Leafy Spurge Control

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Understanding and Manipulating Leafy Spurge Populations with Cattle Grazing and Biological Control Agents

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MBFI Location(s): First Street Pasture

Collaborating Partners:

Start Date: 2019 Status: In Progress (Year 2 of 3)

Introduction

Leafy spurge infests at least 1.2 million acres in Manitoba and has a direct cost to the livestock industry of $10.2 million based on lost carrying capacity[1]. Cattle are most affected by spurge infestations as it exists in place of or among preferred forages, and contains a phytotoxin that causes cattle to experience gastric upset. Biological control agents (the larvae of spurge flea beetles, hawkmoths, leaf tier moths, and gall midges) were introduced to Manitoba in the 1990s but detailed tracking of releases has not been done in most cases. First Street Pasture was also included in a spurge beetle release in the late 1990s, but not tracked until MBFI took over management.

Objectives

The first objective of this project is to teach cattle to increase the amount of leafy spurge in their diet, primarily so that they will be tolerant of foraging among spurge plants, but also as an added impact against the spurge. The second objective is to determine if biological control agents perform better under grazed or ungrazed pasture conditions. Leafy spurge and biocontrol agent monitoring will provide better understanding how cattle and biological control agents can be managed to keep spurge stem densities below critical thresholds. The third objective is to get a better sense of the actual spurge and biological control agent populations at the First Street Pasture.

Project Design and Methods

For the first objective, cattle were trained to eat leafy spurge in the spring of 2019 using the Kathy Voth training method[2,3]. Details on methods for this training are provided in the 2019 Interim Report. It was omitted this year. Trained cattle from previous years are still present at First Street Pasture, so the long-term herd memory of the training is being assessed. This is 30 sampling points (0.25 m^2) in each paddock, where data is collected on number of leafy spurge stems and stem damage after each move of the cattle for the entire first rotation of the grazing season (both rotations were assessed in previous years).

For the second objective, spurge flea beetles and spurge were assessed inside and outside of exclosures established in Paddocks D and H in 2015. At these exclosures, leafy spurge flea beetles were released at points inside and outside each exclosure. In June and July 2020, leafy spurge stem abundance and height, and leafy spurge flea beetle abundance were observed for the 6th consecutive year, in and outside of 6-year old grazing exclosures in Fields D and H at First Street Pasture. Photo monitoring points were also conducted for the sixth year at these locations.

For the third objective there was no specific activity undertaken in 2020 to characterize leafy spurge and biological control agent populations at First Street Pasture, but we can use the data collected from the cattle training objective to get a sense of what is happening. The census activity will continue in 2021. Details on the normal spurge census methods and past results are provided in the 2019 Interim Report.

A couple of factors affected our work towards these objectives in 2020: the retirement of Jane Thornton from the civil service (the workload was passed onto the collaborator, Mae Elsinger) and the various effects of COVID-19 restrictions on ability for the collaborator to work on field projects. Thus new cattle training was suspended until 2021, but the stem impact counts after each grazing event were still performed. The leafy spurge population work of the third objective was partly stifled, but the stem impact data collection is an excellent stand-in. An opportunity to apply a novel technique for using spurge flea beetles for control was taken advantage of in 2020, for the purposes of long term control of spurge at this pasture.

Results and Discussion

Leafy Spurge Consumption and Impacts by Cattle

Training the cattle to eat leafy spurge has occurred for multiple years. The last training for 48 of the 79 cows was in 2019; 19 of 79 had their last training in 2016; and 12 of 79 were never trained. Fifteen were trained 2 or 3 times since 2016. So there is a lot of spurge-tasting experience in the First Street herd.

To evaluate the enduring effect of this past training, spurge stems and damage from grazing and trampling were counted in 2020 after each move in the grazing rotation, but only for the first rotation (Figure 1). The sampling in 2019 (which included the second pass of grazing) is also included in Figure 1.

