Pak. J. Bot., 51(1): 221-223, 2019. DOI: 10.30848/PJB2019-1(24)

AGRONOMIC CHARACTERISTICS OF COMMON KIDNEY VETCH (*ANTHYLLIS VULNERARIA* SSP.*VITELLINA* (VELEN.) KUZM. IN ARTIFICIAL GRASSLANDS IN THE CENTRAL NORTHERN BULGARIA

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Abstract

Biological and morphological features, productivity and qualitative composition of feed of common kidney vetch (*Anthyllis vulneraria* ssp. *vitellina* (Velen.) Kuzm., sown as monoculture in the conditions of Central Northern Bulgaria were determined. It was found that common kidney vetch manifests as high-yielded and fast-growing forage legume crops in this environment. The species was highly productive in spring, but the regrowth was slow and weak, therefore it was suitable for creating grassland with combined field of use. According to the results of biochemical analysis, feed quality of dry biomass of the culture can be described as very good. The average crude protein content was relatively low (12.63%), but it was balanced in terms of established fiber content (27.28%). The feed mass of that species was rich in soluble sugars (3.90%) and contains condensed tannins in low concentration (1.17%), suggesting high levels of voluntary consumption of animals. The high content of Ca is a cause of high critical ratios of Ca: P and Ca: Mg, as well.

Key words: *Anthyllis vulneraria* ssp. *vitellina* Kuzm., Biological and morphological features, Chemical composition, Dry matter yield, Nitrogen fixation.

Introduction

Specific conditions and trends of use of grasslands can provide value for many species identified as forage grasses with minor significance in artificial grass sowing or motley grasses in natural meadows and pastures (Mitev *et al.*, 2013). To that group also pertain common kidney vetch *Anthyllis vulneraria* ssp. *vitellina* (Velen.) Kuzm. defined as legume crops, suitable for grass establishment of areas, on which cultural legume forages do not grow. Common kidney vetch is polymorph species, which is represented in Bulgaria by 5 subspecies as it is widely spread in Bulgaria. It occurs in dry or drained habitats at 2900 m altitude, especially on poor, calcareous soils (Delipavlov & Cheshmedzhiev, 2003). The species is dry and resistant to cold. It has the ability for self-sowing through cracking beans and to self-sustain in the grassland for a long time. It is well studied as an element of natural meadows and pastures (Honnay *et al.*, 2006). Compared with 23 species, making up the high mountain pastures in the Pyrenees, the common kidney vetch has the highest *In vitro* dry matter digestibility. The average for this indicator is 74%, as in September it reached 85.50% (Marinas & García-González, 2006). In some regions of Europe with poor soils, the common kidney vetch is grown as a valuable legume component for pasture use by sheeps and cattle (Duke, 2012).

The present study was conducted to determine the biological and morphological features, productivity and qualitative composition of feed of common kidney vetch (*Anthyllis vulneraria* ssp. *vitellina* (Velen.) Kuzm., sown as monoculture in the conditions of Central Northern Bulgaria.

Material and Methods

In this study common kidney vetch (*Anthyllis vulneraria* ssp. *vitellina* (Velen.) Kuzm. variety Pamir was used. Collection nursery with grazing ecotypes of annual legumes was studied during the period of 2013-2015 (Naydenova *et al.*, 2015). The experiment was carried out in the experimental field of Experimental Station on Soybean, Pavlikeni, Bulgaria, using the block method with 3 replications and plot size of 3.75 m^2. Sowing was done at sowing rate of 1000 germinating seeds/m^2 with 15 cm row spacing. No mineral fertilizers and herbicides were used and no irrigation was done either. The plants were cut at the beginning of flowering stage. The features of species observed included biological characteristics (vigor of seedlings, surface covering in the year of sowing, growth rates, growing up and regrowing, date of onset of harvest phenophase); morphological characteristics (plant height, percentage participation of leaves, stems and inflorescences in dry matter); productivity (dry matter yield per regrowths and years) and forage quality (basic chemical composition). Biometric measurements were conducted on 30 plants, 10 per each repetition. The basic chemical composition was determined according to Anon., (1990). Nitrogen in dry forage mass yield was calculated multiplying dry forage mass yield and % N content. The amount of nitrogen fixed was calculated (kg N/da/year) according to the Carlsson & Huss-Danell (2003) formulae:

Results and Discussion

Although the species has small-sized seeds, with an absolute weight of the seeds of the particular genotype 3.0 g per 1000 seeds, the seedlings had a rapid and vigorous initial development, as the surface covering of the experimental plots average from the repetitions was 87%. In the year of sowing, plants formed only ground leaf rosettes, the spring regrowth in the second and third vegetation entered into a harvest phenophase in the

period of May 12 to 15th. Thus, the rate of spring growing and the early ripening of common kidney vetch is equal to the traditional perennial legumes for the region – alfalfa, bird's-foot-trefoil and red clover (Lingorski & Mitev, 2012; Nakova & Christova, 2012; Mitev, 2014; Naydenova *et al.*, 2015). Its summer regrowth was formed considerably more slowly – for a period from 53 days after the first cutting. The wild forms of common kidney vetch which are spread in Bulgaria are with average permanence, with a slower development rate – full yield is gathered in the third year after plant sprouting (Delipavlov & Cheshmedzhiev, 2003). Their development is also slower during vegetation, as it reaches its maximum in the middle of summer. Common kidney vetch after the data of productivity can be described as a fast-growing and the maximum yield of forage was produced in the second growing vegetation (Table 1).

