Canada Thistle Management in Pasture

Edward Bork, Range Management Specialist, University of Alberta

Canada thistle is a long-lived, perennial weed common in pastures throughout central Alberta, particularly where moisture is relatively abundant. Canada thistle is persistent, in large part due to the extensive creeping root system that allows it to spread. This weed falls into the noxious category under the Weeds Act, indicating that where present, steps must be taken by landowners to prevent its spread into adjacent lands.

Although Canada thistle has been relatively intensively researched in the past, most of this research has taken place within higher profile, agronomic (i.e. cultivated) cropping systems. As a result, there is limited information on the impact of this weed in permanent pastures, nor on the most effective means of control, in either biological or economical terms.

This review outlines the most significant results from a research program initiated in 1999 to answer several questions dealing with the management of this noxious weed in permanent pastures of central Alberta. This program combined resources from the Alberta Agricultural Research Institute, the University of Alberta, AAFRD, over a dozen counties, as well as industry (BASF Canada and Dow AgroSciences).

Yield Loss

The first question that we set out to answer was information on the quantitative level of forage loss associated with increasing levels of thistle infestation. Although yield loss data is relatively common for cereal and oilseed crops, this information has been deficient for permanent pastures, resulting in uncertainty over the importance of thistle control. Between 1999 and 2001, we conducted 8 yield loss assessment trials throughout central Alberta. Our results consistently demonstrated a weak, but significantly negative, trend, thereby increasing levels of thistle [either stem densities (stems/m2) or biomass (kg/ha-dry matter)] resulted in greater forage losses (e.g. see Fig. 1A). Maximum forage losses approached a 2:1 ratio, meaning an increase in thistle biomass of 1 kg/ha reduced forage yield by 2 kg/ha. Initial yield loss relationships were subsequently validated when the removal of thistle from these plots effectively increased forage yields the following year, with greater thistle removal being associated with greater yield gain (Fig. 1B).

Fig. 1A: Relationship of herbage to thistle density at the St. Michael YLA.

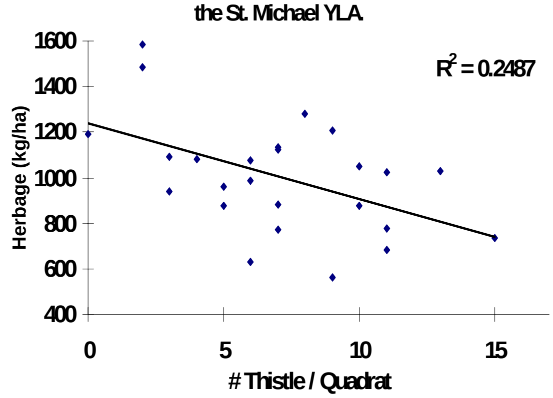
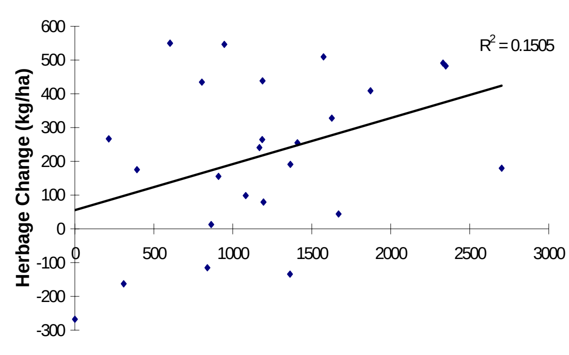


Fig. 1B: Relationship of herbage to thistle removal at the St. Michael YLA.



The results of this study support the concern that Canada thistle reduces pasture forage yields, and should provide a better incentive for producers to control this weed where it exists. However, our results also indicated that the presence of a yield loss and the magnitude of that effect was not consistent among all sites (6 of 8 demonstrated some significant negative effect). In other words, yield losses were inconsistent, likely due to high variability in soil, moisture, and forage types throughout the region, as well as their level of pre-existing management (i.e. grazing history, fertilization, etc.).

Fig. 2: Comparison of live thistle density (#/m2) among treatments in August 1999.

