Evaluation of the Potential for Teaching Cattle to Graze Late Season Diffuse Knapweed

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Summary

This project ran from July 9 – July 20. From July 10 through July 16 I used a refined training process to teach 50 heifers to graze late-season knapweed. The herd successfully grazed the weed in a trial pasture for three days and continued to eat it after July 20 in a larger, 40-acre pasture. This report, as well as a video on DVD describe the process and results of this project.

Background

Diffuse knapweed was most likely imported in alfalfa seed from the Caspian Sea region of Turkmenistan. It was first reported in Washington state in 1907. It is now widespread in all the states west of the Rocky Mountains and is estimated to be increasing at about 18% per year. The plant is allelopathic, meaning that it produces chemicals in the soil that prevent other plants from growing. Infested areas suffer from reduced biodiversity and soil quality and increased erosion. The plant is distributed throughout Boulder County, with especially dense stands in the southern part of the county.

Boulder County has used a variety of methods to control diffuse knapweed populations. Large-scale herbicide applications in the '90s helped set the weed back, but were controversial. Insects have shown success, though progress is slow. Grazing has also presented possibilities. Local permittees pointed out that cattle eat diffuse knapweed when it is bolting. Based on this discovery, a study done in cooperation with City of Boulder Open Space and Colorado State University found that grazing diffuse knapweed in the bolting stage reduced stand densities by about 50% and also reduced seed set by about 50%. This was significant. But since mature plants can produce as many as 18,000 seeds each, even a 50% reduction leaves managers looking for additional tools.

Plants that are grazed in the bolting stage generally resprout and set buds and seeds by the end of the growing season. But if animals would graze the plant after it has set buds and flowered, it might be possible to reduce the plants ability to resprout and set seed. The purpose of this project was to determine if steps used to train cows to eat other weeds might be successfully used to train cows to eat late season diffuse knapweed so that animals already grazing on Boulder County Open Space might become an additional tool in managing the weed.

Methods

In 2004 I developed a seven step process to teach cows to eat weeds and successfully used it to train a small herd of 20 cows to eat Canada thistle, leafy spurge and spotted knapweed in pasture.

These cows continued to graze the weeds in 2005, and taught their calves and herd mates to eat them as well. In 2006 I streamlined the process while training three separate groups of cows (for a total of 65 cows) to eat distaff and Italian thistle in pasture. Using the streamlined process, cows can be taught to eat a new weed in just 5 days and within 10 days they are including it as a normal part of their diet.

Here is the three-step process as applied to this project:

Step 1) Know the target plant. What is its nutritional value? Does it contain any hazardous secondary compounds (toxins)? Will supplements aid animals in eating the plant?

Research demonstrates that animals choose what to eat based on the feedback they get from nutrients and toxins in the plant (Thorhallsdottir 1987, Mirza). Nutrients tend to increase intake and toxins tend to decrease it (Provenza 1995). All plants contain toxins, but very few are so toxic that they cause death. Knowing this, researchers have been interested in how animals manage them in their diets. Their studies show that animals learn to eat mixtures of nutrients and toxins in ways that mitigate the effects of toxins (Villalba et al 2003). Therefore, if plants are nutritious, animals are more likely to eat them, and if they are provided with a variety of different forages, they can safely eat forages that they might otherwise consume in only small quantities. Finally researchers have found that supplements (additional protein/energy or food additives such as Polyethylene glycol) can mitigate toxins or bind to them to eliminate their effect (Villalba 2002, Banner, Provenza 2000).

A review of the literature for diffuse knapweed indicates that there are no toxins of concern. It's nutritional value changes through the season, its crude protein dropping from a high of 18% in the rosette stage to 8% during the bud and flowering stage (Roche). This low nutritional value was of potential concern in this project's success.

Step 2) Choose the right animals. Research shows that younger animals learn more quickly than older animals and that mothers pass diet selection knowledge on to their young (Burritt 2000). Therefore by working with young females, we can eventually have a whole herd of weed eaters for a very small investment.

For this project I worked with 50 bred, angus/limousin cross heifers owned by Babe and Leo Hogan. We trained in a large pasture on the Cohig property where the animals had free choice forage and water. The number of animals and the training location presented two challenges. First, I normally only train 25 to 30 animals because of the logistics of hauling feed and harvesting weeds during the training period. However, since all the animals were already in pasture together we decided to experiment with training a larger number. The second challenge was that in order to conduct training we first had to train the animals to come to the feeding site. Fortunately, it took the heifers only one day to become familiar with grain bags and so they followed me or my volunteers whenever they saw us with a grain bag.

