PROGRESS REPORT 2010
North Central Region
Sustainable Agriculture Research and Education (SARE) Program

Project Title: Measuring the Value of Inter-Seeding Legumes into Established Cool Season Pastures in North Central Kansas – Part 2

Project Number: FNC09-753

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1. Describe in detail your work activities and how you used your grant funds this year. (Use another sheet if necessary.)

In 2009 and 2010, at each species, landscape, and nitrogen combination, stands were evaluated in June and September using two large 40-in. by 40-in. frequency frames. Each large frame was divided into 100 smaller 4-in. by 4-in. subsquares. Each sub-square that contained a new rooted legume seedling was counted, so a frequency score of 100% indicated that all small squares of a large frame contained a legume seedling. A total of eight large frames were counted in each treatment combination on each date. In 2010, the year after legume seedling establishment, stands also were hand harvested for yield just prior to each of three grazing occupancy dates.

2. List the results of your project and what you have learned so far.

Results and Discussion

A frequency of at least 21% was set as the criterion for successful establishment. By dividing the frequency percentage by 10.76 (the number of square feet within the frequency frame), a conservative density estimate of established legumes/ft^2 can be calculated. Successful establishment with 21% frequency subsequently translates into a plant density of at least 2 plants/ft^2, because more than one seedling was present within some of the subsquares that were counted.

Examination of the data reveals a number of important and interesting findings. First and foremost, some legumes had consistently greater establishment at each of the nitrogen fertilizer and landscape position combinations (Table 1 and Table 2). Legumes that showed acceptable overall establishment at both landscape positions were Korean lespedeza, yellow-flowered alfalfa (*falcata*), and purple-flowered alfalfa (*sativa*). However, establishment on the upland site was greater than on the lowland site for these legumes (Table 1). Yellow sweetclover established successfully on the upland site in 2009, but frequency was reduced in 2010. The remaining legumes did not establish consistently well at either landscape position. Averaged over all legume species, upland sites had approximately 40% greater legume establishment than lowland sites.

Fertilization also affected stand establishment. Legumes that showed acceptable overall establishment with or without added N fertilizater were Korean lespedeza, yellow-flowered alfalfa (*falcata*), and purple-flowered alfalfa (*sativa*; Table 2). However, establishment was greater for these legumes and for yellow sweetclover and white clover on sites without added N fertilizer in both 2009 and 2010. Averaged over all legume species, unfertilized sites had 44% greater establishment than fertilized sites.

Stands improved over the first growing season for some legumes (Table 3). Frequency counts in September 2009 were consistently higher than the June counts for both alfalfas and yellow sweetclover. In 2010, yellow sweetclover frequency was lower in the fall than in the spring.

Lowland sites in general had greater yield in 2010 than upland sites (Table 4). Fertilization with 40 lb N/a did not increase season forage yield. However, on upland sites, unfertilized areas with purple alfalfa and yellow alfalfa had greater yield than fertilized areas. Purple- and yellow-flowered alfalfa on the unfertilized uplands also had greater yield than the grass-only control sites. On lowland sites that were fertilized, purple and yellow alfalfa also had greater yield than the grass-only control.

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 frequent re-seeding. The biennial yellow sweetclover may present a long-term maintenance problem depending on timing of grazing. Pasture rest during flowering and seed set should allow natural reseeding to occur. Yellow sweetclover had

completed its life cycle and seed set by late summer 2010. New seedlings had not germinated from the biennial species by the September sampling period, and thus it had a low frequency in the fall of 2010. New biennial sweetclover seedlings may appear in spring of 2011, but likely will not contribute much to spring forage yield. Korean lespedeza, a summer annual, may present a problem with maintenance and reseeding at northern locations. It is a major component in most cool-season pastures in southeast Kansas, and it did set seed in 2009 to successfully reestablish itself in 2010. As long as grazing management allows rest or plants are allowed to flower and set seed without heavy defoliation, Korean lespedeza most likely will produce seed annually, or at least periodically, to maintain stands indefinitely. However, the lespedeza appeared to contribute little to the overall yield of the pastures even though plant frequency values were well above 21%. Of the four legumes with the most successful establishment, purple alfalfa and yellow alfalfa on the upland unfertilized and lowland fertilized sites showed the greatest potential to increase forage yield.

