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YIELD AND QUALITY TRAITS OF SOME FORAGE CROPS CULTIVATED UNDER AGROECOLOGICAL CONDITIONS OF KOSOVA

SUMMARY

The field experiment was carried out in the central part of Kosovo, Prishtina region. The experiment was designed in a CRBD fashion with four replication. The plot sizes were 1.5 x 8 m per plot or 12 m^2. The research comprised 6 treatments of forage mixtures or pure species: *Trifolium pratense + Lolium multiflorum, Lutus corniculatus + Festuca rubra, Lolium multiflorum, Festuca rubra, Trifolium pratense*, *Lotus corniculatus*. Measured traits were, dry matter yield (DMY), mineral composition, acid detergent fiber (ADF), neutral detergent fiber (NDF), Crude Protein (CP), lignin, were determined in this study of each treatments. Our study has revealed that all traits varied significantly ($P<0.01$) among investigated forage species and their combinations.

Keywords: forage, species, yield, mineral composition, NDF, ADF, CP.

INTRODUCTION

The genetic base of sown pastures is very narrow: for example, more than three-quarters of the grass cultivars registered in the European Union are of just six species, and more than half of Lolium perenne and L. multiflorum which account for more than 80 percent of the forage grass seed sold in the EU (Batello et al., 2008). Grasses belong to the family Poaceae (Gramineae)(family names are not written in italic). About 750 genera and 12 000 species, occur in all climatic zones. There are 7 subfamilies: Arundinoideae, Bambusoideae, Centhothecoideae, Chlorideae, Panicoideae, Pooideae (Festucoideae) and Stipoideae (subfamily names are not written in italic). The Poaceae is the fourth largest family of flowering plants after the Orchidaceae, the Compositae and the Leguminosae (family names are not written in italic). (Batello et al., 2008). Alfalfa monoculture is still prevalent in many European countries, where it is the back bone of organic crop-livestock systems and contributes significantly to conventionally managed systems. However, grass-legume mixtures are gaining new interest in Europe and elsewhere, owing to the energy and environmental costs associated with the synthesis and use of nitrogen fertilizer required for grass forage production and the quest for greatest self-sufficiency in feed proteins at

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the farm and the country levels (Annichiarico, 2014). Many grasses contain ecotypes with a range of ecological adaptation and cultivars have been developed within species to suit very varied conditions. Grasslands represent an important and effective source of energy and proteins to ruminants, and combine high yield stability and draught resistance with low tillage operations and pesticide use and thus leading to good environmental conditions (Rusinovci et al., 2014 and 2015). Legumes are important for the high quality of their forage and their ability to fix atmospheric N, through symbiotic bacteria in their root nodules. There are many agronomic reasons for adding grass to perennial legumes. Grass legume mixtures have long been recognized as having several advantages over legumes or grasses alone. The legume component of a mixture generally increases total forage yield, fixes N from the atmosphere (part of which can be utilized by the grass), and enhances the quality of the pasture or hay, by its higher crude protein content and digestibility (Pirhofer-Walz et al., 2012). However, it is a challenge to manage the mineral supply of ruminants fed on grassland, because mineral concentrations in the herbage are influenced by a number of factors including species composition of the sward (Kuusela, 2006). Kosovo has an area of 10.887 km2 or 1.1 million ha, about 430.00 ha forested or 39.1% and 577.000 ha are agriculture land or 52%. From the total agricultural surface, pastures occupy 166.769 hectares or 28.90%, meadows 860.00 hectares or 14.90% and arable forages 38.000 hectares or 6.59% (MAFRD, 2002).The objectives of the present study were to evaluate the differences for some different cultivated forage crops for different qualitative traits under agro ecological conditions in Prishtina locality.

MATERIAL AND METHODS

Locations, Soils, and Weather

Three field experiments were conducted under reined conditions between 2013 and 2014. The experiment was established at a didactic farm in Prishtina, Faculty of Agriculture and Veterinary, Department of Crop Science located 42° 38' 29" N latitude, 21° 08' 45" E longitude, 570 m a.s.l. The in locality Prishtina is classified as vertisol (black soil).The soil analyses was done at the Norwegian University of Life Sciences, Department of Environmental Sciences, Ås, Norway. Soil characteristics are presented in Table 1.

