Originally published in:
Sheep and Goat Research Reports
TAES, San Angleo, TX

Cultivated Cool Season Pastures for Meat Goats in North-central Texas

J. P. Muir

Texas A&M University Experiment Station, 1229 N. U.S. Hwy. 281, Stephenville, TX.
j-muir@tamu.edu.

ABSTRACT

Cultivated cool-season pastures can complement range-based goat production in north central Texas, especially the under-stories of otherwise under-utilized pecan groves. Weight gains of Boer X Spanish nanny kids (average 55 lbs) on four grazing treatments 1) grass-only, 2) mixed grass/legume, 3) mixed grass/legume in a pecan grove, and 4) native hardwood range during two cool seasons were compared at Stephenville, Texas. Animals were stocked in the pasture at 2 head per acre and in the range at 0.8 head per acre for 8 weeks in 2000, when October-May rainfall was 13 in., and 16 weeks in 2001 when rainfall was 26 in. for the same period. Nannies in the pecan grove gained 2.77 and 2.22 lbs per week (0.40 and 0.32 lbs. ADG, respectively) on average compared to 0.66 and 0.72 lbs per week (0.09 and 0.10 lbs. ADG, respectively) for the range animals during the same 8-week periods in 2000 and 2001, respectively. Animals in both grass/legume paddocks out-gained the goats on grass-only in 2000 but not in 2001. At the low stocking rates studied, having pecan trees in the pasture did not decrease goat gains; however, trees did lower forage production and, by implication, carrying capacity. The nannies tended to select for grasses early in the season and equally for grasses and legumes as plants matured but selected plants and plant portions high in crude protein throughout the season. The use of cool-season cultivated legume/grass pastures for growing nanny kids under pecan groves in the Cross Timbers shows promise as a complement to warm-season range-fed goats.

Introduction

The Texas goat industry has a strong interest in maintaining steady weight gains through the cool season in order to meet spring holiday market demands. Traditionally, meat goats with mostly Spanish genetics are left on range during cool winter months when most native forbs are dormant, and the only non-dormant plants are a few perennial grasses and a limited number of evergreen shrubs (Gee et al., 1994). To maximize the potential of recently introduced Boer goat genetics, cultivated cool-season forages may be needed, similar to the

annual grasses presently grown for cattle and white-tailed deer in the region (Gee et al., 1994; Prostko et al., 1999). There are numerous naturalized, self-reseeding annual legumes with proven adaptation to the region (Diggs et al., 1999) whose productivity and persistence (Muir and Reed, 1998; Muir, 2000) may make them ideal components of cultivated pastures designed specifically for goats.

A preliminary trial at Stephenville, TX in 1999 indicated that late winter cultivated grass or grass/legume pastures showed some promise for goat production (Weiss and Muir, 2000). Boer X Spanish nanny kids averaging 50 lbs were placed on a ryegrass/wheat pasture and a ryegrass/legume pasture in April 1999, at 5 animals per acre. During the 28 days of the trial, average weekly gains (AWG) were 2.6 lbs (0.37 lbs ADG) per animal on grass-only and 2.3 lbs (0.33 lbs ADG) per animal in the grass/legume pasture. The animals showed a surge in AWG when the wheat reached dough stage and the goats learned to selectively harvest the seed heads. Further information was therefore needed comparing sustainable, self-reseeding grass-only (excluding wheat) to grass/legume mixtures as pastures for goats starting earlier in the winter, when plant development is much slower. In addition, there was a need to compare these pastures to those grown under pecan orchard and native hardwood range in the Cross Timbers. Pastures under orchards have been effectively used elsewhere (Rai et al., 1998) but is an underutilized system for goat production in Texas.

The objective of this study was to compare AWG of growing Boer X Spanish nanny kids, during the cool season, in a native hardwood range to those grazing cultivated, annual grass-only or grass/legume mixtures as well as grass/legume mixtures under pecan canopies. A further objective was to determine goat selectivity of grasses versus legumes as well as plant components as estimated by comparing forage crude protein of swards with and without goat herbivory.

Materials and Methods

Four production systems studied, consisting of a 2-acre annual grass-only pasture, a 7-acre annual grass/legume pasture, a 4-acre annual grass/legume pasture under a pecan grove (30 trees per acre) and a 14.5-acre native hardwoods range, were studied. A single pasture representing each production system was established across a contiguous soil type at the Texas Agricultural Experiment Station in Stephenville, Texas. Pasture planting took place in the autumns of 1999 and 2000 but animals were introduced into the paddocks for different periods in 2000 (1/24/00 through 3/20/00) and again in 2001 (1/9/01 through 5/1/01).

