Bulgarian Journal of Agricultural Science, 23 (No 5) 2017, 739–742
Agricultural Academy

COMPARATIVE STUDY ON CZECH CULTIVARS OF RED CLOVER (*TRIFOLIUM PRATENSE* L.) IN THE CONDITIONS OF THE CENTRAL NORTHERN BULGARIA

TSVETOSLAV MIHOVSKY[1]; GALINA NAYDENOVA[2*]
[1] *Agricultural Academy, Research Institute of Mountain Stockbreeding and Agriculture, BG-5600 Troyan, Bulgaria*
[2] *Agricultural Academy, Experimental Station on Soybean, BG-5200 Pavlikeni, Bulgaria*

Abstract

Mihovsky Ts. and G. Naydenova, 2017. Comparative study on czech cultivars of red clover (*Trifolium pratense* L.) in the conditions of the central northern Bulgaria. *Bulg. J. Agric. Sci.*, 23 (5): 739–742

Three diploid (Respect, Suez, Vltavin) and two tetraploid (Kvarta and Tempus) Czech varieties of red clover were studied and compared with Bulgarian diploid varieties Sofia-52 and Nika-11 in three consecutive years under the conditions of the Central Northern Bulgaria. It has been found that red clover originating in the Czech Republic, grown in foothill conditions in Bulgaria, shows good growth and development, and is characterized by good ecological plasticity. There was no significant difference in dry matter yield between Czech and Bulgarian varieties in the second and third vegetation when the crop is fully developed. Studied varieties were not significantly different both in growth rate and in seasonal productivity. Bulgarian variety Nika 11 is characterized by high leafiness in spring growing, as for the tetraploid variety Czech Kvarta it was in summer regrowing. A tendency was observed for a lower total productivity of tetraploid germplasm compared to diploid.

Key words: red clover; variety tests; diploid; yield

Introduction

There are about 300 species of genus Trifolium studied by the science, as red clover (*Trifolium pratense* L.) has the greatest significance in Bulgaria (Topalov et al., 1989). It is the most commonly used legume species for establishment of a temporary meadow and grazing grasslands in foothill and mountain areas of Bulgaria. It is also most commonly used in the world agricultural practice (Sato, 2005).

Red clover in particular, and all legume forage crops, have the unique ability to fix atmospheric nitrogen and allow high yields using less nitrogen fertilizer (Vyn et al., 2000; Odhiambo and Bomke, 2001; Dahlin and Stenberg, 2010; Vasileva et al., 2016; Vasileva and Ilieva, 2017).

Red clover helps to retain water and nutrients in the soil (Francis et al., 1998; Unger and Merle, 1998), as well as in dealing with pests and weeds (Fisk et al., 2001; Sarrantonio and Gallandt, 2003).

Red clover is the ideal legume partner for mixtures with grasses (Kirwan et al., 2005), as well as for winter wheat, where it brings multiple benefits (Blackshaw et al., 2010; Gaudin et al., 2013).

The aim of the experiment was to study the established Czech varieties of red clover and to evaluate their behavior under conditions of the Central Northern Bulgaria, as well as for future selection with that species.

Materials and Methods

Five Czech red clovers cultivars were included in the experiment: three diploid – Respect, Suez, Vltavin and two tetraploid – Kvarta and Tempus. Were compared with Bulgarian diploid varieties Sofia-52 and Nika-11 in three consecutive years. The trial was set in the experimental field of RIMSA in 2013 using the block design method in four replications, with a harvest plot size of

**Corresponding author*: gmvg@abv.bg

10 m² split in two parts for simultaneous monitoring of forage and seed productivity (discussed in another paper) of the tested varieties. There were no fertilization and irrigation. Manual sowing used 1400 viable seeds/m2. We recorded the results for dry vegetative mass yield (t/ha), grassland botanical composition (weight %) at the stage of budding-early flowering, and the morphological composition of freshly cut biomass (weight % of leaves, stems and inflorescences). Data statistical processing was done by ANOVA for Excel.

The region of the experiment has the following characteristics: the soils are unsaturated planosols, with pH(KCL) of 4.4, altitude of 384 m, average monthly precipitation amount for the vegetation period of 74.7 mm and average monthly temperature of 15.9°C. The rainfall during the vegetation of the three experimental years is presented in Table 1. In the sowing year the months of August and September were very dry. In the second and third experimental years the monthly precipitation was more than normal.