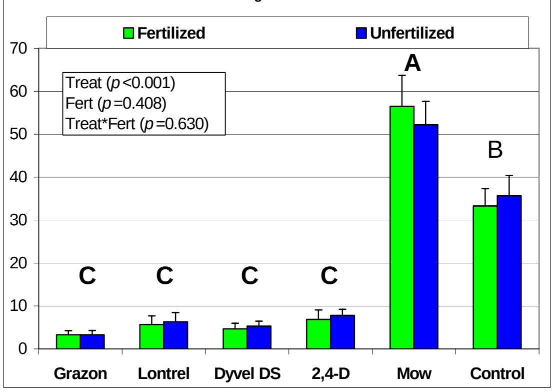
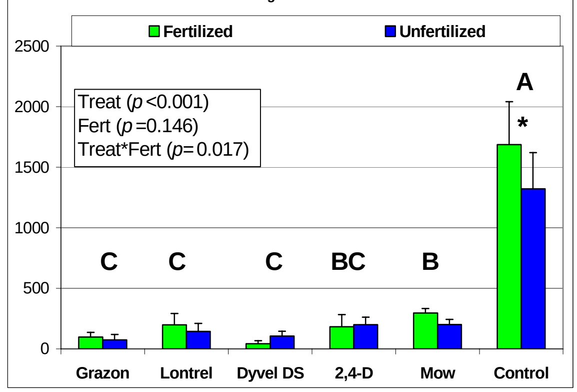


Fig. 3: Comparison of thistle biomass (kg/ha) among the treatments in August 1999.



Efficacy Trial

The second major question we sought to address dealt with the various control options available to producers. In particular, we were interested in the impact of various one-time control treatments and their longer-term effectiveness (up to 3 years) following treatment. To accomplish this, we compared 4 herbicides to one-time mowing and a check treatment at each of 4 sites across central Alberta (Rocky Mtn. House, Barrhead, Two Hills, and Lamont). We also examined each of these treatments with and without annual fertilization (100-45-10-15 kg/ha of N-P-K-S, respectively). This was done because other research has shown that fertility management can also be important for limiting the impact of undesirable weeds. Fertilization treatments were intended to eliminate all macronutrient deficiencies based on soil tests. The 4 herbicides we used covered a range of active ingredients and modes of action, and included 2,4-D ester 700 (2.5 L/ha), Lontrel (0.6 L/ha), Grazon (3.7 L/ha), and Dyvel DS (3.25 L/ha). All treatments were applied in early July of 1999 when thistle root carbohydrates were deemed to be at a minimum, a time when plants are most susceptible to damage.

Results of the trial indicated that initial levels of thistle control in 1999, the year of treatment, were similar between all herbicide treatments, ranging from 84 to 93% mortality. Subsequent reductions in both thistle biomass (Fig. 2) and thistle density (Fig. 3) reflected this control. Two other important effects were evident in the year of treatment. The first is the marked increase in thistle biomass with fertilization in the absence of thistle control (Fig. 3). This result clearly indicates that Canada thistle is well adapted to utilizing nutrients added to pastures. Thus, the addition of fertilizer in the absence of thistle control is likely to waste fertilizer and economic resources, and appears to make the thistle infestation worse. Second, one-time mowing clearly increased thistle density (Fig. 2). This response is a reflection of the pronounced ability of thistle to regrow from basal buds, and highlights the fact that occasional mowing is likely to be cosmetic in nature rather than effective in reducing actual thistle populations. Note that other studies have indicated repeated mowing (e.g. 3 times annually over 2 years) will control thistle, an option that was not tested here.

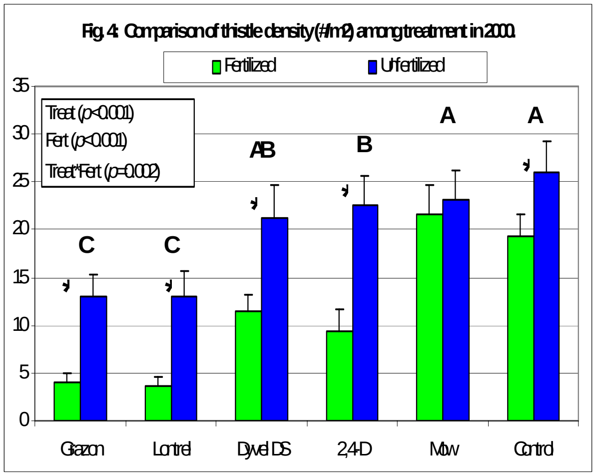


Fig. 4: Comparison of thistle density (#/m2) among treatment in 2000.