Differences in length of grazing were caused by differences in rainfall and subsequent differences in forage availability between years.

Before the trial began, 165 lbs of 0-46-0/acre was applied according to soil test recommendations. In both years, each pasture was lightly disked, seed was broadcast and seedbeds packed in late September or early October, depending on soil moisture. In the mixed grass/legume pastures, arrowleaf clover (*Trifolium vesiculosum* cv. 'Yuchi'), button medic (*Medicago orbicularis* cv. 'Estes'), burr medic (*Medicago polymorpha* cv. 'Armadillo'), hairy vetch (*Vicia villosa*), crimson clover (*Trifolium incarnatum* cv. 'Dixie'), and annual ryegrass (*Lolium multiflorum* cv. 'Tam90') were seeded, each at 20% of the recommended rate for pure stands (2, 2, 2, 6 and 6 lbs seed/acre, respectively) after inoculation of the legumes with specific rhizobia. Bromes (*Bromus* spp.) and black medic (*Medicago lupulina*) volunteered in all pastures and the legume was controlled with an application of Ally (1 oz/acre) in the grass-only pasture in December of 1999 and 2000. Annual ryegrass was seeded into the grass-only pasture at 30 lbs seed/acre. Following germination, the grass/legume pastures received 100 lbs 34-0-0/acre, and the grass-only pasture received 130 lbs 34-0-0/acre. The mixed grass/legume paddocks received less N to favor legume competitiveness.

Bob Duke of Utopia (2000) and Bub Hooten of Lometa (2001) supplied 38 5-7 month old Boer X Spanish cross nanny kids averaging 55 lbs each. The grass/legume, pecan and grass-only pastures were stocked with 14, 8, and 4 goats, respectively, in similar proportions of age, weight and breed percentage in each paddock. Each pasture was stocked based on accessible surface rather than available forage in order to achieve a uniform stocking rate of close to 2 goats per acre. Initial visual estimates indicated that, at this stocking rate, sufficient herbage would be available for selective grazing by the goats in all paddocks. The hardwoods paddock had only 12 animals, a stocking rate of 0.8 animals per acre, since visual estimates of available herbage, including shed tree leaves, indicated that this was all the system was likely to support. Free-choice water, as well as salt, was available in each paddock. Grazing was initiated each year as soon as sufficient herbage had accumulated; in order to facilitate pasture self-reseeding, animals were removed when most of the legumes and ryegrass began producing seed heads. October-May rainfall was 13 in. the first season and 26 in. the second, affecting the duration of the grazing period each year. Each goat was then weighed at two-week intervals and data obtained was used to estimate

biweekly and season-long average weekly gain (AWG) as lbs weight gain per goat.

Forage quantity on offer, crude protein and grass:legume ratios for each cultivated pasture type were determined before, half way through and at the end of the trial each year. Five wire exclosures were placed along a diagonal transect in each cultivated paddock and paired 10 ft^2 samples were cut 2" above the soil surface both inside and outside the exclosures. These samples were separated into grass and legume components to provide an estimate of species composition and herbage components over time.

Biweekly goat AWG's were utilized to detect trend differences among pasture systems within observation periods. Seasonal AWG for pasture systems and years were compared for the 56-day period between January and March in which goats were on pasture in both 2000 and 2001. Duncan's multiple range test (0.05) was utilized to separate treatment season-long AWG means by year. Species composition, herbage on offer, and forage composition (pre-, mid- and post-trial for the preliminary year as well as the two primary years) were utilized as supportive data only. The forage data is presented by year while CP averages are presented for the grass/legume pasture only since trends in the other cultivated pastures were similar.

