.8 ab	2560.0 a	801.8 a
3	Cham-6	81.8 a	1595.0 d	526.5 cd
4	Eminbey	70.3 c	1872.4 c	611.6 bc
5	Bakrajo-1	79.6 a	999.0 f	327.8 ef
6	Ovanto	80.6 a	1352.7 e	422.6 de
7	Simito	74.8 abc	694.0 g	237.4 f
8	Acsad-65	81.2 a	2454.0 ab	824.9 a
	Average	77.2	1720.5	552.9
	CV (%)	5.97	7.95	11.24

*) statistically significant at a level P≤0.05, **) statistically significant at a level P≤0.01

Different wheat cultivars are statistically significant at a level of 5% in terms of plant height and of the 1% in terms of green herbage and dry herbage yields.

Plant Height (cm)

The highest plant height has been obtained from Cham-6 cultivar by 81.8 cm, Acsad-65 cultivar by 81.2 cm, Ovanto cultivar by 80.6 cm and Bakrajo-1 cultivar by 79.6 cm and it was respectively followed Aras (78.8 cm) and Simito (74.8 cm) cultivars, statistically in the same group. The lowest plant height has been obtained from Eminbey cultivar by 70.3 cm.

The plant height average of the cultivars has been defined as 77.2 cm. Our findings are parallel to those obtained under Turkey conditions by Kaya (2004) 86.5 cm, by Mut et al. (2005) 66.9-98.8 cm, by Gumustas (2014) 79.4 cm.

Green Herbage Yield (kg da^{-1})

The highest green herbage yield has been obtained from Aras cultivar by 2560.0 kg da^{-1} and it was followed Acsad-65 cultivar by 2454.0 kg da^{-1}. The lowest green herbage yield has been obtained from Simito cultivar by 694.0 kg da^{-1}. The green herbage yield average of the cultivars has been defined as 1720.5 kg da^{-1}. The green herbage yield of wheat was determined to be 336.75 kg da^{-1} by Yolcu (2008).

Dry Herbage Yield (kg da^{-1})

The highest dry herbage yield has been obtained from Acsad-65 cultivar by 824.9 kg da^{-1} and Aras cultivar by 801.8 kg da^{-1}. The lowest dry herbage yield has been obtained from Simito cultivar by 237.4 kg da^{-1}. The dry herbage yield average of the wheat cultivars has been defined as 552.9 kg da^{-1}. The dry herbage yield of wheat was determined to be 175.54 kg da^{-1} by Yolcu (2008) and 65.1-477.5 kg da^{-1} by Tolu et al. (2013). The crude protein ratio, protein yield, acid detergent fiber and neutral detergent fiber averages observed in wheat cultivars are given in Table 5.

Table 5. The crude protein, protein yield, acid detergent fiber and neutral detergent fiber averages determined in wheat cultivars

		Crude Protein (%)	Protein Yield (kg da^{-1})	ADF (%)	NDF (%)
1	Pehlivan	11.22	75.1 b**	34.92 a**	56.90 ab**
2	Aras	12.27	98.5 a	34.25 ab	57.04 ab
3	Cham-6	10.60	55.8 cd	34.48 ab	56.69 ab
4	Eminbey	11.16	68.1 bc	33.52 ab	56.49 ab
5	Bakrajo-1	12.01	39.3 e	30.78 c	51.86 d
6	Ovanto	12.85	53.4 d	32.72 bc	54.54 bc
7	Simito	12.19	29.6 e	31.02 c	52.40 cd
8	Acsad-65	11.42	94.2 a	34.02 ab	57.26 a
	Average	11.71	64.2	33.21	55.40
	CV (%)	8.89	12.13	3.59	2.66

*) statistically significant at a level P≤0.05, **) statistically significant at a level P≤0.01

Different wheat cultivars are statistically significant at a level of 1% in terms of protein yield, acid detergent fiber and neutral detergent fiber.

Crude Protein Ratio (%)

Wheat cultivars are statistically insignificant in terms of crude protein contents. The crude protein content of the wheat cultivars to range from 10.60 to 12.85%. The crude protein average of the wheat cultivars has been defined as 11.71%. The crude protein content we have obtained were similar to those reported by Yolcu (2008) 13.11% and by Tolu et al. (2013) 4.0-14.0%.

Protein Yield (kg da^{-1})

The highest protein yield has been obtained from Aras cultivar by 98.5 kg da^{-1} and Acsad-65 cultivar by 94.2 kg da^{-1}. The lowest protein yield has been obtained from Bakrajo-1 cultivar by 39.3 kg da^{-1} and Simito cultivar by 29.6 kg da^{-1}. The protein yield average of the wheat cultivars has been defined as 64.2 kg da^{-1}. The protein yield was determined to be 21.26 kg da^{-1} by Yolcu (2008).

