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Warm-Season Forages for Free-Ranging White-tailed Deer in South Texas

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ABSTRACT

Several warm-season forages were planted in irrigated food plots in 1999 and 2000 on high pH soils in semi-arid south Texas. Objectives were to test different warm season forages for utility in south Texas food plots based on agronomic and nutritional attributes and deer use. Nutritional profiles were collected bi-weekly in 1999 and monthly in 2000. Least squares means and 95% confidence intervals for production, nutritional, and mineral values were calculated. Variables recorded included biomass, and concentration of crude protein, detergent fiber, tannin, Cu, Zn, Na, Mg, K, Ca, and P. Lablab (*Lablab purpureus* (L.) Sweet), cowpeas (*Vigna unguiculata* (L.) Walp), and 'BeeWild' bundleflower (*Desmanthus bicornutus* S. Watson) produced the most biomass and the highest crude protein in both years of the study. Low concentrations of tannins were recorded in the bundleflower. BeeWild bundleflower was lower in fiber content in both years of the study when compared to the other forages tested. Every mineral tested met or exceeded established minimum requirements for maintenance in white-tailed deer. We recommend lablab, Iron & Clay cowpeas, and BeeWild bundleflower for irrigated warm season food plots in south Texas.

KEYWORDS: Food plot, white-tailed deer, nutrition, forage.

INTRODUCTION

Planting food plots to supplement white-tailed deer (*Odocoileus virginianus*) diets is a common practice in the southeastern USA. Precipitation fluctuations in south Texas directly influence the quality and quantity of deer populations, as native forages are often nutritionally inadequate for growth and maintenance in drought conditions (Varner et al., 1977; Teer et al., 1991; Ginnett and Young, 2000). Nutritional stress for females occurs in the summer due to lactation demands and recovery from parturition.

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

Fawns are susceptible to summer stress when lactation demands are not met and when the nutritional value of native forages is poor at weaning (Keegan et al., 1989). Research in other areas of the white-tailed deer's range indicate supplemental feeding can be effective at providing nutrition for deer in times of stress. Page and Underwood (2006) reported supplemental feed can significantly influence the protein and energy status of white-tailed deer in the winter stress period in the northeastern United States. Smith et al. (2007) found that crops from food plots in North Dakota made up a high proportion of deer diets in the winter stress period, reduced depredation on adjacent agricultural lands, and reported high survival of females, although the authors noted a consequence could be overpopulation.

Examining the nutritional profiles of potential forages is very important in determining if the potential forage will be beneficial to targeted species, and if the forage will help supplement the diet in times of stress. Analysis of crude protein, fiber content, secondary compounds, and mineral content of potential forages are important in determining which forages will best meet the needs of a manager. Nutritional values of native forages in south Texas are often lowest in summer, when females and males are already under stress due to lactation and antlerogenesis demands, and protein and energy may be lacking (Meyer et al. 1984, Soltero-Gardea et al. 1994). Zaiglin and DeYoung (1989) found deer use of pelleted feed increased when native forages protein levels decreased. Asleson et al. (1997) noted that deer raised on a high protein diet gained weight faster than deer fed a lower protein diet. High levels of tannins can deter herbivory and be nutritionally detrimental (McArthur et al. 1991, Van Soest 1994), but Campbell and Hewitt (2000) found that secondary compounds in browse dominated diets in south Texas did not affect antler growth or composition. Although livestock show deleterious effects to non-protein N in secondary compounds, Mayfield et al. (2004) concluded deer fed a diet of guajillo did not absorb large amounts of non-protein N that must be detoxified and excreted. Fiber content can also influence intake by deer, since deer have a relatively quick passage rate compared to other ruminants. Waer et al. (1992) found deer shifted to less fibrous species as some forages increased in fiber content.

Hunting produces a significant amount of revenue for Texas landowners (Adams et. al., 2004). Many landowners strive to improve antler size and the quantity of white-tailed deer for economical and aesthetic purposes. Often, nutrition is a limiting factor in deer populations, leading many landowners to provide supplemental feed in the form of food plots or protein pellets. Food plots can be an important management tool for improving the deer diet in times of stress, increasing recruitment, and attracting deer for hunting or observational purposes. According to Thigpen et al. (1990) and Adams et al. (1992), 22 and 23% respectively, of ranches surveyed in Texas planted food plots for white-tailed deer. In a survey conducted by Bryant et al. (1999) in south Texas, more than 56% reported planting food plots, and of these, 41% planted both summer and winter plots. Although risky, food plots can be more cost effective than feeding a pelleted protein ration (McBryde, 1995). Males often dominate protein feeder sites and not all females may use feeders (Bartoskewitz et al., 2003). Food plots can provide more access to sub dominant animals than feeders, allowing a greater percentage of the deer population to benefit from supplemental feeding. However, in semi arid environments dry-land farming practices and possibly irrigation are needed for successful propagation, which may take considerable expense. We also caution landowners not to plow up their most diverse woody plant communities to plant food plots, as native plants provide numerous benefits to wildlife other than nutrition.