Step 3) Build on how animals choose foods by creating positive experiences with new foods, and making the unfamiliar seem familiar.

Basic behavioral research shows that the more positive experiences with new things a creature has the more willing it is to try other new things (Villalba 2004, Thorhallsdottir 1987, Burritt 1990, duToit). I built on this basic behavior by giving cows a series of good food experiences as described in the **Feeding Schedule** below. Familiar tubs, people and flavors were

incorporated in the feeding, because of research showing that animals are more likely to try something if it is associated with familiar forms and flavors (Launchbaugh 1997, Provenza 1995). In this case the tubs used for training were the same tubs used for protein supplement through the winter, so the heifers were already familiar with them. The familiar flavors I took advantage of were ones the animals were already familiar with from their winter feeding: corn and molasses. When I used molasses as an additive, I diluted it to 25% molasses and 75% water so I could spray it on using a hand sprayer.

Feeding Schedule

Day One, July 10, 2007:

Since my first challenge was just to get the cows to come to the feed tubs, I decided to start with a food they might recognize. The heifers had eaten dried ear corn over the winter, so I fed rolled corn the first day, luring them down with a grain bag and a little trail of corn to the tubs. Eventually, all the heifers came to the tubs. I fed two 50 pound bags of corn. Though not every animal got something to eat, the herd as a whole learned from this experience. So when I returned that afternoon, they all came to the feed site.

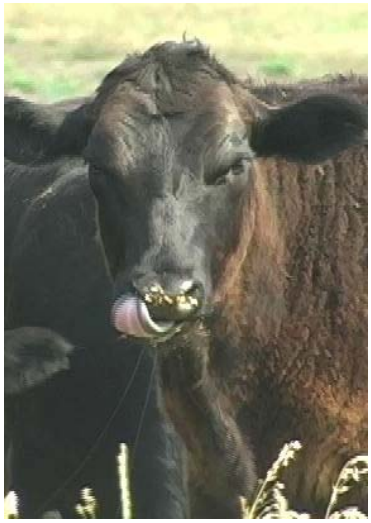
Feeding Site

For the afternoon feeding the cows ate 2 bags of "Niwot Special 14" a high protein mixture for dairy cows that includes corn, barley, and molasses.

Day Two, July 11, 2007:

The heifers followed me to the feeding site to try barley mixed with molasses. Though they drooled at the sight of the feed tubs, it was obvious from their reaction that they were a little unsure of what was in them. They did finish two 50 pound bags of the grain molasses mix.

The afternoon's feeding was two bags of soybean flakes. I added diluted molasses as the familiar flavor. Though they had never seen this food before, they cleaned their tubs again.



"Pavlov's Cow"

Day Three, July 12, 2007:

On day three the cows walked about a mile in to try Red Bran. This is a powdery, high protein supplement fed to horses that need to gain weight. I sprayed on diluted molasses for a familiar flavor. I chose Red Bran because of its high nutritional value and its very unusual texture to help the trainees think of food in a whole new way.

That afternoon the cows were waiting for me when I arrived at the feeding site. I fed them alfalfa pellets. While the flavor may have been familiar, the texture was not. After checking out all the tubs, the cows eventually ate all 100 pounds I'd served them.

Day Four, July 13, 2007:

For the morning of the fourth day I fed the heifers hay cubes. Of course the flavor was familiar, but the texture and the size was very different and was harder for them to eat. In preparation for feeding diffuse knapweed, I wanted the heifers to have some experience eating things that took a little more time.

Every day I evaluated how well the animals were reacting to new foods. At this point, what I saw were animals that were enthusiastic about coming to the feeding site, that ate well and cleaned their tubs. So I decided to begin feeding diffuse knapweed the afternoon of the fourth day.

Example of what they ate

At this stage the plant is very stemmy with very few leaves. The only parts that seemed potentially edible were the buds and flowers. So I focused on gathering these parts of the plant for the training. It was quite hot, and picking the weed was difficult, so I didn't have a lot of the weed for the very first try. I put it in the tubs, sprayed it with the diluted molasses mixture, added red bran and some barley and molasses and set it out for the heifers.

Typically, the first time I feed weeds there is a lot more milling about, and these heifers were no exception. It is also typical that not all weeds are eaten immediately as was the case here.

Day 5, July 14, 2007:

On Saturday, the hot weather continued. My husband volunteered to join me to cut weeds so there was a lot more to feed the heifers. They ran to the tubs as usual, and ate much more of the weed than they had the day before.

