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Nutritional Quality and Palatability to White-tailed Deer of Four Cool-Season Annual Forages

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Summary

The standing crop, use percentages, and chemical composition of four cool-season annual forages in food plots for free-ranging white-tailed deer (*Odocoileus virginianus* Raf.) were determined during the winter of 1988-89. The standing crop of common oats (*Avena sativa* L.) (274 lb/acre) was greater than the standing crops of hairy vetch (*Vicia villosa* Roth) (76 lb/acre) and hubam sweetclover (*Melilotus albus* Medic.) (66 lb/acre) but was similar to the standing crop of arrowleaf clover (*Trifolium vesiculosum* Savi) (207 lb/acre). Percentage use of oats, hairy vetch, arrowleaf clover, and hubam sweetclover was similar. Crude protein (CP) differed among forages, averaging 18% for oats and hairy vetch and 13 and 16% for arrowleaf and hubam sweetclovers, respectively. Hairy vetch had more phosphorus (P) than did hubam sweetclover, oats, and arrowleaf clover. In-vitro dry matter digestibility (IVDMD) was similar among forages, averaging 84% across species. Because they are more productive and as nutritious and palatable as the other species tested, oats are recommended for supplementing deer diets in winter.

Introduction

In south Texas, native vegetation is low in CP, energy, and P during dry winters. During winters when native forages are low in quality, white-tailed deer may be unable to meet their nutritional requirements for growth, maintenance, and reproduction (Varner et al. 1977, Meyer et al. 1984). Food plots can compensate for low-quality forage in winter.

Forbs, least abundant in summer and dry winters in south Texas, are preferred by deer over browse (Varner and Blankenship 1985). Johnson et al. (1987) found that about 40% of cool-season diets of free-ranging deer in southeast Louisiana was composed of forages from food plots that totalled < 1% of the habitat. Johnson and Schultz (1992) concluded that supplementing deer diets with four cool-season clovers contributed to the weight gains of captive young male white-tailed deer but that one clover was not necessarily more beneficial than another.

Little information is available on which cool-season agricultural food plants are the most palatable and nutritious to deer or which species are the most productive. Our overall objective was to determine the most palatable, nutritious, and productive species of four cool-season annual forage species. Specific objectives were to determine (1) the standing crop and percentage use of each species by white-tailed deer and (2) the monthly standing crop, CP, P, and IVDMD of ungrazed forages.

Procedures

The study was conducted on the 12,000-acre Rio Paisano Ranch in Kleberg County, 8 mi west of Riviera, Texas. Soil of the study area was fine sandy loam of the Delfina series, a fine-loamy, mixed, hyperthemic Aquic Paleustalf (Soil Conservation Service 1982).

Food plots were planted at two locations – one location in the Rio Paisano division and one in the El Salto division of the ranch – about 1 mi apart and separated by an 8-ft-tall game fence. White-tailed deer density on the Rio Paisano and El Salto divisions averaged about 93 and 57 deer/mi^2 (excluding improved pastures) in 1988 and 1989, according to helicopter counts.

Common oats, 'Hairy' vetch, and 'Yuchi' arrowleaf clover and 'Hubam' sweetclover were planted in mid-October 1988 with a Brillion seeder at 64, 30, and 12 lb/acre pure live seed, respectively (Knight and Hoveland 1985). Each site contained 16, 0.25-acre plots arranged in a 4 by 4 Latin-square experimental design and was surrounded by a five-strand barbed wire fence that excluded cattle. A 10-ft buffer, maintained by periodic disking, separated plots. Rainfall data were collected at both sites by a plastic rain gauge.

Before planting, both sites were fertilized with 300 lb/acre of 10-20-20 (nitrogen [N] - P - potassium [K]) and disked twice. Hairy vetch and the two clovers were inoculated with rhizobia before planting.

Keywords: arrowleaf clover / *Avena sativa* / hairy vetch / hubam sweetclover / *Melilotus alba* / oats / *Trifolium vesiculosum* / *Vicia villosa*.

Palatability of each forage species to white-tailed deer was determined by randomly placing two circular wire (2- by 4-in. mesh) exclosures 5-ft in diameter within each experimental unit immediately after planting. Sampling began about 1.5 months after planting. All plant material within a 2.3- by 2.3-ft quadrat inside and outside each exclosure was clipped to ground level, dried to a constant mass at 104 °F, and weighed. The difference between the dried forage mass inside and outside exclosures was used to estimate the amount of each species consumed and produced. Quadrats outside and within exclosures were clipped and randomly relocated monthly after clipping for 4 months.

Use (U) by white-tailed deer and biomass (B) of each forage species were determined with equations described by Bonham (1989). Percentage of use (PU) was estimated as the amount U of a species relative to the amount of B of the species times 100; that is,

$$PU = (U/B) \times 100.$$

To determine the productivity and nutritional quality of each plant species in the absence of grazing, a 12- by 21-ft exclosure was placed in the center of each plot on the El Salto site. Winter forages in three randomly chosen 1.6- by 1.6-ft quadrats (relocated monthly) within each exclosure were clipped to ground level monthly for 4 months and dried at 104 °F to a constant weight. The samples were then cleaned of weeds and sand, reweighed, ground in a Wiley mill, and stored in sealed plastic bags.

