Proceedings, Western Section, American Society of Animal Science

Vol. 53, 2002

SNAKEWEED *(GUTIERREZIA SPP.)* CONSUMPTION BY GRAZING BEEF CATTLE

S. H. Cox and T. T. Ross

New Mexico State University, Las Cruces, NM

ABSTRACT: Two studies were designed to investigate snakeweed (SW) consumption by grazing beef cattle. In study 1, microhistological examinations were performed on fecal samples (n = 337) that were collected seasonally from beef cows at two independent ranches and New Mexico State University's Chihuahuan Desert Rangeland Research Center and Corona Range and Livestock Research Center. Standing crop (kg/ha), percentage of vegetative composition and percentage of ground cover were estimated at each collection period for each study area. Standing crop (excluding SW) ranged from 183 to 1108 kg/ha, while SW ranged from 20 to 536 kg/ha. Snakeweed made up from 0.6 to 13.7% of total vegetative composition of pastures. Stocking rate ranged from 0.2 to 40.5 ha/hd. Fecal occurrence of SW was only evident in a single sample, at 1.25% of total composition. In study 2, 12 Hereford X Angus cross beef cows were assigned by pairs to six 1 ha paddocks (d 0) at the CDRRC. Bite counts were recorded morning and afternoon on d 1 and d 8. Beginning total herbage varied among paddocks from 669 to 928 kg/ha, with SW ranging from 251 to 538 kg/ha (33 and 70% of total herbage by weight). Snakeweed comprised between 17 and 44% of vegetative composition and between 3 and 13% of basal cover for paddocks. All cattle were observed to have bitten SW during the study. SW comprised 4% of the diet (estimated by bite counts) on d 1 and 2% on d 8. Bite counts for SW, grass and forbs were different (P = 0.03, 0.01 and 0.008, respectively) between d 1 and 8, with the selection of snakeweed and forbs shifting downward by half from d 1 to 8. Percentage of SW bites taken was positively correlated with dropseed as percentage of vegetative composition (P = 0.03) for d 1, and with croton as percentage vegetative composition and basal cover (P < 0.05, < 0.01, respectively) for d 8. The relationship that the increase in SW bitten has with available dropseed and croton may simply be due to a cows desire for green forage during early spring and selecting for color more than plant species.

Key Words: Snakeweed, intake, beef cattle

Introduction

Broom snakeweed (*Gutierrezia sarothrae*) and threadleaf snakeweed (*Gutierrezia microcephala*) infest western rangelands from northern Mexico to southwestern Canada. Torrell et al. (1988) estimated the losses, incurred by direct toxicosis and reduced stocking capacity, due to snakeweed (SW) for both New Mexico and Texas for 1980 to 1988 at $40 million annually. SW toxicosis has been characterized in many domestic species. Early studies indicated the abortifacient and retained placenta effects, and in severe cases death in domestic livestock. More recently, researchers at New Mexico State University reported the embyro-, geno- and maternal toxic effects SW has on female rats, decreased fertility of male rats, and effects upon estrus in fine-wool ewes, while suggesting hepato-renal involvement across all investigated species, including cattle.

Diet composition analyses from various studies at New Mexico State University have revealed range cattle diets consisting of between 0 to 3.7% SW (Thetford et al., 1971; Havstad, 1977; Judkins et al., 1985; Hakkila et al., 1987 Nakamatsu, 1989) and Pieper (1989) suggest that season, percent SW in pasture, and amount of other available forage are all variables contributing to the amount of SW in the diet. Researchers at the Chihuahuan Desert Rangelands Research Center (CDRRC) found no evidence of seasonal use of SW by beef cows using either, botanical composition of esophageal samples (Rosiere, 1973) or observed bite counts (Nsinamwa et al., 1999). However, at the adjoining Jornada Experimental Range, Herbal and Nelson (1966) suggest seasonal preferences for SW by Hereford cows (observed over a four year period) to be 3.1, 1.0, 0.6, and 0% of observed grazed species during the spring, fall, winter and summer, respectively.

However, to date, little is known as to what extent SW appears in the diets of cattle. The following studies were designed to determine dietary levels of SW of beef cows grazing rangeland with varied degrees of SW infestation, and the relationship between SW intake and SW population.