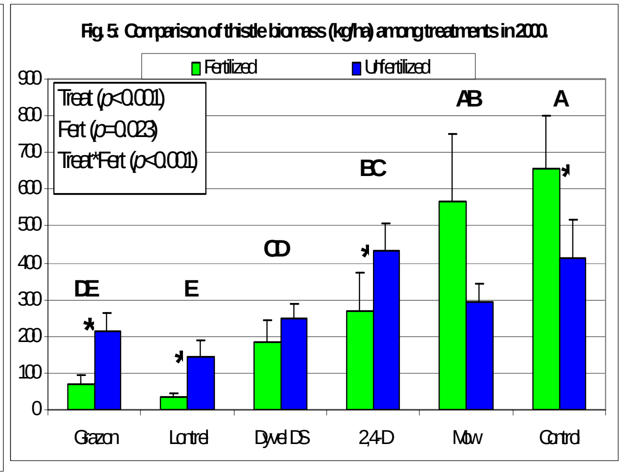


Fig. 5: Comparison of thistle biomass (kg/ha) among treatments in 2000.

Residual effects of the treatments were also observed for 2 subsequent growing seasons (in 2000 and 2001). In particular, thistle biomass and density (e.g. Figs. 4 and 5) continued to be lower within the herbicide treated plots. However, there were 2 additional important effects observed. First, the use of a combination of fertilizer and herbicide clearly resulted in a greater reduction in thistle abundance through both years. This is likely a result of the increased vigor of the forage stand associated with fertilization, which in turn, appears to further suppress the recovery of damaged thistle. These findings clearly indicate the longer-term effect of a one-time herbicide treatment can be enhanced by the addition of fertilizer. Second, there are some minor differences among the herbicide treatments in terms of their residual level of thistle control. Whether these differences are significant, however, particularly in terms of a cost-benefit analysis, remains to be determined. One final note on thistle control. One of the study sites we investigated had a high population of perennial sow thistle. Of the herbicides we used, 2,4-D resulted in significantly better control of this weed compared to the others.

In terms of forage responses, thistle removal from the herbicide treatments resulted in a widespread increase in grass biomass one year after treatment (Fig. 6). These results reinforce the yield loss findings reported earlier, and suggest that the removal of thistle is effective in enhancing the amount of forage available for grazing. There were also differences apparent in the biomass of forbs (broad-leafed plants) among the treatments. While Lontrel initially resulted in the greatest retention of forbs in 2000, little forb biomass was present in any of the herbicide treated plots by the final year of data collection, 2 full years after treatment.

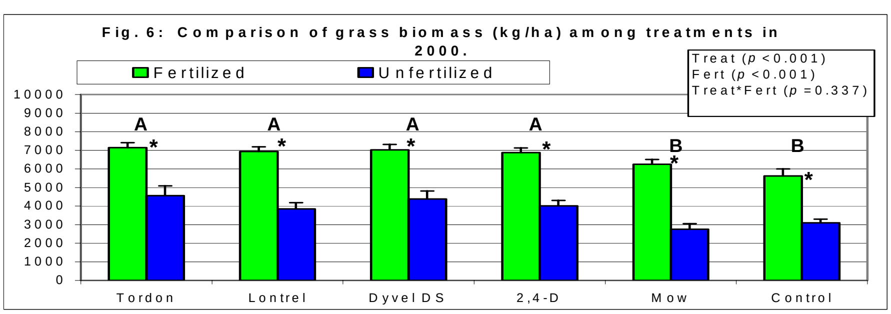


Fig. 6: Comparison of grass biomass (kg/ha) among treatments in 2000.

