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ORIGINAL PAPER

COMPARISON OF PLANT NUTRIENT CONTENTS OF SOME LOCAL BARLEY (*Hordeum vulgare*L.) VARIETIES OF BLACK SEA REGION

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Abstract

Barley(Hordeum vulgare L.) is a very important animal feed plant in terms of their protein content as well as plant nutrientand vitamins.Along with the present study, it was aimed to determine and compare macro (N, P, K, Ca and Mg) and micro-nutrients (Fe, Mn, Zn and Cu), and protein contents of local barley varieties of Black Sea Region. For this purpose, leaf and grain samples were taken from 17 barley varieties. In this context, total N, P, K, Ca, Mg, Fe, Mn, Zn and Cu were analysed in the leaves and grain samples, and crude protein contents were determined in the grain samples.

Accordingly,the total N, P, K, Ca, Mg, Fe, Mn, Zn and Cu contents of leaf samples of local barley varieties of Black Sea Region were 2.50- 4.10 %, 0.03- 0.06 %, 0.78-1.65 %, 0.95-1.87 %, 0.19-0.34 %, 47.4-246.7 mg/kg, 37.8-84.5 mg/kg, 7.7-14.0 mg/kg and 4.0-7.4 mg/kg, respectively. Also, it was found that the protein, total N, P, K, Ca, Mg, Fe, Mn, Zn and Cu contents of the grain samples of the barley varieties were 10.2-16.0 %, 1.75-2.74 %; 505.1-837.5 mg/kg, 3822-5652 mg/kg, 651-46380 mg/kg, 1587-2413 mg/kg; 12.2-474.2 mg/kg; 11.2-23.6 mg/kg; 13.1-20.9 mg/kg and 2.3-4.0 mg/kg, respectively.As a conclusion, it was determined that the leaf and grain samples of the local barley varieties ofBlack Sea Region of Turkey were determined to vary in terms of plant nutrient content. It can be deduced that varieties can be deemed as animal feed sources for their rich protein content.

Key words: Local, Barley, Variety, Macro-nutrients, Micro-nutrients.

INTRODUCTION

Like all living organisms, human beings need energy and thus nutrition to maintain their vital functions.Nutrition is considered as of the most important requirements of the survival and sustainable proper functions of organisms.Adequate amounts of nutrients (fats, carbohydrates, proteins, vitamins and minerals) should be taken for the regular and balanced functioning of the cells comprising the body.Animal foods, one of the most important of these nutrients, have an important place in human nutrition.Animal proteins containing abundant amino acids necessary for the human body are as important as plant foods to sustain the activity of body metabolism.

The level of development of a society is directly proportional to the amount of animal food consumed by its members.The amount of valuable protein sources such as meat, fish, milk and eggs consumed in our country is far behind when compared with the developed countries (Yıldırım and Tayyar, 2006).The most important reason for this situation is that despite the fact that our animal wealth is higher than many other countries, animal foods cannot be produced in such a way as to meet the needs of the rapidly growing population in our country and our animal productivity are low (Serin and Tan, 2008).The high level of animal production depends on healthy animals.Animals' health depends on their adequate and balanced diet. In animal husbandry, especially in terms of adequate and balanced nutrition, providing the necessary nutrients from cheaper foods is very significant(Doğanet al.,2000).For this reason, fodder crops have a great importance in animal feeding (Serinand Tan 2008).

Today, human health and animal feeding are even more prominent the interest in high nutritional products is increasing steadily. Especially in recent years, the need for fodder crops has been increasing and the decrease in livestock activities has been an important feed, and at the same time, the need for studies on barley plants, which is an important cereal, is also increasing (Grandoand Macpherson, 2005). Barley contains plant nutrients and vitamins, as well as a very important feed plant in terms of protein content.

Turkey is among the most important countries with their barley varieties. When literature reviews are examined; it is noteworthy that studies on barley plants, which are an important feed plant and utilized in different forms in human nutrition, are evaluated in terms of quality criteria and studies on mineral compositions of barley plants are less. In this study, it was aimed to determine the contents of crude protein, macro- and micro-nutrients of 17 local barley varieties of the Black Sea Region of Turkey, and to determine the differences among barley varieties.

