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Annual and Short-lived Perennial Summer Legumes for the Cross Timbers

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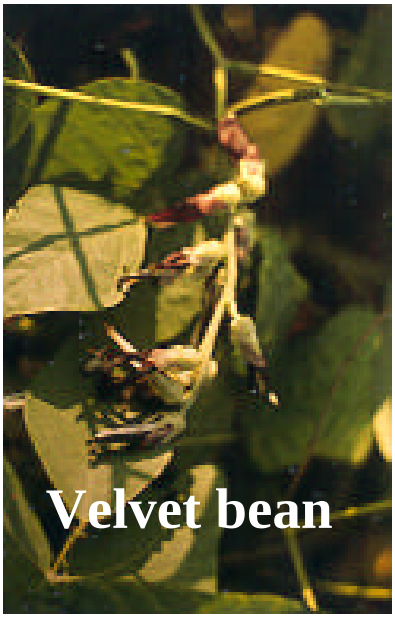
Summary

Eight warm-season annual and short-lived perennial legumes, with or without 9 tons manure per acre added to the soil, were hand-plucked (browsable material only) throughout the summer or only in the autumn. Manure increased only forage P concentration. Continuous harvesting increased forage yields to over a ton for "Iron-clay" cowpea, "Tecomate" lablab and "Tamrun 96" peanut. The lablab and peanut retained the greatest quantity of forage into the autumn when harvest was deferred. Phasey bean and partridge pea both produced over 5,000 seeds/10 ft^2 when harvest was deferred. Fiber was generally low and crude protein (CP) high for the forages while lignin varied from 3.7 to 7.3 % of dry matter. Quality of autumn-only harvested material was high due to the hand-plucked nature of forage growth following autumn rain.



Introduction

Late summer and early autumn forage quality is often insufficient to meet the nutritional needs of livestock and wildlife in the Cross Timbers. Legumes, planted as food plots or forage banks, are an alternative to expensive protein and energy supplements or hays. Legumes are generally more digestible and higher in protein, calcium and phosphorus (P) than grasses. An additional benefit of legumes is that they are not dependent on soil nitrogen (N) or commercial N fertilizer since they can fix atmospheric N. However, species adaptation, management requirements, productivity of both forage and seeds in the Cross Timbers area are not known for many of these legumes.

The question of soil phosphorus buildup from dairy waste application and subsequent plant uptake is of great concern in some counties of the Cross Timbers. If P is added to the soil, some crops, especially legumes, may have increased yields in the generally low P soils of the region. These plants, when grown on manured soils, can also serve as P sinks when the whole plants are removed as silage, green chop or hay.

Traditional methods of harvesting forages in small plots involve clipping at a set stubble height. This includes stem materials in the sample that the animals rarely ingest. Yield data is often skewed higher than what is actually useful for the animal. Quality indicators such as crude protein are skewed down and anti-quality indicators such as lignin are skewed up. A partial solution is to harvest only that forage material which is normally ingested by the animals. This makes harvesting small plots more tedious since clippers or mowers give way to manual harvests of individual leaves and tender stems such as took place in this trial.

The objectives of this trial were to:

1. Quantify productivity and quality indicators of eight summer legumes
2. Measure the effects of dairy manure application on legume forage and seed production
3. Measure the benefits of harvest deferment on seed production and forage yield
4. Measure P uptake capacity of eight legumes.

Procedure

In April 1998, six warm-season annual legumes and two perennials that act as annuals in North Texas were seeded into ploughed Windthorst fine sandy loam (pH 6.5; 3 ppm P; 24 ppm $N0_3$; 130 ppm K; 855 ppm Ca and 124 ppm Mg). Seed, inoculated with a general cowpea

Rhizobium, were drilled using a small-plot belt planter (see Table 1 for seeding rates) in 20 in. rows. Seedlings were thinned to 10 in. between plants within rows. Weeds were hoed and plots irrigated only during the first 28 days to guarantee establishment. Rainfall and irrigation totaled 15.4 in. of moisture from April 1 to September 30.