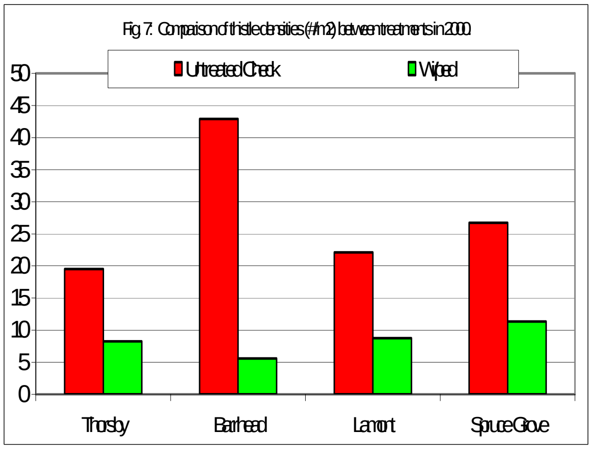


Fig. 7: Comparison of thistle densities (#/m2) between treatments in 2000.

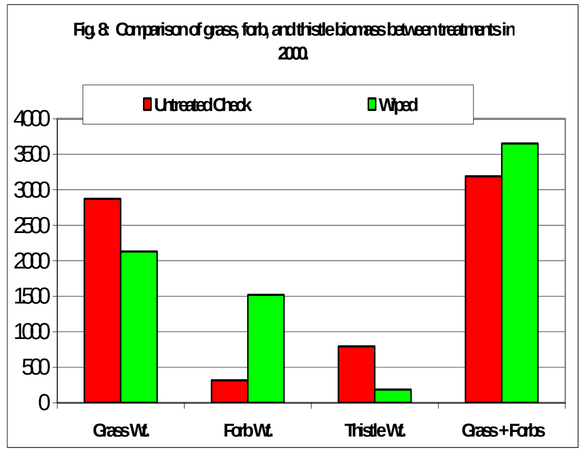


Fig. 8: Comparison of grass, forb, and thistle biomass between treatments in 2000.

Wiping for Thistle Control

The efficacy trial was accompanied by an evaluation of the use of weed wipers for controlling thistle with herbicides. Weed wipers apply a relatively concentrated herbicide through a saturated sponge, wick, or carpet, directly onto weeds. A key pre-requisite to the successful use of wipers is that the target weed (e.g. Canada thistle) must be taller than the forage base itself, which is normally obtained through livestock grazing as cattle reduce the height of the forage plants and leave taller weeds behind. Wipers have 2 potential advantages, including a reduction in the amount of herbicide used (per unit area) compared to broadcast spraying, and the retention of desirable plants (i.e. clover) in the understory that may be susceptible to the herbicide.

To date, the only herbicide with recommended label specifications for applying herbicide with a wiper is glyphosate (i.e. Roundup). As a result, an initial trial was conducted at 4 locations in central Alberta during 1999 examining thistle and forage responses to wiping. Glyphosate at 33% concentration was applied bi-directionally using an 11 foot Smucker wiper to 4 replicates at each location, and contrasted to check (untreated) plots. All pastures had been grazed leading up to the applications.

Wiping with glyphosate resulted in a marked reduction in thistle density and biomass at all locations in 1999, a pattern that continued to be apparent in the summer of 2000 (Fig. 7). However, the reduction in thistle also coincided with a reduction in grass biomass and increased forbs (Fig. 8). Data from 2001 indicated those forbs were largely annual, weedy species. The loss of grass biomass appeared to result from the application of glyphosate to grasses that escaped grazing and were hidden within the taller thistle canopy, and were therefore exposed to herbicide. Where this occurred, dead patches of grass were evident later in 1999, likely a result of the translocation of glyphosate into the crowns and roots of grasses resulting in some mortality. In addition, the patchy removal of grasses appeared to allow short-lived, weedy annual and biennial species (e.g. flixweed, stinkweed, pigweed, lamb's quarters, etc.) to germinate and increase in abundance. Thus, although wiper applied glyphosate was effective in reducing thistle, it also reduced forage production and increased undesirable annual weeds.