Acid Detergent Fiber (%)

The lowest acid detergent fiber has been obtained from Simito cultivar by 31.02% and from Bakrajo-1 cultivar by 30.78%. The highest acid detergent fiber has been obtained from Pehlivan (34.92%), Cham-6 (34.48%), Aras (34.25%), Acsad-65 (34.02%) and Eminbey (33.52%) cultivars. The acid detergent fiber average of the wheat cultivars has been defined as 33.21%. The acid detergent fiber was determined to be 34.21% by Yolcu (2008), 38.4-48.5% by Tolu et al. (2013) and 27.6% by Canbolat (2012).

Neutral Detergent Fiber (%)

The lowest neutral detergent fiber has been obtained from Bakrajo-1 cultivar by 51.86% and from Simito cultivar by 52.40%. The highest acid detergent fiber has been obtained from Acsad-65 (57.26%), Aras (57.04%), Pehlivan (56.90%), Cham-6 (56.69%) and

Eminbey (56.49%) cultivars. The acid detergent fiber average of the wheat cultivars has been defined as 55.40%. The acid detergent fiber was determined to be 58.64% by Yolcu (2008), 49.2-60.8 by Tolu et al. (2013) and 49.9% by Canbolat (2012). The calcium, magnesium, phosphor and potassium averages observed in wheat cultivars are given in Table 6.

Table 6. The calcium, magnesium, phosphor and potassium averages determined in wheat cultivars

		Calcium (%)	Magnesium (%)	Phosphor (%)	Potassium (%)
1	Pehlivan	0.40 cd*	0.12 cd**	0.36	2.01
2	Aras	0.36 d	0.11 d	0.36	1.83
3	Cham-6	0.39 cd	0.14 b	0.36	1.90
4	Eminbey	0.38 cd	0.13 bc	0.36	1.99
5	Bakrajo-1	0.46 ab	0.14 b	0.38	1.96
6	Ovanto	0.43 abc	0.11 d	0.38	2.22
7	Simito	0.47 a	0.17 a	0.36	1.61
8	Acsad-65	0.40 bcd	0.13 bcd	0.35	1.83
	Average	0.41	0.13	0.36	1.92
	CV (%)	8.29	7.48	3.53	10.04

*) statistically significant at a level P≤0.05, **) statistically significant at a level P≤0.01

Different wheat cultivars are statistically significant at a level of 5% in terms of calcium and of the 1% in terms of magnesium.

Calcium (%)

The highest calcium content has been obtained from Simito cultivar by 0.47%. It was respectively followed Bakrajo-1 (0.46%) and Ovanto (0.43) cultivars, in the same statistically group. The lowest calcium content has been obtained from Aras cultivar by 0.36%. The calcium content average of the wheat cultivars has been defined as 0.41%. The calcium ratio was determined to be 0.57% by Yolcu (2008).

Magnesium (%)

The highest magnesium content has been obtained from Simito cultivar by 0.17%. The lowest magnesium content has been obtained from Aras and Ovanto cultivars by 0.11%. The magnesium content average of the wheat cultivars has been defined as 0.13%. The magnesium ratio was determined to be 0.27% by Yolcu (2008).

Phosphor (%)

Wheat cultivars are statistically insignificant in terms of phosphor content. The phosphor content of the wheat cultivars to range from 0.35 to 0.38%. The phosphor content average of the wheat cultivars has been defined as 0.36%. The phosphor ratio was determined to be 0.35% by Yolcu (2008).

Potassium (%)

Wheat cultivars are statistically insignificant in terms of potassium content. The potassium content of the wheat cultivars to range from 1.61 to 2.22%. The potassium content

average of the wheat cultivars has been defined as 1.92%. The potassium ratio was determined to be 1.44% by Yolcu (2008).

CONCLUSIONS

The highest plant height has been obtained from Cham-6, Acsad-65, Ovanto and Bakrajo-1 cultivars; the highest green herbage yield has been obtained from Aras cultivar; the highest dry herbage yield has been obtained from Acsad-65 and Aras cultivars; the highest protein yield has been obtained from Aras and Acsad-65 cultivars; the lowest acid detergent fiber and neutral detergent fiber has been obtained from Simito and Bakrajo-1 cultivars; the highest calcium and magnesium content has been obtained from Simito and Bakrajo-1 cultivars. However, wheat cultivars are statistically insignificant in terms of crude protein ratio, phosphor and potassium content. Based on these results; Aras and Acsad-65 cultivars with high green herbage, dry herbage and protein yields, Simito and Bakrajo-1 cultivars with low acid detergent fiber and neutral detergent fiber ratios and high calcium and magnesium content were recommended for wheat hay as roughage.

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