Annual Summer Legumes for the Cross Timbers of Texas and Oklahoma

James P. Muir
Texas Agricultural Experiment Station, Stephenville TX
j-muir@tamu.edu

Twain J. Butler
The Noble Foundation, Ardmore OK
tjbutler@noble.org

G. Ray Smith
Texas Agricultural Experiment Station, Overton TX
grsmith@ag.tamu.edu

Summary and Application

Legumes can provide highly digestible crude protein for livestock or wildlife. In the Cross Timbers (Stephenville TX), dry matter forage yields and crude protein concentrations of eight annual, warm-season legumes either commercially available or native to north-central Texas and southern Oklahoma were evaluated.

Yields ranged up to 2.5 tons/acre/year when rainfall was plentiful but Iron & Clay cowpea and Rongai lablab produced over 1.5 tons/acre/year even in a drought year. Crude protein concentration averaged over 25%, resulting in up to 160 lbs N/acre/year in the more productive entries. The native wild beans were the only entries to self-reseed and Rongai was the only entry that did not produce seed. These annual legumes can provide high quality summer forage in the Cross Timbers. Based on seed costs, availability, forage production, and tissue-N concentration, Iron and Clay cowpea should be considered as a viable warm-season annual forage crop.

Image 1. Rio Verde lablab produces abundant forage and seed in Texas and Oklahoma.

Introduction

Legumes, in association with rhizobia bacteria, can fix nitrogen from the atmosphere (unavailable to plants) into forms that are available to the plant. Crude protein, which is based on nitrogen, is essential for maximum animal growth, whether wildlife, small ruminants or cattle. Legumes have greater concentrations of crude protein compared to unfertilized grasses or forbs, and they are also generally more digestible than grasses, making the crude protein better utilized.

Ideally perennial legumes would be preferred, but unfortunately, there are no widely-adapted perennial forage legumes in the Cross Timbers of north-central Texas and southern Oklahoma. Alfalfa does not persist well in many soils of this region due to susceptibility to cotton root rot, an endemic soil-borne fungus. Rhizoma peanut may have potential, but long-term winter survival

is a concern and plant material is not readily available.

Annual summer legumes in wildlife plots or in pasture mixtures with other forbs and grasses may be worth the expense of cultivating and seeding each year, since they fix nitrogen and are of high quality. Producers in the region are looking to reduce the expense of nitrogen fertilizer and increase the nutritive value during the summer when forage quality is typically low. It is unclear which summer annual legume would be the most productive and better adapted to the Cross Timbers area in north-central Texas. Therefore we examined the season-long forage yield and crude protein concentration of eight annual forage legumes at Stephenville TX to see which of these might be useful for annual pastures or wildlife food plots in the Cross Timbers.

Materials and Methods

Plots located on a Windthorst fine sandy loam (pH 6.6 and 11 ppm phosphorus), were disked twice, roller-packed, and seeded with eight annual warm-season legumes (see Table 1) that had been scarified and inoculated with specific rhizobia (to guarantee nodule formation and nitrogen fixation) at recommended commercial rates and depths.

Table 1. Latin and common names, seeding rates, growth habit, and flowering pattern of eight annual warm-season legumes planted at Stephenville, TX during the 2004 and 2005 growing seasons.

Latin binomial	Common name	Cultivar/ accession	Seed rate lb/acre	Seed $/acre	Growth habit	Reproduction
Glycine max L.	Soybean	'Laredo'	30	24	Upright	Indeterminant
Lablab purpureus (L.) Sweet	Lablab	'Rongai'	38	76	Upright-viney	Did not flower
L. purpureus	Lablab	'Rio Verde'	38	152	Upright-viney	Determinant
Strophostyles helvula (L.) Elliott	Trailing wildbean	TX-00-H1	38	-	Trailing-viney	Indeterminant
S. leiosperma (Torr. & A. Gray) Piper	Smooth-seeded wildbean	TX-00-L1	15	-	Trailing-viney	Indeterminant
Vigna radiata (L.) Wilczek	Mungbean	'TexSprout'	30	21	Trailing-viney	Determinant
V. unguiculata (L.) Walp.	Cowpea	'Iron and clay'	38	34	Upright-viney	Indeterminant
V. unguiculata var. *catjang*	Cowpea	'Catjang'	30	27	Upright-viney	Indeterminant

Plots were only irrigated immediately after planting each year to ensure good germination, but after that soil moisture was dependent only on rainfall. Year 2004 had 37" rainfall (20% above the long-term average) whereas year 2005 only had 18" rainfall (approximately 43% below average). This difference in rainfall between years was fortuitous because it allowed us to compare yields and crude protein in both high and low rainfall conditions.

