Soil Fertility Studies:
Sericea Lespedeza on Sand Mountain

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Introduction

> Sericea lespedeza (first recognized as *Lespedeza sericea* and later as *Lespedeza cuneata*) is a widely adapted, non-bloating, warm-season perennial legume that can be used for grazing, as hay, or as a conservation plant. Though it is best suited to deep, well-drained upland soils, it can be grown on a wide range of soil types and sites. It responds well to fertilization, but can be grown in areas too acidic and infertile to support other forage legumes. It is adapted to most areas in Alabama, except low-lying wet areas, extremely dry or shallow soils, and the alkaline soils in the Black Belt region. (Ball and Mosjidis, 2007, p. 1)

Sericea is well adapted to the acid, infertile soils of the Southeast. It has been extensively used as a soil stabilization and reclamation plant, and has much to offer as a forage crop for cattle, horses and especially goats, the latter of which is a livestock enterprise that is expanding rapidly. Auburn University forage budgets in 2009 showed it to be one of the lowest cost forages for pastures in the South (Table 1). Sericea produced gains for 49 to 60 cents per pound compared to 30 cents to $1.49 per pound for 34 other pasture types (Ball and Prevatt, 2009).

Auburn University has released several improved varieties of sericea (Ball and Mosjidis, 2007):

- 1962: 'Serala,' a fine-stemmed, upright and widely adapted plant.
- 1969: 'Interstate,' a spreading selection suitable for highway roadbank stabilization but also suitable for livestock.
- 1978: 'Interstate 76,' an improvement on 'Interstate;' more open growth habit and higher yields; resistant to 3 species of root-knot nematodes.
- 1978: 'Serala 76,' similar to 'Serala' but resistant to root-knot nematodes.
- 1980: 'AU Lotan.' Improved digestibility and improved gains in cattle because of low tannins; also root-knot nematode resistant.
- 1987: 'AU Donnelly,' another low tannin, higher yielding variety that is higher in digestible dry matter than 'AU Lotan'.
- 1997: 'AU Grazer™' tolerates frequent and/or close grazing.

One concern with sericea is its slow establishment from seed and accompanying weed problems. Although this plant is known to tolerate acid and infertile, droughty soils, no studies have been conducted to evaluate establishment and persistence under higher fertility conditions.

Slow establishment could be due to the poor quality soils where sericea is most often planted. Recently developed varieties, such as 'AU Grazer™', have stimulated more producer interest in the crop and they may also perform differently than older varieties, such as 'Serala'. Given its unique characteristics of wide adaptation, low cost production and its incredible ability to improve soil quality over time, sericea has much potential for enhancing the profitability and sustainability of many livestock farms.

The Two-Year Rotation Experiment (circa 1929) and the Rates of N-P-K Experiment (circa 1954) at the Sand Mountain Research & Extension Center are the oldest, continuous experiments at this site (Cope, 1984). Similar experiments exist at five other locations around the State. Until 1992, these experiments were planted to traditional row crops, cotton, corn, wheat and soybean. Because of the decline in row-crop acreage and the increase in forage acreage on soils of the Appalachian Plateau region, all four replications of these treatments have been in forage crops since 1992 (tall fescue, 1992-1997; hybrid bermudagrass, 1998-2004). Established plots with varying levels of soil test P, K, Mg, soil pH, and N rate variables make these experiments ideal for measuring establishment and maintenance of any crop as affected by soil fertility variables.

Table 1
Ten Lowest Calculated Pasture Costs Per Pound of Gain

Pasture type	Line or variety	Grazing days	Grazing dates	ADG	Costs/acre
Tall Fescue w/ Ladino	KY 31/Regal	205	10/15–1/15 & 3/15–7/19	1.53	$172.26
Orchardgrass w/Ladino	Hallmark/Regal	238	9/5–12/5 & 3/15–7/20	1.62	$172.08
Tall Fescue w/ Birdsfoot	KY 31/Fergus	194	10/15–1/15 & 3/15–7/20	1.51	$173.28
Bermudagrass w/Vetch	Coastal/Hairy	161	4/4–9/27	1.29	$230.75
Sericea lespedeza	AU Lotan	139	4/22–9/8	1.87	$148.84
Sericea lespedeza	AU Lotan	139	4/22–9/8	1.65	$148.84
Sericea lespedeza	Serala	139	4/22–9/8	1.39	$148.84
Rye & Ryegrass	NS*	153	10/24–5/15	1.36	$318.34
Bermudagrass w/Rye	Coastal/Explorer	161	3/19–9/27	1.30	$328.35
Rye, Oats & Crim. Clover	NS*	121	10/18–5/2	1.37	$352.78

Note: From D. Ball & W. Prevatt, 2009

Soil Fertility Studies

With Sericea Lespedeza on Sand Mountain

Objective: To determine the effect of soil fertility on establishment, persistence, and yield of two modern cultivars of sericea in North Alabama.