Results and Discussion

The annual dry matter productivity varied greatly depending on the age of grasslands and differences in climate conditions in different years and regrowths (Figures 1-3). In the year of sowing, the dry matter yield was in the range of 2.9 (cv. Tempus) to 5.4 t/ha (cv. Suez). In the second harvest year, which is characterized by very wet conditions during the summer months, the yield was the highest – between 16.9 (cv. Nika 11) and 19.7 t/ha (cv. Vltavin). In the third year, defined as moderately dry, it was between 6.2 (cv. Kvarta) and 7.5 t/ha (cv. Sofia 52).

According analyses of variance no statistically significant differences were found for dry vegetative mass yield of the examined cultivars over the trial period – Table 2. Similar results were recorded for all cuts in the second and third growing season when the crop was fully developed – Figures 2 and 3.

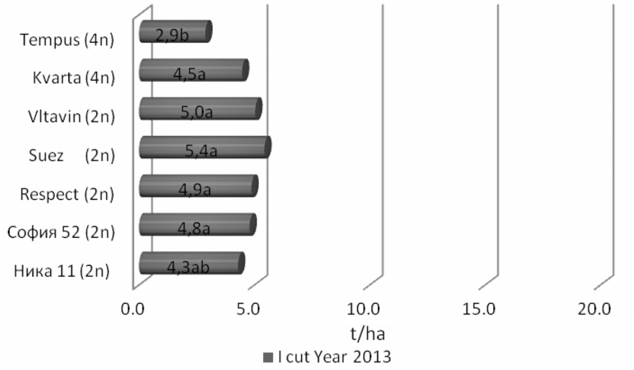

Fig. 1. Yields of dry vegetative matter per cuts in 1st experimental year, t/ha

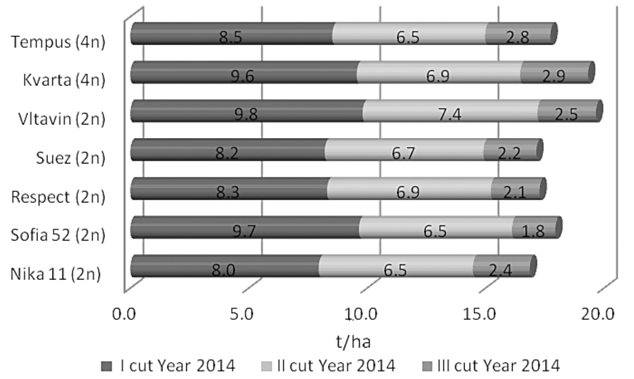

Fig. 2. Yields of dry vegetative matter per cuts in 2nd experimental year, t/ha

The genotypic factor has a significant effect (P = 0.05) on phenotypic variation in yield only in the year of the creation of swards – Figure 1. Then tetraploid variety Tempus yielded with significant differences with the other varieties in the study, with the exception of variety Nika 11. According to the productivity results, all studied varieties had a high development rate – giving maximum yield in the second vegetation. They did not also differ in the course of develop-

Table 1
Monthly precipitation amount and monthly average temperature for the vegetation period in different years (Troyan)

Year	Measure	Apr	May	Jun	Jul	Aug	Sep	Oct	Average
2013 yr	t (°C)	12.0	17.5	18.7	19.4	22.7	15.4	12.1	16.8
	mm	92.1	90.3	274.6	61.2	14.9	22.7	53.2	87.0
2014 yr	t (°C)	11.1	14.5	18.3	20.2	20.6	15.4	10.5	15.8
	mm	86.3	164.3	71.7	194.2	75.4	228.5	119.3	134.2
2015 yr	t (°C)	9.7	16.7	17.8	22.0	27.7	17.6	10.4	17.4
	mm	57.7	67.9	186.6	58.4	74.2	149.4	89.0	97.6
Average for 20 yr period 1988-2008	t (°C)								15.9
	mm								74.7