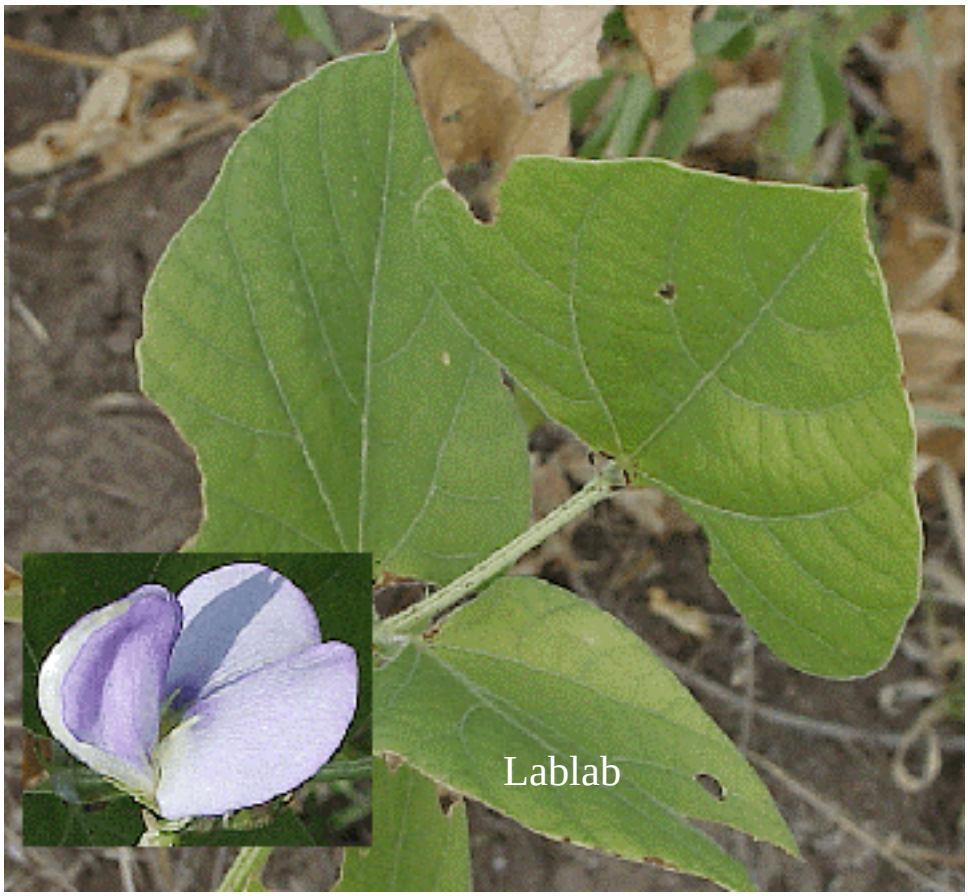


Table 1. Names, growth characteristics and seeding rates of eight legumes studied at Stephenville.

Legume	*Scientific name*	*Annual/perennial*	*Seeding rate*
Phasey bean	Macroptilium lathyroides	True annual	3 lbs/acre
Tecomate lablab	Lablab purpureus	True annual	6 lbs/acre
Comanchee partridge pea	Chameacrista fasciculata	True annual	16 lbs/acre
Velvet bean	Stizolobium deeringianum or Mucuna pruriens	True annual	20 lbs/acre
Iron-clay cowpea	Vigna unguiculata	True annual	50 lbs/acre
"Donegal" soybean	Glycine max	True annual	100 lbs/acre
Tamrun 96 peanut	Arachis hypogea	Perennial: acts as cultivated annual	30 lbs/acre
Kudzu	Pueraria lobata	Perennial: acts as annual in N. Texas	5 lbs/acre

