Interseeding Legumes into Established Cool Season Pastures

Final Report for FNC07-660

Project Type: Farmer/Rancher
Funds awarded in 2007: $2,758.50
Projected End Date: 12/31/2009
Region: North Central
State: Kansas
Project Coordinator:

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Adams Ranch

Project Information

Summary:

PROJECT BACKGROUND
My wife Sue and I operate a 400-acre grass farm in SE Mitchell County, Kansas (North Central Kansas). It is about ½ native rangeland and ½ cool-season grass. We utilize management intensive grazing on all of our grass. We have custom-grazed sale barn stockers for some time now, taking one group from green-up in spring to mid-July, and a second group from mid-Sept. to Dec. each year. This project is just one of the things we are adding in our effort to enter the grass finished segment of our industry. I learned the basics of grazing management at the basic and advanced Management Intensive Grazing School taught by Jim Gerrish at the Missouri Forage Systems Research Center. I have attended various local workshops and schools since then, including those conducted by the Kansas Society for Range Management and the Kansas Graziers Association. Cost-share funds for water and fencing systems have been received through the NRCS, Environmental Quality Incentives Program, the Kansas Rural Center Clean Water Farm Program, and the Mitchell County Conservation District State Conservation Commission Program.

During the last nine years I have collected data to evaluate annual forage production, species composition from transects, and range and pasture trend and health. These data provide the basis for many of our management decisions. I actively network with fellow graziers as a co-founder of our local graziers group and am on the board of directors of the Kansas Graziers Association. Until recently, I had an off-farm job. I worked two days a week at the Kansas Neurological Institute in Topeka as a PhD Neuro-scientist. I retired from this job on 1/1/09. Previously, I served 6 years in the Army Research Lab at Ft. Knox, Kentucky, where I helped develop the first safety standards for Ruby Laser use and worked on early development of the night vision devices the military now use so extensively. I next spent 10 years at the University of Florida, where I led a group of behavioral scientists and materials engineers in the development of the first and only scientifically based methodology for training women to do breast self-examination. This methodology is now patented throughout the free world. I then returned to my

home of origin for health reasons.

PROJECT DESCRIPTION AND RESULTS
Goals: To establish one or more of eight tested legumes into established smooth brome pastures. Eight carefully selected legumes (2 alfalfa, 2 true clovers, birdsfoot trefoil, Korean lespedeza, cicer milkvetch, and hairy vetch) were seeded into 2 paddocks of an existing brome pasture using a Great Plains no-till drill. Stands were evaluated using a square frequency frame.

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These are my cooperators. They helped in many ways to complete this project. Particular thanks to Keith for completing the data tabulation and analysis.

RESULTS
Year One: No grant funds were used in year one. Because we were led to believe that grant funds would not be available until late spring and seeding needed to take place in late winter/early spring, we decided to use non-grant funds to do pilot work in year one. The legumes needed to be planted by early March if at all possible to give them adequate time to germinate and mature.

We, therefore, used non-grant funds to purchase small quantities of the eight legumes, combined them into three mixes, based on seed size and inoculated and planted them using a Great Plains no-till drill (10 ft wide/ 7.5 in. row spacing) on 3/14/08.

Mix I contained, alfagraze alfalfa, sweetclover, birdsfoot trefoil, red clover, and white clover. Mix 2 contained yellow flower alfalfa, Korean lespedeza, red clover, white clover, and cicer milkvetch. Mix 3 contained hairy vetch (only large sized seed in group). Mix 1 was seeded at 9.7 lb/ac, Mix 2 at 10.5 lb/ac, and Mix 3 at 14.2 lb/ac.

The legumes were planted into the other side of the two paddocks intended to be used in our SARE grant proposal. An unfertilized 100 ft. strip was utilized to plant 10 foot strips of each mix in alternating order in two replicated blocks. The order of seeding in each replicated block was Mix 1, Mix 2, and Mix 3. Each strip ran the length of the two paddocks (880 ft.). On 3-10-08, 40 lb N/ac as urea was spread in two marked 40 ft. bands perpendicular to the strips of planted legumes. One fertilizer band was on the lowland type soil, and one band was on the upland type soil.

The legume stand was evaluated on 6-27-08 and 10-10-08 using a square frequency frame as described in our proposal. Almost no legumes seedlings were found. The only species found in any number was Korean lespedeza, and that mainly where the brome stand was thin.