Plants were harvested whenever they either flowered or their canopy filled in the plots, which would be when landowners should allow access to white-tailed deer, livestock, or cut a hay crop. The native smooth-seeded wild bean flowered earlier than the other legumes and Rongai lablab did not flower at all in our region and remained vegetative throughout the growing season. The native wild beans were more productive early in the season whereas others, such as the lablabs, responded to

autumn rainfall by growing right up to the first frost.

Image 2. Trailing wildbean can be found from Canada to the Gulf Coast of Texas and provides both forage and seed for wildlife plantings.

After harvesting, plants were ground and then analyzed for N concentration (which is converted to crude protein equivalents by multiplying by 6.25). Seed (Table 1) and seedbed preparation costs were estimated to calculate cost of producing a ton of forage. In addition, dry matter yields and tissue-N concentrations were used to calculate how much N was removed to give a rough estimate of how much N might be fixed by each species.

Results & Discussion

Forage yields (Fig. 1) were, not surprisingly, greater in 2004 when rainfall was approximately double that of 2005. The lablabs were particularly productive that year, reaching almost 2.5 tons of dry matter. Iron & clay cowpea and Rongai lablab were the most consistent-yielding legumes across both high and low rainfall years. The native trailing and smooth wild beans were the only entries to self-reseed the following years, although volunteer seedlings were more abundant two years after seed production (it takes a while to break seed dormancy) than they were the year after.

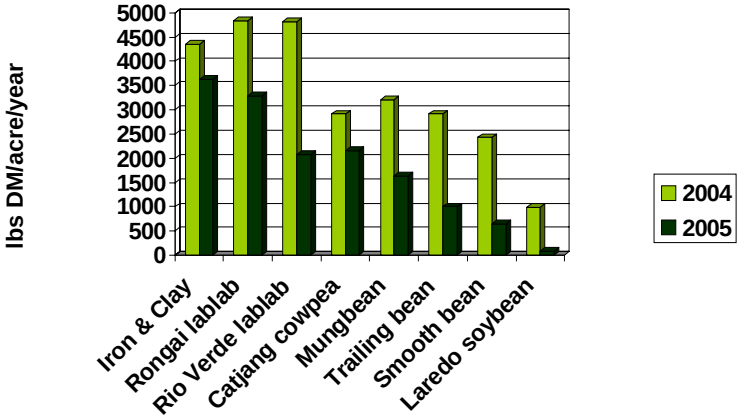

Figure 1. Forage dry matter yield of annual, warm-season forage legumes grown during 2004 (37" rainfall) and 2005 (18" rainfall) at Stephenville TX. Year by legume interaction $P < 0.05$).

Crude protein concentration was around 20% for most entries (Fig. 2). This is much greater than most grasses can achieve even with high rates of nitrogen fertilizer application. It is also well above the nutrient needs of most domesticated animals and white-tailed deer.

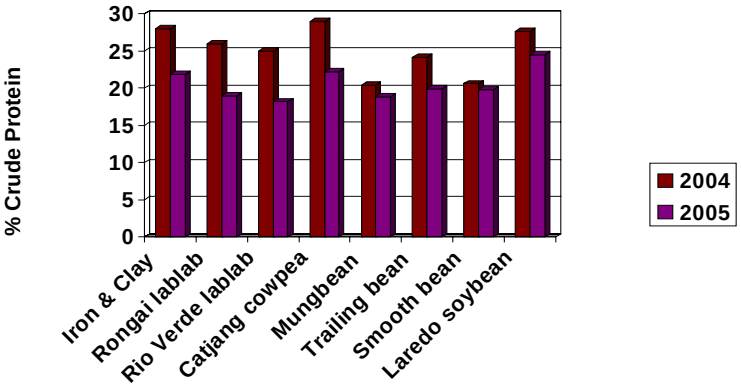

Figure 2. Crude protein concentration (averaged over growing season) of annual, warm-season forage legumes grown during 2004 (37" rainfall) and 2005 (18" rainfall) at Stephenville TX. Year by legume interaction $P < 0.05$).

Crude Protein concentrations were considerably greater the high rainfall year (2004) compared to the droughty year and climbed above 25% in five entries.

It is important to have an idea of how much it will cost to produce a ton of forage, which is a function of forage yield, seed and establishment costs (seed cost plus $32/acre for seedbed preparation and estimated fertilizer cost). Each field should be soil sampled and tested to determine exactly how much P and K should be added. Iron and Clay cowpea production costs were $33/ton of forage (Fig. 3), followed by mungbean, Catjang cowpea, and Rongia lablab ($44, $46, and $53/ton, respectively).

