Mechanical weeding of *Rumex obtusifolius* in organically managed grassland

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Abstract

The effect of mechanical weeding of *Rumex obtusifolius* performed at two different depths was studied in the north of the Czech Republic (near Liberec) under organic farming conditions from 2007 to 2010. Applied treatments were: unmanaged control, grazing management without mechanical weeding (digging of taproots) and grazed management with mechanical weeding at a depth of 5 cm or 20 cm once or twice. The first weeding was made in August 2007 and the second in May 2008. Numbers of *R. obtusifolius* plants per 1m² were counted during four years of the experiment. Repeated weeding was more effective than by digging out only once during the experiment. Digging out *R. obtusifolius* taproots showed better results at a depth of 20 cm below ground than at 5 cm (below ground). After weeding two times at a depth of 20 cm, resprouting plants were no longer found. It seems that repeated mechanical weeding at 20 cm depth is effective for *R. obtusifolius* suppression in grassland under organic farming.

Keywords: broad-leaved dock, taproot, digging out, grassland, weed

Introduction

Broad-leaved dock (*Rumex obtusifolius*) is one of the most troublesome weeds in grasslands worldwide (Zaller, 2004). These plants often colonise grasslands as well as permanent agricultural crops (Novák, 1994; Brant *et al*., 2006), where they can survive for a long time (Martínková *et al*., 2009). In conventionally managed grassland systems, *R. obtusifolius* can be controlled chemically but results are not straightforward and require repeated treatment (Niggli *et al*., 1993). However, under conditions of organic farming the use of chemical substances is prohibited and only biological or mechanical methods are allowed. Biological methods include use of specific insects or pathogenous fungi controlling *R. obtusifolius* plants. Nevertheless, their application is still problematic (Strnad *et al*., 2010). Mechanical methods can be used with a variable intensity of defoliation. In the current study the effects of manual digging taproots of *R. obtusifolius* at different depth and frequency was investigated.

Material and methods

The experiment was conducted in the northern Czech Republic, 5 km north from the town of Liberec on an oganically managed farm. The experimental grassland was infested by broad-leaved dock (*R. obtusifolius*). Mechanical weeding of taproots was performed manually using a special narrow hoe on a particular plot. The first intervention was made in August 2007 and the second one was made in May 2008. Six treatments were applied:
(1) grazing with digging out of taproot of *R. obtusifolius* at a depth of 20 cm below ground twice
(2) grazing with digging out of taproot of *R. obtusifolius* at 20 cm below ground only once
(3) grazing with digging out of taproot of *R. obtusifolius* at 5 cm below ground twice

(4) grazing with digging out taproot of *R. obtusifolius* at 5 cm below ground only once
(5) grazing without digging out of taproot of *R. obtusifolius*
(6) unmanaged control.
The experiment was arranged in four complete randomised blocks with individual plot sizes of 3 m×3 m. Numbers of broad-leaved dock plants were monitored in 2 m×2 m areas allocated in the middle of each plot from 2007 to 2010. The experimental grassland was rotationally grazed with four grazing cycles. One way ANOVA and repeated measures ANOVA were used to evaluate the number of broad-leaved dock plants. The success rate referred to the initial number of *R. obtusifolius* plants as calculated in 2010.

Results and discussion

During 2008, a gradual decrease in the plant number of *R. obtusifolius* was recorded mostly in the treatments with mechanical weeding (Figure 1). The lowest abundance was found in treatments where mechanical weeding was applied twice. At the end of the experiment three groups of treatments showed a similar density of *R. obtusifolius*: i) unmanaged and without mechanical weeding; ii) mechanical weeding once (5 and 20 cm) and iii) mechanical weeding twice (5 and 20 cm). There was a similar pattern for the unmanaged treatments and the treatments without mechanical weeding in terms of the number of *R. obtusifolius* plants; however, abandonment can sometime suppress *Rumex* cover considerably (Pavlů *et al*., 2008; Martínková *et al*., 2009).

