Project Title: Fertilizing Summer-Annual Grasses for Forage Production

Investigator: Robert L. Kallenbach

Objectives and relevance of project: Summer-annual grasses are becoming more popular each year, especially forage varieties of crabgrass and dwarf, brown mid-rib sorghum sudangrass. These grasses provide high-quality forage for summer grazing and/or stored forage. However, we have almost no information about how to fertilize these grasses for optimum economic production. This is especially true for nitrogen fertilizer. Although these grasses represent a great opportunity for forage/livestock producers at present, there is little data for solid agronomic recommendations.

The **overall objective** is to develop research-based recommendations that help industry personnel and farmers properly fertilize summer annual grasses. Specific objectives are:

Objective 1: Determine the optimum economic N rates for crabgrass, dwarf brown mid-rib (BMR) sorghum-sudangrass hybrids, non-dwarf sorghum-sudangrass hybrids and pearl millet.

Objective 2: Determine if split application of nitrogen fertilizers provides a significant advantage compared to larger single applications.

Objective 3: Determine the influence of N application rates on nitrate accumulation and/or prussic acid concentrations in forage.

Procedures:
Treatments: This experiment has 32 treatments; four forage entries and eight N rates x timing applications. The four forage entries are 'Big-n-Quick' crabgrass, dwarf BMR sorghum x sudangrass, BMR sorghum-sudangrass and pearl millet. The eight nitrogen treatments are described in the table below.

Treatment	Annual N rate	No. of Applications	Notes
	lb/acre	#	
1	300	3	1/3 late May, 1/3 late June, 1/3 late July
2	300	2	1/2 in late May, 1/2 late June
3	150	3	1/3 late May, 1/3 late June, 1/3 late July
4	150	1	Applied in late May
5	100	2	1/2 in late May, 1/2 late June
6	100	1	Applied in late May
7	50	1	Applied in late May
8	0	-	Control

Cultural practices: Stands of each annual forage were established in early May at the Southwest Center, near Mt. Vernon, MO and at the Forage Systems Research Center near Linneus, MO. Both sites were planted using a Truax no-till drill. The seeding rates (PLS) for each species was as follows; crabgrass 4 lb/acre, sorghum-sudangrass 40 lb/acre, and pearl millet 30 lb/acre.

Design: Each treatment was replicated three times in a randomized complete block design in a split-block arrangement. Forage entries were main plots and nitrogen treatments sub-plots.

Measurements:
Forage yield and growth rates. Growth rate of forage was measured weekly using a rising plate meter for crabgrass and by measuring the natural height with a meter stick for the other forage species. Mechanical forage harvest for an individual treatment occurred when forage reached the following threshholds:18 rising plate meter units for crabgrass, 30 inches for the other species. For those unfamiliar with rising plate meter measurements, this would equate to approximately 8 inches in height for crabgrass. Subsamples for forage nutritive value, prussic acid, and plant nitrates were also collected at the time of a mechanical harvest.

Figure 1. Length of harvest strip being measured in field plots near Mt. Vernon, MO.

Results
At Mt. Vernon, MO summer precipitation was 59% less than the 30 year average in 2011. As a result, dry matter yields of all 4 species were lower than normal (Table 2). For instance, the sorghum x sudangrass hybrids, which commonly yield 4 to 6 tons per acre, produced less than 1 ton per acre. Additionally, pearl millet, which is known as a drought-tolerant species, was the only species of forage that showed a response to N applications, but that response was not economical by most standards.

At Linneus MO, dry matter yields were greater than those at Mt. Vernon (Table 3). However, late summer precipitation limited yields at this location. The pearl millet did not establish well at this site and is not included in the preliminary data analysis. Crabgrass did not respond to N applications but both sorghum x sudangrass hybrids did. The preliminary data show that early applications of N were more favorable than late-summer applications. Dry matter yields were often no better if N was spread out over the summer in 2 or 3 applications. This result was likely influenced by the precipitation shortage in late summer; we expect the later N applications to stimulate more growth when summer precipitation is more evenly distributed.

While the yields for 2011 were below average for both sites, it does show how variable summer annual forage yields can be in Missouri and the need to conduct multi-year studies to develop sound agronomic recommendations.

Table 2. Annual yield of four species of summer annual grasses under eight different N fertilization regimes. Data were collected near Mt. Vernon, MO in the summer of 2011.

Annual N rate	No. of Applications	Crabgrass	Dwarf Sorg x sudan	BMR Sorg x sudan	Pearl Millet
lb/acre	#	---------- lb/acre ----------			
300	3	4970 a	2053 a	1801 a	2148 bc
300	2	4262 a	2296 a	1502 a	2938 a
150	3	4477 a	1685 a	1787 a	2682 abc
150	1	4417 a	1786 a	1908 a	2764 ab
100	2	4936 a	1982 a	1638 a	2149 bc
100	1	4120 a	1713 a	1948 a	2143 bc
50	1	4825 a	1835 a	1873 a	1977 cd
0	-	4352 a	1483 a	1529 a	1261 d

Table 3. Annual yield of three species of summer annual grasses under eight different N fertilization regimes. Data were collected near Linneus, MO in the summer of 2011.

Annual N rate	No. of Applications	Crabgrass	Dwarf Sorg x sudan	BMR Sorg x sudan
lb/acre	#	---------- lb/acre ----------		
300	3	6443 a	6174 ab	7961 ab
300	2	6414 a	7818 a	8467 a
150	3	6045 a	5897 b	6751 c
150	1	6420 a	7648 a	7245 bc
100	2	4659 a	5857 b	6888 bc
100	1	5271 a	5890 b	6721 c
50	1	5785 a	6156 ab	5449 d
0	-	4451 a	5414 b	4823 d

Timetable for proposed research: This study began in spring of 2011 and will end in December of 2013 (three years of study). The table below gives a brief summary of the project's activities. (* indicates task to be done on an annual basis throughout the three-year study)

Spray existing perennial forage in plot areas with glyphosate	3/15/12
No-till plant forage at the Southwest Center and at the Forage Systems Research Center	*Late April or Early May
Take plate meter readings to guide forage harvests	*Weekly from 1 June until frost.
Apply appropriate nitrogen fertilizer treatments (see table on page 1 for details)	*May, June, July
Harvest appropriate plots for forage yield and retain subsamples for forage quality, prussic acid, and nitrate analysis	*Variable based on plant growth - expect 3 to 5 harvests per yr.
Analyze latest results & report findings to Fertilizer/Ag Lime Advisory Council	*December
Incorporate results into soil testing reports, grazing school materials and forage conferences. Work with press on articles.	October 2013 through December 2014
Submit manuscript on this research to a peer-reviewed journal	March 2014

Year 2 Budget:

Salary and Benefits

Research Specialist (20% of $48,000)	$ 9,600
Benefits for Research Specialist	$ 3,072
Total Salary and Benefits	$12,672

Operating Expenses

Fertilizer, bags, repair parts for harvester and other field supplies	$ 1,500
NIR charges for forage quality analysis (1280 samples @ $4 each)	$ 3,840
Wet chemistry for NIR calibration (90 samples @ $10.50 each)	$ 945
Prussic acid and nitrate analysis	$ 1,250
Travel to research locations (mileage, lodging, and meals for 8 trips/yr)	$ 1,600
Total Operating Expenses	$ 9,135

Equipment

None requested	$ 0
Total Equipment	$ 0

Total Proposal Request for Year #2 ***$21,807***