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

Research is needed to evaluate alternative forages for their use in food plots. Forage growth, and utilization differ with climatic and soil conditions. In south Texas, important forage attributes include tolerance to drought and periodic flooding rains, adaptation to high pH soils, productivity, ease of establishment, perennial traits, and palatability to white-tailed deer.

The objectives of this study were to evaluate several forages in south Texas, and ascertain which forages have good agronomic, forage production and nutritional traits and are well utilized by White-tailed deer.

MATERIALS AND METHODS

The study was conducted on the 20,200 ac. West Wind Ranch, located in Zavala County, 7 miles southeast of La Pryor, TX. Average annual rainfall is 22 inches, with 60% falling between April and September (Soil Conservation Service, 1981). Four different food plots were used in the study. These food plots had been established on the ranch prior to this research, so food plot size, irrigation system layout, fencing design, and soil type were pre-determined on this working game ranch. All food plots were cleared blocks of land surrounded by native mixed brush. Soil types differed among plots. Plot 1 was a clay loam of the Chacon series, a fine, montmorillonitic, hyperthermic Torrertic Argiustolls with a pH of 8.3. Plot 2 was 4 miles from Plot 1 and was a sandy clay loam of the Brundage series, a fine-loamy, mixed, hyperthermic Ustollic Natrargids, with a pH of 8.4. Plot 3 was a loam of the Conalb series, a coarse-silty, carbonatic, hyperthermic Fluventic Ustochrepts with a pH of 8.6. Plot 4 was a clay loam of the Bookout series, a fine-silty, mixed, hyperthermic Aridic Ustochrepts, with a pH of 8.4 (Soil Conservation Service, 1981). Plots 1 and 2 were used in 1999, while Plots 3 and 4 were used in 2000. Soil fertility tests recommended no fertilizer for planting legumes. Surveys indicated deer density surrounding all food plots was 1 deer per 20 ac. (Larry Martin and George Hundley, personnel communication).

Plot Establishment and Maintenance

Forages evaluated under irrigation included 12 different legumes and two perennial sunflowers (Table 1). The four bundleflower lines were not released at the time of this research but have since been released as ‘BeeTAM-06’, ‘BeeTAM-08’, ‘BeeTAM-37’, and ‘BeeTAM-57’ and are being marketed as a mechanical blend of all four cultivars under the trademarked name of ‘BeeWild’ bundleflower, (Ocumpaugh et al., 2004a,b,c & d). For simplicity we will use the released cultivar names when discussing specific lines, but will use “BeeWild” when talking about their general performance.

Ten different annual and perennial forages were planted in two separate food plots in each year of the study. Prior to planting, a seedbed was prepared by disking. Forages were planted utilizing a split-plot field design. A grain drill was used to plant forages in strips 14 feet wide and 160 to 260 feet long, depending on the width of each existing food plot. Forages were planted with a 10 foot gap of bare ground between the planted strips to allow deer free access to all forages and to aid in visual determination of deer utilization of the planted forages (data not reported here). Weeds in the 10 ft. buffer zone between the planted strips were sprayed with Roundup® (N-(phosphonomethyl) glycine) herbicide at a rate of 24 oz/A.

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

Table 1. Description and characteristics for forages planted in Zavala Co., Texas.

Forage	Scientific name	Year planted	Longevity
Rongai lablab	*Lablab purpureus*	1999, 2000	Annual
Iron & Clay cowpeas	*Vigna unguiculata*	1999, 2000	Annual
Mung beans	*Vigna radiata*	1999, 2000	Annual
BeeTAM-06 bundleflower	*Desmanthus bicornutus*	1999, 2000	Perennial
BeeTAM-08 bundleflower	*Desmanthus bicornutus*	2000	Perennial
BeeTAM-37 bundleflower	*Desmanthus bicornutus*	2000	Perennial
BeeTAM-57 bundleflower	*Desmanthus bicornutus*	1999, 2000	Perennial
Sabine Illinois bundleflower	*Desmanthus illinoensis*	2000	Perennial
Rio alfalfa	*Medicago sativa*	1999, 2000	Perennial
Comanche partridge pea	*Chamaecrista fasciculate*	1999	Annual
Laredo soybeans	*Glycine max*	1999	Annual
Padre soybeans	*Glycine max*	2000	Annual
Plateau awnless bush sunflower	*Simsia calva*	1999	Perennial
Aztec maximilian sunflower	*Helianthus maximiliani*	1999	Perennial