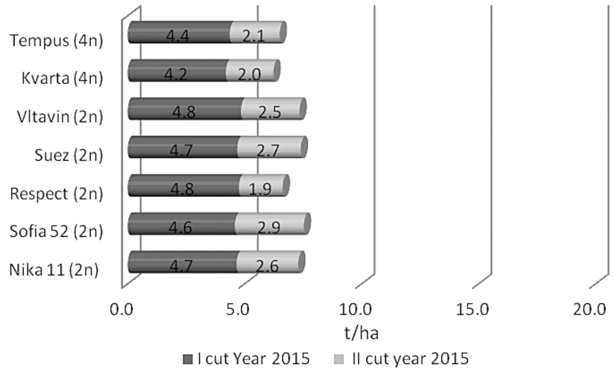

Fig. 3. Yields of dry vegetative matter per cuts in 3rd experimental year, t/ha

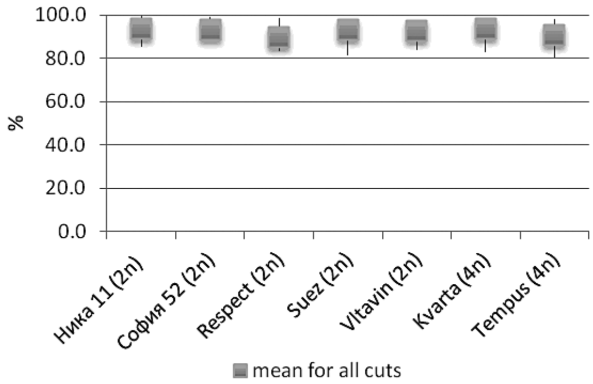

Fig. 4. Limit and average values for relative participation of red clover in the mass of harvested regrowths

ment in vegetation – according to productivity of regrowths and consequently during seasons in the second and third vegetation, all tested varieties fall within a homogeneous group. Although there were no significant differences in dry matter yield depending on the level of ploidy, there was a tendency to lower the overall productivity of tetraploid germplasm included in the experiment. Lower adaptability of tetraploid varieties of red clover to the foothill and mountain conditions of Bulgaria, expressed by yield and durability of use is established in our previous studies (Goranova et al., 2003; Michovski et al., 2014).

Genotypic effect is also unreliable in relation to observed variation in the relative share of red clover in grassland – Table 2. For all harvested regrowths the share of clover in fresh weight was over 80% (Figure 4), as these results can be taken as an indicator for good competitiveness and adaptability of the tested Czech varieties. Relatively low level of weed infestation was observed in the grasslands of Bulgarian variety Sofia 52.

Red clover leaves are an important ingredient of quality forage (Vasiljevic et al., 2009) and the parameters of proportion of leaves in the forage or leaf/stem ratio are main agronomic traits in variety testing of red clover (Mihovski and Yancheva, 1998; Vasileva, 2015). Leaves in red clover are the morphological fraction, related also to another specific quality character of this species, namely content and activity of the polyphenol oxidase enzyme, which protects proteins and glycerol-based lipid in the rumen (Parveen et al., 2010). In the present study, the genotypic variance in the values of the ratio of leaves:stems is unreliable (Table 2). The index is influenced significantly by the conditions of growing, as Nika 11 variety is characterized by high облистеност in spring growing, when the greater part of the annual crop is formed and tetraploid Czech variety Kvarta formed it in summer regrowing (Figure 5).

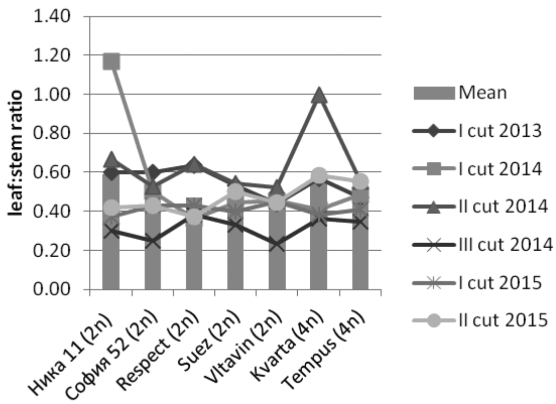

Fig. 5. Values of weight share leaves/stems in different regrowths and average for the period

Table 2
Analysis of variance on dry matter yield (t/ha), red clover participation in grassland (%) and leafiness represented by the values of the ratio of leaves /stems

	Significance of effect of factors		
	Genotype (G)	Year, regrowth and age of grassland	Interaction (GxY) %
Dry matter yield	P < 0.10	P < 0.001	ns
Share participation of red clover in the grassland	ns	P < 0.001	–
Leafiness	ns	P < 0.01	–

Conclusion

Red clover originating in the Czech Republic, grown in foothill conditions in Bulgaria, shows good growth and development, and is characterized by good ecological plasticity.

There was no significant difference in dry matter yield between Czech and Bulgarian varieties in the second and third vegetation when the crop is fully developed. Studied varieties were not significantly different both in growth rate and in seasonal productivity.

Bulgarian variety Nika 11 is characterized by high leafiness in spring growing, as for the tetraploid variety Czech Kvarta it was in summer regrowing.

A tendency was observed for a lower total productivity of tetraploid germplasm compared to diploid.

References

Blackshaw, R. E., L. J. Molnar and J. R. Moyer, 2010. Suitability of legume cover cropwinter wheat intercrops on the semi-arid Canadian prairies. *Can. J. Plant Sci.,* **90**: 479-488.

