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FORAGE VALUE OF WEED SPECIES IN A GRASS SEEDING

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Abstract. Weeds are a major problem in seeding rangeland and cropland to native grasses. However, many immature weedy forbs and grasses are palatable to cattle. Research was conducted using yearling cattle for weed control in big bluestem (*Andropogon gerardii* var. *gerardii* Vitman) seedings (1987, 1988) at Mead, Nebraska on a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll) soil. Prominent volunteer species were annual foxtails (*Setaria* spp. Beauv.), redroot pigweed (*Amaranthus retroflexus* SSL.), velvetleaf (*Abutilon theophrasti* Medic.), and common ragweed (*Ambrosia artemisiifolia* L.). Cattle consumed annual foxtails and redroot pigweed, but did not consume velvetleaf or common ragweed. Annual foxtails were grazed completely while heifers mainly stripped leaves and defoliated the tops of redroot pigweed. Redroot pigweed and annual foxtails were randomly collected within blocks during both grazing seasons to quantify forage value. Foliage (upper stem and leaves) was analyzed for crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and *in vitro* dry matter disappearance (IVDMD). Redroot pigweed foliage and leaves were analyzed for nitrate (NO_3). Crude protein levels of annual foxtails and redroot pigweed were never below nutritional requirements for heifers. Fiber (NDF and ADF) and IVDMD values were similar to early-vegetative smooth brome (*Bromus inermis* Leyss.) and early-bloom alfalfa (*Medicago sativa* L.). Nitrate concentration reached toxic levels (10,000 ppm NO_3) in redroot pigweed by mid-July, 1987. In 1988 nitrate levels exceeded the toxic level at the beginning of the grazing season. An abundance of forage nitrate accumulators in weedy vegetation limits grazing as a weed control practice. However, grazing may be an adequate weed control practice when the prominent weeds are annual grasses.

Key Words. redroot pigweed, *Amaranthus retroflexus*, annual foxtails, *Setaria* spp., forage value, nitrates, seeding, Nebraska

INTRODUCTION

Weed competition is the primary reason for seeding failures (Anderson 1981, King 1987). However, weeds are often palatable and nutritious before reaching maturity and can be used as a forage resource in many circumstances. Launchbaugh and Owensby (1978) suggested using the weed crop in first-year grass seedings as a grazing resource. Big bluestem (*Andropogon gerardii* var. *gerardii* Vitman) seedings grazed or mowed regularly (twice weekly from late April to mid August), or treated (0.75 kg/ha) with 2,4-D [(2,4-dichlorophenoxy)acetic acid] on 15 June produced comparable results (Launchbaugh and Owensby 1978). Anderson (1986) listed flash grazing as an effective weed control method.

Redroot pigweed (*Amaranthus retroflexus* L.) is a nitrate accumulator (Osweiler *et al.* 1985). Potential toxic level is 10,000 ppm NO_3 (Bradley *et al.*, Osweiler *et al.* 1985). Others reported lower concentrations for potential toxic levels (Lawrence *et al.* 1981, Rasby *et al.* 1988). Nitrate accumulation in plants is affected by several factors: plant species, content and form of soil nitrogen, soil conditions, drought conditions, light intensity, and herbicide treatment. Nitrate concentration is higher in the lower stem than in other plant parts (Osweiler *et al.* 1985). Pigweed species (*Amaranthus* spp. L.), are excellent sources of protein (Cheeke *et al.*, Rawate 1983, Bressani 1983). The objective of this study was to quantify the forage quality of available weed species occurring in a big bluestem seeding in eastern Nebraska.

METHODS

The study area had been a weedy smooth brome (*Bromus inermis* Leyss.) pasture located at the Agricultural Research and Development Center near Mead, Nebraska on a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll) soil. The pasture was tilled and planted to corn (*Zea mays* L.) in 1985 and 1986. 'Pawnee' big bluestem was seeded (220 PLS/m^2) on May 8, 1987 on one-half of the area following a double disking of the corn residue. The remainder was seeded to corn. On 25 April 1988 the remaining half was seeded with Pawnee big bluestem.

Three weed control practices (herbicide, flash grazing, and continuous grazing) were applied to paddocks in a randomized complete block design with four replications. Atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] was applied (2.2 kg/ha) on 14 May 1987 and 6 May 1988. Flash grazing (10-28 yearlings/0.05 ha) of paddocks was accomplished in less than 24 hr/occupation four times during 1987 and twice in 1988. Paddocks were grazed when redroot pigweed was 30-60 cm tall. Continuous grazing (5 yearlings/0.20 ha) occurred from 10 June to 22 July 1987. Cattle were removed from plots during wet conditions. Adequate water was provided in each paddock and hay was fed as needed in the continuously grazed paddocks. Continuous grazing was not attempted in 1988 due to high nitrate levels.