planted strips to allow deer free access to all forages and to aid in visual determination of deer utilization of the planted forages (data not reported here). Weeds in the 10 ft. buffer zone between the planted strips were sprayed with Roundup® (N-(phosphonomethyl) glycine) herbicide at a rate of 24 oz/A. Each food plot contained 3 to 4 strips (replications) of each forage. In most cases, we planted 4 replications of most of the forages, but to make the experiment fit within the existing food plot, some forages could only be replicated 3 times. An existing 8-foot fence surrounded each food plot. The fences were constructed so the top 4 ft of the fence could be folded down to allow deer access to the plots as desired. Forages were protected from grazing for 9 weeks after planting in each year. Irrigation was accomplished with the use of irrigation guns spaced about 130 feet apart. The guns covered a circular pattern 100- 150 feet in radius, and delivered approximately ½ in/hr.

Plots 1 (4.7 ac) and 2 (5.7 ac) were planted on 7 April 1999. Eight of the ten forages planted were legumes (Table 1). All legumes were inoculated with appropriate rhizobia immediately before planting. Due to the poor emergence of BeeTAM-06 bundleflower (planted too deep) and maximilian sunflower (poor seed quality), were replanted in their designated strips on 29 April. Black-tailed jackrabbits (*Lepus californicus* Gray) grazed heavily on the soybean and alfalfa in Plot 2, forcing us to replant the soybeans on 20 May. Jackrabbits within 0.5 miles of the plot were harvested intensely for two weeks. Plots were irrigated as needed to supplement rainfall, generally about once per week for 3.5 to 4.5 hours per riser, for a total amount of about 1.75 to 2.25 inches per week in 1999.

In 2000, two new food plots in different locations from 1999 were used. Plots 3 and 4 were approximately 1 mile apart. Plot 3 was separated from the rest of the ranch by a fixed 8-foot high fence. Species which did not establish or proved unpalatable to deer in 1999, were replaced with alternate species in 2000 (Table 1) Four species of annual legumes and six perennial legumes were planted in 2000 (Table 1). The planting

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

procedures and experimental layout in 2000 were similar to that used in 1999. Planting was initiated on 11 April in Plot 3 (3.4 ac), but rain and mechanical problems delayed completion until 17 April 2000. All of Plot 4 (6 ac) was planted on 17 April. In 2000, an intense drought and high temperatures required a much more rigorous irrigation schedule than for 1999. Irrigation time per riser was increased to 6 hr to increase moisture depth and account for evaporation (about 3 in. of water applied per week). Soon after planting in 2000, an infestation of Johnson grass (*Sorghum halepense* (L.) Person) and croton (*Croton capitatus* Michx. Var. *lindheimeri* (Engelm. & Gray) Muell. Arg.) was evident in both plots. These two weeds greatly reduced growth of mung beans, alfalfa, soybean, and Illinois bundleflower. Johnson grass was controlled with two applications of Fusillade® (R-2-[4-[[5-(Trifluoromethyl)-2-pyridinyl]oxy] phenoxy]propanoate) at 16 to 24 oz/ac. Croton was controlled by mowing and manual removal, as no herbicide was available which would not also harm the planted forages. Diazonon® (O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl)phosphorothioate) was used to control harvester ants. The high pH soils induced chlorosis in mung beans, Iron & Clay cowpeas, and Padre soybean, so a mixture of liquid Fe and Zn was applied during the first week of June in 2000.

Deer Herbivory Observations

Deer were observed with night vision binoculars in an attempt to determine preference. Additional confirmation of herbivory was evaluated with plant use observations. (For the purposes of this report, relative herbivory will be limited to observation of use vs. complete rejection of a forage.)

