Effects of Simulated Browsing on Spiny Hackberry after Top Removal

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ABSTRACT

Spiny hackberry (*Celtis pallida*) regrows readily after top removal. Our objective was to determine effects of various simulated browsing intensities in fall and early winter on regrowth and nutritional quality of spiny hackberry after top removal. Spiny hackberry plants were cut to a 10-inch stump height in June 1984 and regrowth was removed either once (6 months after top removal) or twice (3 and 6 months after top removal) at intensities of 0, 25, 50, 75, and 100%. Standing crop and number of sprouts per shrub were measured 13 months after top cutting to determine recovery. Crude protein (CP), neutral detergent fiber (NDF), *in vitro* organic matter digestibility (IVOMD), calcium (Ca), potassium (K), and phosphorous (P) content of regrowth subjected to 0 and 100% defoliation (3 and 6 months after top removal) was determined at 3, 6, and 13 months after top cutting. Defoliation at the intensities and frequencies tested had no significant ($P > 0.05$) effect on standing crop or number of sprouts per plant. Crude protein content, P content, NDF, and IVOMD of regrowth exceeded that of controls (not subjected to top removal) at 3 and 13 months after top removal. Calcium content was lower in regrowth than in controls 3 and 6 months after treatment. Regrowth and controls had similar K levels. Fall and early winter browsing of plants subjected to summer top removal may have little effect on nutritional quality and vigor of regrowth the following growing season.

INTRODUCTION

Browse is a major component of white-tailed deer (**Odocoileus virginianus**) diets in south Texas (Arnold and Drawe 1979, Meyer et al. 1984). Powell and Box (1966) found that top removal by shredding and roller chopping increased utilization of woody plants by white-tailed deer. Regrowth after top removal is more available to deer and higher in nutritional quality than mature plant parts (Powell and Box 1966, Everitt 1983). Everitt (1983) suggested shredding brush in the summer to provide nutritious regrowth during the summer and fall when forbs are less available.

Utilization of regrowth by range animals affects recovery and the ability of the plant to continue growth (Cook and Stoddard 1953). Knowledge of the effects of various levels of regrowth utilization will aid in management of treated areas.

Meyer et al. (1984) reported that spiny hackberry (**Celtis pallida**) was the most preferred browse plant for white-tailed deer during late summer and fall in honey mesquite (**Prosopis glandulosa**) - mixed brush rangeland of south Texas. Our objective was to determine effects of various simulated browsing intensities in fall and early winter on recovery and nutritional quality of spiny hackberry after top removal.

MATERIALS AND METHODS

Study area

The study was conducted at the Texas A & I Range and Wildlife Research Area 7 miles south of Kingsville, Texas, from June 1984 to July 1985. The study area was surrounded by a fence that excluded cattle (**Bos** sp.), deer, and javelina (**Dicotyles tajacu**). Vegetation of the area was described by Ham (1979) and Meyer and Brown (1985) as a honey mesquite-mixed brush association. Soil is Willacy fine sandy loam, a fine-loamy mixed, hyperthermic Udic Argiustoll. The climate is subtropical with hot, humid summers and mild winters. During the study rainfall at the study area totaled 38 inches and varied from trace rainfall in September to 9 inches in May 1985.

Effects of top removal and simulated browsing on regrowth

Spiny hackberry plants 6.5 - 16.4 feet in height were cut to a stump height of about 10 inches above ground level with a chain saw in June 1984. Remaining stems per shrub were recorded. Regrowth was removed either once (January 1985) or twice (October 1984 and January 1985). Height of regrowth from the stump was measured and either 0, 25, 50, 75, or 100% of the regrowth was removed with forage clippers to simulate various browsing intensities. Ten plants were randomly assigned to each treatment. All regrowth was harvested in July 1985, dried at 105°F for 3 days, and weighed. Samples were separated into woody and leaf material by shaking dry leaves from the plants.

Statistical analyses utilized SAS (1982) procedures. Analysis of variance was used to compare treatment effects, and Tukey's test (Kleinbaum and Kupper 1978) was used to identify significantly differently means.