Although the 2008 results were disappointing, they are at least partially explainable. On 5-20-08 during an informal observational walk through the test plots, numerous

small legume seedlings with 1 to 3 trifoliate leaves had emerged but were nearly desiccated from several weeks without precipitation. The weather was hot and dry, and much needed spring rains didn't come until a week later. However, the seedlings did not survive that final week without moisture. It is our belief that the seedlings simply could not survive the severe moisture stress they were exposed to from the weather and the competing smooth bromegrass. The lespedeza being a summer annual legume emerged later and thus survived. Additionally, we did observe good seedling stands on a few isolated small bare ground spots without any grass competition, particularly in the lowland soil area.

We believe we learned three important things from year one.
1. There was good seedling emergence using the no-till drill.
2. Competition from the existing brome reduced seedling survival. To that end, the brome where we will seed in 2009 was grazed short during the fall of 2008 and has not been fertilized since spring of 2008. Space allocated to three of the four replications of the study also had an unplanned winter fire which burned all of the dead standing residual vegetation that was not consumed by grazing the previous fall.
3. Timely precipitation may be the most critical factor in seedling establishment.

Year Two: On 3/19/09 we planted the legumes as described in our SARE grant proposal into individual strip plots with four replicated blocks in the pasture. Each of the 8 legumes was planted individually in four-880 ft. strips, using a 10 ft. no-till drill with 7.5 in. row spacings. Each strip of a legume planted was in a separate block so that all four strips were not next to each other and to take into account any field variability from one side of the pasture to the other. A strip with no legumes seeded, which served as a control plot, was left between each replication. Seeding rates for each of the legumes were as follows:
1) Magnagraze purple flowered alfalfa (sativa) – 10.5 lb/ac PLS
2) Yellow flowered alfalfa (falcata) – 7.5 lb/ac PLS
3) Yellow sweetclover – 10.5 lb/ac PLS
4) Birdsfoot trefoil – 9.5 lb/ac PLS
5) Cicer milkvetch – 9.1 lb/ac PLS
6) Korean lespedeza (unhulled) – 21.4 lb/ac PLS
7) Ladino white clover – 4.9 lb/ac PLS
8) Hairy vetch – 21.1 lb/ac PLS

The test plots were evaluated twice, once on 6/16/09 and once on 9/15/09. Establishment was measured using a square frequency frame divided into 100 subframes, with each subframe measuring 4x4 inches. In each frequency frame, the number of 4x4 subframes with at least one desired (target) legume rooted within it was counted. A total of two frequency frames were counted in each legume strip in the fertilized, unfertilized, upland and lowland portion of the paddocks in each of the 4 replications. A total of 8 frames were counted in each treatment combination on each date. The results are as follows.

TABLE 1: Average number of 4x4 subsquares having at least one desired (target) legume rooted within it.

[EDITOR'S NOTE: For a copy of Table 1, please contact NCR-SARE at ncrsare@umn.edu or 1-800-529-1342.]

Examination of the data reveals a number of important and interesting findings. First and most importantly, we were able to meet our establishment criteria of 2 or more plants per square foot for four of the legumes. By dividing the frequency percentage by 10.76 (the number of square feet within the frequency frame), a most conservative estimate of established legumes/ft2 is achieved. Legumes that showed acceptable overall establishment were Korean lespedeza (7.2 plants/ft2),

yellow flowered alfalfa (falcata) (3.7 plants/ft2), Magnagraze alfalfa (sativa) (3.3 plants/ft2), and yellow sweetclover (2.1 plants/ft2). White clover, although it didn't do as well overall (1.3 plants/ft2), did establish well when grass received no N fertilizer. The remaining legumes just did not establish consistently well in any locale.

TABLE 2: Legume frequency combined across landscape position and fertilizer status. Frequency is number of 4x4 subsquares having at least one rooted desired (target) legume. Each average is based on 64 observations. Legumes followed by a different letter are statistically different at the P

Frequency %/Plants per Sq Ft/Statistical Groups
Korean lespedeza 77.7/ 7.2/ A
Alfalfa (falcata)39.5/ 3.7/ B
Alfalfa (sativa) 35.6/ 3.3/ B C
Yellow sweetclover 22.5/2.1/ D C
White clover 13.6/ 1.3/ D E
Cicer milkvetch 4.9/ .5/ E
Birdsfoot trefoil 4.6/ .4/ E
Hairy vetch 2.7/ .3/ E

Secondly, we found that both landscape position and fertilization affected stand establishment. Overall, upland sites had 40% greater establishment than lowland sites, and unfertilized sites had 51% greater establishment than fertilized sites. Both effects were statistically significant at the P

Lastly, the stands improved over the first season for some legumes. Frequency counts in September were consistently higher than the June counts for all four of the best established legumes.