Methods: The Two-Year Rotation Experiment (Table 2) and the Rates of N-P-K Experiment (Table 3) were treated as two separate experiments because they are located about a half mile apart and contain different soil fertility treatments. However, both experiments are on a Hartsells fine sandy loam (fine-loamy, siliceous, thermic Typic Hapludults), a widespread soil series of the Appalachian Plateau region of North Alabama. Soil samples were taken from all plots in the Rates of N-P-K Experiment in the fall of 2006, and again in 2008. Samples were taken from the Two-Year Rotation Experiment only at the end of the experiment, in the fall of 2008.

In April 2004, plots were seeded in a prepared seedbed to two modern varieties of Sericea lespedeza: 'Serala,' a fine-stemmed, widely adapted variety, released in 1962; and 'AU Grazer™,' a selection tolerant of close grazing, released in 1997. Seed were inoculated with the appropriate *Rhizobium sp.* at planting. Existing plots were split with each variety planted across the plots. All treatments had received dolomitic limestone in the past to raise the soil pH to 6.5 except those treatments specifically designated as unlimed. However, all plots in both experiments were quite acidic as shown by the 2008 soil samples. The unlimed treatment on the Two-year Rotation had a mean soil pH of 4.5. The soil pH was 4.6 on the unlimed plots in the Rates of N-P-K Experiment (Tables 4-6). The low Mg plots received a calcitic hydrated lime in the past. All treatments were replicated four times in both experiments (Table 2,3).

Stand counts were made in October 2004, the year of establishment, in the Two-Year Rotation Experiment only. No yield data were collected in the year of establishment. For the purpose of comparing varieties, the crop was treated as a hay crop, with two harvests per year in 2005 through 2008: mid-June and again in late summer.

Table 2
Treatments Used in the 2004 Revision of the Two-Year Rotation (circa 1929) Test at Sand Mountain for Serecia Lespedeza

Treatment number	Description	Annual rate N-P_2O_5-K_2O[a] (lbs/ac)	Ground limestone?
1	Untreated since 1928	0-0-0	0
2	No S	0-60-80	+
3	Intermediate soil P	0-30-80	+
4	NO LIME, soil pH=4.5	0-60-80	0
5	Low Mg (calcitic lime only)	0-60-80	+ calcitic only
6	No K	0-60-0	+
7	Low K	0-60-40	+
8	+ micronutrients[b]	0-60-80	+
9	No N-P-K, plus lime	0-0-0	+
10	High N	120-60-80	+
11	Low N	30-60-80	+
12	No P	0-0-80	+
13	Intermediate N	60-60-80	+
14	Annual N-P-K (Control)	90-60-120	+
15	High soil K	0-60-120	+
16	No N	0-60-80	+
17	Same as 14 in 1978-82	0-0-0	0

a. The N rate listed is the annual N rate applied as ammonium nitrate (34-0-0) in split applications with half applied in early spring and the complement applied after the first harvest. Phosphorus and K applications are the total annual amount applied in early spring only. Sources of P and K were concentrated or triple superphosphate (0-46-0) and muriate of potash (0-0-60).
b. A total micronutrient mix applied annually to this treatment in order to apply approximately 2 lb Zn/acre, 0.5 lb Cu/acre, 1 lb B/acre, and 5 lb. Mn/acre. Iron (Fe) application is optional.
Note: This test was in a residual P and K study 1982-1997. Fertilization plot size is 21 feet x 69.2 feet (1/30 acre).

Table 3
Rates of N-P-K Experiment (circa 1954) for Sericea at Sand Mountain

Treatment number[a]	Description	(lbs/ac/yr) N[b]	P_2O_5	K_2O
N rate variables				
1	No N	0	100	100
2	Low N rate	30	100	100
3	Intermediate N rate	60	100	100
4	High N rate	120	100	100
5	Control (complete fertilization)	90	100	100
6	Very High N/No S	150	100	100
P rate variables				
7	No P (very low soil P)	0	0	100
8	Low P	0	20	100
9	Intermediate P	0	40	100
10	High P	0	60	100
K rate variables				
11	No K	0	100	0
12	Very Low K	0	100	20
13	Low K	0	100	40
14	Intermediate K	0	100	60
15	High K	0	100	80
No lime				
16	No lime (pH=4.6)	0	100	100

a. All treatments except #16 are limed to maintain a pH between 5.8 and 6.5
b. The N rate listed is the annual N rate applied as ammonium nitrate (34-0-0) in split applications with half applied in early spring and the complement applied after the first harvest. Phosphorus and K applications are the total annual amount applied in early spring only.
Note: Fertilization plot size is 21 feet x 34.6 feet (1/60 acre)