Heifer eats plain knapweed from tub on Day 7

Day 6, July 15, 2007:

For their third day I fed plain knapweed. The heifers didn't eat a lot, mostly pulling it out of the buckets and throwing it on the ground. Then they huddled up and refused to try any more that day.

Day 7, July 16, 2007:

On Monday morning, the seventh day of the process, Rob Alexander met me at the feeding site to see how the heifers were doing. While I shared with

him my concerns that this might be a weed so low in nutritional value that the heifers might not eat it, they came over to see if we had brought them anything to eat. The diffuse knapweed left over from the day before was still in the tubs and on the ground around them. The heifers proceeded to eat these very dry leftovers.

That afternoon I decided to feed the heifers plain diffuse knapweed once more. My parents volunteered to help me pick some in 90 degree heat. I decided that the body language of the first to arrive at the tubs helped others decide to try and created a better eating environment. So I sprayed diluted molasses on the bottoms of the tubs to make sure all heifers would stick their heads in the tubs. The results were just what I hoped for. They came to the tubs and ate everything in them.

Step 4) Transition to pasture by building trial pastures for the switch from training in tubs to grazing.

Research has demonstrated that a small amount of pressure increases an animals willingness to try new foods in a new environment (Villalba 2004). Therefore when I transition animals to the pasture I begin by putting them in small trial pastures. A good trial pasture has only a few days of forage and includes a wide variety of foods along with the target weed. The **Pasture Schedule** below describes this step.

Pasture Schedule

Day 8, July 17, 2007:

On the eighth day the cows rested while we built fence for their trial pastures. A good trial pasture is small enough so that cows can't just eat the best and leave the rest. It also has plenty of variety so they don't have to eat just the target weed. Our trial pasture was 2.11 acres. It included grasses, mullein, thistles a variety of forbs and several large diffuse knapweed patches; enough forage for three days. That afternoon we lured the cows into the trial pasture by feeding them grain.

Trial pasture boundaries and knapweed patches.
Circle marks molasses tub location.

Days 9 – 11, July 18 –20, 20067:

On the morning of the 9th day I went to see if they were eating knapweed. All cows were grazing the weed and they continued to eat it for the three days they were in trial pasture. They seemed to enjoy the knapweed just as much as they did the grass in the pasture.

On the last day in the trial pasture, Rob Alexander and Leo and Babe Hogan came by to check on the heifers' progress. The ranchers had never seen cows eat diffuse knapweed at this stage of growth, and were delighted to see that they were eating it now.

At about 10:00 on the morning of the 11th day we moved the heifers across the road to a 40 acre pasture on the Mayhoffer/Singletree property where they continued to eat knapweed.

Cows graze diffuse knapweed in trial pasture and an example of a grazed knapweed plant

Training Time and Materials Cost

The following chart shows the actual feeding times (less travel) for the project along with costs of feeds for training. It took about 30 minutes per feeding, twice a day for 4 days. Actual times will depend on where a producer's cows are located and how long it takes to get to that site.

On the days we gathered weeds, there was an additional two to three hours in labor because gathering this weed took longer than usual since we focused on picking only those parts that we thought the cows would eat.

Total cost of materials per cow for the training was about $3.40 for 50 trained heifers. If you keep in mind that each heifer will likely train one calf, cost per animal drops to $1.70 for 100 trained cows.

Day 1	1 hour	4 bags of feed	$35.50
Day 2	1 hour	4 bags of feed	$41.00
Day 3	1 hour	4 bags of feed	$39.45
Day 4	3 hours	3.5 bags of feed	$31.20
Day 5	3 hours	1.5 bags of feed	$13.30
Day 6	3 hours		
Day 7	3 hours		
Day 8	3 hours	(fencing)	
		Molasses	$10.00
Totals	18.5 hours	17 bags of feed	$170.45

Results

The cows didn't eat every single bud and blossom, but they made progress as shown by the following before and after pictures.

I had hoped to be able to do more in-depth monitoring on the plants grazed by the heifers in this project. My plans were based on anticipated assistance from a seasonal Boulder County Open Space employee. However, that employee took another position a week before this project began. To complete the training and fence building it was necessary to do photo monitoring instead of split plot monitoring.

Future

Next year we hope to put these same cows with their calves into a similar pasture so that the next generation will eat late season knapweed too. We are also looking at the potential for further research to quantify the impacts of grazing late season knapweed.

Before

After

Before

After

Before

After

Before

After

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