Table 1 Soil characteristics at locations Prishtina

Location	Depth	pH in H_2O	pH in KCl	Humus (%)	N (%)	mg/100 g soil	
						P_2O_5	K_2O
Pristina	0-30	7.10	6.58	3.01	0.21	4.2	14.9
	30-60	7.05	6.74	2.19	0.19	3.7	11.3
	60-90	7.06	6.42	1.31	0.059	1.7	8.2

The area has an annual rainfall usually in the range of 700-750 mm (HMIK, 2008). Precipitation and temperature data for the Prishtina locations are shown for appropriate years in Table 2. Conditions were droughty with high temperatures especially in the summer time of growing season. Precipitation was considerably above normal at all locations in 2013, and above long term average in 2014. Summer temperatures in this region are sometimes exceeding 35°C resulting in high evapotranspiration (Aliu et al., 2010).

Table 2. Monthly precipitations (mm) and Temperatures (^{o}C) at location Prishtina

Month	Precipitations			Temperatures		
	2013	2014	LTA	2013	2014	LTA*
January	38.7	34.5	59.6	2.3	4.3	-0.2
February	5.8	12.5	18.1	3.6	6.7	1.9
March	70.3	74.5	52.5	5.4	10.2	6.4
April	40.4	52.3	48.1	13.4	13.5	11.5
May	122.3	154.2	126.2	17.4	16.1	16.9
June	55.3	65.5	42.3	20.2	20.4	19.9
July	32.6	68.9	51.6	22.3	22.3	21.5
August	21.2	71.5	32.2	22.9	21.5	21.1
September	56.6	58.5	42.9	15.7	18.3	16.8
October	64.8	48.7	58	13.6	14.1	11.9
November	42.6	49.8	41	8.4	9.2	6
December	15.9	52.3	44.7	1.6	4.6	1.7
Total	566.5	743.2	59.6	12.2	13.4	11.3

*LTA - Long Term Average

Plot Layout and Stand Establishment

The experimental desing was complete random block with four replications. The general formula for these kind of experiment was: 6 treatmenst x 4 replication=24 plots. The species (grasses or their mixtures with legumes) included in experiment were: (1) red clover+Italian ryegrass (Trifolium pratense + Lolium multiflorum), (2) birdsfoot trefoil+red fescue (Lutus corniculatus + Festuca rubra), (3) Italian ryegrass (Lolium multiflorum, (4) red fescue (Festuca rubra), (5) red clover (Trifolium pratense),(6) birdsfoot trefoil (Lotus corniculatus). Aim of the research was to determined the dry matter yield, mineral composition: Iron (Fe), Calcium (Ca), Cupper (Cu), Magnesium (Mg) and Phosphorus (P) and acid detergent fiber (ADF), neutral detergent fiber (NDF),Crude Protein (CP), Lignin . During this year the analyses are conducted only for first cutting. The first cutting term was in the beginning of June, after one year of establishment of plots. The herbage sampling methods was standard. Oven-dried samples of plots were ground and 1 g sample was used for the total nitrogen determination and 0.5 g for ADF and NDF. ADF and NDF were

analyzed by sequential detergent analysis method (Goering and Van Soest, 1970) and total nitrogen by Kjedahl method (AOAC, 1984). Crude protein content was calculated by multiplying total nitrogen with 6.25 constant.The samples were decomposed with concentrated HNO3 at 250°C in UltaClave from Milestone (Milestone microwave Ultraclave III). Samples were diluted in 10 % concentrated HNO3 before analysis. The determination of elements was done on ICP_OES (inductively coupled plasma optical emission spectrometry) with a Perkin Elmer Optima 5300 DV instrument (Perkin Elmer,Inc 2004 Shelton, USA). This analysis was done at The Norwegian University of Life Sciences, Department of Environmental Sciences, Ås, Norway. Statistics were performed by SPSS.version.19, and MS-Excel programme.

RESULTS AND DISCUSSION

The results revealed significantly high difference between investigated variants considering the yield in dry matter (Table 3).The results revealed significantly high difference between investigated variants considering the yield (Dry Weight tha-1). In the second year for the all cuts with higher yield was characterized Italian ryegrass of (5.96, 4.13 and 3.09 tha-1) .The lowest value at all cuts was observed for Birdsfoot -trefoil-red fescue on value (3.15, 2.24 and 1.99 t ha-1).The total value for Italian ryegrass was 13.18 t ha-1, while for combination of Birdsfoot- trefoil-red fescue the total yield was 7.38 t ha-1. The differences between higher and lower total yield were +5.8 t ha-1 or expressed in relative values was 55.39%. During the year 2014 in locality of Prishtina the precipitations were relatively higher and the yield was higher compare with year 2013. Results are presented in Table. 3.