Results and Discussion

Twice as much rainfall fell in the 1999-2000 cool season (26 in) compared to the 2000-2001 season (13 in) resulting in nearly 50% greater herbage production by day 56 of 2000 compared to the 2001 trial (Fig. 1 and 2). As a result, AWG of goats on the four pasture systems were different for each year (pasture system by year interaction P=0.01). On average, AWG was 31% higher for nannies on grass/legume pastures in 2000 compared to 2001 whereas nannies on grass-only pastures gained 10% less the first year (Table 1). Different genetics of the animals in the two years may have played a minor role in these differences despite the fact that both groups had similar percentages of Boer and Spanish blood and were of similar age and weight both years. Since available herbage mass was not limiting either year and was actually greater in 2001 when animals produced less gains, a dilution of forage quality may have occurred the second season. Unlike the 1999 trial (Weiss and Muir, 2000), where cultivated plants were mature when animals were introduced late in the season and the wheat produced an edible seed head, the goats on the grass/legume pasture during 2000 out-gained the grass-only animals by 53%. In the second year of the trial, with greater amounts of grass available early in the season, there

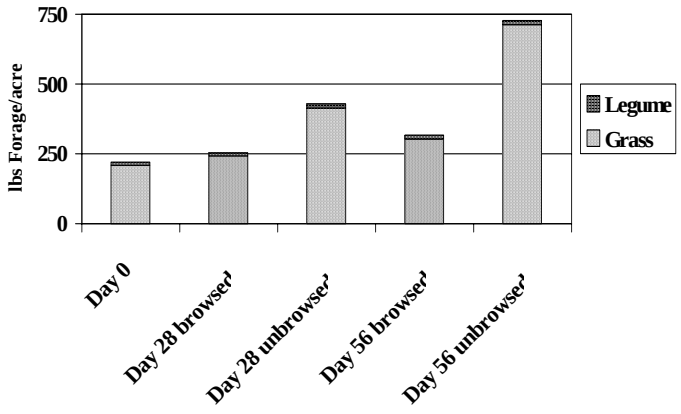
were no differences in AWG between animals in the mixed and grass-only paddocks. The animals in the pecan grove out-produced those on grass/legume paddock in 2001 but were similar in 2000, likely an effect of the lower soil moisture that may have resulted in greater competition between trees and herbaceous forage species the first year.

Table 1. Cool season average weekly gains (AWG) of weaned Boer X Spanish nanny kids grazing native hardwoods, annual grasses, annual grass-legume pasture or annual grass-legume pasture under a pecan canopy over 56 days (pasture by year interaction *P*=0.01).

Pasture:	2000	2001	2000	2001
	AWG lbs/acre		ADG lbs/acre**	
Grass/legume pasture under pecan	2.77a*	2.22a	0.40a	0.32a
Grass-legume pasture in full sunlight	2.45a	1.75b	0.35a	0.25b
Grass-only pasture in full sunlight	1.60b	1.79b	0.23b	0.26b
Hardwoods range	0.66c	0.73c	0.09c	0.10c

*Means within a column followed by different letters differ (alpha=0.05) according to Duncan's multiple range test.

**ADG = average daily gain
AWG = average weekly gain



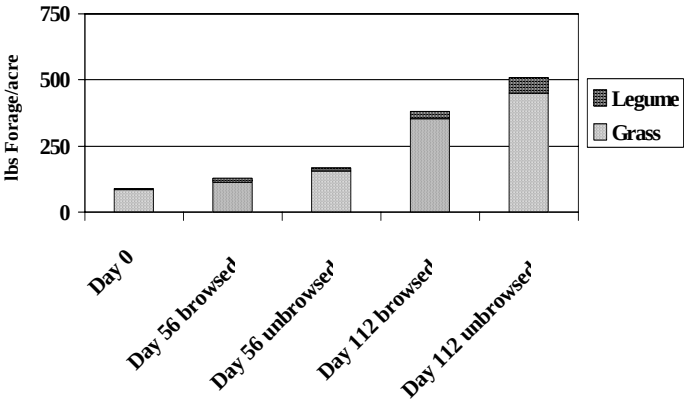


Figure 1. Biomass of herbage protected from or available to goats grazing a full-sun grass/legume mix pasture in 2000 (top) and 2001 (bottom).