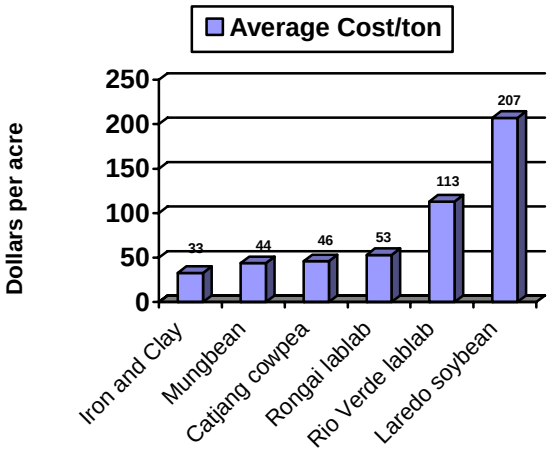

Figure 3. Average cost per ton of forage produced based on seed price and estimated establishment cost (seedbed preparation and fertilizer) of $32/acre.

Producers want to know how much N these legumes can fix and what it is worth. Nitrogen removal (tissue-N concentration x dry matter yields) was valued at $0.45/lb of N (February 2007 fertilizer price) to estimate potential N-fertilizer savings. Nitrogen removal of Iron and Clay cowpeas was 159 lbs/acre, followed by Rongai lablab (147 lb/acre), then Rio Verde lablab (113/acre) (Fig. 4).

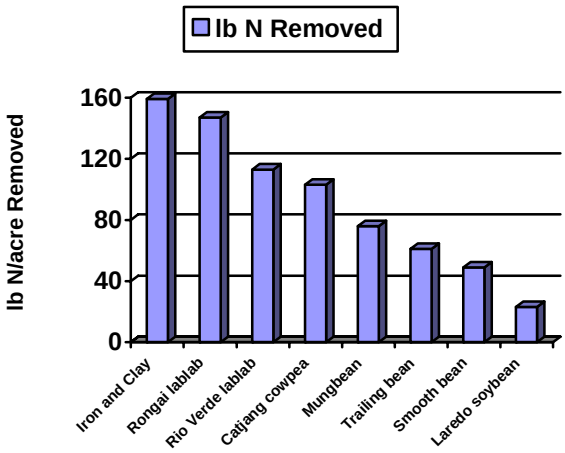

Figure 4. Average value of legume nitrogen removal based on N concentration and dry matter yield.

The value of N (an estimate of potential N savings) followed the same trend (Fig. 5), with Iron and Clay cowpeas valued at $71/acre, Rongai lablab at $66/acre, Rio Verde lablab at $51/acre.

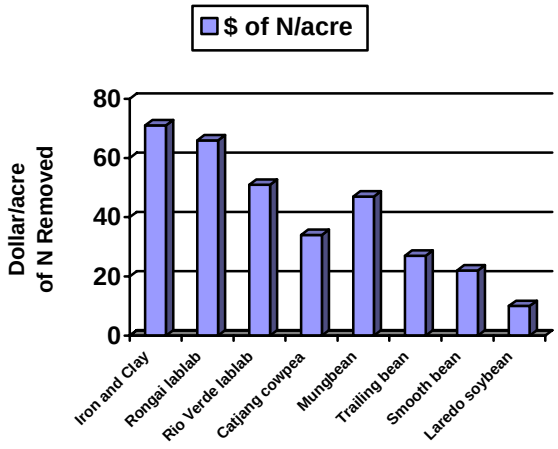

Figure 5. Average value of legume nitrogen removal based on N concentration, dry matter yield, and N fertilizer at $0.45/lb.

Landowners must figure in their own farming costs to determine whether this would be a good return on their

investment. Since all legumes produced high quality forage, the best legume would be the one that produced the greatest yield at the lowest cost. Based on these data, Iron and Clay cowpea would be the most economical choice, since it produced the least expensive forage and produced the most N in the forage removed.

Conclusions

Depending on individual farming costs and market prices of protein supplements and nitrogen fertilizers, these annual summer legumes could be an economical source of highly digestible forage protein for cattle, goat and wildlife producers in the Cross Timbers.

Image 3. Smooth-seeded wildbean produces forage and abundant seed early in the growing season and is native to the Cross Timbers.

They can be used as wildlife plots and attractants, creep-feed pastures, mixed in with annual grass and forb pastures, or hay production. Their deep tap roots (compared to shallower grass roots) can keep them green and growing into the drier months of July and August, even in drought years. Based on seed costs, availability, DM production, and tissue-N concentration, Iron and Clay cowpea should be considered as a viable warm-season annual forage crop.