The main part of yield was formed in the spring growing as according to the results of the morphological analysis, the stems accounted for half of the dry feed mass in the first cutting. The summer regrowing besides slowly, could also be described as weak – the generative stalks were significantly lower in the second cutting. As a result, the relative participation of the summer undergrowth in the Table of annual yield is very low – 14.8 and 24.6%, respectively for the second and third growing season. The participation of individual morphological factions in summer cutting was more equal of value, suggesting high levels of uptake of biomass of that species in summer grazing.

In terms of annual productivity in comparison with alfalfa (local pasture ecotypes, grown in the same seed-plot), the common kidney vetch was significantly distinguished by a higher dry matter, both in the year of establishment of grasslands and in the second year (Fig. 1), as its productivity decreased in the third year.

Crude protein content of forage mass of common kidney vetch (11.94-13.31%) was found inferior to red and white clovers, typical for the region (Mihovsky & Goranova, 2005; Mihovsky *et al.*, 2014) (Table 2).

The concentration of soluble sugars in the forage biomass was positively associated with the levels of intake, digestion and utilization of forage. According to our results, common kidney vetch is characterized by very high levels of soluble sugars – in the second vegetation, at maximal plant growth; they constituted 4.2% of dry matter. According to this indicator, that species equals to white clover (Mihovsky & Goranova, 2005) – the legume with the most qualitative composition in terms of pasture using in the region.

The nutritional value of forage mass depends also on the content of macroelements and their mutual qualitative proportions. The results indicated that the calcium content (2.26 - 2.46%) in forage mass of common kidney vetch was found very high. The studied species did not distinguish in the average phosphorus content (0.30%) from the common legume forages widespread in the region. The concentrations of that macroelement that we find significantly exceed those of Marinas & García-González (2006) in a study of the species as a component of alpine pastures (0.27-0.33% compared to 0.11-0.15%). The content of magnesium (0.10-0.12%) was evaluated as low. The obtained values of quantitative ratios Ca:P and Ca:Mg are 7.95 and 21.55, respectively, as repeatedly exceed those considered as optimal, i.e., Ca:P = 2 and Ca:Mg = 3 (Halgerson *et al.*, 2004).

The content of condensed tannins from 1 to 4% of dry matter is significant for prevention of ruminal tympany in pasture using of legumes, for increase of use of nitrogen and macromineral elements contained in them, and also for restriction of certain gastro intestinal parasites in ruminants (Theodoridou, 2010). The content of condensed tannins in the forage mass of the studied type has identical values in the second and third vegetation (1.17%) (Table 3).

Table 1. Forage productivity and morphological characteristics in spring growing and summer regrowing of common kidney vetch.

	DMY (kg/da)	
	First cut	**Second cut**
Year of sowing	355	-
Second vegetation	2289	338
Third vegetation	574	141
	Morphological characteristics	
Plant height in second vegetation (cm)	64.7 ± 4.2	37.3 ± 7.7
Plant height in third vegetation (cm)	35.6 ± 5.4	30.0 ± 6.0
Stems (%)	50.3	42.1
Leaves (%)	22.9	35.6
Inflorescences (%)	26.8	22.3

Table 2. Qualitative composition of forage of common kidney vetch in the second and third vegetation and average for the period of study,% DM.

	CP	**CF**	**Ca**	**P**	**Mg**	**Ca: P**	**Ca:Mg**	**WSS**	**Tannins**
Second vegetation	13.31	26.99	2.46	0.33	0.12	7.45	20.50	4.20	1.17
Third vegetation	11.94	27.56	2.26	0.27	0.10	8.37	22.60	3.60	1.17
Average	12.63	27.28	2.36	0.30	0.11	7.95	21.55	3.90	1.17

Table 3. Nitrogen in DMY and amount of fixed nitrogen on average for three years.