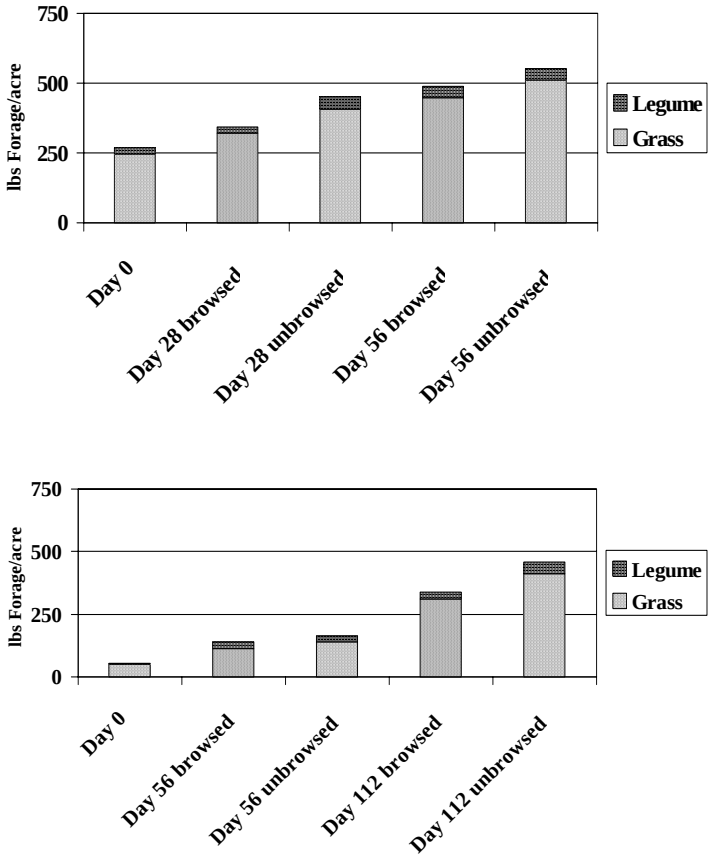


Figure 2. Biomass of herbage protected from or available to goats grazing a grass/legume mix pasture under a pecan canopy in 2000 (top) and 2001 (bottom).

Nanny kids on the range paddock produced only 29 and 38% of the average AWG for the three cultivated pastures in 2000 and 2001, respectively (Table 1). The difference was even higher if the comparison is made between the range and the pecan grove animals that produced 4.2 and 3.0 times as much AWG in 2000 and 2001, respectively. This occurred despite the fact that stocking rate was 2.5 times greater in the pecan grove. This large difference was likely due less to the forage quantity and more with the low quality of the leaf litter and the unfertilized annual grasses in the range paddock. The forage available to the goats in the hardwoods consisted primarily of sparse, dormant but evergreen *Smilax* spp. vines, growing *Bromus* spp. grasses and leaf litter of *Quercus* spp. and *Ulmus* spp. Leaf litter was plentiful but of low quality (6.2% CP and 29.7% lignin) while the grasses were constantly grazed to ground level and were of higher quality (12.8% and 3.0% lignin). As animals were forced to eat proportionately more leaf litter in weeks 2-6 of both years, AWG values declined in 2000 and stagnated in 2001 (Fig. 3 and 4). Note that in the 2001 trial, which lasted longer due to greater amounts of cultivated herbage, the nanny kids on range showed a marked increase in gains weeks 8-16 as warmer weather brought on spring leaf production of the warm-season perennial browse species. In goat production systems where range and cultivated pasture complement each other, this time in the spring may be the most useful for returning goats to range paddocks to

allow annual, cultivated pasture species to self-reseed.

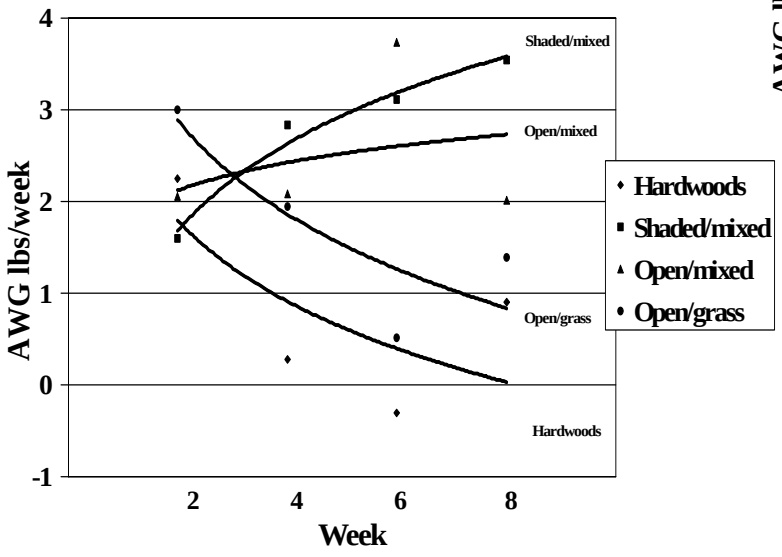


Figure 3. Weaned nanny kid average weekly gain (AWG) by 2- week period during the 1999-2000 cool season in four pasture systems showing trend lines.