MATERIALS AND METHODS

This study was carried out as three replications according to the Randomized Block Design at at the Research Station of the Faculty of Agriculture, University of Akdeniz, Antalya-Turkey; plants 20 cm row spacing, 3 m row height, planted in 5 rows and the sowing amount was set at 20 kg/da. The barley varieties used in experiment were IG 18764, IG 19087, IG 19180, IG 27260, IG 28576, IG 28577, IG 28735, IG 28796, IG 28805, IG 112948, IG 115978, IG 115998, IG 128138, IG 128140, IG 128146, IG 128148, IG 128177.

Planting was taken place on November 28, 2015.Based on the farmer's conditions, fertilizer was applied to the parcels in the form of ammonium nitrate in the order of 8 kg N. Half of nitrogenous fertilizer was planted with sowing, the other half was given before stem elongation period. The harvest of the plants was made by hand when the humidity level in the grain fell below 12-13%.

Prior to the establishment of the experiment, the soil samples were taken to represent the soil characteristics of the experiment area, representing 0-20 cm deep test plots in according to Jackson (1967). In soil samples; texture was measured by hydrometer method (Bouyoucos, 1955); soil pH and electrical conductivity (EC) in 1: 2.5 soil: water ratio (Jackson, 1967); $CaCO_3$ by Scheiblercalcimeter (Çaglar, 1949); organic matter by modified Walkey-Black method (Black, 1965); total N was determined by the Modified Kjeldahl method (Kacar and İnal, 2008), available P by $NaHCO_3$ extraction (Olsen and Sommers, 1982); exchangeable K, Ca and Mg by 1 N ammonium acetate (pH 7) extraction (Kacar, 1995), available Fe, Mn, Zn and Cu by DTPA extraction methods(Lindsay and Norvell, 1978). The results of soil analysis of the experiment area were given in Table 1.

Table 1. The Results of Some Physical and Chemical Analysis of the Soil of Experiment Area.

Soil Properties		References
Texture	Clay Loam	Black (1957)
pH	7.33	Kellog (1952)
EC (dS/m)	0.17	Soil Survey Staff (1951)
Organic Matter (%)	2.1	Thun et al. (1955
$CaCO_3$ (%)	53.77	AereboeandFalke (Evliya 1964)
TotalN (%)	0.057	Loue (1968)
Available P (mg/kg)	9.5	Olsen and Sommers (1982)
Exchangeable (me/100 g)	0.155	Pizer (1967)
Exchangeable Mg(me/100g)	0.715	Loue (1968)
Exchangeable Ca (me/100 g)	32.8	Loue (1968)
Available Fe (mg/kg)	4.15	Lindsay and Norvell (1978)
Available Zn (mg/kg)	1.2	Lindsay and Norvell (1978)
Available Cu (mg/kg)	1.15	Lindsay and Norvell (1978)
Available Mn (mg/kg)	18.35	Lindsay and Norvell (1978)

Leaf and grain samples from each variety were taken and the cconcentrations of P, K, Ca, Mg, Fe, Mn, Zn and Cu in the extracts obtained by wet digestion were determined by using ICP-OES according to Kacar and İnal (2008). The total N content of the cultivars was determined by the Modified Kjeldahl method (Kacar and İnal, 2008) and the crude protein contents of the grains were calculated with multiplying the total N content by a factor of 5.83.

As a result of the analysis; it was determined that the soil of the experiment area is clay loam, the soil pH is neutral, the EC is no salinity, the organic material with less humus, excess calcareous; the contents of total N, available P, exchangeable K and available Zn were low level, the contents of exchangeable Ca and Mg were high level, the contents of available Fe, Cu and Mn were sufficient level.

RESULTS AND DISCUSSION

The total N contents of leaf samples the local barley varietiesin Black Sea Region were between 2.50-4.10 %; P contents ranged from 0.03 to 0.06 %; K content is between 0.78 and 1.65 %; Ca contents ranged from 0.95 to 1.87 %; Mg contents ranged from 0.19 to 0.34%; Fe contents ranged from 47.4 to 246.7 mg/kg; Mn contents ranged from 37.8 to 84.5 mg/kg, Zn contents ranged from 7.7 to 14.0 mg/kg and Cu contents ranged from 4.0 to 7.4 mg/kg (Table 2). The mineral content of the varieties was compared by Jones et al. (1991); the varieties were found to be in sufficient class in terms of the contents of N, Ca, Mg, Fe and Mn; and the contents of P, K, Zn and Cu of the varieties were in the insufficient class.