Dahlin, A., Sigrun and M. Stenberg, 2010. Transfer of N from red clover to perennial ryegrass in mixed stands under different cutting strategies. *European Journal of Agronomy*, **33**: 149-156.

Fisk, J., O. Hesterman, A. Shrestha, J. Kells, R. Harwood, J. Squire and C. Sheaffer, 2001. Weed suppression by annual legume cover crops in no-tillage corn. *Agron. J.,* **93**: 319-325.

Francis, G., K. Bartley and F. Tabley, 1998. The effect of winter cover crop management on nitrate leaching losses and crop growth. *J. Agric. Sci.* **131**: 299-308.

Gaudin, A., S. Westra, C. Loucks, K. Janovicek, R. Martin and W. Deen, 2013. Improving resilience of northern field crop systems using inter-seeded red clover. *Agronomy*, **3**: 148-180.

Goranova, G., B. Chourkova and Ts. Mihovski, 2003. Study of introduced red clover (Trifolium pratense L.) Di- and Tetraploid varieties grown in Central North Bulgaria. *Bulgarian Journal of Agricultural Sciences*, 9: 167-171.

Kirwan, L., G. Belanger, J. Finn, M. Fothergill, B. Frankow-Lindberg, R. Garcia-Sarrion, A. Ghesquiere, P. Golinski, A. Helgadottir, M. Jorgensen, Z. Kadziuliene, D. Nyfeler, P. Nykanen-Kurki, G. Parente, V. Vasileva, R. Collins, J. Connolly, A. Luscher, C. Porqueddu and M. Sebastia, 2005. Higher yield and fewer weeds in four-species grass/legume mixtures than in monocultures: results from the first year at 20 sites of COST action 852. In: XX International Grassland Congress: Offered papers. *Wageningen Academic Publishers*, p. 425.

Mihovski, Ts. and N. Yancheva, 1998. Comparative evaluation of red clover in the conditions of Central Northern Bulgaria. *Journal of Mountain Agriculture on the Balkans,* 1 (3-4): 299-302.

Mihovski, Ts., K. Okumura, M. Sabeva and G. Naydenova, 2014. Comparative study of four Japanese varieties of red clover under the conditions of RIMSA – Toyan, Bulgaria. Aktuální poznatky v pěstování, šlechtění, chraně rostlin a zpracování produktů. úroda 12/2014, ISSN 0139-6013, 223-229.

Odhiambo, J. and A. Bomke, 2001. Grass and legume cover crop effects on dry matter and nitrogen accumulation. *Agron. J,*. **93**: 299-307.

Parveen, I., M. Threadgill, J. Moorby and A. Winters, 2010. Oxidative phenols in forage crops containing polyphenol oxidase enzymes. *J Agric Food Chem*., **58** (3): 1371-1382.

Sarrantonio, M. and E. Gallandt, 2003. The role of cover crops in North American cropping systems. *J. Crop Prod*. **8**: 53-74.

Sato, S., 2005. Somparative structural anslysis of the genome of red clover (*Tr. pratense* L.). *DNA Research*, **12**: 301-364

Topalov, V., I. Dechev and M. Pehlivanov, 1989. Plant Production. Textbook for Students of the Agricultural University in Plovdiv, *Zemizdat*, Sofia

Unger, P. and F. Merle, 1998. Cover crop effects on soil water relationships. *J. Soil Water Conserv.,* **53**: 200-207.

Vasileva, V., 2015. Morphological parameters and ratios in some mixtures with subclover. *Science International*, **3** (4): 107-112.

Vasileva, V. and A. Ilieva, 2017. Some physiological parameters in mixtures of cocksfoot and tall fescue with subterranean clover. *Bulgarian Journal of Agricultural Science*, **23** (1): 71-75.

Vasileva, V., E. Vasilev and R. Tzonev, 2016. Subterranean clover (*Trifolium subterraneum* L.) as a promising forage species in Bulgaria. *Bulgarian Journal of Agricultural Science*, **22** (2): 222-227.

Vasiljević, S., D. Milić and A. Mikić, 2009. Chemical attributes and quality improvement of forage legumes. *Biotechnology in Animal Husbandry*, **25** (5-6): 493-504.

Vyn, T., J. Faber, K. Janovicek and E. Beauchamp, 2000. Cover crop effects on nitrogen availability to corn following wheat. *Agron. J.,* **92:** 915-924.

Received March, 24, 2017; accepted for printing June, 9, 2017