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Effects of top removal and simulated browsing on nutritional quality

In a second experiment, all regrowth of 10 randomly selected plants was removed in October 1984 and in January 1985 to simulate repeated heavy browsing. Regrowth of ten other randomly selected plants did not receive simulated browsing. Ten additional plants were randomly selected as controls (i.e., not subjected to top cutting). Browse samples (leaves and green non-lignified twigs) from each treatment were clipped in October 1984, January 1985, and July 1985. Samples were oven-dried 3 days at 105°F, ground to pass through a 0.25-inch screen with a Wiley mill, and stored in polyethylene bags before analysis. Samples were analyzed for crude protein (CP), neutral detergent fiber (NDF), **in vitro** organic matter digestibility (IVOMD), calcium (Ca), potassium (K), and phosphorus (P).

Crude protein (%N × 6.25) was determined by the micro-kjeldahl procedure (A.O.A.C. 1970). Neutral detergent fiber was determined by procedures described by Goering and Van Soest (1970). **In vitro** organic matter digestibility was analyzed by the Tilley and Terry (1963) two-stage technique as modified by Moore et al. (1972). Rumen inoculum was obtained from a Jersey cow (**Bos indicus**) on a roughage diet and forages with known **in vivo** digestibility were included in the **in vitro** digestion. Samples for CP, NDF, and IVOMD were digested in duplicate. Calcium and potassium were determined using a Perkin Elmer Model 2903 atomic absorption spectrometer (Jones 1972). Phosphorus was analyzed by the colorimetric method using a phosphomolybdate reduction with ascorbic acid (Murphy and Riley 1962). Digestion for mineral analysis was done by the nitric acid procedure of Havlin and Soltanpour (1980) with citrus samples included in the digestion.

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Data for each nutrient were analyzed by analysis of variance (SAS 1982). Tukey's test was used at the 0.05 level to identify significantly different means when F values were significant (Kleinbaum and Kupper 1978).

RESULTS AND DISCUSSION

Effects of top removal and simulated browsing on regrowth

Standing crop of spiny hackberry regrowth 13 months after top removal was not affected ($P > 0.05$) by the various simulated browsing treatments (Table 1). Leaf standing crop was similar for all treatments. These findings are similar to those of Trlica (1977), Neff (1978), and Cisse (1980) in which short-term defoliation of shrubs did not reduce growth.

Table 1. Mean standing crop (leaves and stems) and leaf standing crop (ounces/shrub) 13 months after top removal for spiny hackberry regrowth subjected to simulated browsing treatments of 0, 25, 50, 75, and 100% at either 6 months or 3 and 6 months after top removal.

Simulated browsing frequencies	Simulated browsing intensities (%)			
	25	50	75	100
Once (6 months after top removal)				
Standing crop	10±1.5[1]	9±2.3	4±1.5	6±1.1
Leaves Only	3±0.6	3±0.3	2±1.1	2±0.6
Twice (3 and 6 months after top removal)				
Standing crop	4±1.7	4±1.1	5±2.2	6±1.4
Leaves only	2±0.3	1±0.3	2±1.0	3±0.6
No simulated browsing (0%)				
Standing crop	4±1.1			
Leaves only	2±0.5			

[1]Mean ± standard error, n = 10.

Top removal of spiny hackberry plants stimulated profuse sprouting from the base (Table 2). The number of sprouts per shrub were significantly ($P < 0.01$) higher 13 months after top removal at all simulated browsing intensities compared to original number of stems per shrub. There was no significant ($P > 0.05$) difference in the number of sprouts among the various treatments 13 months after top removal.

Table 2. Average original number of stems and number of stems per shrub about 13 months after top removal for spiny hackberry plants subjected to simulated browsing treatments of 0, 25, 50, 75, and 100% at 6 months or 3 and 6 months after top removal.

Simulated browsing frequencies	Simulated browsing intensities (%)			
	25	50	75	100
Once (6 months after top removal)				
Original no. stems	7±3[1]	7±5	7±4	6±4
Sprouts/shrub	35±5**	43±10**	27±9**	39±7**
Twice (3 and 6 months after top removal)				
Original no. stems	4±3	5±3	6±5	7±3
Sprouts/shrub	28±5**	30±5**	40±14**	32±5**
No simulated browsing (0%)				
Original no. stems	4±2			
Sprouts/shrub	32±13**			

**Significantly ($P < 0.01$) different from the original number of stems.
[1]Mean ± standard error, n = 10

Effects of top removal and simulated browsing on nutritional quality

Crude protein content, NDF, and IVOMD of spiny hackberry regrowth exceeded ($P < 0.05$) that of control plants in October and July, but not in January (Table 3). No significant ($P > 0.05$) difference in CP, NDF, and IVOMD existed between simulated browsing treatments. The minimum CP requirement for white-tailed deer is 13% (French et al. 1956, Verme and Ullrey 1972). Crude protein content was above this requirement on all sampling dates.