Materials and Methods

Study 1. Four study areas were used in which two were located in central New Mexico and similar in most attributes (approximately 48 km distant). Bard Cattle Co. is located approximately 7 km west of Ancho with an elevation of approximately 1790 m. The Corona Range Livestock Research Center (CRLRC) is located 16 km east of Corona with an elevation of approximately 1880 m. The average annual precipitation is 404 mm with 188 mm in July, August and September. Predominate plant communities are similar. Pinyon-juniper was predominate on most sites within these study areas. Blue grama (*Bouteloua gracilis*) and sideoats grama (*B. curtipendula*), wolftail (*Lycurus phleoides*) and threeawns

(*Aristida* spp.) were the most abundant grasses. Browse species differed somewhat between study areas, however SW, various cacti (*Opuntia* spp.) and yucca (*Yucca spp.*) were common to each, with the addition of oak brush (*Quercus* spp.) and four-wing saltbush (*Atriplex canescens*) at Bard Cattle Company.

Chihuahuan Desert Rangelands Research Center. The (CDRRC) is located approximately 38 km north of Las Cruces, in south central New Mexico, with an altitude of about 1400 m. Average annual precipitation is 235 mm with 53% in July to September. The most abundant grasses are black grama (*Bouteloua eriopoda*), mesa dropseed (*Sporobolus flexuosus*) and threeawns. The most common browse species include SW, yucca and mesquite (*Prosopis glandulosa*).

The Beck Land and Cattle Company is located in southwestern New Mexico, with an approximate elevation of 1456 m. Average annual precipitation is 254 mm with over 50% in July to September. The most abundant grasses are black grama and sideoats grama, threeawns and dropseeds (*Sporobolus* spp.) Predominate browse species are SW, sage brush (*Artemesia* spp.) and yucca. Collection dates and stocking rates for all sites are presented in Table 1.

Sampling Procedure. Each of the study areas were used to sample cattle within normal working schedules. When each ranch scheduled its pre-calving (winter), branding (early spring) or weaning (fall or early winter) dates; fecal samples were taken from the cows and standing crop and pasture composition data (using step-point method) were collected.

Fecal samples were taken by grab-sample method. Fecal material was stored, individually packaged, on ice until taken to the laboratory where it was then stored frozen until defrosted, dried in a forced air drying oven for 96 h at 50^{o} C. The sample was then ground through a 1 mm screen in a Wiley Mill, placed in dry storage until all samples were sent to University of Arizona Range Analysis Lab for microhistological examination.

Pastures were sampled using clipping for total herbage and a modified step-point technique for vegetation composition. Three to six sets of transects were used per pasture with initial transect starting points randomly distributed throughout the pasture. Each set of transects consisted of three transects 200 paces in length and 50 paces apart. A vertical wire was dropped, to define a point, at each right-pace and basal cover, bareground, rock or litter were recorded at this point, and the nearest plant was recorded in four categories, grass, forb, browse and SW. Additionally, a 0.5 m^2 plot was clipped at the 50^{th} and 100^{th} point on each transect, and herbage was sorted by grass, forb, browse and SW. Forage samples were dried for 96 h in a 50^{o} C forced air drying oven. Standing crop (kg/ha) was then calculated, on a dry-weight basis.

Study 2. Prior to the study period, which was late April to mid May, (while grasses were in late dormancy), six 1 ha paddocks were fenced at the CDRRC, with fresh, clean water available to each. Three randomly assigned transects per pasture were used for herbage clippings. Three 0.5 m^2 plots, 25 paces apart, were clipped along each transect. All herbage was clipped at ground level, sorted by categories (grass, forb and SW) into bags. This design allowed for all clipping to be no less than 25 paces from border fences. Herbage samples were dried for 96 hours in a 50^{o} C forced air drying oven and weighed. Standing crop was then calculated on a dry-weight basis as kilograms per hectare. An additional three randomly assigned transects were used for assessing vegetative composition and cover. These transects were paced south to north with a record of closest plant or plant hit at every right-step. These were done prior to introduction of cows into paddocks and again when cows were removed from paddocks.

Twelve Hereford X Angus cross beef cows from the New Mexico State University campus were used. These cattle, having had prior extensive handling, were allowed to acclimate in a common pasture adjacent to study paddocks two weeks prior to study initiation. After initial range evaluation, the cows were randomly assigned to paddocks, with two cows per paddock (day 0). On day 1, beginning at first light (light enough for observing cattle) and proceeding for 2 hours, bite counts of plant type (grass, forb, SW and unknown) were recorded by trained technicians (two per paddock). Each technician observed one cow for the sampling period, with minimum disruption due to previous human interaction. Observations were repeated in the afternoon, during the 2 hours before sunset. On day 8, bite counts were again recorded using the above protocol. Cattle were then removed from paddocks.