Table 4

Fall 2006 Mean Soil Test From the Rates of N-P-K Experiment

Treatment number	Description (lbs/ac)	Soil pH_w	P[a] (lbs/ac)	K[a] (lbs/ac)	Mg[a] (lbs/ac)	Ca[a] (lbs/ac)	ECEC (cmol/kg)
			N rate variables				
1	0 N	6.2	208	454	107	1187	7.4
2	30 N	6.0	182	474	107	1140	7.5
3	60 N	6.1	178	434	121	1172	7.6
5	90 N	6.1	185	439	137	1297	7.9
4	120 N	6.3	193	445	203	1614	8.7
6	150 N	5.9	177	421	176	1348	8.3
			P variables				
7	0 P_2O_5	6.2	86	461	158	1364	7.9
8	20 P_2O_5	6.0	90	507	129	474	7.7
9	40 P_2O_5	5.9	111	428	124	1093	7.4
10	60 P_2O_5	6.0	130	442	118	1075	7.4
5	100 P_2O_5	6.1	185	439	137	1297	7.9
			K variables				
11	0 K_2O	6.0	186	187	181	1380	8.1
12	20 K_2O	5.9	186	204	159	1149	7.6
13	40 K_2O	6.3	171	290	195	1512	8.2
14	60 K_2O	6.2	181	311	180	1370	8.0
15	80 K_2O	6.0	210	450	201	1708	9.1
5	100 K_2O	6.1	185	439	137	1297	7.9
			No lime				
16	No lime	4.9	178	395	52	505	6.5
Critical soil test value[b]		5.8+	50+	160+	50+	--	

a. Mehlich-1 Extractable
b. Where no lime or nutrient would be recommended for sericea (Mitchell, et al., 2012)

Table 5
Fall 2008 Mean Soil Test From the Rates of N-P-K Experiment

Treatment number	Description (lbs/ac)	Soil pH_w	P[a] (lbs/ac)	K[a] (lbs/ac)	Mg[a] (lbs/acre)	Ca[a] (lbs/ac)	ECEC (cmol/kg)
			N rate variables				
1	0 N	5.2	196	135	66	734	5.1
2	30 N	4.9	195	124	56	632	4.8
3	60 N	4.8	183	107	58	559	4.7
5	90 N	4.7	204	95	46	461	4.1
4	120 N	4.6	182	96	44	405	4.3
6	150 N	4.4	194	89	35	293	5.2
			P variables				
7	0 P_2O_5	5.4	16	147	96	711	4.8
8	30 P_2O_5	5.5	29	149	143	987	6.0
9	40 P_2O_5	5.2	52	115	83	742	5.7
10	60 P_2O_5	5.3	84	140	103	861	5.6
5	100 P_2O_5	4.7	204	95	46	461	4.1
			K variables				
11	0 K_2O	5.1	159	58	97	820	5.5
12	20 K_2O	5.2	160	66	100	750	5.1
13	40 K_2O	5.2	155	79	98	801	5.5
14	60 K_2O	5.3	165	90	103	831	5.2
15	80 K_2O	5.2	170	94	98	868	5.4
5	100 K_2O	4.7	204	95	46	461	4.1
			No lime				
16	No lime	4.6	198	115	37	409	4.2
Critical soil test value[b]		5.8+	50+	80+	50+	--	--

a. Mehlich-1 Extractable
b. Where no lime or nutrient would be recommended for sericea (Mitchell, et al., 2012)

Table 6
Fall 2008 Mean Soil Test From the Two-Year Rotation Experiment

Treatment number	Description (lbs/ac)	Soil pH_w	P[a] (lbs/ac)	K[a] (lbs/ac)	Mg[a] (lbs/ac)	Ca[a] (lbs/ac)	ECEC (cmol/kg)
1	Nothing since 1928	4.7	14	91	54	286	3.9
2	No S	5.2	61	129	130	735	5.2
3	30 P_2O_5	5.1	36	118	97	529	4.3
4	No lime pH=4,5	4.5	104	119	24	217	3.8
5	No Mg	4.7	60	92	32	323	3.5
6	No K	5.3	93	48	125	657	4.5
7	40 K_2O	5.1	66	66	92	476	3.9
8	+ micros	5.1	54	101	91	518	3.9
9	No NPK	5.1	9	58	86	353	3.4
10	120 N	4.4	69	77	23	164	3.3
11	30 N	4.9	74	116	55	446	3.8
12	No P	5.2	10	172	79	430	4.1
13	60 N	4.7	65	104	48	353	4.2
14	NPK+lime	4.6	115	101	49	370	4.1
15	120 K2O	5.2	98	162	106	762	5.4
16	No N	5.3	96	144	119	836	5.4
17	Nothing since 1982	5.1	21	85	118	654	5.1
Critical soil test value[b]		5.8+	50+	80+	50+	--	--

a. Mehlich-1 Extractable
b. Where no lime or nutrient would be recommended for sericea (Mitchell, et al., 2012)

Results:

Establishment

A good stand of both varieties was obtained during the year of establishment. May rainfall at this location in 2004 totaled 4.34 inches (Table 7). A total of 32.35 inches of rainfall occurred from April to October in the year of establishment, which most likely accounts for part of the success in establishing this forage. Six months after seeding, there was an average of 40 stems per square foot for 'AU Grazer™,' only slightly higher than that of 'Serala' (Table 8). Weeds were never a problem in these experiments. Plant height was the same for both varieties. There were height differences ($P<0.05$) due to soil fertility treatment, as would be expected due to the extreme variables in this long-term soil fertility experiment. As shown in Table 9, the untreated control (#1) and treatments that had never received any lime (#4, soil pH ~4.5), no P (#12), no K (#6), low Mg (#5) and low K (#7), produced the shortest plants.

Table 7
Seasonal Rainfall at the Sand Mountain Research and Extension Center

	Rainfall (in.)				
Month	**2004**	**2005**	**2006**	**2007**	**2008**
April	2.5	1.91	5.85	3.45	1.87
May	4.34	0	3.09	0.68	0.01
June	6.22	0.64	2.66	1.64	3.55
July	4.36	6.92	1.31	3.81	0.68
August	3.08	2.88	1.85	2.61	1.25
September	7.97	1.62	4.91	3.63	4.32
October	3.9	0.09	5.75	1.68	3.57
7-MONTH TOTAL	**32.37**	**14.06**	**25.42**	**17.5**	**15.25**

Table 8
Cultivar Effect on Stem Counts and Plant Heights on October 26, 2004

Cultivar	Stem count (sd) (stems/ft^2)	Plant height (sd) (in.)
AU GRAZER™	40±8[a]	33±6
SERALA	36±5	34±6

a. Indicates significant difference at $P<0.10$

Table 9
Effect of Treatment on Plant Height on October 26

Treatment number	Description	Plant height[a] (in.)
11	Low N rate in past	38.0a
13	Intermediate N rate in past	37.7a
8	+ total micronutrients	37.5a
16	No N in past	37.1ab
15	High soil K	36.8ab
10	High N rate in past	36.5ab
14	Control – standard NPK	36.2ab
3	Intermediate soil P	36.0ab
2	No sulfur	35.5ab
9	No NPK, + lime	35.2ab
17	Same as 14 in 1978-82	34.7abc
5	Low Mg (calcitic lime only)	34.0bc
7	Low soil K	32.0cd
12	No P	29.5d
1	Untreated since 1928	23.9e
4	No lime – soil pH=4.5	23.7e
6	No K	19.2e

a. Values followed by the same letter are not significantly different at P<0.05 using DMRT.
Note: Six months after planting in the Two-Year Rotation Experiment. No additional fertilizer was applied the year of establishment.

Dry Matter Yields

Dry matter yields varied from year to year due to weather, mainly moisture distribution. While 2004 was an extremely wet year, 2005 was the driest year during this study with 14.06 inches of rainfall from April to October. However, yields seemed to be most dramatically affected by the summer drought in 2008, where less than 2 inches of rain fell in July and August after a dry spring. In fact, visitors commented that the only green spots on Sand Mountain in the summer of 2008 were the sericea plots at the Sand Mountain Research and Extension Center. Average yields on the Two-Year Rotation ranged from 14,000 pounds per acre in 2005 to 7800 pounds per acre in 2008 (Table 10). The control treatment #14, which received a complement of NPK fertilizer plus lime and was used as the standard of comparison for other treatments, averaged 12,500 pounds dry matter per acre per year over the 4-year study (6.25 tons per acre per year). Average yields on the Rates of N-P-K Experiment ranged from 18,200 pounds per acre in 2006 to 6400 pounds per acre per year in 2008 (Table

11). Yields exceeded anything we produced on these plots with tall fescue and hybrid bermudagrass in preceding years. Considering that sericea is a legume and requires no N fertilization, the conclusion of Ball and Prevatt (2009) that sericea is the "...lowest cost forage for pastures in the South" seems to be confirmed by these data.

Table 10
Total Annual Dry Matter Yields of Sericea at Sand Mountain on the Two-Year Rotation Experiment (c. 1928)