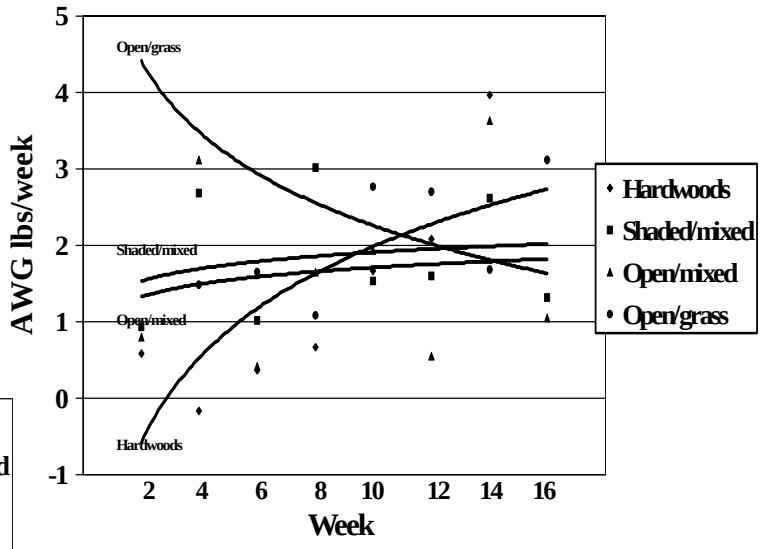


Figure 4. Weaned nanny kid average weekly gain (AWG) by 2-week period during the 2000-2001 cool season in four pasture systems showing trend lines.

Visual estimates and the generally unchanged proportion of the legume component of the grazed paddocks both years (Fig. 1 and 2) indicate that the nannies in this trial did not necessarily select for the legume component. This preference for grasses over legumes has been observed in cool climates (Penning et al., 1996) but not in warm climates (Norton et al., 1990). Evidence from the 1999 trial (Weiss and Muir, 2000) as well as late-season data from the present trial both indicate, however, that goats tended to select greater proportions of legume as the bromes and ryegrass matured in late spring. Both these grasses and the crimson clover tended to go into reproductive mode before the bulk of the legumes.

In the grass/legume paddock, legume CP levels were generally greater than grass CP although this difference was less distinct in 2000 when low soil moisture resulted in lower forage yields, thus allowing greater N concentration in the grass (Fig. 5). By the end of the 56-day trial in 2000 and the 112-day trial in 2001, legume CP was greater in the ungrazed sward than in the grazed sward, indicating the same preferential selection by goats for plant portions high in N as has been observed elsewhere (da Silva et al., 1999). This trend was not as strong for grasses late in the 2000 season or for either legumes or grasses in the 1999 pre-trial (Weiss and Muir, 2000) when animals were introduced late in the season and stocking rates were quadruple of those used in this trial. The CP concentration of grasses in the grazed sward by day 112 in 2001, however, was considerably lower than in the ungrazed plants, indicating a strong selection for higher CP by the end of the trial as plants went into reproductive phases.

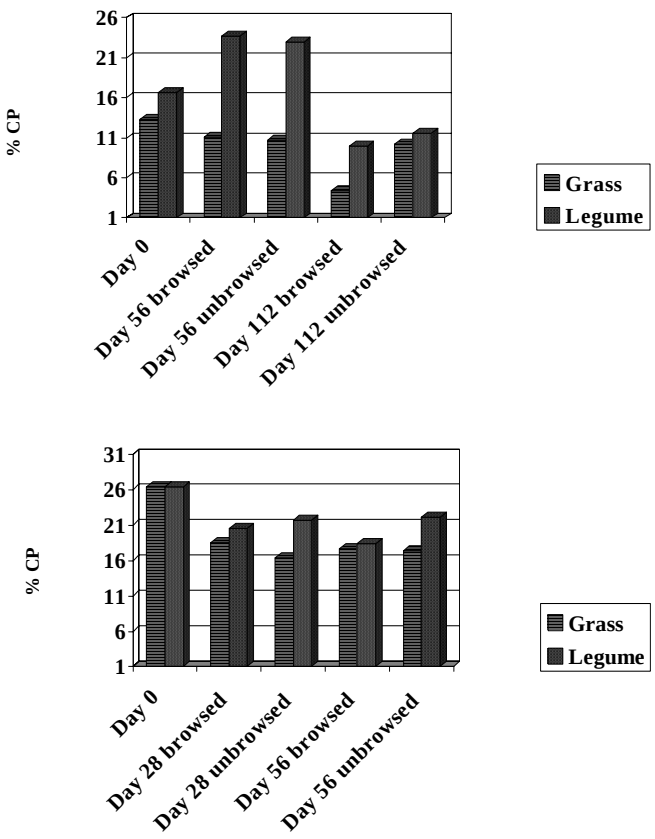


Figure 5. Crude protein (CP) concentration in herbage protected from or available to goats grazing a full-sun mixed grass/legume pasture in 2000 (top) and 2001 (bottom).