Total herbage varied among paddocks, with a range between 669 and 928 kg/ha on day 1 and between 562 and 776 kg/ha on day 8. Initial available SW ranged from 251 to 538 kg/ha, whereas it was as low 33% and as high as 70% of total herbage by weight. SW comprised between 17% and 44% of vegetation composition and between 3 and 13% of basal cover for paddocks.

All data were analyzed with simple correlation analysis using Pearson Correlation Coefficients and General Linear Models Procedure (SAS Inst., Cary, NC). Bites taken by cattle for herbage categories were analyzed as a split-plot design with paddock in the whole plot and day and paddock by day in the subplot (SAS Inst., Cary, NC). No day by paddock interaction was noted for any forage category, therefore, data are presented by paddock and by day.

Results and Discussion

Study 1. Stocking rate for each ranch at each sample period is included in Table 1. Total herbage, excluding SW (sum of grass, forb and browse weights in kg/ha) for growing season (collection periods June and August) range as low as 407 kg/ha to a high of 1108 kg/ha and during dormant season (collection periods October to January) range from 183 to 398 kg/ha. Total SW, for growing season, was 74 to as high as 536 kg/ha and during the dormant season, was as little as 20 kg/ha to a high of 379. SW, as percent vegetative composition of pasture, varied from 0.6 to 13.7 % of total available plants. Herd sizes varied from 27 to 295 hd. Pasture sizes varied from a 61 ha paddock to a 1813 ha pasture. Hectares per head differed widely, due to location, season and grazing management, from a low of 0.2 ha/hd to 40.5 ha/hd. The two collection periods with the least offered hectares per head (0.2 and 0.3 ha/hd during the growing and dormant season, respectively) were at Beck Land and Cattle Co., the only short duration grazing system included in the study. The collection periods with the least concentration were 28.3 and 40.5 ha/hd, both located at the CDRRC, the only continuous grazing system included in the study. The two central New Mexico sites utilized seasonal rotation through larger pastures (however, cattle were usually grazing smaller working traps for collection periods), these ranches varied 1.3 to 20.0 ha/hd, growing season and 4.1 to 8.2 ha/hd, dormant season.

Fecal occurrence of SW, as revealed by microhistological examinations, was evident in only one sample, at 1.25% composition.

Table 1. Collection date and relative grazing pressure at time of collection of fecal samples from four New Mexico ranches (Study 1).

Study Area	Date	Hd/pasture	Ha/pasture	Ha/hd
Bard Cattle Company	June 93	41	777	20.0
	Nov 93	220	907	4.1
	Jan 94	220	1813	8.2
Corona Range and Livestock Research Center	May 93	199	777	3.9
	Aug 93	199	259	1.3
	Jan 94	183	1425	7.8
Chihuahuan Desert Rangeland Research Center[a]	Pasture 1	34	963	28.3
	Pasture 15	27	1093	40.5
Beck Land and Cattle Company[b]	July 93	295	61	0.2
	Oct 93	295	101	0.3

[a] Continuous use grazing system
[b] Short-duration grazing system

Study 2. All cattle were seen to have bitten SW at some time. Cattle selected a mean diet (estimated by bite counts) going onto fresh paddocks (day 1) of 58% grasses, 28% forbs and 4% SW, however, 10% of bites were classified as unknown. On day 8, diets shifted somewhat towards less forbs and SW (which were the primary green forage at this particular time) and more towards grasses. Bite counts were 78% grasses, 12% forbs, 2% SW and 7% unknown, possibly indicating an initial craving for green forage and a subsequent shift with the depletion of more palatable, green forbs. Nsinamwa et al. (1999) suggest cows that have been grazing on similar vegetation type for a period prior to release into study paddocks, probably are observed selecting preferred species during the first day. However, available forbs, as percent vegetative composition, basal cover or standing crop, were not different ($P > 0.05$) between day 1 and day 8.

Nsinamwa et al. (1999) observed no bites of SW taken during 6 day grazing trials in June and September of 1992 and 1993, and Rosiere (1973) who reported that botanical composition of cattle diets (collected through esophegeal cannulas) had no SW present during seasonal collections during 1972 and 1973. However, Herbal and Nelson (1966) found the average spring preference for SW to be 3.1% (of total bites counted) for Hereford cows grazing a similar study area.

