Trifolium subterraneum L. (Subterranean clover) on arable land in regions with limited precipitation

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Introduction

Trifolium subterraneum L. (Subterranean clover) is an annual species which is able to overwinter. Its native area of occurrence is in the Mediterranean. Wild forms of this species are sometimes accidentally and temporarily introduced into the area of the Czech Republic. In Europe, *T. subterraneum* growing on arable land is associated mainly with the support of non-production functions of agriculture, organic farming, and with the technologies of soil conservation tillage. The aim of this study was to assess the growth characteristics of *T. subterraneum* stands on arable land in areas with limited precipitation under the conditions of the Czech Republic.

Materials and methods

The development of *T. subterraneum* stands grown as monocultures and as summer cover crops on arable land was tested at the Červený Újezd experimental station of the Czech University of Life Sciences in Prague during the years 2005 – 2007. An average yearly temperature on the stand is 7.9°C and the yearly precipitation is 525.8 mm. The soil can be classified as clay loam. The sum of precipitations for the period from May to August was 380.8 mm in 2005, 274.0 mm in 2006, and 324.5 mm in 2007.

Monoculture stands were established on 29 April 2005, 10 May 2006, and 2 May 2007 with the row width 25 cm (sowing rate 30 kg ha^{-1}). The area of each experimental plot was 75 m^2 (3 x 25 m). The aboveground biomass production of the stands was tested on the area of 0.1 m^2 in five replicates on each experimental plot during 10^{th} and 15^{th} week after the sowing (evaluation dates are presented in Table 1). During the aboveground biomass evaluation, the whole biomass that was above the soil surface was counted. Weeds on the stands were managed mechanically during the vegetation period. The stands established as a summer cover crop after winter wheat harvest were sown on 24 May 2005, 30 August 2006, and 14 August 2007 (sowing rate 30 kg ha^{-1}, wide sowing). The area of each experimental plot was 30m^2 (3 x 10 m) in four replicates. The first evaluation of the aboveground biomass production was realised on 4 October 2005, 11 October 2006, and 3 October 2007, the second one on 20 October 2005, 1 November 2006, and 1 November 2007. The aboveground biomass production was evaluated on the area of 0.1 m^2 (two replicates in each plot). The production of the aboveground biomass of *T. subterraneum,* volunteer cereal forecrop, and weeds was recorded. In our trial breeding material from Deutsche Saatenveredlung Bückwitz (Germany) was used as seed of *T. subterraneum*. Statistical analysis was performed using STATGRAPHICS®Plus, ver. 4.0, ANOVA, Tukey method ($\alpha = 0.05$).

Results and discussion

The average dry aboveground biomass production of pure stands of *T. subterraneum* (2005 – 2007 average) tested in 10^{th} week after sowing was 3.012 Mg ha^{-1} and 7.498 Mg ha^{-1} $^{in\ 15th}$ week after sowing. There were no statistically significant differences between the values of biomass production obtained in experimental years (Table 1). The stands of *T. subterraneum* showed 100 % soil cover during the second term of aboveground biomass evaluation.When assessing the yield of dry aboveground biomass of *T. subterraneum* grown as a summer cover crop, the highest values of biomass production were obtained in 2007. These values were statistically significantly higher compared to the aboveground biomass production obtained in 2005 and 2006 (Table 2). The increase in the aboveground biomass production in 2007 was probably caused by higher rainfall intensity during the period between the date of sowing and the date of the last evaluation of aboveground biomass production. The rainfall during this period was 93 mm higher in 2007 than in previous years. The values of the aboveground biomass production of *T. subterraneum* grown as a summer catch crop were comparable to the production of *Trifolium incarnatum* stands. *T. incarnatum* aboveground biomass production at the same location and with the same dates of sowing obtained during the last date of evaluation was 396.4 kg ha^{-1} in 2005, 592.6 kg ha^{-1} in 2006, and 2681.5 kg ha^{-1} in 2007 (Brant et al., 2009). Occurrence of weeds and volunteer cereal forecrop in *T. incarnatum* stands was also comparable. The stands of *T. subterraneum* grown as a summer cover crop can be classified as stands with a lower competitive ability against the volunteer cereal forecrop based on the volunteers development which was higher than in the stands of *Sinapis alba* and *Phacelia tanacetifolia* (Brant et al., 2009).

Table 1: Date of sampling and dry matter production (Mg ha^{-1}) of the stands of *T. subterraneum* (spring seeded) in the years 2005 – 2007

Year	10^{th} week after sowing		15^{th} week after sowing	
	date of sampling	dry matter production (Mg ha^{-1})	date of sampling	dry matter production (Mg ha^{-1})
2005	7.7.2005	3.039a	10.8.2005	7.200a
2006	18.7.2006	3.001a	23.8.2006	6.982a
2007	11.7.2007	2.996a	9.8.2007	8.312a

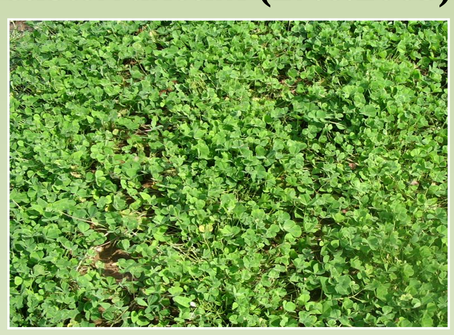
ANOVA; $\alpha = 0.05$; different letters document statistically different means columnwise

Pure stands of *T. subterraneum* (27.6.2005)

Table 2: Dry matter production (kg ha^{-1}) of *T. subterraneum* (catch crop), volunteers and weeds in the years 2005 - 2007

Date	dry matter production (kg ha^{-1})			Date	dry matter production (kg ha^{-1})		
	T. subterraneum	volunteer	weed		*T. subterraneum*	volunteer	weed
4.10.2005	432.5a	507.5a	170.8b	20.10.2005	563.3a	504.9a	98.3a
11.10.2006	297.6a	417.1a	9.6 a	1.11.2006	640.3a	489.0a	12.9a
3.10.2007	800.0b	289.9a	67.1ab	1.11.2007	2360.8b	522.5a	97.1a

ANOVA; $\alpha = 0.05$; different letters document statistically different means columnwise



Pure stands of *T. subterraneum* (13.7.2005)

Conclusion

In future research it would be important to focus on the possibilities of *T. subterraneum* growing in conservation tillage systems in wide row crops and in the area of agro-environmental actions, especially in relation to the elimination of the risk of soil erosion. Next, it would be necessary to evaluate the possibility of using *T. subterraneum* in mixtures with other legumes and grasses grown on arable land and to evaluate the production and growing parameters of these mixtures from the point of view of their growing period and competition ability against the weeds

Acknowledgements: Supported by the Projects No. QH 82191 and No. 6046070901.