Biomass Production Sampling

Protective cages were used to prevent grazing and evaluate total biomass of the forage. For the first year, one cage was placed randomly in each strip. Biomass production was estimated by clipping the forages in the protective cages to within 2 in. of the soil with hand shears. Each forage sample was weighed in the field, recorded as fresh weight, and discarded. Biomass samples were converted to dry weights by correcting for moisture content from a subsample dried at 130° F. After each clipping, the protective cages were moved to a new, randomly determined location within each forage strip. Samples were collected every other week in the 1999 season. In the 2000 season, sample collection was reduced to once per month. For the second year, each planted strip was divided into three zones (based on distance from the side fence), because deer began feeding at the outside of the plot and worked their way inward as forage biomass was depleted. A paired plot system was established in order to sample a representative portion of each zone. Caged and unprotected clippings were taken from random paired locations in a different zone each collection period, beginning with the zone nearest the fence. Forage collection began before the fence was lowered and continued until the end of September for both years.

Nutritional Sampling and Analyses

Nutritional samples were collected from unprotected plants in each forage strip using a “grab” sampling technique to simulate herbivory by taking approximately four inches of the top portion of each forage within reach of deer. Samples were dried as above and ground through a 1 mm stainless steel screen. Nitrogen was determined using the micro-Kjeldahl method, and then multiplied by 6.25 to estimate crude protein

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

(AOAC, 1990). Samples were analyzed for fiber content using the neutral detergent fiber (NDF) and acid detergent fiber (ADF) procedures of Goering and Van Soest (1970). Biologically important tannin levels were assessed by the bovine serum albumin (BSA) precipitation procedure (Martin and Martin, 1982). The atomic absorption spectrophotometer method was used for analysis of K, Ca, Cu, Na, Mg, and Zn, and a colorimetric method was used to determine inorganic P levels (Fick et al., 1979).

Statistical Analyses

Seasonal means and 95% confidence intervals were calculated using Statistical Analysis Software (SAS, 1989) for all measured attributes. The data presented here was averaged across both food plots for each season.

RESULTS AND DISCUSSION

Forage Use by White-tailed Deer

Close inspection of the maximilian sunflower, bush sunflower, and partridge pea in 1999 revealed no evidence of herbivory on any of the plots. Therefore, we replaced these forages in the 2000 planting. In both seasons, deer grazed all other forages.

Biomass Production and Nutritional Profiles

All minerals evaluated were at or above the reported requirements for White-tailed deer, in both years so will not be reported. For those interested in knowing specific responses, please see (Kunz, 2002)

Iron & Clay cowpeas, lablab, BeeTAM-06 and BeeTAM-57 bundleflower, and mung beans produced the most biomass in 1999 (Table 2). With the exception of mung beans, these forages also contained the highest protein levels.

Tannin levels might be greater than reported, because drying samples at 130° F is less desirable than freeze drying, or drying samples at 104°F, (Servello et al., 1987). However, identical methods were used, so differences should be relevant. Both bundleflowers contained low to moderate levels of tannin, which could have reduced the amount of protein available for digestion. Partridge pea was the only other forage in 1999 found to contain tannins. Partridge pea tannin levels were greater than the bundleflowers in 1999 (Table 2). The NDF and ADF values were lower for both BeeTAM-06 and BeeTAM-57 bundleflowers than all other forages in 1999 (Table 2).

Lablab and BeeWild bundleflower produced the most biomass in the 2000 season (Table 3), indicating these forages would be desirable when cultivated in warm-season food plots.

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

Table 2. Means and 95% confidence intervals for production & nutritional content of forages evaluated in 1999.

Forage	Biomass	CP	NDF	ADF	Tannin
	(lb/A)	- - - - - (%) - - - - - - - - -			(ppm) precipitated
Rongai lablab	3222 ± 555	21 ± 2	36 ± 3	26 ± 3	0
Iron & Clay cowpeas	3413 ± 396	23 ± 2	33 ± 3	21 ± 2	0
Mung beans	2442 ± 344	13 ± 1	37 ± 3	26 ± 3	0
Rio alfalfa	789 ± 153	17 ± 1	37 ± 3	27 ± 2	0
Laredo soybeans	720 ± 221	17 ± 1	38 ± 3	29 ± 2	0
BeeTAM-06 bundleflower	2060 ± 614	20 ± 1	29 ± 2	17 ± 2	130 ± 25
BeeTAM-57 bundleflower	3083 ± 590	22 ± 1	27 ± 3	17 ± 2	100 ± 25
Plateau bush sunflower	1184 ± 391	15 ± 2	42 ± 3	31 ± 2	0
Aztec maximilian sunflower	20 ± 20	17 ± 1	35 ± 2	24 ± 2	0
Comanche partridge pea	1870 ± 418	19 ± 1	33 ± 2	24 ± 1	200 ± 25

Iron & Clay cowpeas produced more biomass than the remaining forages, but produced much less biomass than in 1999 (Tables 2 & 3). Iron & Clay cowpeas peak production in August 2000 was still less than the lowest production values in any sampling period of 1999 (data not shown). Several factors might have influenced Iron & Clay cowpeas reduced growth including weed competition, soil type, and a high soil pH which induced chlorosis.