Treatment number	Factor	Dry matter yield (lbs/ac)			
		2005	2006	2007	2008
1	Nothing since 1928	9760d	10520d	7750cde	4690c
2	No S	15420ab	15620ab	11370a	8330ab
3	30 P_2O_5	15850ab	14780ab	10050abcd	8520ab
4	No lime pH=4,5	12320c	13530c	8840abcd	5940c
5	No Mg	17620a	14520ab	8220bcde	8300ab
6	No K	8480d	8350d	8040bcde	4090c
7	40 K_2O	14760bc	13950bc	10710abc	8490ab
8	+ micros	14180cd	14740ab	7910cde	9210ab
9	No NPK	9280d	8460d	6770e	5180c
10	120 N	16190ab	13900bc	9900abcd	8750ab
11	30 N	14740bc	16630a	10120abc	9190ab
12	No P	9600d	8450d	7210de	5390c
13	60 N	16020ab	15350ab	9820abcd	8320ab
14	NPK+lime	14770bc	15310ab	10830abc	9150ab
15	120 K_2O	16870ab	16230a	11960a	10350a
16	No N	17770a	15330ab	10940abc	10020ab
17	Nothing since 1982	14760bc	13450bc	6720e	4930b
Mean of all treatments		14020	13480	9240	7760
Treatment effect P>F		<0.0001	<0.0001	0.0023	<0.0001
Cultivar effect P>F		ns	0.0017	ns	0.0010
Treatment x cultivar P>F		ns	ns	ns	ns

Table 11
Total Annual Dry Matter Yields of Sericea at Sand Mountain on the Rate of NPK Test (c. 1954)

Treatment number	Rate applied (lbs/ac)	Dry matter yield (lbs/ac)			
		2005	2006	2007	2008
N Rates					
1	0	14040abc	19630abc	14340a	7550ab
2	30	15300abc	18510abcde	12170cd	7140abc
3	60	14350abc	18470abcde	14240a	8150a
5	90	16480a	19320abc	13760abc	7160abc
4	120	16470a	19280abcd	11370de	7040abc
6	150	15860abc	20180ab	12280cd	6090bcd
P_2O_5 Rates					
7	0	12480cd	16890e	8830f	2980f
8	20	13910abc	w17320de	13520abc	6690abcd
9	40	15420abc	18100cde	13550abc	7040abc
10	60	15470abc	19630abc	13640abc	7580ab
5	100	16480a	19320abc	13760abc	7160abc
K_2O Rates					
11	0	10090d	13570f	10130ef	4080f
12	20	12970bcd	15020f	12170cd	5990bcd
13	40	13700abc	20410a	12440bcd	5630de
14	60	16200ab	19260abcd	14790a	6350abcd
15	80	17790abc	17940 cde	14010ab	7060asbc
5	100	16480a	19320abc	13760abc	7160abc
Soil acidity					
16	No lime pH=4.6	13530abc	18240bcde.	11370de	5230de
Mean yield		14500	18240	12660	6360
Treatment P>F		0.0028	<0.0001	<0.0001	<0.0001
Cultivar P>F		ns	<0.0001	<0.0001	ns
Treatment x cultivar P>F		ns	ns	0.0567	ns

There were no differences in dry matter yield of the two cultivars in either of the two experiments (Figure 1). Because these experiments were not grazed, the advantage of 'AU Grazer™' for its reported tolerance to frequent clipping was not evident. In every year, between 55 and 77 percent of the total annual dry matter yield was harvested in the first clipping in June. There did not appear to be any difference in the two cultivars in the percentage harvested at first cutting (Table 12).