Table 2. The Mineral Nutrients Contents of Leaf samples of Local Barley Varieties in the Black Sea Region, Turkey.

No	Variety	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
		(%)					(mg/kg)			
1	IG 18764	4.02	0.049	0.779	1.112	0.253	101.9	37.8	12.7	4.8
2	IG 19087	2.98	0.042	1.040	1.337	0.225	246.7	39.6	9.0	4.6
3	IG 19180	3.38	0.039	1.064	1.193	0.203	107.6	40.9	7.7	4.5
4	IG 27260	3.37	0.041	1.015	1.110	0.193	230.9	44.8	10.2	5.8
5	IG 28576	3.27	0.046	0.999	1.522	0.242	105.9	44.5	10.6	4.9
6	IG 28577	3.38	0.042	1.249	1.870	0.297	116.5	54.0	9.9	7.2
7	IG 28735	3.47	0.047	1.421	1.262	0.258	66.6	59.3	12.6	7.4
8	IG 28796	3.08	0.042	1.419	1.315	0.253	71.9	80.6	10.9	6.7
9	IG 28805	3.70	0.055	1.647	0.947	0.281	47.4	84.5	12.7	6.6
10	IG 112948	4.10	0.043	1.374	1.399	0.286	64.5	70.0	11.4	4.9
11	IG 115978	3.46	0.040	1.073	1.376	0.259	79.7	57.2	10.0	4.8
12	IG 115998	2.79	0.044	1.060	1.480	0.257	75.6	55.8	9.1	4.8
13	IG 128138	3.52	0.043	1.211	1.682	0.336	92.6	66.2	10.3	5.1
14	IG 128140	3.74	0.040	0.944	0.998	0.240	68.6	38.4	8.2	5.4
15	IG 128146	2.70	0.043	1.019	1.485	0.333	221.9	51.9	9.4	5.3
16	IG 128148	3.31	0.035	1.622	1.498	0.276	93.1	62.1	13.4	4.0
17	IG 128177	2.50	0.057	1.116	1.311	0.244	77.5	70.9	14.0	6.3
	Minimum	2.50	0.035	0.779	0.947	0.193	47.4	37.8	7.7	4.0
	Maximum	4.10	0.057	1.647	1.870	0.336	246.7	84.5	14.0	7.4
	Mean	3.40	0.044	1.179	1.347	0.261	109.9	56.4	10.7	5.5

The protein contents of grain samples of barley varieties10.2-16.0 %; total N contents between 1.75% and 2.74 %; P contents ranged from 505.1-837.5 mg/kg, K contents ranged from 3822-5652 mg/kg, Ca contents ranged from 650.5-46380 mg/kg; Mg contents ranged from 1587 to 2413 mg/kg; Fe contents ranged from 12.2 to 474.2 mg/kg; Mn contents ranged from 11.2-23.6 mg/kg; Zn contents ranged from 13.1-20.9 mg/kg and Cu contents ranged from 2.3-4.0 mg/kg (Table 3). In the study carried out on the maturity quality of some barley varieties, Koçaket al. (1992) reported that the protein proportion of varieties ranged from 11.6 to 13.8%, Altuntaş (2012) determined that the protein contents of Tokatlocal barley varieties were 12-14.47%, Çölkesen et al. (1999) reported that the protein content of 25 barley varieties varied between 10.32 and 11.95%. Protein content is one of the important features of malting barley. High protein causes blurring of the colour of the beer, the bitterness of the taste, and the decrease of the durability of the shelf life. For this reason, it is desirable that the protein content be less than 12%. However, it has been reported that the content of protein should be between 12-16% in feeder barley (Kün and Akbay, 1983). According to the results of the protein contents, it is seen that most of the barley varieties of the Black Sea Region are feeder barley variety (Table 3).

Table 3. The Mineral Nutrients Contents of Grain Samples of Local Barley Varieties in the Black Sea Region, Turkey.