Conclusions/Implications

A comparison of cultivated pasture systems versus native range during the cool season clearly indicates that cultivated, cool-season forages may have a promising future in regions of Texas where cool-season annuals are able to grow throughout the winter months. A mixture of annual grasses and legumes had a positive effect on animal gains, especially in low rainfall years. In addition, this mixture allowed greater selectivity for

goats that appear to favor the grasses earlier in the season and the legumes later in the season as the bromes and ryegrass became lignified and produced seed heads. The exception to this was reported in the 1999 pre-trial when wheat was included and produced a palatable, high-energy seed head that the nanny kids selectively grazed.

This study also indicates that stocking rates should allow grazing pressure that permits adequate goat selection of forages high in CP. The 1999 pre-trial grass analyses showed, however, that grazing pressure may be particularly important when animals are allowed access after swards become mature late in the growing season and selection for high CP concentrations is more pronounced.

The cultivation of pecan grove under-story did not result in lower goat AWG compared to open, full-sunlight pastures. In the low rainfall year, there were no differences between these two systems despite lower herbage yields under the trees. In contrast, higher rainfall the second year resulted in greater animal gains under the pecans compared to the full sunlight pasture. There may, however, be differences in carrying capacity or goat-grazing days between mixed legume/grass pastures with and without a pecan over-story. Greater yields, especially in lower rainfall years, may favor greater production per acre in full sunlight but further research is required to confirm this as well as to determine ideal, long-term stocking rates.

Acknowledgements

This article is based in part upon work supported by the Texas Advanced Technology Program under grant No. 517-48-1999. Thanks also go to Bob Duke of Utopia and Bub Hooten of Lometa for providing the nannies for this study.

References

da Silva, J.H.V., M.T. Rodrigues and J. Campos. 1999. Influencia da selecao sobre a qualidade da dieta ingerida por caprinos com feno oferecido em excesso. Revista Brasileira Zootécnica 28:1419-1423.

Diggs, G.M., Jr., Lipscomb, B.L. and O'Kennon, R.J. 1999. Illustrated Flora of North Central Texas. Botanical Research Institute of Texas. Ft. Worth, TX.

Gee, K.L., M.D. Porter, S. Demarais, F.C. Bryant and G. van Vreede. 1994. White-tailed deer: their foods and management in the Cross Timbers, Second Ed. Samuel Roberts Noble Foundation Publications. Ardmore, OK.

Muir, J.P. 2000. Agronomic characteristics of naturalized cool

season legumes. Forage Research in Texas http://forageresearch.tamu.edu.

Muir, J.P. and R. Reed. 1998. Medic forage and seed yield at Stephenville as affected by initiation date of monthly harvests. Forage Research in Texas http://forageresearch.tamu.edu.

Norton, B.W., P.J. Kennedy and J.W. Hales. 1990. Grazing management studies with Australian cashmere goats. 3. Effect of season on the selection of diet by cattle, sheep and goats from two tropical grass-legume pastures. Australian Journal of Experimental Agriculture 30:783-788.

Penning, P.D., R.H. Johnson and R.J. Orr. 1996. Effects of continuous stocking with sheep and goats on sward composition and animal production from a grass and white clover pasture. Small Ruminant Research 21:19-29.

Prostko, E., J.P. Muir and S.R. Stokes. 1999. Effect of physiological maturity on forage quality of 2 sorghum varieties. Forage Research in Texas http://overton.tamu.edu/frt/.

Rai, P., Solanki, K.R., Roy, R.D. and Singh, R. 1998. Performance of lambs and kids on silvopastoral systems and effects of grazing on constituent vegetation. Indian Journal of Animal Science. 68, 973-975.

Weiss, S. and J.P. Muir. 2000. Winter annual pastures for finishing goats under pecan groves. Agronomy Abstracts. ASA Minneapolis, Mn. pg 173.