Table 3. Mean percent crude protein, percent neutral detergent fiber and percent *in vitro* organic matter digestibility of spiny hackberry browse from control (i.e., no top removal or simulated browsing) plants, plants subjected to top removal only, and top-removed plants with regrowth clipped in October 1984 and January 1985.

Chemical analyses	Sampling date		
	October 1984	January 1985	July 1985
Crude protein (%)			
Control	23.4a[1]	23.7a	18.2a
Top removal only	26.8b	26.7a	23.8b
Top removed and clipped	26.4b	25.9a	24.2b
Neutral detergent fiber (%)			
Control	29.4a	25.6b	36.9a
Top removed only	21.0b	25.8b	28.8b
Top removed and clipped	24.2b	23.4b	29.3b
In vitro organic matter digestibility (%)			
Control	49.6a	55.7a	46.3a
Top removed only	59.0b	57.3a	51.8b
Top removed and clipped	58.2b	59.9a	54.3b

[1]Means for a nutrient within a sampling date followed by the same letter are not significantly ($P > 0.05$) different according to Tukey's test.

Calcium was lower ($P < 0.05$) in regrowth than in browse from controls in October and January but not in July (Table 4). Mature growth in plants is associated with high calcium concentration (McDowell et al. 1983) because Ca is immobilized in intercellular spaces and the phloem (Fitter and Hay 1981). No significant ($P > 0.05$) difference in Ca existed between top removal only and top removal and clipped treatments. Ca requirements for white-tailed deer range from 0.1-0.2% (Verme and Ullrey 1972). Ca concentration was above these levels on all sampling dates.

Table 4. Mean percent calcium, percent potassium and percent phosphorus of spiny hackberry browse from control (i.e., no top removal or simulated browsing) plants, plants subjected to top removal only, and top-removed plants with regrowth clipped in October 1984 and January 1985.

Chemical analyses	Sampling date		
	October 1984	January 1985	July 1985
Calcium (%)			
Control	3.0a[1]	3.3a	3.2a
Top removal only	2.2b	2.9b	2.9a
Top removed and clipped	2.3b	2.3c	2.9a
Potassium (%)			
Control	1.6a	1.8a	1.8a
Top removal only	1.6a	1.7a	1.8a
Top removal and clipped	1.6a	1.7a	2.0a
Phosphorus (%)			
Control	0.09a	0.10a	0.06a
Top removal only	0.11b	0.10a	0.10b
Top removed and clipped	0.12b	0.10a	0.08b

[1]Means for a nutrient within a sampling date followed by the same letter are not significantly ($P > 0.05$) different according to Tukey's test.

Potassium concentrations did not differ significantly ($P > 0.05$) among treatments and controls on all sampling dates (Table 4). Everitt (1983) reported similar findings for growth from shredded and untreated shrubs. Potassium requirements for white-tailed deer are not established; however, Maynard et al. (1979) stated that minimum levels for ruminants are 0.2-0.3% of the dry ration. Potassium concentrations in spiny hackberry browse exceeded these levels on all sampling dates.

Phosphorus concentration was significantly ($P < 0.05$) higher in top removed than in control plants in October and July (Table 4). Browse from top removed only and top removed and clipped plants had similar ($P > 0.05$) phosphorus concentrations. Phosphorus requirements for white-tailed deer range from 0.25-0.56% of the dry ration (Magruder et al. 1957). Browse samples from controls and regrowth from treated plants contained P levels below these requirements. Other authors have reported P deficiency in range plants in south Texas (Black et al. 1943, Reynolds et al. 1953).

CONCLUSIONS

Inferences based on the results of this study are restricted to the study area because experiments were conducted at only 1 location. Fall and early winter browsing of spiny hackberry subjected to top removal in the summer may have little effect on vigor of regrowth the following growing season. Heavy simulated browsing does not affect the nutritional quality of regrowth; however, regrowth may have higher crude protein and phosphorus levels and higher digestibility than current growth from mature plants for at least 13 months after treatment.

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