No	Variety	N	Protein	P	K	Ca	Mg	Fe	Mn	Zn	Cu
		(%)					(mg/kg)				
1	IG 18764	2.60	15.2	636.4	4271	1876	2080	474.2	23.5	20.9	3.8
2	IG 19087	2.02	11.8	759.7	4448	651	2036	38.2	14.1	20.5	2.4
3	IG 19180	2.17	12.7	505.1	3822	957	1827	46.0	15.1	20.0	2.8
4	IG 27260	2.27	13.2	582	4848	1136	1849	28.4	13.1	15.7	2.7
5	IG 28576	2.28	13.3	569.9	4346	1194	2057	72.9	15.8	19.7	3.7
6	IG 28577	1.95	11.4	521.9	4267	675	1587	37.6	11.2	15.1	2.3
7	IG 28735	2.74	16.0	801.5	5271	938	2199	28.1	15.6	17.7	2.8
8	IG 28796	2.27	13.3	830.9	4662	10630	2278	91.2	22.0	19.7	3.7
9	IG 28805	2.69	15.7	837.6	5607	21330	2413	56.2	23.6	19.0	4.0
10	IG 112948	2.65	15.5	769.5	3849	17850	1985	27.8	21.8	17.6	3.6
11	IG 115978	1.83	10.6	599.7	3943	986.8	1805	12.2	16.3	15.3	2.3
12	IG 115998	2.29	13.4	777.8	4336	1168	2061	18.7	20.4	17.6	3.4
13	IG 128138	2.39	13.9	735.6	4727	37740	2282	128.7	18.2	19.3	3.6
14	IG 128140	2.19	12.8	737.2	5652	46380	2048	33.8	16.4	14.9	2.3
15	IG 128146	2.03	11.9	791.2	5635	739	1954	28.1	15.0	14.5	3.6
16	IG 128148	2.44	14.2	686.2	3910	2060	2001	64.5	21.4	13.1	3.5
17	IG 128177	1.75	10.2	669.9	4919	907	1843	100.8	17.1	15.1	3.3
	Minimum	1.75	10.2	505.1	3822	651	1587	12.2	11.2	13.1	2.3
	Maximum	2.74	16.0	837.5	5652	46380	2413	474.2	23.6	20.9	4.0
	Mean	2.27	13.2	694.8	4618	8660	2018	75.7	17.7	17.4	3.2

In their study, Villacres and Rivadeneira (2005) reported that the P contents of the barley content varied between 2400-4700 ppm, 2200-4800 ppm for K content, 26-72 ppm for Fe content and 30-50 ppm for Zn content. Altuntaş (2012) determined that the Ca concentration of barley grains varied between 306.7-428.7 ppm, the Mg concentration was between 1214-1439 ppm, the Mn concentration was between 15.4-21.2 ppm, the Zn concentration was between 28.4-39.6 ppm, and the Cu content was between 5.4-8.5 ppm. When the mineral contents of grain samples of local barley varieties of Black Sea Region, Turkey were compared with other studies; it was determined that the contents of K, Mg, Fe and Mn were good; the contents of P, Zn and Cu were found to be deficient and Ca contents were found to be in the high group.

CONCLUSIONS

- In this study, based on farmer growing conditions, the total N contents of the varieties and thus the protein content were determined at a good level. Also,it was found that the majority of barley varieties can be used as fodder barley.
- As a result of the lack of phosphorus fertilization, the phosphorus content of the leaf and grain samples of the varieties was determined to be deficient.
- It was found that leaf samples of barley varieties were deficient in terms of K; but the K content of the grain samples was found to be generally adequate, although no potassium fertilization was done.
- The experiment area has high calcium content. For this reason, the Ca content of both leaf samples and grain samples of the varieties was found to be high.
- The zinc contents of the soils of Turkey are generally low level. Furthermore, the lack of zinc fertilization caused the zinc content of leaf and grain samples to be low.

As a result, the leaves and grains of local barley varieties in Black Sea Region at Turkey vary in terms of plant nutrient contents.It has been understood that the grains of local barley varieties of the Black Sea Region are rich in protein content and therefore can be used as animal feed, it is important to carry out more specific studies on local barley varieties which are important genetic resources of Turkey

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