Based on the results obtained in the first wiping trial, a second trial was established in 2000 at 3 locations comparing the use of Roundup, Lontrel, Grazon, and Dyvel DS. All locations were mixed stands of perennial grass, clover, and Canada thistle. Differences in the uptake and translocation of these herbicides, as well as their selectivity (only Roundup is non-selective) and residual properties were hypothesized to allow the latter 3 treatments to retain more grasses and legumes in the forage stand. Herbicide concentrations were relativized on a cost equivalency basis (using Roundup as the benchmark), resulting in concentrations of 33, 2, 20, and 24%, respectively, for the 4 herbicides listed above.

Results of the second trial showed that although the Roundup treatment resulted in the greatest individual control of thistle in the year of treatment, all herbicides effectively reduced thistle. Similar results were also evident one year later in 2001, with Grazon and Lontrel resulting in the lowest levels of live thistle (Fig. 9). Perhaps most importantly, one year after application the Roundup treatment had the lowest biomass of grass, and again underwent an increase in annual forbs, a trend not seen with any of the other herbicides (Fig. 10). Thus, the use of selective herbicides for the control of thistle in permanent pastures appears to be an effective alternative to glyphosate for not only achieving thistle control, but also maximizing forage production following treatment. No reduction in forb biomass was observed during the first 2 years following the application of Grazon or Lontrel.

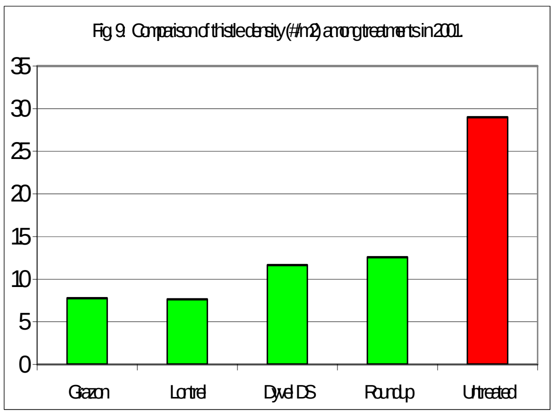


Fig 9. Comparison of thistle density (#/m2) among treatments in 2001.

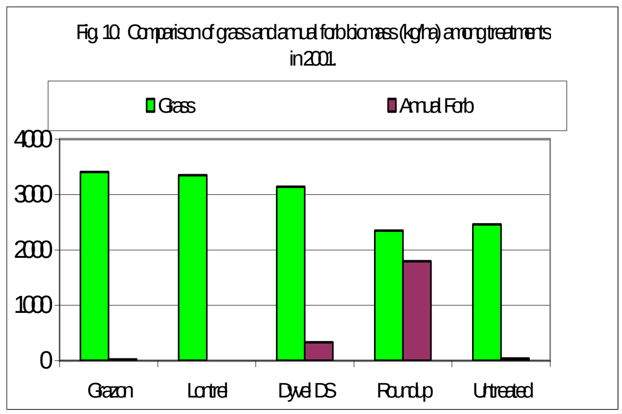


Fig 10. Comparison of grass and annual forb biomass (kg/ha) among treatments in 2001.

Grazing Systems for Thistle Management

The management of permanent pastures to prevent the invasion and spread of weeds such as Canada thistle is partially dependent on maintaining a vigorous, competitive forage stand that is capable of preventing weed establishment and subsequent spread. Maintaining a competitive forage stand, in turn, is largely determined by the type of defoliation regime (i.e. grazing system) a producer uses. Continuous or season-long grazing, where cattle remain in a single pasture for the duration of the grazing season, is most likely to maximize the patchiness of forage use, with some areas heavily over-utilized and other areas under-utilized. Weakened forage plants in over-utilized areas are poor competitors against weeds such as thistle. Additionally, the increased bare soil associated with overgrazing creates microsites for weeds to become established.