Bite counts for SW, grasses, and forbs were different ($P = 0.03$, 0.01 and 0.008, respectively) between days 1 and 8 (Table 2). Bite counts for SW and forbs were lower by one-half from day 1 to day 8, while bite counts for grasses went up over 30%. This shift in diet happened with seemingly little shift in vegetative composition, basal cover or standing crop for any category. The initial selection of more palatable, lush forbs would be expected, but it still presents an interesting question as to why the number of SW bites goes down between days 1 and 8, or for that matter why SW was eaten on any day. Observation of individual species might have helped to explain these shifts in diet by quantifying shifts among species for each plant category.

Table 2. Bite counts (percent of total bites) of cattle grazing native range at beginning and end of 8 day grazing trial (Study 2)[a].

Forage	Day 1[b]	Day 8[b]	SE
Snakeweed	4.0[c]	2.0[d]	0.5
Grasses	57.8[c]	76.3[d]	3.6
Forbs	27.8[c]	12.4[d]	2.8
Unknown	10.4	9.3	1.8

[a] Collection period was May 9 (Day 1) and 16 (Day 2), 1998.
[b] Day 0 cattle were introduced into paddocks and day 8 they were removed after observation.
[c,d] Row means with different superscripts are different ($P < 0.01$).

Analysis reveals no significant correlation**'s** ($P <= 0.05$) between bite count and standing crop (for any category; Table 3) which is contrary to other studies reviewed by Pieper (1989) where the amount of SW in the diets of cattle varied with the amount of SW and other forage species available. Croton as percentage of basal cover has a positive correlation ($P = 0.03$) with percent forbs chosen for day 1. Being the most abundant and palatable forb during the trial, an increase in croton availability would raise expectations of higher levels of croton chosen. Herbal and Nelson (1966) reported that cows grazed croton yearlong (less in the winter months) and on several occasions it made up 50% of the grazed plants. Percent SW chosen has a positive correlation with dropseeds as percent vegetative composition ($P = 0.03$)

for day 1, and with croton as percent vegetative composition and basal cover (*P* = 0.04, < 0.01, respectively) for day 8 (Tables 4 and 5). Dropseeds green up earlier and respond faster to less moisture than the other available warm-season grasses (Nsinamwa et at., 1999) and are the most preferred grass species during this period of time (Herbal and Nelson, 1966; Rosiere, 1973; Mohammad et al., 1995; Nsinamwa et al., 1999). The cows innate desire for green forage and preference for dropseed and croton (Herbal and Nelson, 1966) would seem to explain the relationship that SW bitten has with each, which would be due to simply selecting for green forage, by color more than plant type or species.

Table 3. Correlation coefficients for bite counts and standing crop at beginning and end of 8 day grazing trial (Study 2)[ab].

Day 1	Standing Crop			
Bite Counts	Snakeweed	Grasses	Forbs	kg/ha
Snakeweed	0.08	-0.28	0.65	0.60
Grasses	0.26	-0.18	-0.22	0.34
Forbs	-0.31	0.36	-0.19	-0.32
Unidentified	-0.18	0.01	0.52	-0.36
Day 8				
Bite Counts	Snakeweed	Grasses	Forbs	kg/ha
Snakeweed	0.21	-0.35	0.54	-0.71
Grasses	-0.30	0.29	-0.17	0.65
Forbs	0.30	-0.26	0.08	-0.58
Unidentified	0.29	-0.29	0.17	-0.65

[a] Collection period was May 9 (Day 1) and 16 (Day 8), 1998.
[b] None differed from 0 (*P* > 0.05).

Implications

The present study demonstrates that beef cattle will select SW as part of their daily diet. When other forages were present, relative availability was not a factor in the amount of SW grazed. However, a preference for green forage seems to be the inherent reason for the daily inclusion of dietary SW. Further investigation into SW preference is required to quantify the amount of SW in beef cattle diets proportional to available forage or exclusion of available forages. Such information would assist in the economic decisions necessary to implement essential grazing management, herbicide, mechanical or fire control of SW infested pastures.

Literature Cited

Hakkila, M.D., J.L. Holechek, J.D. Wallace, D.M. Anderson, and M. Cardenas. 1987. Diet and forage intake of cattle on desert grassland. J. Range Management. 40:339-342.