Additional Studies: Because the objective of this research is to solve real world problems as soon as possible, we have taken the knowledge gained each year and applied it to additional plantings. To that end, we have done two additional plantings in other brome pastures.

On 3/20/09, we planted 14 acres of a legume mixture using the same no-till drill. The landscape profile varied from creek bottom to moderately sloping hillsides. The legume mixture was as follows: 1) Cicer milkvetch---1.27 lb/ac PLS, 2) Yellow flowered alfalfa---1.85 lb/ac PLS, 3) Ladino white clover---0.79 lb/ac PLS, 4) Yellow sweetclover---3.85 lb/ac PLS, 5) Birdsfoot trefoil---lb/ac PLS; Total—10.5 lb/ac PLS.

On 9/7/09, using the same no-till drill, we planted 28 acres of another mix on an adjacent brome pasture that was creek bottom lowland. The legume mixture seeded was as follows: 1) Yellow flowered alfalfa---2.0 lb/ac, 2) Magnagraze purple flowered alfalfa---1.0 lb/ac, 3) Yellow sweetclover---1.5 lb/ac, 4) Birdsfoot trefoil---1.5 lb/ac, 5) Korean lespedeza---3.0 lb/ac; Total---9.0 lb/ac.

On 9/15/09 we evaluated the 14 acres planted, using the same frequency frame procedures as the main study. Out of the mixture seeded on the 14 acres, only yellow flowered alfalfa (11.4% and 9.4% for the upland and lowland landscapes) and yellow sweetclover (18.1% and 11.4% for the upland and lowland landscapes) established. A lowland terrace area directly adjacent to a riparian drainage resulted in 1.5% and 100.0% frequency for yellow flowered alfalfa and yellow sweetclover, respectively. Visual inspection of the seeded stand on the 28 acres planted this fall indicates that we have numerous seedlings that have emerged. No quantitative evaluation has been attempted at this 28-acre site.

DISCUSSION
Our two years of research has produced both good highs and depressing lows. The mini-drought in May of 2008 that almost totally wiped out our year one plantings

made us acutely aware of the tremendous effects that variations in weather can have. Precipitation during 2009 was much more kind to our seedlings. Although total rainfall received was only near the long term average, the rains were timelier.

Given that rather auspicious beginning, we are quite pleased with our year two results. To have four legumes established with acceptable stand densities is considerably more than I had originally hoped. However, we clearly understand that establishment is just the first part of the process, whether and to what extent these legumes can maintain and mature into meaningfully productive stands that positively affect forage production and quality and improve soil quality remains to be seen. We are preparing a follow up grant proposal to do just that.

Each of the established legumes offers unique opportunities and challenges. The two alfalfas, as perennials, offer the possibility of long term survival and production without having to worry about re-seeding frequently. The sweetclover as a biennial may present a long term maintenance problem depending on timing of grazing. Korean lespedeza, as an annual, would seem to present a serious problem with maintenance, but I am told (Gary Kilgore, retired Kansas State University Forage Specialist) that it is a major component in most cool-season pastures in SE Kansas. As long as it is allowed to produce seed annually, or at least periodically, these stands are maintained indefinitely.

Lastly, informal observations of replacement heifers' grazing behavior on the creek area of the 14 acres planted last spring indicate that the brome/sweetclover mix is highly preferred and vigorously eaten – an expected and highly satisfying result of our initial application of this research.

Outreach
We are schedule to present at the following meetings this winter.
1. Hay and Grazing Conference, Manhattan, Kansas, Jan. 18, 2010. Oral presentation
2. Kansas Natural Resources Conference, Feb. 4-5, 2010, At the Airport Hilton, in Wichita, KS. Poster session.
3. Kansas Graziers Assoc. Winter Conference, Jan. 23, 2010, McPherson, KS. Poster session
4. Post Rock Graziers Assoc. Coffeshop Meetings, Jan. 13, Jan. 20 and Jan30th, Beloit, Kansas. Poster sessions.

Research

Participation Summary