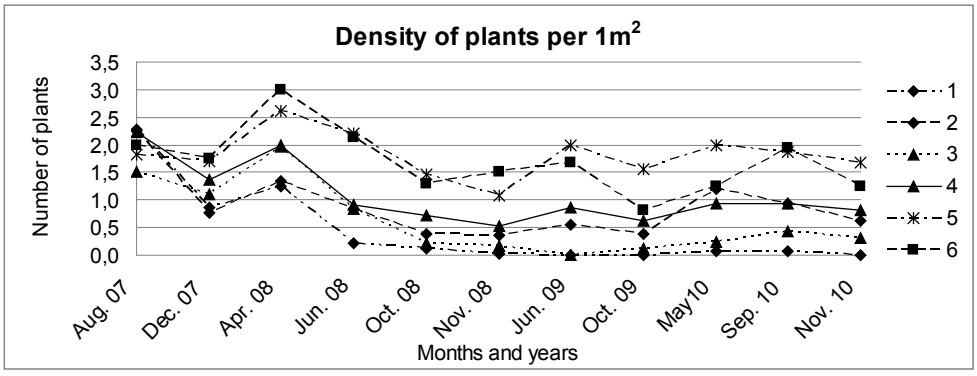

Figure 1. Development of numbers of *Rumex obtusifolius* plants per 1 m² during four years of experiment. Repeated ANOVA measures, study effects: Treatment $P < 0.001$, Year $P < 0.001$, Treatment×Year $P < 0.057$. For treatment number see Materials and methods.

Regeneration of *R. obtusifolius* plants dug out once from 5 cm below the soil surface was 37% (Figure 2), which is higher than results reported by Bond *et al*. (2007). On the other hand, Dierauer (1993) even recorded a regeneration rate of 73% for plants cut at the same depth. It seems that for successful weeding the soil nutrient content may play an important role. For example, in grassland with high phosphorus (P) and potassium (K) contents in the soil, Strnad *et al*. (2010) found no effect of mechanical weeding at a depth of 5 cm. On the other hand, Bond *et al*. (2007) suggested that plants did not regenerate after a cut at a depth of 10 cm and more and Dierauer (1993) reported that mechanical weeding at 10 cm depth resulted in a 20% rate of regeneration only. In our study, mechanical weeding at the depth of 20 cm below ground without repeating showed a regeneration of about 28%. However, no plants were found after weeding twice at a depth of 20 cm.

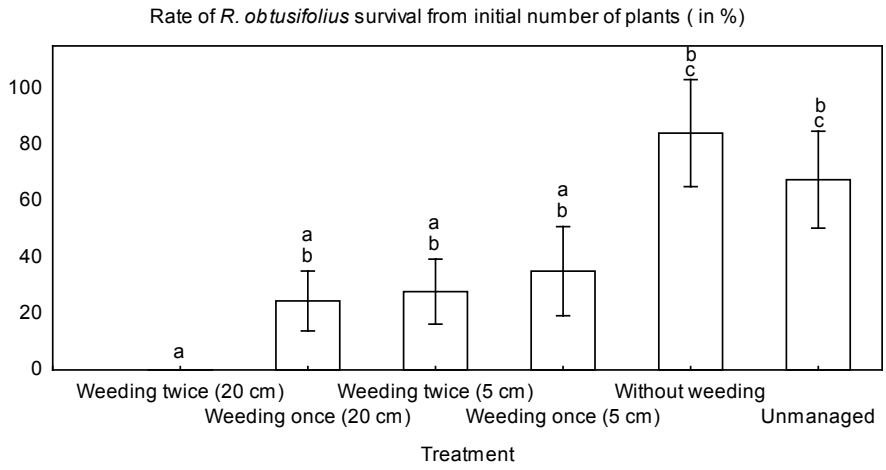

Figure 2. Survival rate of *R. obtusifolius* in November 2010 referred to the initial number of plants. Significant differences ($P < 0.001$) according to the Tukey post hoc test are indicating by different letters. Error bars represent standard error of the mean.

Conclusion

Repeated mechanical weeding of *Rumex obtusifolius* was more effective than a single treatment, especially at the depth of 20 cm. It seems that repeated mechanical weeding at the depth of 20 cm is effective for *R. obtusifolius* suppression in grassland under organic farming.

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