Implications

Adding legumes to smooth bromegrass pasture could reduce the amount of commercial fertilizer needed to attain optimal forage production. Furthermore, adding legumes to brome pasture could extend the brome grazing season by increasing the quantity and quality of forage produced in mid-summer, and could improve animal weight gain and profitability potential. Purple-flowered alfalfa and yellow-flowered alfalfa no-till seeded into smooth bromegrass pasture established at acceptable plant densities of more than 2 plants/ft^2. Both alfalfa types provided increased forage quantity above that of fertilized or unfertilized smooth bromegrass pasture. At current approximate cost of $53.00/a to seed the purple-flowered alfalfa, $67.00/a to seed the yellow-flowered alfalfa, and $27.80/a to apply 40 lb N/a, savings in N fertilizer application alone could pay for alfalfa seeding in two to three growing seasons. Purple- and yellow-flowered alfalfas seeded into smooth bromegrass pasture have potential to contribute to greater season forage quantity and quality within two years of seeding.

Table 1. Average frequency (number of 4-in. by 4-in. subsquares) having at least one desired (target) legume rooted within it at each landscape position in 2009 and 2010. Values are averaged across both fertilized and unfertilized plots, and averaged across both spring and fall sampling

	2009		2010	
	Upland	Lowland	Upland	Lowland
	----------Frequency (%)----------			
Birdsfoot trefoil	6	3	1	1
Cicer milkvetch	7	3	6	4
Hairy vetch	3	3	0	0
Korean lespedeza	80	76	58	39
Purple alfalfa	48	23	55	33
Yellow sweetclover	30	15	13	7
White clover	13	14	10	19
Yellow alfalfa	48	31	56	35
$LSD^{1}_{0.05}$		7		
Average	29	21	25	17

[1] $LSD_{0.05}$ = Least significant difference. Values compared within rows or columns that differ by more than the LSD value are statistically different.

Table 2. Average frequency (number of 4-in. by 4-in. subsquares) having at least one desired (target) legume rooted within it at each fertilization level in 2009 and 2010. Values are averaged across both upland and lowland plots, and averaged across both spring and fall sampling

	2009		2010	
	40 lb/a N	0 lb/a N	40 lb/a N	0 lb/a N
	----------Frequency (%)----------			
Birdsfoot trefoil	5	5	1	1
Cicer milkvetch	5	5	4	6
Hairy vetch	3	3	0	0
Korean lespedeza	71	85	37	60
Purple alfalfa	29	43	28	61
Yellow sweetclover	13	32	4	16
White clover	5	23	3	26
Yellow alfalfa	31	48	26	65
$LSD^{1}_{0.05}$			7	
Average	20	30	13	29

[1] $LSD_{0.05}$ = Least significant difference. Values compared within rows or columns that differ by more than the LSD value are statistically different.

Table 3. Average frequency (number of 4-in. by 4-in. subsquares) having at least one desired (target) legume rooted within it at each spring or fall sample period in 2009 and 2010. Values are averaged across both upland and lowland plots, and averaged across both fertilized and unfertilized sites.

	2009		2010	
	Spring	Fall	Spring	Fall
	----------Frequency (%)----------			
Birdsfoot trefoil	8	1	1	1
Cicer milkvetch	7	3	9	2
Hairy vetch	5	0	0	0
Korean lespedeza	77	79	49	48
Purple alfalfa	29	42	45	44
Yellow sweetclover	17	28	20	0
White clover	16	12	16	13
Yellow alfalfa	34	45	43	48
$LSD^{1}_{0.05}$		8		
Average	24	26	23	19

[1] $LSD_{0.05}$ = Least significant difference. Values compared within rows or columns that differ by more than the LSD value are statistically different.

Table 4: Average total yield (lb/a) of legume-bromegrass mixtures at two landscape positions and two N fertilizer levels one year following legume interseeding. Yields are the sum of two spring harvests and one fall harvest in 2010. Due to poor establishment, trefoil, milkvetch, and hairy vetch plots were similar to the grass-only control and were not harvested.

	Lowland		Upland	
	40 lb/a N	0 lb/a N	40 lb/a N	0 lb/a N
	----------Yield (lb/a)----------			
Grass-only control	5173	4784	2893	2688
Korean lespedeza	6067	5059	3384	2740
Purple alfalfa	7524	6456	3124	5348
Yellow sweetclover	5781	5523	3931	3739
White clover	5667	5357	2938	1927
Yellow alfalfa	7824	4776	3007	4864
$LSD^{1}_{0.05}$		1552		
Average	6339	5326	3213	3551

[1]$LSD_{0.05}$ = Least significant difference. Values compared within rows or columns that differ by more than the LSD value are statistically different.

3. Describe your work plan for next year.

We will continue to do what has been described in our proposal.

4. How did you share information from your project with others? (Include the number of people who attended field days or demonstrations.) What plans do you have for sharing information next year?

We were scheduled to present our results at the Kansas Hay and Forage Conference but the conference was canceled at the last minute. We plan to present the results at the 2012 Kansas Hay and Forage Conference. We will also do additional outreach next year as described in our proposal including the farm tour, poster presentations, and professional journal article.

Send completed report by mail or e-mail:

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