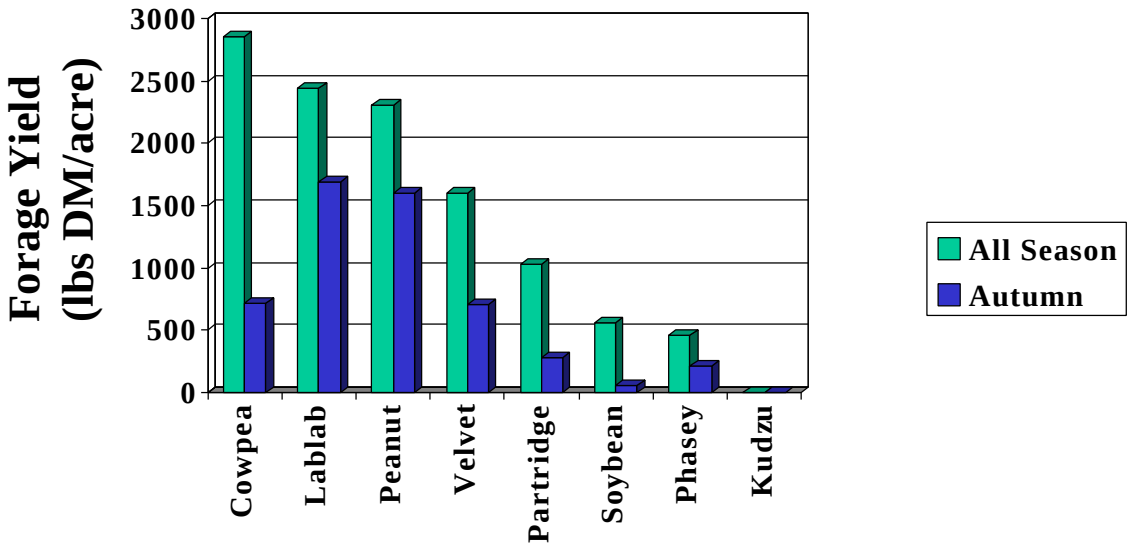
Treatments were arranged in a split-split plot design with four replications. Main plots (13 ft X 13 ft) were seeded to legumes, sub-plots (13 ft X 6.5 ft) received 9 tons DM manure/acre (0.51 % N or 92 lbs N/acre; 0.29 % P or 52 lbs P/acre) incorporated to a 6 in. depth prior to seeding. Sub-subplots (6.5' X 6.5') were either hand-plucked every 6 weeks throughout the season following 42 days establishment or plucked once in early October. Hand-plucking was used to imitate the action of a browser and consisted of removing, by hand, every leaf, flower, green pod or tender stem starting at 4 in. above the soil. Seed production (number of seeds per 10 ft^2) was measured throughout the season for phasey bean while all other entries were evaluated only in early October since they did not flower until autumn.

Variables measured in sub-subplots included: hand-plucked DM yield/acre; forage crude protein (CP) concentration, forage acid detergent fiber (ADF) concentration, lignin concentration, P cocnetnration in plant DM material and seed production.

Results

Kudzu was unable to establish under the dry conditions of this study while forage soybean and phasey bean did poorly as well (Figure 1). Cowpea, lablab and peanut all produced over a ton of forage DM per acre when harvested throughout the growing season. Velvet bean established well but suffered from fungal attacks on leaves when drought-stressed in August. In contrast, partridge pea had difficulty establishing, but surviving plants were vigorous once established. Deferring harvest to the autumn, an option for white-tailed deer hunters wishing to use these legumes as attractants, decreased total forage production for all entries (Figure 1). Both lablab and the peanut, however, were able to maintain 69 % of their leaf biomass well into the autumn.

Figure 1. Forage yield of eight legumes hand-plucked at 6 wk intervals all season or only once in the fall (legume X harvest *P*=0.002; LSD 616).



Seed production was over 5,000 seeds/10 ft^{-2} for both partridge pea and phasey bean when harvests were deferred to the autumn (Figure 2). Soybean, phasey bean and partridge pea were able to produce over 1,200 seeds/10 ft^{-2} even when hand-plucked at 6 wk intervals over the growing season. Phasey bean produced this seed throughout the growing season via indeterminate flowering while partridge pea flowered only in September with seed production in October. On average, hand-plucking at 6 wk intervals throughout the season reduced seed production approximately 65%.