The top graph in Figure 1 shows that there is far more spurge than what is eaten or trampled, indicating that cattle grazing alone has minimal potential to reduce spurge abundance (the potential is increased with adding other factors such as trampling and biological control agents). The more important result is

that for all pastures, cattle tolerated grazing among spurge plants, even in pastures where some sampling locations had more than 120 spurge stems/m^2 (a threshold stem count established by past research in the United States that would discourage cattle from grazing in spurge-infested pasture[4]).

The lower graph in Figure 1 is a magnification of the damage done in the upper graph. There is no consistent difference among paddocks or between 2019 versus 2020, despite this year not being a training year. Unfortunately there is no way for us to measure how a herd with 100% untrained cows would perform in similar conditions of land, spurge pressure, and herd management, and no pre-training spurge surveys were conducted at First Street Pasture in 2015.

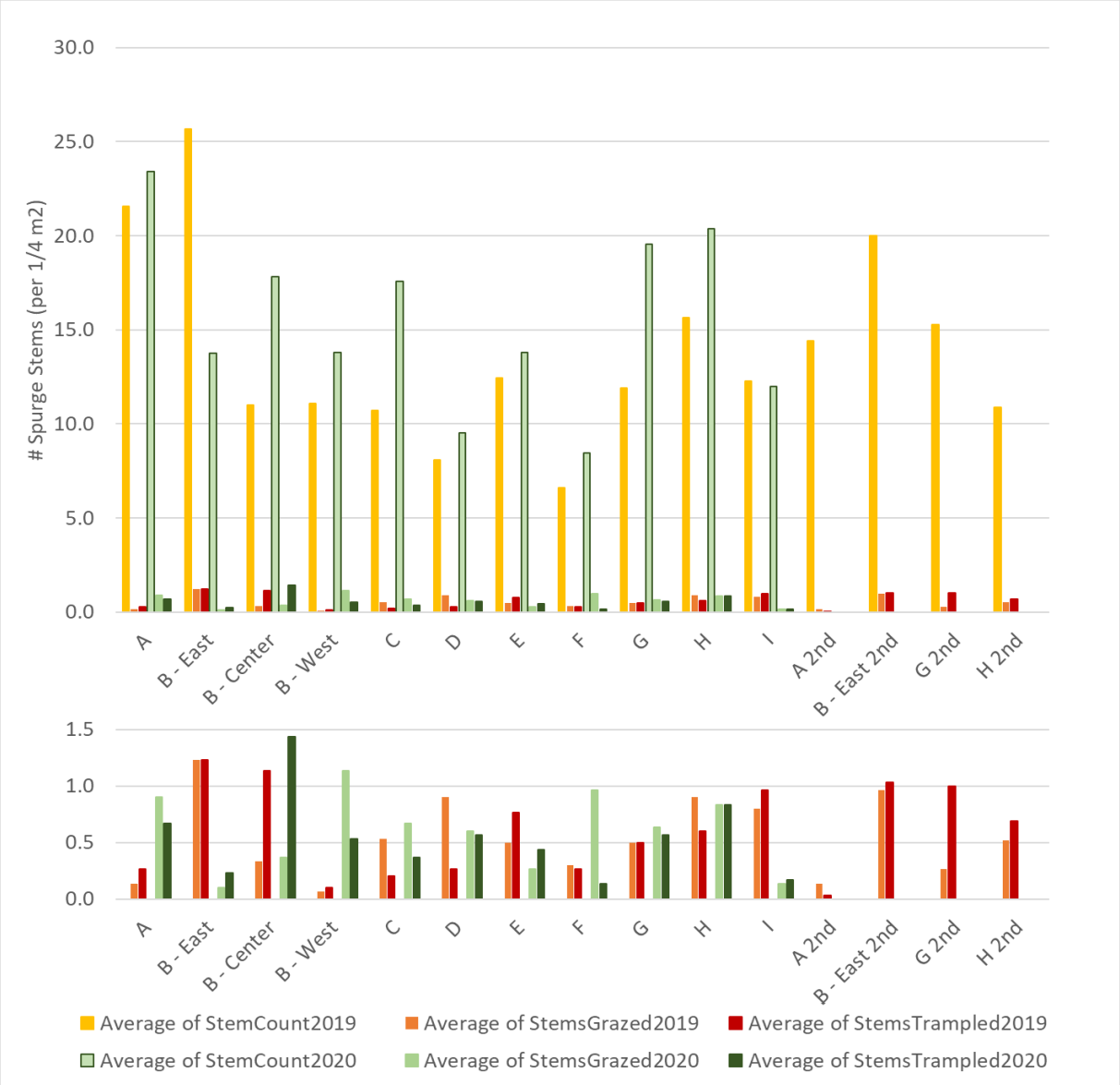

Figure 1. Counts of leafy spurge stems and stems damaged by cattle grazing and trampling at First Street Pasture in 2019 and 2020. The lower graph is a magnification of the damaged stems from the upper graph. Each average is of 30 sampling locations in each field. Counts were done for the second pass of grazing in only 2019 (far right).

The First Street Pasture herd appears to have lost its aversion to spurge in their daily routine of grazing and loafing. When they graze spurge, they only take a portion of the top of the plant. Rarely do cattle consume even 50% of an individual stem. Through observations during monitoring, it seems cattle will nip up to 14 percent of the available spurge plant. Some spurge consumption looks targeted while