Samples from the ungrazed exclosures were analyzed for dry matter, CP, P, and IVDMD. Dry matter was determined by oven drying subsamples at 221 °F for 8 hr. No other analyses were performed on subsamples used for dry matter determinations. Nitrogen was determined by the ammonia electrode method, and this value was multiplied by 6.25 to obtain CP (Parkinson and Allen 1975). Phosphorus concentration was determined colorimetrically (Parkinson and Allen 1975). In-vitro dry matter digestibility was determined with the revised procedure of Tilley and Terry (1963) as modified by Moore and Dunham (1971). Rumen inocula was obtained from a fistulated Jersey cow fed a mixture of one-third alfalfa (*Medicago sativa* L.) hay and two-thirds coastal bermuda (*Cynodon dactylon* [L.] Pers.) hay. Forages with known in-vivo values (blanks) were included with each digestion run to standardize the results. All samples were analyzed in duplicate.

Data were analyzed by analysis of variance with repeated measures for biomass, CP, P, and IVDMD to test for month × species interactions ($P < 0.05$) (Snedecor and Cochran 1967). Analysis of variance (ANOVA) was performed according to the statistical analysis system (SAS) ANOVA procedure (SAS Inst., Inc. 1985), with species as the main effect. Tukey's (HSD) test was used to identify significantly ($P < 0.05$) different means. Data sets that were unbalanced as a result of missing data (percentage of use and IVDMD) were analyzed by the SAS general linear models (GLM) procedure. Tukey's (HSD) test was used to identify significantly ($P < 0.05$) different species means.

Results

The standing crop of oats was greater than the standing crops of hairy vetch and hubam sweetclover but was similar to the standing crop of arrowleaf clover averaged (December - February) across both sites (Table 1). Percentage use of oats, arrowleaf clover, and hubam sweetclover averaged across 3 months (December - February) on two sites, and hairy vetch averaged across 2 months (December and January) on two sites was similar ($P = 0.08$). Use averaged 83% for oats, 60% for hairy vetch, 50% for arrowleaf clover, and 54% for hubam sweetclover.

Standing crop was similar among species in December, January, and February in the ungrazed exclosures on the El Salto site (Table 2). Standing crop differed among species in March; however, this difference was not detected by Tukey's (HSD) test.

Table 1. Mean (December - February) standing crop and use (%) of four cool-season annual forages, based on consumption by white-tailed deer on the Rio Paisano and El Salto sites, Kleberg County, Texas, 1988-89.

Forage species	Standing crop	Use
	lb dry matter/acre	%
Common oats	274 A*	83
Hairy vetch	76 B	60
Yuchi arrowleaf clover	207 AB	50
Hubam sweetclover	66 B	54
P-value	0.0017	0.0817

*Means in a column not sharing the same letters were significantly ($P < 0.05$) different, based on Tukey's (HSD) test.

Table 2. Monthly trends in standing crop of four ungrazed cool-season annual forages on the El Salto site, Kleberg County, Texas, 1988-89.

Forage species	December	January	February	March
	lb dry matter/acre			
Common oats	80	143	259	310
Hairy vetch	177	86	86	20
Yuchi arrowleaf clover	72	90	134	91
Hubam sweetclover	46	109	96	30
	NS*	NS	NS	NS
P-value	0.0644	0.6718	0.1982	0.0486

*Not significant.

Crude protein among the four cool-season forages in the ungrazed exclosures differed (P = 0.05), averaging (December - January) 18% for oats and hairy vetch and 13 and 16% for arrowleaf clover and hubam sweetclover, respectively. All forages had greater (P = 0.0003) CP in December (19%) than in January (14%).

Hairy vetch (0.42%) had significantly (P < 0.05) higher P (December - January) than did hubam sweetclover (0.30%), oats (0.25%), and arrowleaf clover (0.24%). Phosphorus was similar (P = 0.50), averaged across species, between December (0.31%) and January (0.29%). In vitro dry matter digestibility was similar (P > 0.05) among forages, averaging 85, 81, 83, and 87% for oats, hairy vetch, arrowleaf clover, and hubam sweetclover, respectively.

Discussion

The greater standing crop of oats compared with hairy vetch and hubam sweetclover may have resulted from several factors. The maximum growth of hairy vetch occurs later in the season relative to other vetch varieties, and its yield by mid-March may be 25% the yield of other vetch varieties by the same time (Hoveland and Townsend 1985). Hubam sweetclover's intolerance to acidic soils may have resulted in its lower standing crop because soil on the sites ranges from slightly acidic to mildly alkaline (Soil Conservation Service 1982). The growth of hairy vetch and hubam sweetclover may have been affected by the continuous grazing of deer. In contrast, arrowleaf clover can withstand continuous grazing until maturity and still maintain high forage quality (Knight and Hoveland 1985). Knight and Hoveland (1985) reported that frequent grazing until April stimulates arrowleaf clover to maximum forage yield.

The relatively low standing crops of all forages may have resulted from weed competition and low rainfall. Rainfall totalled 6.3 in. on each site from October 1988 through March 1989; 5 in. (79%) of this rainfall occurred in October on the Rio Paisano site and 4.6 in. (73%) in October on the El Salto site. No rain fell during November 1988 and March 1989. Thus, forage growth was hampered because of below-average (9.9 in. in October - April) rainfall (NOAA 1992), and standing crops of all forages were low. An ice storm in early February 1989 may also have affected the growth of all forages thereafter.

Although hairy vetch had greater P than did the other three forages, all forages had greater P relative to the P of many available native forages (Varner et al. 1977, Meyer and Brown 1985). All planted forages were equally digestible (IVDMD > 80%) from December to January and more digestible than native forages during the same time (Varner et al. 1977, Meyer and Brown 1985).

Grown in drought conditions, oats was the best food-plot forage of the four cool-season species tested on the sandy loam soil of the study area. Oats had the greatest standing crop and percentage of use and was as nutritious as the other species tested.

Managers that plant supplemental forages for white-tailed deer often do not apply weed control to reduce costs. However, we hypothesize that controlling weeds by mechanical means or with herbicides would have improved forage yields in our study.

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