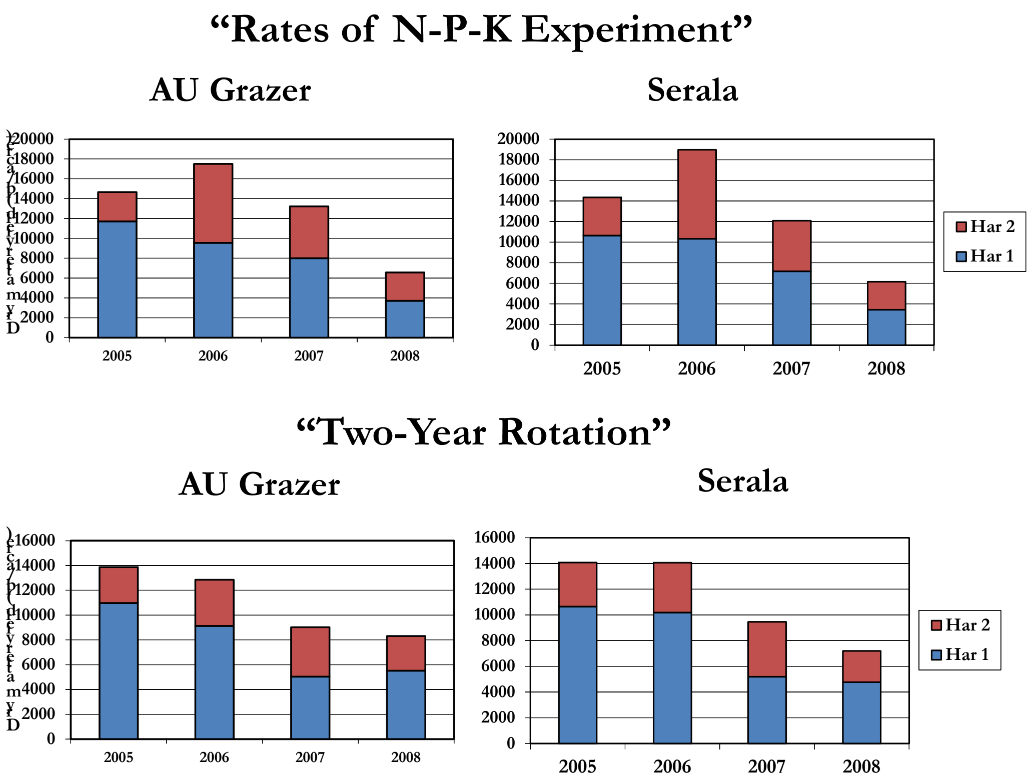

Figure 1. Mean annual yield by year of two sericea cultivars used in the two experiments. There were two harvests each year.

Table 12
Harvest Percentage of Sericea for the Two-Year Rotation and Rates of N-P-K Experiments

	Harvest 1		Harvest 2
Year	Date of harvest	% Yield	Date of harvest
	Two-year Rotation		
2005	6/22	77	10/29
2006	6/05	55	8/02
2007	6/13	60	8/06
2008	6/11	56	8/18
	Rates of N-P-K		
2005	6/24	76	10/28
2006	6/07	72	8/11
2007	6/18	55	8/16
2008	6/09	66	8/04

Soil Fertility and Yields

One reason that sericea has been popular in the Southeastern U.S. is because of the long-held belief that it is tolerant to the acid, infertile soils of the region. This is supported by dry matter yields of over 8,000 pounds per acre (4 tons) on Treatment no. 1 in the Two-Year Rotation Experiment that has not received any lime or fertilizer since it was established in 1928 (Table 10). Average soil test values for this treatment in 2008 were pH = 4.7; P would be rated low; K would be rated medium, and Mg would be marginally high (Table 6).

Direct N application did not increase dry matter yields in either experiment. The only reason to include N-application variables was because they were a part of these established experiments. As expected, N application did contribute to soil acidification. Soil samples from the upper 6 inches were taken from the Rates of N-P-K Experiment in the Fall of 2006 and again in the Fall of 2008 (Table 14,5). Samples were taken only in the Fall of 2008 from the Two-Year Rotation (Table 6). Mean soil pH_w (pH measured in water) had dropped from 6.2 to 5.2 where no N was applied (Treatment #1). It had dropped from 6.1 to 4.7 where 90 pounds N per acre per year were applied annually as ammonium nitrate; pHw had dropped from 5.9 to 4.4, where 150 pounds N per acre per year was applied.

Data in Tables 10-11 clearly show that the treatments that are low and very low in P and K with small or no annual applications of these nutrients result in significantly lower dry matter yields. To compare yields across years, we compared all yields in the Rates of N-P-K Experiment to the yield of Treatment no. 5, the completely fertilized control. Using 2007 and 2008 yield data and soil test values for 2008, Figures 2-3 were generated for relative yield response to soil test P and K. The current critical soil test value for Mehlich-1 extractable P for sericea and most other crops on sandy and loamy soils (CEC<9.0 cmol/kg) is 50 pounds P per acre or pp2m (25 mg P/kg). Above this value, no yield response to added P is expected. Data in Figure 2 show that the critical value for sericea data are very close to the critical value used by the A.U. Soil Testing Laboratory (Mitchell and Huluka, 2012).

For Mehlich-1 extractable K, a different critical value is used for three different crop groups on four different soil groups (Mitchell and Huluka, 2012). Currently, for sericea on sandy soils (group 1), a critical soil test K would be 80 pounds K per acre or pp2m (40 mg K/kg), the same as that used for grasses (Figure 3). The critical value for legumes would be 120 pounds M-1 extractable K per acre. Again, data for K in Figure 3 from the Rates of N-P-K Experiment suggest that this is indeed the value at which a response to added K is not likely (Figure 3). Because of the low CEC of this soil, soil test K levels never reached as high as 120 pounds K per acre.

Changes in Mehlich-1 extractable soil test values for P, K, Mg and Ca from 2006 to 2008 on the Rates of the N-P-K Experiment were dramatic (Tables