Table 3. Means and 95% confidence intervals for production & nutritional content of forages evaluated in 2000.

Forage	Biomass	CP	NDF	ADF	Tannin
	(lb/A)	- - - - - - -% - - - - - - - - -			(ppm) precipitated
Rongai lablab	1909 ± 1381	20 ± 2	41 ± 3	27 ± 3	0
Iron & Clay cowpeas	916 ± 326	20 ± 3	39 ± 4	25 ± 4	0
Mung beans	297 ± 142	13 ± 2	38 ± 4	26 ± 4	0
Rio alfalfa	550 ± 230	19 ± 2	40 ± 2	26 ± 2	0
Padre soybeans	580 ± 378	18 ± 2	39 ± 4	25 ± 4	0
BeeTAM-06 bundleflower	2041 ± 977	21 ± 1	35 ± 3	19 ± 2	140 ± 25
BeeTAM-08 bundleflower	2060 ± 1412	20 ± 2	36 ± 3	20 ± 2	140 ± 25
BeeTAM-37 bundleflower	1356 ± 708	20 ± 2	36 ± 4	21 ± 3	150 ± 30
BeeTAM-57 bundleflower	1423 ± 681	19 ± 2	38 ± 4	22 ± 3	110 ± 25
Illinois bundleflower	275 ± 106	16 ± 2	41 ± 3	24 ± 3	80 ± 10

The infestation of croton (*Croton* sp.) may have affected biomass and nutritional profiles of forages in 2000. Most forages with growth forms less than 3 ft. in height, including mung beans, Padre soybean, and Illinois bundleflower, had sporadic stands and were uneven in stature. The soil pH in both plots (pH of 8.6 and 8.4 in Plot 3 & 4, respectively), was high and may limit productivity of many legumes (Martin, 1987). Additionally, because the cages were moved to a new location after each sampling period

The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

forages that experienced heavy utilization, such as lablab and Iron & Clay cowpea, recorded low biomass due to grazing.

BeeWild bundleflower, lablab, and Iron & Clay cowpeas maintained the highest protein levels in 2000, with levels close to or exceeding 20% (Table 3). For gestation, lactation, and maximum antler growth, deer require 16 to 18 % protein. Requirements for maintenance and growth during antler genesis (5.7 – 9.9%) are considerably lower (Asleson et al., 1996). Illinois bundleflower and mung beans contained less crude protein than other forages, but with the exception of mung beans in the final sampling period (data not shown), still maintained protein levels exceeding the requirements for growth and maintenance in deer.

BeeWild bundleflowers and Illinois bundleflower did contain tannins in 2000, which could affect the amount of protein available to deer (Table 3). BeeTAM-57 bundleflower and Illinois bundleflower contained less tannin than the remaining bundleflowers, but tannin levels for all the bundleflowers were low to moderate. Many mammals, including deer, have evolved physiological responses to tannins, so the effects of low to moderate levels of tannins could be further reduced in the rumen (Robbins et al., 1991). The presence of low levels of tannin may be beneficial to ruminants. Binding with tannins may inhibit the deleterious effects of viruses and other pathogens in the gastrointestinal tract (Keating et al., 1988).

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

For the environmental conditions present in south Texas, we found that lablab, Iron & Clay cowpeas, and BeeWild bundleflower are desirable forages for planting in irrigated food plots for free-ranging white-tailed deer.

BeeWild bundleflowers exhibit several qualities that are desirable in white-tailed deer food plots, including good drought tolerance, good productivity and nutritional values, and tolerance to alkaline soils common in south and central Texas (Grichar et al., 1998). BeeWild bundleflower is perennial, and will re-grow to productive levels in the spring if adequate moisture is available. Multiple other plantings of BeeWild bundleflower in south Texas indicates that it can be established without a high fence to protect it from grazing during the seedling stage. None of the other useful forages can be established without a high fence. Rongai lablab, Iron & Clay cowpeas, and BeeWild bundleflower show good potential for successful utilization in irrigated food plots in south Texas.

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The Texas Journal of Agriculture and Natural Resource 22:7-16(2009)

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