some looks accidental (i.e. consumed in a mouthful of grass). In 2019, cattle seemed to eat more spurge earlier in the grazing season but did not necessarily target young plants or regrowth. The paddocks are not shown in chronological order in Figure 1. Future reports will include a chronological analysis, plus a study of any differences between the mob-grazed fields and the regular rotation paddocks.

In Figure 2 the grazing combined with trampling and biological control agents (excluding flea beetles and hawk moth larvae) affected from 9 to 38 percent, on average per paddock, of all stems counted in 2020. This is appears to be greater than the 2019 results, but different ways of amalgamating the data were used. Hawkmoth larvae and flea beetles were counted but not included in Figure 2 because the stems that they are impacting can't be counted easily. Three of five paddocks counted during the main activity period of flea beetles (approximately June 20 – July 20) had them in 10-27% of plots (note that they may be scared out of the plots by the observer). The other two paddocks had none. No hawkmoth larvae were recorded by the observers this year, but they tend to be rare. We suspect that the enduring presence of all these biological control agents are keeping the leafy spurge at a low enough level for cattle to tolerate grazing there. Cattle grazing and trampling are two more things adding to the pressure against the spurge.

Spurge and Spurge Beetle Performance in Rotational Grazing Versus Non-Grazing

All spurge stem counts in the grazed versus grazing exclusion component have remained lower than the usability threshold for cattle use (120 stems/m^2)[2]. The maximum individual sample count is 104 stems/m^2, and all averages for each site in any year fall within the range of 27.2 to 64 stems/m^2, which is well below this threshold.