Livestock producers have 2 general strategies to implement rotational grazing systems, both of which are intended to promote more uniform use of pastures and in the process, maintain a vigorous forage stand. These strategies involve altering defoliation intensity and frequency, and are reflected in 2 grazing systems. In high intensity-low frequency (HILF) grazing, infrequent defoliation is accompanied by a long rest period between consecutive grazing events to allow rapidly growing grasses sufficient time to recover. The opposite approach, known as short duration (SD) grazing, uses more frequent, but relatively light defoliation events to maximize plant vigor.

Fig. 11: Comparison of accumulated grass and forb biomass (kg/ha) under various treatments in 2001.

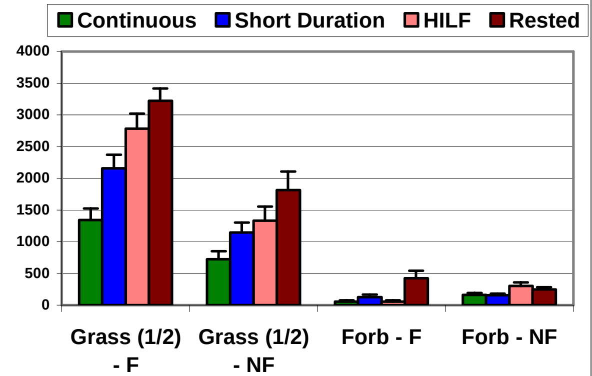
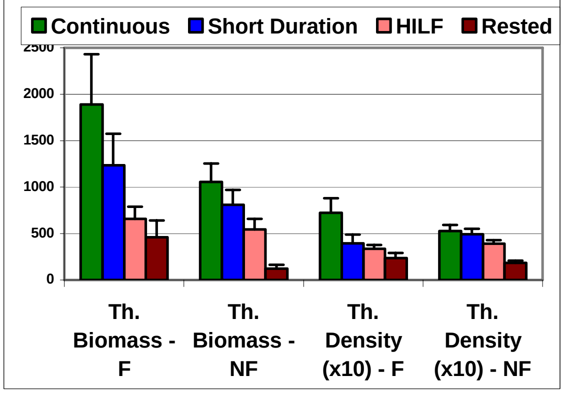


Fig. 12: Comparison of thistle biomass (kg/ha) and density (#/m2) among treatments in 2001.



To evaluate the effect of these defoliation regimes on thistle abundance, a clipping study was conducted at 4 locations from 1999 to 2001 evaluating accumulated forage yields and thistle responses. All defoliation treatments attempted to mimic the selective grazing behaviour exerted by livestock (i.e. an animal’s tendency to remove non-thistle herbage). Defoliation regimes simulated continuous (clipping every 2 weeks to 2 cm stubble height), HILF (every 4 weeks to 2 cm), and SD (every 2 weeks to 10 cm), along with a deferred treatment (clipping at maximum biomass in August). Each defoliation regime was investigated with and without annual fertilization.

Results of this study revealed marked differences in both accumulated forage yield (Fig. 11) as well as thistle abundance (Fig. 12) among the defoliation treatments. Furthermore, these treatment differences continued to develop through time, with the greatest effects evident in the last year (2001). Forage yields among the defoliation regimes were clearly greatest within the deferred treatment, followed by the HILF, SD, and finally, the continuous treatment (Fig. 11). Fertilization resulted in a greater positive response in accumulated forage yield within the HILF treatment. This trend suggests that defoliation intensity is not as important as frequency for maximizing forage production in central Alberta. That is, the grasslands found in pastures of this region appear well-adapted to relatively intense defoliation, provided it occurs quickly and they receive a long rest period (4 weeks) to facilitate recovery and maintain plant vigor and growth.