	2012				2013				
Treatment/ Cut	I	II	III	Total	I	II	III	Total	Average
R. clover- It. ryegrass	5.48^{a}	3.75^{b}	2.76^{b}	11.99	6.83^{c}	4.85^{b}	3.11^{c}	14.79	13.39
B. trefoil- Red fescue	3.15^{e}	2.24^{e}	1.99^{c}	7.38	3.94^{f}	3.12^{d}	2.02^{e}	9.08	8.23
Italian ryegrass	5.96^{a}	4.13^{a}	3.09^{a}	13.18	7.39^{a}	5.34^{a}	3.55^{b}	16.28	14.73
Red fescue	4.07^{d}	2.81^{c}	2.17^{c}	9.05	5.12^{d}	3.77^{c}	2.60^{d}	11.49	10.27
Red clover	5.74^{b}	3.82^{b}	2.87^{b}	12.43	7.06^{b}	5.11^{a}	3.81^{a}	15.98	14.21
Birdsfoot trefoil	4.05^{d}	2.62^{d}	2.15^{c}	8.82	4.87^{e}	3.83^{c}	2.59^{d}	11.29	10.05

*Means bearing by the same letter in a column were not significantly different at the $p < 0.05$ level using the LSD test.

From our experiment at all cuts for higher yield was characterized Italian ryegrass with a total yield 14.73 tha-1 , but for lower total yield was obtained at combination Birds foot –trefoil red on value 8.23 tha-1 .The differences between

them were +6.5 tha-1 or expressed in percentage value 55.03%. If compared year 2013 (10.47 tha-1) and 2014(11.81 tha-1) for average total yield the differences were +1.34 tha-1 or 12.02% higher. Concentrations of minerals content varied significantly among investigated species. The maximum average values at the first year for Calcium (Ca) concentration was found in Birds foot trefoil (25.61 g-1 kg-1), while for the second year was at the red clover (10.16 g-1 kg-1) .The difference between them was significant (15.45 g-1 kg-1at level of probability P<0.01). Sultan et al., 2008 have realized different results for Calcium content too, which varied from 0.13 to 0.38%. Also the variations for Iron (Fe) were with small differences. In the first year (2013) the average values at all treatments were 0.24.On higher average values were characterized the Italian ryegrass (0.393 g-1 kg-1). In the second year with higher values was characterized the Birds foot trefoil (0.35 g-1 kg-1). The values of Copper (Cu) and for Potassium (K) were not significantly only for K in the first year of investigation were with differences. Harrington et al., 2006 obtained different results at different forage crops for Ca (0.36 till 1.87) and for Iron (Fe) on value 67 till 167 mg kg-1 . The average values for Zinc (Zn) for both two years investigated were 0.03 and 0.02 mg kg-1. The findings of Sultan et al. (2008) study revealed that Ca content in free rangeland grasses generally increased with maturity .Optimum level of Calcium (Ca) in plants ranged from 0.40 to 0.60% and its level above 1.0% is considered high (Georgievskii, 1982), whereas, Minison (1990) reported Calcium (Ca) level from 0.31 to 1.98% and the mean as 0.63%. Some results was obtained for forage crops for mineral composition with higher variation from Rusinovci et al. (2014). Results are presented in Table.4.

Table.4. Average values for mineral composition (g^{-1} kg^{-1})

	Ca		Cu		Fe		K		Mg		Mn		Zn	
Treatment/years	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
R. clover-It. ryegrass	10.23^{c}	3.72^{b}	0.013^{a}	0.006^{a}	0.156^{b}	0.29^{b}	27.58^{b}	22.75^{a}	2.43^{b}	1.82^{ab}	0.53^{a}	0.063^{a}	0.026^{b}	0.021^{a}
B. trefoil-Red fescue	6.16^{d}	4.06^{b}	0.013^{a}	0.0067^{a}	0.123^{b}	0.28^{b}	25.27^{d}	20.79^{a}	1.63^{d}	1.49^{b}	0.046^{ab}	0.056^{b}	0.023^{bc}	0.016^{ab}
Italian ryegrass	2.47^{e}	7.36^{ab}	0.013^{a}	0.011^{a}	0.393^{a}	0.33^{ab}	20.13^{e}	24.43^{a}	1.15^{e}	1.76^{ab}	0.04^{b}	0.056^{b}	0.01^{c}	0.021^{a}
Red fescue	17.61^{b}	8.91^{b}	0.014^{a}	0.0067^{a}	0.163^{b}	0.31^{ab}	25.27^{d}	24.43^{a}	2.77^{a}	1.01^{b}	0.036^{b}	0.066^{a}	0.026^{b}	0.02^{a}
Red clover	12.03^{b}	10.16^{a}	0.017^{a}	0.0067^{a}	0.183^{ab}	0.25^{b}	30.26^{a}	19.43^{b}	2.5^{b}	1.79^{ab}	0.056^{a}	0.065^{a}	0.026^{b}	0.013^{b}
Birdsfoot trefoil	25.61^{a}	4.11^{b}	0.21^{a}	0.011^{a}	0.393^{a}	0.35^{a}	25.61^{c}	21.77^{a}	2.09^{c}	2.02^{a}	0.053^{a}	0.053^{b}	0.041^{a}	0.021^{a}
Average	12.35	6.39	0.05	0.01	0.24	0.30	25.69	22.27	2.10	1.65	0.13	0.06	0.03	0.02

*Means bearing by the same letter in a column were not significantly different at the $p < 0.05$ level using the LSD test.