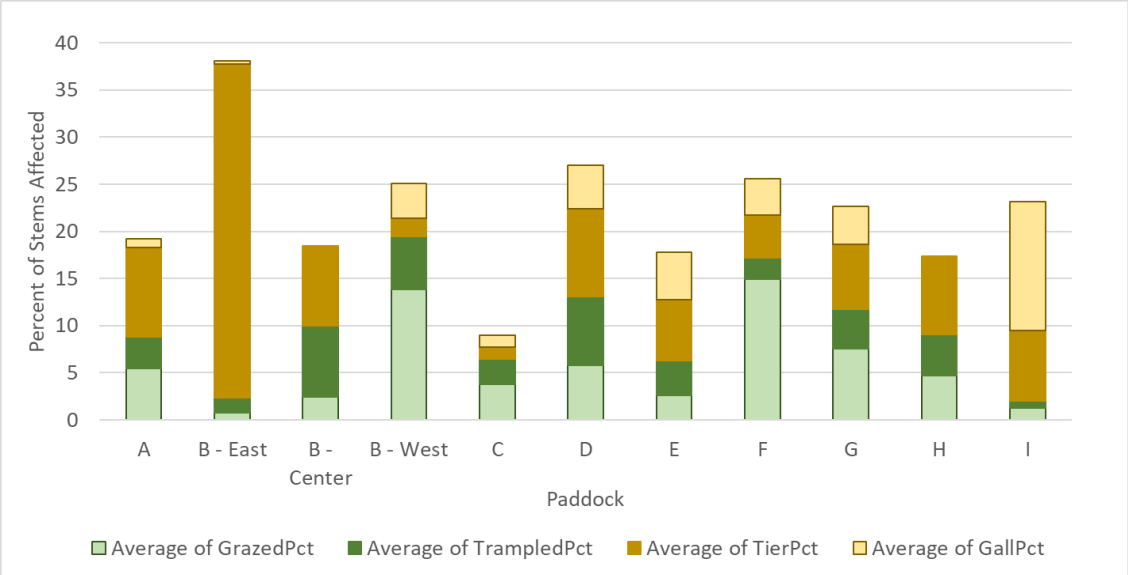

Figure 2. Contribution of grazing, trampling, leaf tier moths, and gall midges to leafy spurge damage in 2020. Each average is from 30 sampling locations in each field.

Unfortunately there is no consistent pattern of spurge abundance or reproductive status of grazed versus ungrazed sites, or change since the 2015 releases, other than the count of spurge stems being consistently higher inside of the exclosure in paddock D. Unfortunately this pattern has held right from the beginning of the study, indicating that we started out with lower amounts of spurge in the grazed area and it has been kept that way. Additionally, any expected effects of grazing exclusion and the 2015 releases may be masked by the background effects of the leafy spurge beetles released in the 1990s.

Abundance of leafy spurge flea beetles has been challenging to track in this exclosure study. The recommended survey date of mid July has proven to be too late for beetles at this pasture in the first 3 years of the study. First Street Pasture has sandy and infertile soils that are prone to dryness by the second week in July. It seems from reconnaissance surveys that the beetles emerge earlier on First Street pasture than many other places. For the duration of the project, the beetles are being surveyed last week of June or first few days of July. However, by the 5th year since the beetle release, the beetles have most likely dispersed beyond the study area.