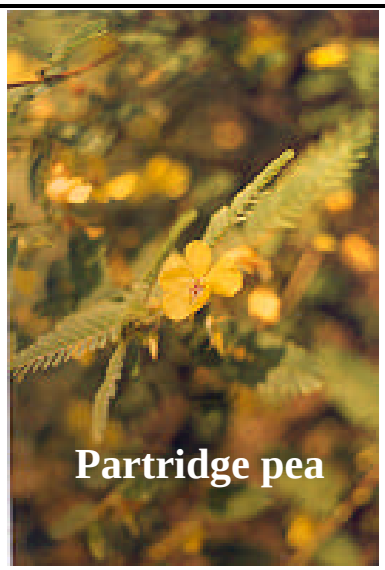
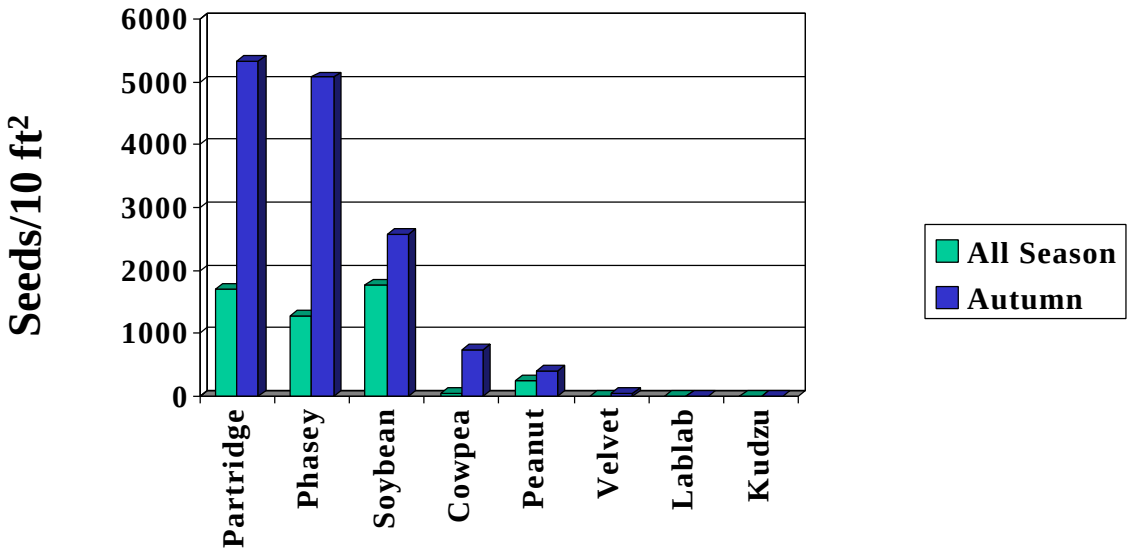


Figure 2. Number of seed per 10 ft^2 produced by eight legumes when hand-plucked at 6 wk intervals all season or once only in the fall (legume X harvest *P*=0.001; LSD1053).



The peanuts were the only entry whose forage ADF and lignin concentrations were higher when harvested only in the autumn compared to plucking at 6 wk intervals during the growing season (Table 2). High summer temperatures generally tend to increase lignin and ADF concentrations in forages. Partridge pea, phasey bean, soybean, cowpea and velvet bean ADF decreased in the autumn. This would be unusual for clipped trials but not necessarily for hand-plucked forage that included only leaves, tender tips, flowers and green pods. Early autumn rains accentuated this phenomenon because it stimulated fresh regrowth. Partridge pea and phasey bean lignin concentrations decreased while peanut, lablab, soybean and velvet bean increased in the autumn. The only entry whose P and CP concentrations increased in the autumn was phasey bean, due perhaps to new regrowth and fresh, edible pod formation late in the season

Table 1. Acid detergent fiber (ADF), lignin, phosphorus (P) and crude protein (CP) concentration as a percentage of hand-plucked forage in seven summer legumes harvested throughout the summer or only once in autumn.

	ADF	Lignin	P	CP
	----------%----------			
Partridge Pea				
Season average	20.4	6.3	0.17	17.1
Autumn	17.3	5.9	0.14	13.6
Peanut				
Season average	21.3	3.4	0.16	18.4
Autumn	26.3	4.8	0.14	13.7
Phasey bean				
Season average	24.7	7.3	0.20	18.8
Autumn	17.7	3.7	0.22	22.5
Lablab				
Season average	22.8	4.6	0.22	16.1
Autumn	23.1	5.4	0.22	15.6
Soybean				
Season average	19.6	4.2	0.20	11.0
Autumn	18.6	4.7	0.26	9.2
Cowpea				
Season average	21.5	4.0	0.22	16.6
Autumn	19.8	3.9	0.16	13.5
Velvet bean				
Season average	25.1	6.1	0.21	16.3
Autumn	24.3	7.3	0.21	13.3
Legume X harvest				
P Value	0.001	0.001	0.001	0.001
LSD	1.96	0.55	0.025	1.13

The application of manure did not affect forage yields, seed produciton, ADF, lignin or CP concentrations (Table 3). The addition of manure to the soil did, however, increase P concentration in the hand-plucked forage by 7 %.

