Mechanical control of *Cirsium arvense* in organic farming

E. Graglia & B. Melander
Forskningscenter Flakkebjerg DK-4200 Slagelse
Enrico.graglia[a]agrsci.dk

Introduction

Cirsium arvense L. (Scop) is a troublesome weed wherever it is found in agro-ecosystems (Donald, 1994; Skinner *et al*., 2000). In conventional agricultural systems, targeted use of herbicides during the growing season can provide satisfactory control, whereas the problem tends to increase in organic growing systems. A very expansive root system and the ability to form new aerial shoots from root buds, facilitate the formation of dense patches only a few years after establishment (Bakker, 1960). Furthermore, the high presence of labile carbohydrates in the roots of *C. arvense* enables the plant to regenerate even from root fragments 10 mm long (Hamdoun, 1972). It has been suggested that the amount of labile carbohydrates varies across the season (McAllister & Haderlie, 1985) and further, that minimum regrowth of underground regenerative organs, hence the time when the plant is most susceptible to removal of aboveground plant tissue, occurs when the aerial shoot has approximately eight expanded leaves (Gustavsson, 1997). Here, it is hypothesized that the use of repeated mechanical control events, removing aboveground biomass, are likely to deplete the carbohydrates of the root system.

Materials and methods

A two-factor experiment was conducted on a sandy loam in two consecutive periods from 2000-2002 and 2001-2003 at two adjacent experimental sites, hereafter called EXP1 and EXP2, respectively. The first factor consisted of three levels of mechanical weed control and untreated control plots. The second factor, included plots sown with a grass/white clover mixture and plots with unsown stubble of spring barley, making up a total of 32 plots including four replicates.

The mechanical treatment consisted of three different numbers of mowings, two, four and six respectively, carried out from mid May until end of July in the second experimental year. Mowing was carried out whenever the majority of the shoots of *C. arvense* had reached a height of 10 cm. After ending the treatments the field was left untouched until November, when the field was ploughed. The following spring, i.e. in the third experimental year, the plots were re-established from fixed points along the field. All plots were fertilised with pelleted chicken manure, corresponding approximately to 70 kg N/ha, just before sowing of spring barley. In the third experimental year no control of *C. arvense* was carried out. Just before harvest, the number of above ground shoots of *C. arvense* within the plots was counted and the biomass estimated.

Results and discussion

In EXP1 a regression line fitted to data, explained 87,6% and 89,5% of the variation in the aboveground biomass of *C. arvense* when mowed in unsown stubble and in the white clover/grass mixture, respectively (Fig. 1). In EXP2 none of the suggested regressions lines fitted significantly to the data even though the maximum number of mowings (six) reduced the above ground biomass of *C. arvense* by 64% and 69% in unsown stubble and in grass/white clover mixture, respectively, when compared to no mowing (Fig. 1). A power-test showed that the power of the tests was below 0.8, thus the null hypothesis – no treatment effect – should be accepted cautiously. A comparison of the two regression lines within each experiment showed that, in both cases, there was no difference between the regression coefficients, whereas the intercepts differed significantly from each other, suggesting that the presence of a competitive crop, here a grass/white clover mixture, is likely to suppress the growth of *C. arvense* significantly.

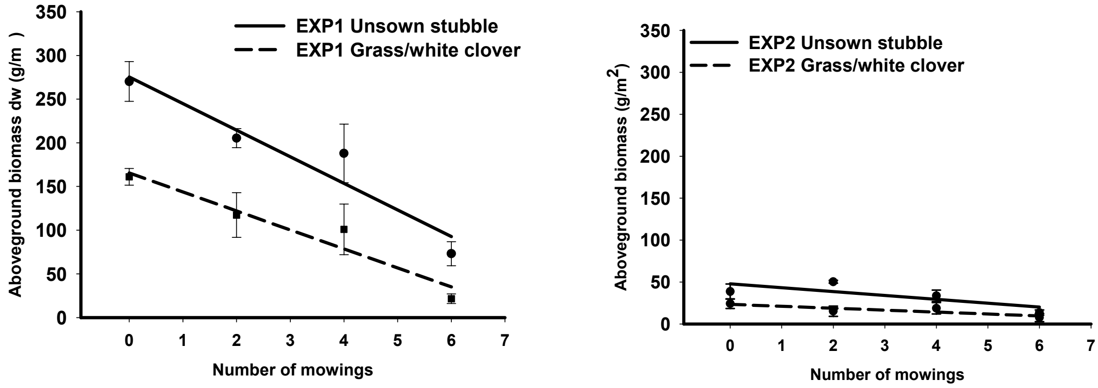

Figure 1. Relationship between number of mowings and aboveground biomass of *C. arvense* in the subsequent year. Treatments were carried out in plots with a grass/white clover mixture and in plots with unsown stubble.

Our results support the hypothesis that a continuous depletion of carbohydrates from the root system, caused by mowing and/or the use of a competitive crop, will diminish the regrowth capacity of the plant. Assuming that the root energy reserves attain a minimum during springtime (Gustavsson, 1997), any control strategy would be most effective at this time of year. However, Bourdot *et al*. (1998) reported that late season mowing had the most severe impact on root biomass. It is likely though, that the number of treatments confounded the effect of timing, as it was the case in the present study.

Reference List

BAKKER D (1960) A comparative life-history study of Cirsium arvense (L.) and Tussilago farfara L.,the most troublesome weeds in the newly reclaimed polders of the former Zuiderzee. In: Harper JL (ed). The Biology of Weeds. Blackwell Scientific Publications, Oxford, England, 205-222.

BOURDOT GW, LEATHWICK DM, HURRELL GA, SAVILLE DJ & O' CALLAGHAN M (1998) Relationship between aerial shoot and root biomass in Californian thistle. In: Proceedings of the Fifty First New Zealand Plant Protection Conference, 28-32.

DONALD WW (1994) The Biology of Canada Thistle (Cirsium Arvense). *Reviews of Weed Science* 6, 77-101.

GUSTAVSSON AMD (1997) Growth and Regenerative Capacity of Plants of Cirsium Arvense. *Weed Research* 37, 229-236.

HAMDOUN AM (1972) Regenerative Capacity of Root Fragments of Cirsium Arvense. *Weed Research* 12, 128-136.

MCALLISTER RS & HADERLIE LC (1985) Seasonal Variations in Canada Thistle (Cirsium Arvense) Root Bud Growth and Root Carbohydrate Reserves. *Weed Science* 33, 44-49.

SKINNER K, SMITH L & RICE P (2000) Using Noxious Weed Lists to Prioritize Targets for Developing Weed Management Strategies. *Weed Science* 48, 640-644.