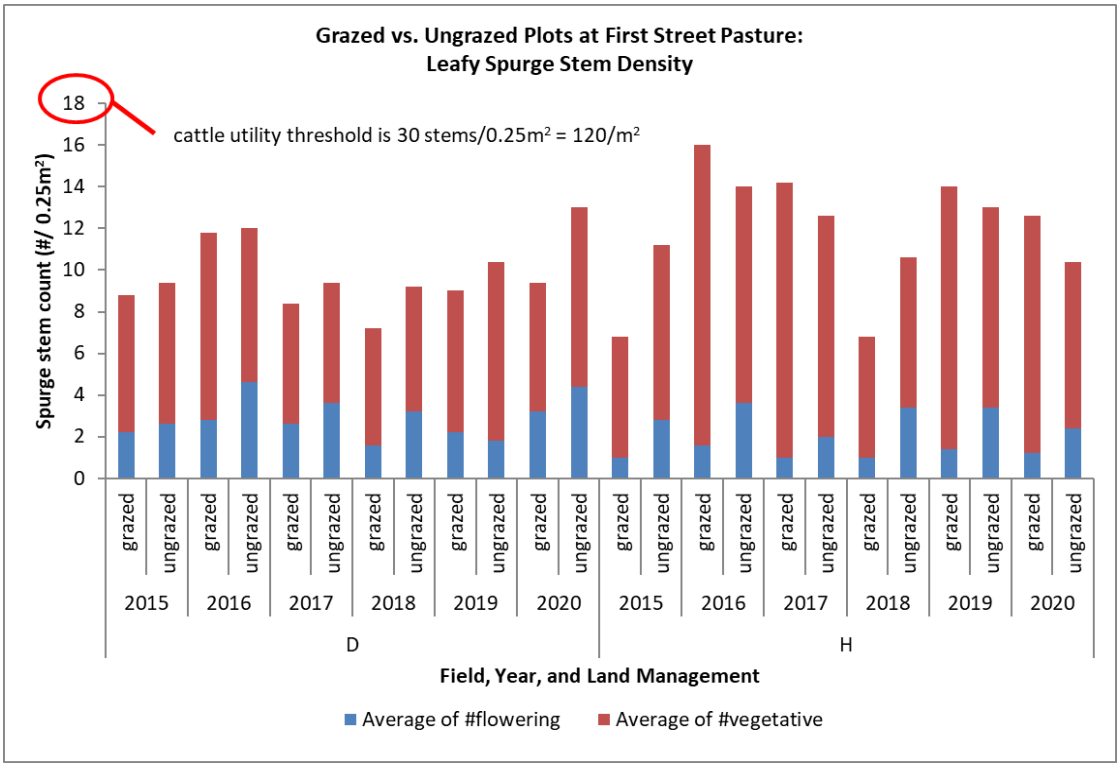

Figure 3. Leafy spurge stem density on grazed verses ungrazed plots. Paddocks D and H.

Census of Spurge and Biological Control Agents

The presence of biological control agents for leafy spurge is known for the pasture (leaf tier moths, gall midges, stem borers, hawk moths, and leafy spurge flea beetles). Some were released at the First Street Pasture 20 to 25 years ago, while others likely migrated in from other releases nearby. The abundance and direct effects for the first two were demonstrated as part of the first objective (Figure 2), along with a limited assessment of the frequency of leafy spurge flea beetles and hawkmoths. Determining the

abundance of leafy spurge flea beetles and hawkmoths requires different sampling and analysis, which were not done in 2020, even though they were noted *if occurring in the small sampling frames*.

With regards to effectiveness, we understand from literature that spurge left unchecked can be as much as 200 stems/m^2 on sandy soils[5]. None of the 69 sampling points in 2017 had spurge stem densities exceeding an amount that would discourage cattle from grazing (<120 stems/m^2), according to a study of cattle utilization in spurge-infested pasture in the United States[2]. Most had less than 80 stems/m^2. The worst potential condition (200 stems/m^2) does exist at First Street Pasture, but at only 2% of the 779 locations sampled between 2019 and 2020 (Figure 4). The worst counts were in Paddock A, B, and G, but no pastures exceeded 100 stems/m^2 *on average*. The worst paddock by far was A in 2020, with 30% of samples exceeding 120 stems/m^2. Paddock B (east) on its first pass was also poor 2019 with 27% of samples exceeding 120 stems/m^2.

As described above, the majority of samples are below 80 stems/m^2. Of all 779 sample sites 327 or 42% have spurge densities between 5 and 41 stems/m^2, which is the effectiveness level found in a peak control year (i.e. lowest spurge stem count recorded) of a study that monitored leafy spurge beetle releases in Montana and South Dakota[6]. This shows that there is spurge suppression at the pasture, likely from leafy spurge flea beetles.