	N in DMY, (kg N/da/y)	N fix (kg N/da/y)
Year of sowing	7.56	5.39
Second vegetation	25.09	21.68
Third vegetation	7.22	5.43
Average	13.29	10.83

Additionally, common kidney vetch accumulated on average up to 13.29 kg N in dry matter yield. As a legume crops common kidney vetch fixed on average 10.83 kg N/y/da (Table 3)

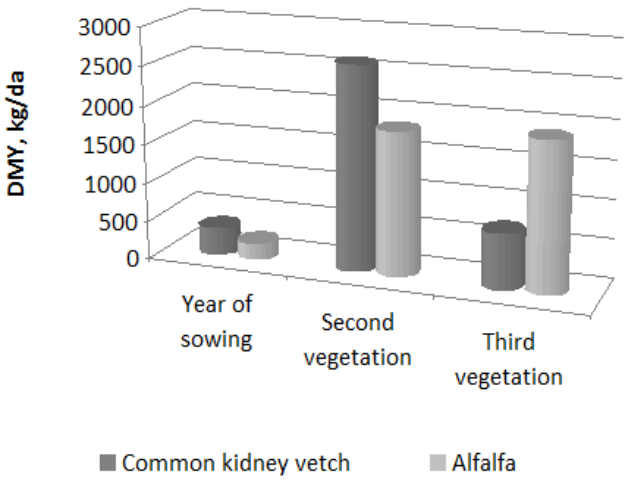

Fig. 1. Annual productivity of dry matter (kg/da) of common kidney vetch in comparison with local pasture ecotypes of alfalfa (Naydenova *et al.*, 2015).

Conclusions

The common kidney vetch manifested as high-yielding, fast-growing forage legume crops in monoculture growth conditions of the Central Northern Bulgaria. The species is highly productive in spring, but the regrowth is slow and weak, therefore it is suitable for creating a grassland with combined field of use.

The forage quality of dry biomass can be described as very good. The average crude protein content is relatively low (12.63%), but it is balanced in terms of established fiber content (27.28%). The species is rich in soluble sugars (3.90%) and contains condensed tannins in low concentration (1.17%), which suggests high levels of voluntary intake by animals. The high content of Ca should be pointed as an unfavorable qualitative characteristic and therefore an excess over the critical values for the quantitative macromineral ratios Ca: P and Ca: Mg.

References

Anonymous. 1990. Official Methods of Analysis (AOAC) (15th ed.). Association of Official Analytical Chemists, Arlington, Va. K. Herlich (Ed.). Arlington, Va., USA.

Carlsson, G. and K.H. Danell. 2003. Nitrogen fixation in perennial forage legumes in the field. *Plant & Soil*, 253: 353-372.

Delipavlov, D. and I. Cheshmedzhiev. 2003. Key to the plants of Bulgaria. Academic Press of Agrarian University, *Plovdiv, Bulgaria.*

Duke, J.A. 2012. Handbook of legumes of world economic importance. Springer Science & Business Media.

Halgerson, J., C. Sheaffer, N. Martin, P. Peterson and S. Weston. 2004. Near-infrared reflectance spectroscopy prediction of leaf and mineral concentrations in alfalfa. *Agron. J.*, 96(2): 344-351.

Honnay, O., E. Coart, J. Butaye, D. Adriaens, S. Van Glabeke and I. Roldán-Ruiz. 2006. Low impact of present and historical landscape configuration on the genetics of fragmented *Anthyllis vulneraria* populations. *Biol. Conser.*, 127(4): 411-419.

Lingorski, V.I. and D. Mitev. 2012. Comparative testing of some perennial drought tolerant legume grasses by foothill conditions of Central Northern Bulgaria. *Banat's J. Biot.,* III(6): 37-42.

Marinas, A. and R. García-González. 2006. Preliminary data on nutritional value of abundant species in supraforestal pyrenean pastures. *Pirineos.*, 161: 85-109.

Mihovsky, T.S. and G. Goranova. 2005. A comparative study of varieties of white clover (*Trifolium repens* L.) in foothill conditions of the Central Balkan Mountains. *Plant Sci.*, 43(1): 57-61.

Mihovsky, T.S.., K. Okumura, M. Sabeva and G. Naydenova. 2014. Comparative study of four Japanese varieties of red clover under the conditions of RIMSA in Troyan, Bulgaria. *Úroda.*, 12/2014, 223-229.

Mitev, D. 2014. Adaptability of some cultivars and populations of legume grasses towards the ecological variability in the region of the Central Balkan mountain. *J. Moun. Agri. on the Balk.*, 17(5): 1178-1186.

Mitev, D., B. Churkova and M. Iliev. 2013. Comparison of some grasses and legumes of local origin under conditions of the Central Balkan. *J. Moun. Agri. on the Balk.*, 16(5): 1233-1246.

Nakova, R. and S. Christova. 2012. Contemporary investigations on competitive relations between maize (*Zea mays* L.) and weeds. *Plant Sci.*, 59.

Naydenova, G., V. Vasileva and D. Mitev. 2015. Productivity of Bulgarian grazing ecotypes of perennial legumes. *J. Moun. Agri. on the Balk*., 18(6): 972-982.

Theodoridou, K. 2010. The effects of condensed tannins in sainfoin (*Onobrychis viciifolia*) on its digestion and nutritive value. Agricultural Sciences. Universite Blaise Pascal - Clermont-Ferrand II, 2010.

(Received for publication 27 March 2017)