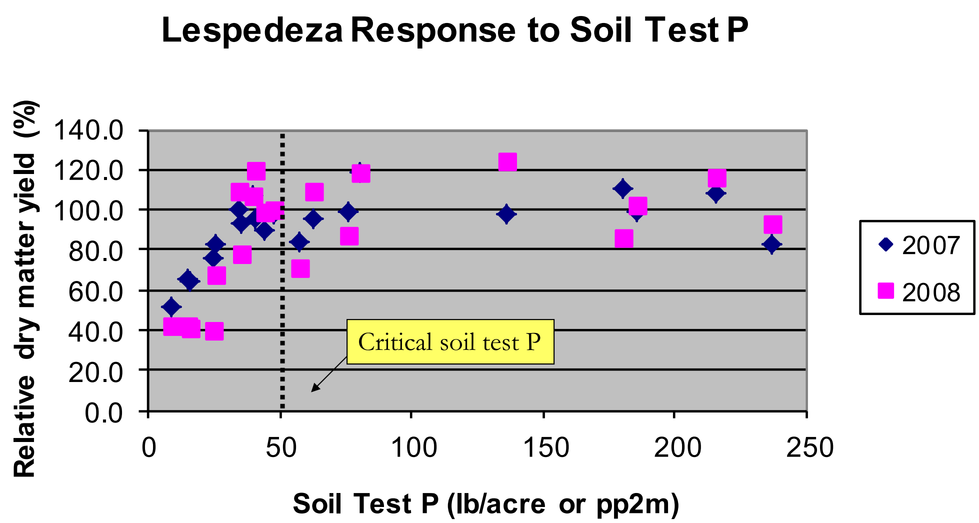

Figure 2. Response of sericea lespedeza to Mehlich-1 extractable P in the Rates of N-P-K Experiment in 2007 and 2008. Critical soil test P currently used is 50 pounds P per acre.

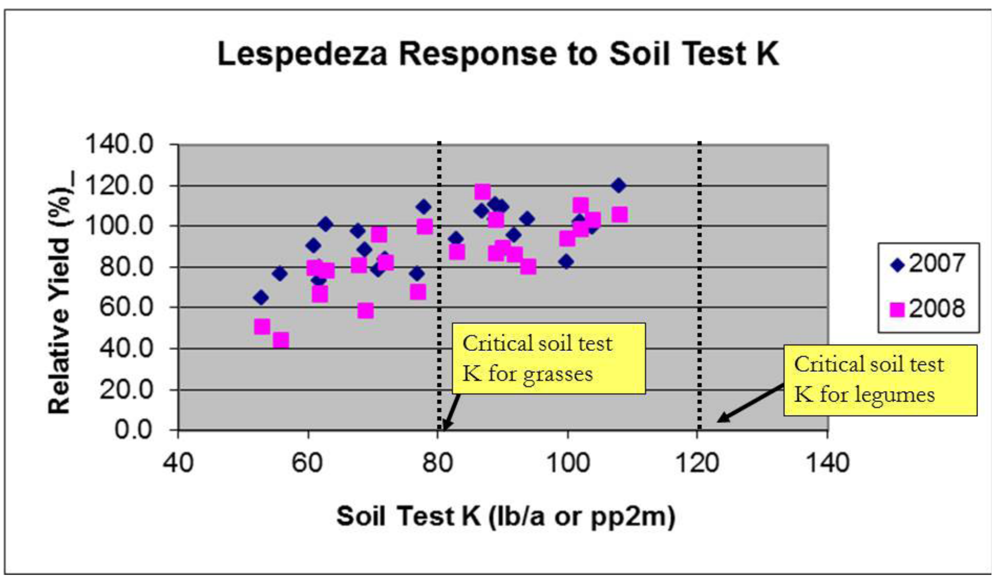

Figure 3. Response of Sericea lespedeza to Mehlich-1 extractable K in the Rates of N-P-K Experiment in 2007 and 2008. The current critical soil test K for Sericea lespedeza on sandy soils with a CEC <4.6 cmol/kg is 80 lb. K per acre, the same as that for grasses.

4-5) and cannot easily be explained. Because these plots were cut as hay, high nutrient removal would have been expected. Table 13 summarizes the average annual nutrient removal from selected treatments in the Two-Year Rotation. For Treatment no. 14 (complete fertilized control), N, P, K, Mg and Ca removal were 294, 38, 139, 29 and 95 pounds per acre per year, respectively. For one ton of Sericea hay, this would be 49 pounds N, 11 pounds P (25 pounds P_2O_5), 42 pounds K (50 pounds K_2O), 8 pounds Mg and 27 pounds Ca per ton of dry matter removed. Without considering N, removal of plant nutrients is slightly higher but comparable to that removed by hybrid bermudagrass hay on well fertilized plots (~50 pounds N, 10 pounds P_2O_5 and 40 pounds K_2O per ton). Of course, one of the greatest expenses in producing grass hay is the fertilizer N required. The higher dry matter yields and no N fertilizer costs is what made sericea come out near the top of Ball and Prevatt's most economical pasture forages (2009).