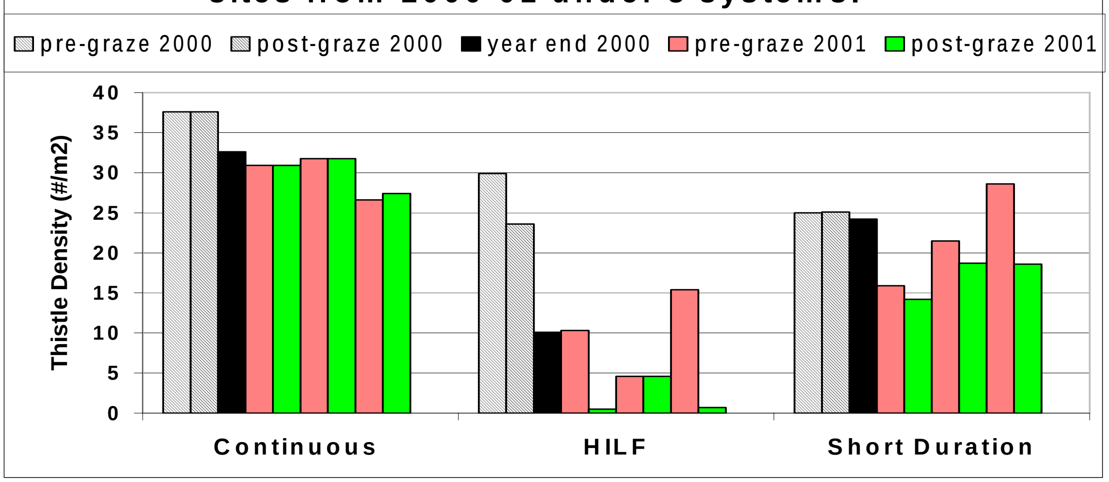
Notably, the thistle data displayed the opposite trend to these results, with the greatest thistle density and biomass within continuously defoliated plots (Fig. 12). In contrast, the HILF and deferred treatment had the lowest thistle, with fertilization resulting in a further decline in thistle abundance. Overall, these results appear to reinforce the notion that HILF grazing is effective in not only maximizing accumulated forage yield, but also reducing the abundance of thistle within heavily infested pastures. HILF grazing appears to convey a competitive advantage away from thistle and in favor of more rapidly growing forage grasses.

Thistle Biocontrol With Grazing

There has been a growing interest among producers for utilizing livestock grazing directly as a means for controlling weeds such as thistle. Although typically low in palatability to animals, Canada thistle plants are non-toxic and relatively high in forage quality (e.g. crude protein). As indicated earlier, continuous grazing tends to maximize the patchiness of grazing, leading to a loss of forage vigor and an increase in weeds. As shown previously, HILF grazing can increase forage production, as well as limit thistle abundance through increased competition. An additional effect of HILF grazing, however, is the increased grazing pressure within the forage stand during any one grazing period, and its direct effect on vegetation. That is, a high stocking density increases the uniformity of defoliation (or trampling) of all plants, including weeds such as thistle. Defoliation of weeds, in turn, may increase the ultimate level of weed control achieved with these grazing systems.

To test the effect of HILF grazing for direct thistle control, 4 trials were initiated (2 in 2000, 2 in 2001) comparing HILF, SD, and continuous grazing for their affect on thistle abundance. The grazing regimes were similar to those examined in the clipping study described earlier. The results of those trials support the data collected in the previous study, with HILF grazing once again resulting in the greatest decline in above-ground thistle stem densities (e.g. Fig. 13). It is also apparent that each grazing period within the HILF rotation caused an incremental or additive decline in thistle abundance through time. Collectively, these findings suggest that the close manipulation of livestock grazing, as obtained in HILF grazing, can be effective in reducing thistle abundance directly. However, it remains unknown whether this decline in above-ground thistle population is paralleled by a reduction in the below-ground growth of thistle.

Fig. 13: Comparison of thistle densities at 2 sites from 2000-01 under 3 systems.



Conclusion

Overall, these results indicate that there is good reason for livestock producers to control Canada thistle, as these plants are effective competitors and are able to utilize nutrients (including fertilizer), resulting in a loss of forage production. It is also clear, however, that there are many tools that producers can use to control thistle. Where thistle is an existing problem, the use of herbicides in conjunction with fertilization, can be very effective in controlling thistle and increasing forage yields. Similarly, changing from a continuous to a HILF rotational grazing system can reduce thistle abundance, as well as increase accumulated forage yields. Although weeds such as Canada thistle will likely never be eliminated, the integrated use of many tools, including herbicides, fertilization, and rotational grazing systems, can work together to minimize their impact on pasture and livestock production.