Havstad, K.M. 1977. Effects of range site and nitrogen fertilization upon botanical and chemical content of cattle diets. M.S. Thesis. New Mexico State Univ., Las Cruces, NM.

Herbal, C.H., and A.B. Nelson. 1966. Species preference of Hereford and Santa Gertrudis cattle on a southern New Mexico range. J. Range Management. 19:177-181.

Judkins, M.B., J.D. Wallace, M.L. Galyean, K.D. Jones, and E.E. Parker. 1985. Intake and diet selection by protein supplemented grazing steers. J. Range Mgt. 38:210.

Mohammad, A.G., R.D. Pieper, J.D. Wallace, J.L. Holechek, and L.W. Murray. 1995. Comparison of fecal analysis and rumen evacuation techniques for sampling diet botanical composition of grazing cattle. J. Range Management 48:202-205.

Nakamatsu, V.B. 1989. Spatial behavior and diet selection of cattle and bonded and non-bonded smalll ruminants grazing arid rangeland. M.S. Thesis, New Mexico State Univ., Las Cruces, NM.

Nsinamwa, M., R.F. Beck, and R.P. McNeely. 1999. Use of plants in seasonal grazing trials on Chihuahuan Desert rangeland. Agric. Exp. Sta. Res. Rep. 733. New Mexico State Univ., Las Cruces, NM.

Pieper, R.D. 1989. Broom snakeweed content of herbivore diets. In: Snakeweed problems and perspectives. pp. 203-210. Agric. Exp. Sta. Bull. 751. New Mexico State Univ., Las Cruces, NM.

Rosiere, R.E. 1973. Cattle diets on semidesert grassland. PhD. Dessertation. New Mexico State University, Las Cruces, NM.

Thetford, F.O., R.D. Pieper, and A.B. Nelson. 1971. Botanical and chemical composition of cattle and sheep diets on pinyon-juniper grassland range. J. Range Mgt. 24:425.

Torell, L.A., H.W. Gordon, K.C. McDaniel, and A. McGinty. 1988. Economic impacts of perennial snakeweed infestations. In: L.F. James, M.H. Ralphs and D.B. Nielsen (Eds.). The ecology and economic impact of poisonous plants on livestock production. pp. 57-59. Westview Press, Boulder, CO.

Table 4. Correlation coefficients for bite counts and percent vegetation composition at beginning and end of 8 day grazing trial (Study 2)[a,,b].

Day 1	Percent Vegetation Composition			
Bite Counts	Snakeweed	Dropseed	Croton	Black Grama
Snakeweed	-0.42	0.85[c]	0.75	-0.66
Grasses	0.44	-0.01	-0.73	0.42
Forbs	-0.58	-0.28	0.54	-0.10
Unidentified	-0.19	0.21	0.73	-0.60
Day 8 Bite Counts				
Snakeweed	-0.17	0.06	0.83[d]	-0.55
Grasses	0.39	0.10	-0.58	0.34
Forbs	-0.41	-0.07	0.41	-0.26
Unidentified	-0.35	-0.21	0.74	-0.37

[a] Collection period was May 9 (Day 1) and 16 (Day 8), 1998.
[b] Values with superscripts differ from 0 ($P < = 0.05$), values without do not differ from 0 ($P > 0$).
[c] $P = 0.03$
[d] $P = 0.04$

Table 5. Correlation coefficients for bite counts and percent basal cover at beginning and end of 8 day grazing trial (Study 2)[a,b].

Day 1	Percent Basal Cover			
Bite Counts	Snakeweed	Dropseed	Croton	Black Grama
Snakeweed	0.16	0.52	0.22	-0.56
Grasses	0.38	0.62	-0.80	0.41
Forbs	-0.18	-0.79	0.87[c]	-0.07
Unidentified	-0.53	-0.41	0.59	-0.62
Day 8 Bite Counts				
Snakeweed	0.70	0.05	0.93[d]	-0.53
Grasses	-0.37	0.16	-0.62	0.26
Forbs	0.25	- 0.14	0.46	-0.17
Unidentified	0.44	- 0.29	0.75	-0.30

[a] Collection period was May 9 (Day 1) and 16 (Day 8), 1998.
[b] Values with superscripts differ from 0 ($P < = 0.05$), values without do not differ from 0 ($P > 0$).
[c] $P = 0.03$
[d] $P = 0.01$