Crude protein content is one of the most important criteria for fodder quality evaluation. The forage crude protein contents of the treatments varied

greatly. From results which is considering examined years, red clover-italian ryegrass had the higher cp (11.38%) year 2013 and 12.33% year 2014.while with lowest average values of cp for both years (2013 and 2014) was characterized the birdsfoot trefoil on values (9.88 in year 2013) and 10.08 in year 2014. The differences between years for higher cp were +0.95% higher for year 2014, while the differences between years for lowest values were +0.2% for year 2014. Acid detergent fiber (adf) and neutral detergent fiber (ndf) concentrations are important quality parameters of forages (schroeder, 1994; caballero et al., 1995; henning et al., 1996; assefa and ledin, 2001; albayrak et al., 2011). The highest percent of ndf in 2013 was determined the red fescue (72.63%), while in 2014 it was in the mixture of birdsfoot trefoil-red fescue (66.40%).for adf the higher results were obtained at red fescue 39.57 in year 2013 and for year 2014 was characterized the birdsfoot trefoil on value 38.92.on the other hand, in both years combination red clover-italian ryegrass obtained the higher content of lignin 7.56 (2013) and 6.37 (2014).while for lowest value of lignin was determined at birdsfoot trefoil-red fescue 5.53 in year 2013, and italian ryegrass 5.87 in year 2014. Similar results have been reported by some researchers studied similar mixtures of cereals and legumes under intermediate winter crop system (lithourgidis et al.,2006; kokten et al., 2009; yucel and avci, 2009). Results are presented in table. 5**.**

Table.5. Forage quality parameters (%) of forage crops mixtures in Prishtina location

		Year									
		2012					2013				
	Treatment/ Parameters	CP	CF	NDF	ADF	Lignin	CP	CF	NDF	ADF	Lignin
Location Prishtina	R. clover-It. ryegrass	11.28^{a}	33.8^{ab}	60.11^{bc}	38.89^{ab}	7.56^{a}	12.43^{a}	31.73^{c}	54.48^{bc}	33.05^{c}	6.27^{ab}
	B. trefoil-Red fescue	10.42^{b}	35.2^{a}	64.75^{b}	38.29^{ab}	5.53^{c}	10.51^{c}	34.76^{ab}	66.40^{a}	37.18^{ab}	5.86^{c}
	Italian ryegrass	10.86^{ab}	30.7^{c}	65.44^{b}	35.3^{c}	6.30^{b}	10.27^{d}	33.74^{b}	60.74^{ab}	37.94^{ab}	5.77^{c}
	Red fescue	10.41^{ab}	31.89^{b}	55.82^{c}	39.57^{a}	7.31^{a}	10.50^{c}	35.77^{ab}	59.10^{b}	37.36^{ab}	6.06^{b}
	Red clover	10.69^{ab}	33.22^{ab}	72.53^{a}	37.24^{b}	6.43^{b}	11.03^{b}	36.09^{a}	52.07^{c}	36.47^{bc}	6.24^{b}
	Birdsfoot trefoil	9.78^{c}	32.42^{b}	53.28^{c}	37.35^{b}	6.52^{b}	10.07^{d}	32.21^{b}	60.02^{ab}	38.92^{a}	6.57^{a}

*Means bearing by the same letter in a column were not significantly different at the $p < 0.05$ level using the lsd test.

Notes : cp-crude protein; cf-crude fiber; ndf- neutral detergent fiber; adf- acid detergent fiber

CONCLUSIONS

Weather was the most important factor affecting yield. Forage crops mixtures can obtain several cuts during the year with significant yield but only if species combination is adequate-with adequate grass species, if there is enough

water by precipitation or irrigation and if the plants are cut in proper time. The same was confirmed for mineral composition too with differences . Data obtained in this research may be usefull to practitioners in forage production and utilization, especially when bringing decisions on species composition in new swards establishment. Also, the observed mineral composition, ADF, NDF, CP may provide some data on the need for supplements in livestock nutrition when pastured or fed with investigated forage species.Further research should be based on finding adequate species mixture and their ratio for different cites with specific climate in order to overpass possible losses and ensure feed during the whole year.

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