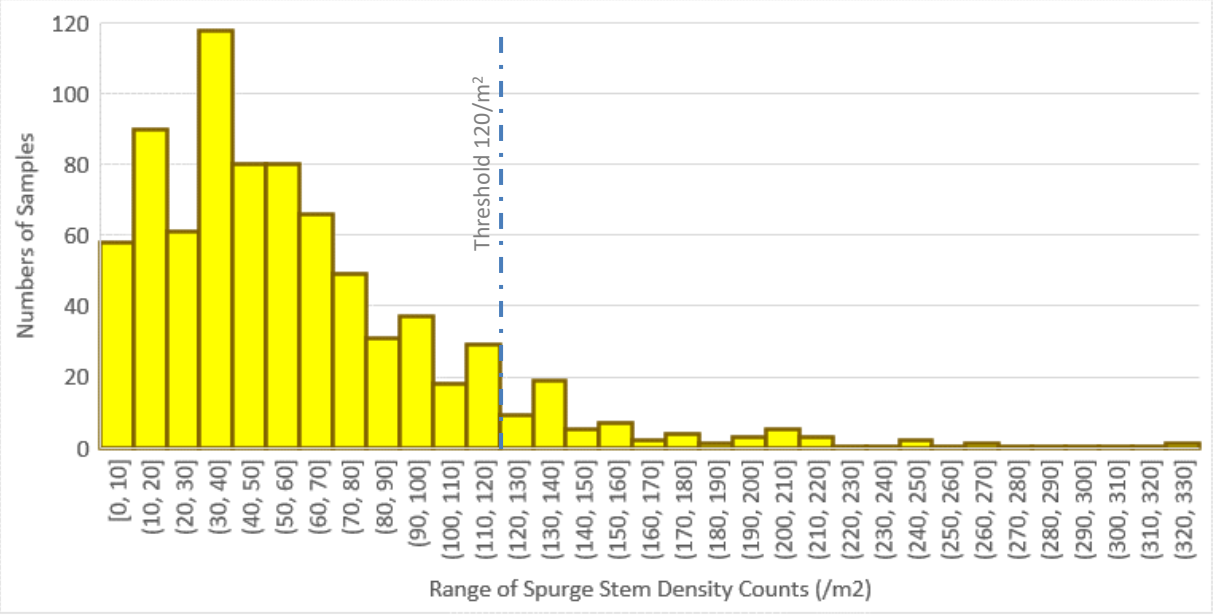

Figure 4. Distribution of leafy spurge stem counts from 779 samples taken at First Street Pasture in 2019 and 2020.

This type of analysis can be used to let us know where priority sites are for future treatment efforts (e.g. inundative spurge flea beetle releases). Anecdotally, inundative flea beetle releases in the Brandon area are having significant effects compared with the historical method consisting of single releases of about 2000 beetles in one spot and waiting for the result to happen. The new inundative approach consists of multiple clusters of releases checked on every year and moved within 50 m if the population numbers are favourable. This approach keeps the numbers concentrated and fresh and dense populations always being moved. The approach was applied as an additional activity at First Street Pasture in 2020 in the southwester part of Paddock H, with over 15 releases in the space of less than 10 acres. Given the high counts of beetles in Paddocks A and B, the next inundative releases should include these paddocks.

Summary

Cattle consume a small amount of leafy spurge ranging from 0 to 14 percent of available stems. Even with training, the quantity remains low, far below that of sheep and goats. The cattle grazing and trampling along with the biocontrols likely has some impact on LS vigour.

There has been no significant or consistent change in spurge abundance or reproductive status in or outside of the exclosures since the 2015 flea beetle releases.

Of the 69 sampling points, leafy spurge flea beetles (for biological control of spurge) were present at 49 of the sampling points. Many of these beetles are probably from releases done in the 1900's.

Acknowledgements

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References

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[6]Butler J.L., Parker M.S. and Murphy J.T. Efficacy of Flea Beetle Control of Leafy Spurge in Montana and South Dakota. Rangeland Ecol. Manage. 2006; 59:453–461.

Budget summary:

Salary dollars were used to accomplish Objective 1. No additional dollars were spent directly by MBFI on Objectives 2 and 3. Agriculture and Agri-Food Canada contributed 4 hours of survey time on Objective 2 and 28 hours of data analysis and reporting, 4 hours of project planning time, and field time for additional spurge beetle releases in paddock H. Measurements, observations, and beetle releases were conducted with old supplies. No new materials were purchased.

Leafy spurge eaten by cattle shortly after training completed June 2019

Cattle trying spurge during the training process Paddock A June 2019

Hawk moth larvae July 2017

Black flea beetles Paddock C June 2017

Flea beetle larva on spurge root Paddock C June 2017

An example of how patchy and thin leafy spurge is at First Street Pasture Paddock H 2017