Table 13
Estimates of 4-year mean annual nutrient removal by Sericea in selected treatments in the Two-Year Rotation Experiment

Treatment number	Description	lbs/ac/yr				
		N	P[a]	K[b]	Mg	Ca
1	Untreated	165	16	68	16	48
4	No lime	208	24	99	14	51
6	No K	183	27	33	18	56
8	No N	258	35	151	24	86
9	No NPK + lime	148	10	46	17	50
10	High N	296	28	113	23	71
12	No P	152	10	84	15	50
14	NPK+Lime	294	38	139	29	95
Mean of all treatments		213	23	92	20	63

a. Multiply P by 2.29 to get P_2O_5
b. Multiply K by 1.20 to get K_2O

Forage Quality

Forage quality analyses were conducted on the 2008 harvest from selected treatments in the Two-Year Rotation Experiment only (Table 14). There were significant differences due to fertility treatment but no statistical difference due to cultivar. Crude protein tended to be lower in those treatments with nutrient deficiency stress such as "untreated" and "no P" treatments. Surprisingly, the highest CP was in the "no K" treatment, one of the lowest dry matter yield treatments. Crude protein(CP) was 13.8 percent across all treatments.

Table 14
2008 Lespedeza Forage Quality on Selected Treatments From the Two-Year Rotation Experiment

Treatment	Forage quality (%)						
	Crude Protein	Crude Fiber	TDN	Ca	K	Mg	P
1.Untreated	12.6	28.7	53.8	0.59	0.83	0.20	0.19
4, No lime	12.8	29.5	53.2	0.50	0.97	0.14	0.24
6. No K	15.8	28.5	54.0	0.77	0.45	0.25	0.37
8. No N	14.0	31.7	51.4	0.75	1.31	0.21	0.30
9. No NPK+lime	12.5	30.1	52.7	0.68	0.62	0.23	0.14
10. High N	15.2	32.6	50.6	0.58	0.93	0.19	0.23
12. No P	12.4	31.5	51.5	0.65	1.09	0.19	0.13
14. NPK+lime	14.7	35.1	48.6	0.76	1.11	0.23	0.30
Means of all treatments	13.8	31.0	52.0	0.66	0.91	0.21	0.24
LSD $_{P<0.05}$	1.8	3.6	3.0	0.18	0.25	0.03	0.06
Differences between treatments	***	***	**	**	***	***	***

*Note: *** = P<0.01, ** = P<0.05, * = P<0.10*

Interestingly, the lowest crude fiber was also associated with those treatments under nutrient stress. Crude fiber averaged 31 percent across all treatments. Because total digestible nutrients (TDN) are calculated using crude fiber, this relationship between nutrient stress and higher digestibility is also seen in the TDN values.

Nutrient Concentrations in Sericea

Although it was not the purpose of this study to try and determine optimum ranges of plant nutrients for sericea, sometimes producers want to know if a particular nutrient concentration is within an optimum range or if it is low. Knowing this information can sometimes help to diagnose plant deficiency symptoms and help with a fertilization program. Data in Table 14 can be used to predict the following optimum concentrations of P, K, Mg and Ca in sericea hay:

- P = 0.20+%
- K = 0.90+%
- Mg = 0.20 +%
- Ca = 0.60+%

Summary

- Both ‘Serala’ and ‘AU Grazer™’ were relatively easy to establish on a prepared seedbed in April 2004, no doubt due to favorable rainfall after planting. ‘AU Grazer™’ had a slightly higher stem count (40/foot^2) compared to ‘Serala’ (36/foot^2) 6 months after planting. There were no differences in height between cultivars but soil fertility level of treatment did affect plant height.
- There were no measureable differences in forage yield or quality between ‘Serala’ and ‘AU Grazer™’ when harvested twice a year.
- Between 55 and 77 percent of the annual dry matter yield was produced at the first harvest in mid-June.
- Compared to previous experience (unpublished data) with tall fescue and hybrid bermudagrass on these experiments, sericea is a much higher yielding forage under all conditions at this location. The best treatment produced 10.1 tons dry matter per acre in 2006, whereas the worst treatment on the Rates of N-P-K Experiment (no K) produced 2 tons dry matter per acre in 2008. Overall, the Two-Year Rotation produced an average of all treatments of 6.25 tons per acre per year and the Rates of N-P-K Experiment averaged 7.1 tons per acre per year.
- Well-fertilized sericea removed approximately 49-25-50 pounds N-P_2O_5-K_2O per ton of dry matter, respectively, plus 8 pounds Mg and 27 pounds Ca.
- Critical Mehlich-1 extractable P and K values for sericea on this soil were identified as near 50 pounds P per acre (25 mg P/kg) and 80 pounds K per acre (40 mg K/kg), the same value as currently used in the Auburn University Soil Testing program.
- Although these data did not allow establishing a critical soil test pH value for sericea, we did observe significant yield decreases when the soil pH was below 5.0. As previously reported, sericea is quite tolerant of soil acidity and produced dry matter yields of 5.1 tons per acre at a pH of 4.5.
- There were no differences in forage quality due to cultivar but fertility treatment affected all forage quality measurements. Crude protein increased with overall better liming, P and K management but higher fertility tended to increase crude fiber and lower TDN slightly.
- Tannins, a forage quality concern with sericea, was not included in the forage quality analyses.

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