Table 3. Effect of dairy manure application on hand-plucked forage yield, seed production and forage concentration of acid detergent fiber (ADF), lignin, phosphorus (P) and crude protein (CP) averaged across 7 legumes.

Manure Treatment	DM Yield	Seed	ADF	Lignin	P	CP
	Lbs DM/acre	#/10 ft^2	----------%----------			
No Manure	1,022	787	21.2	5.1	0.188	15.9
9 tons/acre Manure	1,035	1,092	21.6	5.1	0.202	15.6
P value	NS	NS	NS	NS	0.01	NS
S.d.					0.0038	

Conclusions

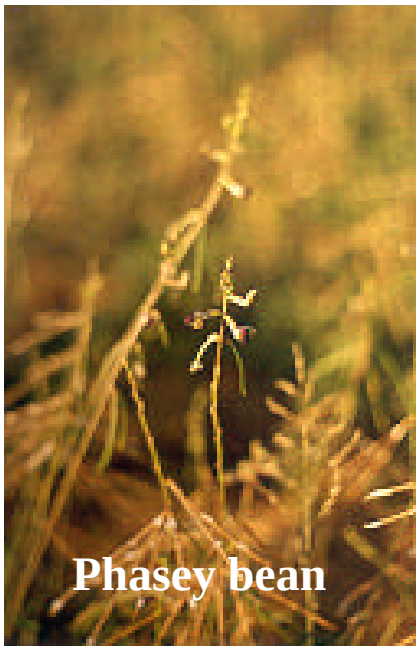
For continuous harvest or browsing throughout the growing season under dryland conditions, “Iron-clay” cowpea, “Tecomate” lablab and “Tamrun 96” peanut appear to be the most promising entries. For autumn-deferred grazing, “Tecomate” lablab, which does not flower at the Stephenville latitude, and “Tamrun 96” peanut maintained the most growth. Low tonnage was a result of low rainfall as well as the hand-plucked nature of the harvest. This method, however, is more likely to give an accurate idea of edible material available to browsing animals.

If seed production is the primary goal in growing these legumes, for example for turkey or quail, partridge pea and phasey bean were by far the most productive. Browsing during the season, however, reduces the seed crop considerably, an important consideration with self-reseeding annuals. Due to the cost of reseeding, these two entries may also be attractive since their copious seed production will more likely result in stand maintenance and expansion into subsequent seasons. “Tecomate” lablab and kudzu have no chance of reseeding while velvet bean, “Iron-clay” cowpea and Tamrun 96 peanut, under the low-rainfall conditions of the trial, would not likely maintain a stand into the next summer growing season either.

The general quality of the hand-plucked browse was high, with low ADF and high CP concentrations. Lignin concentrations tended to be high, typical for summer legumes. These characteristics are typical of plant material highly selective browsers ingest. Even small quantities of these legumes can considerably improve rumen activity, digestibility of accompanying grasses and productivity of the browsers.

In the P-deficient soils of Central Texas, the increased P concentration in the browse resulting from applying manure to the soils may make a large difference in ruminant nutrition. Long-term viability of plant stands, namely the capability to self-reseed, may also be enhanced by the manure if individual seed viability is enhanced. Other than these factors, the manure had little to no effect on legume forage productivity and quality. The legumes in this trial may be able to extract sufficient P from the soil or may be adapted to growing well without large quantities of P. The N provided by the manure did not enhance additional legume growth, as it might have with grasses, since the legumes had the capability of fixing atmospheric nitrogen.

A general consideration in dealing with these annual legumes for browse, whether for goats, cattle or wildlife, is the cost of establishment compared to the benefit derived. A ton of forage is not much of a return for the cost involved, especially with costly legume seeds. Weed control costs, with the decrease in biomass production that accompanies this cultivation practice, is also unattractive. This investment will likely only pay for itself if the browsers provide a high return. This will more likely occur with wildlife, non-native deer and high-value goat husbandry. An additional benefit might be the capacity for reseeding. Entries such as Tecomate lablab must be reseeded each spring while partridge pea and phasey bean, if allowed sufficient rest to build up soil seed banks, can become naturalized and volunteer in subsequent years.



Acknowledgements

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