Redroot pigweed and annual foxtails (*Setaria* spp. Beauv.) were clipped at ground level and separated into foliage (upper stem and leaves) and stems. Giant foxtail (*Setaria faberii* Herm.), yellow foxtail [*Setaria glauca* (L.) Beauv.], bristly foxtail [*Setaria verticillata* (L.) Beauv.], and green foxtail [*Setaria viridis* (L.) Beauv.] were included as annual foxtails. Lower stems and leaves were excluded due to little or no consumption by grazing livestock. Annual foxtail foliage included all plant material except the lower 10 cm of the plant. Redroot pigweed foliage was all plant material except the lower 15 cm. Plant material (500 g) representative of available forage and independent of grazing treatment was randomly collected and composited from a selected replication(s) at each sample date. Samples were weighed, dried at 60 C, and ground to pass a 1 mm screen. Multiple replications were sampled when stage of growth was variable among blocks. Samples were collected 6 times in 1987 and 3 times in 1988.

Crude protein (CP) was determined by Kjeldahl nitrogen. The Van Soest method was used for neutral detergent fiber (NDF) and acid detergent fiber (ADF) (Goering and Van Soest 1970). Duplicate samples were run for NDF and ADF analysis. Values not within 2% were reanalyzed. The sample value is a mean of duplicates when one block was sampled or a mean of block values when multiple blocks were sampled to characterize the vegetation. *In vitro* dry matter disappearance (IVDMD) was determined using the method described by Marten and Barnes (1981).

Nitrate (NO_3) was determined using a flow injection system, similar to the method described by Carlson and Paul (1969). Values are the mean of all samples collected for the date to give a general characterization. In 1988 a second category of leaves only was also sampled.

RESULTS AND DISCUSSION

Velvetleaf (*Abutilon theophrasti* Medic.), common ragweed (*Ambrosia artemisiifolia* L.), redroot pigweed, and annual foxtails comprised the majority of the weed population in 1987. Livestock avoided velvetleaf and common ragweed. Consumption of redroot pigweed and annual foxtails appeared similar when both were relatively abundant. In 1988, velvetleaf and common ragweed were not as abundant, and the annual foxtails were also reduced. The majority of the weedy vegetation was redroot pigweed.

Crude Protein

Crude protein concentration in redroot pigweed and annual foxtails generally declined through the sampling period during 1987 except for the July 16 sampling date (Table 1). Both species had initiated seed production by 23 June 1987. Redroot pigweed usually was higher than annual foxtails in crude protein. General trends in crude protein values reflected advancing maturity of the plant material. Data for 16 July 1987 were an exception due to a high proportion of regrowth plant material following grazing and timely rain. Redroot pigweed appeared to be a valuable protein source and annual foxtails never were lower than about 12% crude protein. Similar trends were recorded for 1988 (Table 2). Redroot pigweed and annual foxtails contained crude protein levels similar to early-vegetative smooth brome and early-bloom alfalfa (*Medicago sativa* L.). Crude protein, NDF, and ADF values for comparison forages are from Church (1984). Values of IVDMD are typical of these species in eastern Nebraska (Dr. B.E. Anderson, University of Nebraska-Lincoln, personal communication).

Neutral Detergent Fiber

Neutral detergent fiber estimates cell wall components and is inversely related to voluntary intake. Redroot pigweed and annual foxtails NDF values generally increased through the sampling pe-

Table 1. Forage quality of redroot pigweed (AMRE) and annual foxtails (SESP) foliage collected in 1987 from grazed paddocks of a new big bluestem seeding at Mead, Nebraska.

	CP[1]		*NDF*[2]		*ADF*[3]		*IVDMD*[4]	
Date	*AMRE*	*SESP*	*AMRE*	*SESP*	*AMRE*	*SESP*	*AMRE*	*SESP*
	%							
June 11	23.0	17.7	25.9	45.1	15.9	23.6	71.9	73.0
June 16	20.5	16.0	27.1	43.1	14.8	22.4	76.3	70.9
June 23	19.1	15.7	28.8	47.6	15.4	24.5	77.8	71.1
July 6	17.5	14.2	29.9	50.8	15.9	24.0	75.9	74.2
July 16	18.1	19.0	40.7	42.8	23.7	20.6	75.7	73.3
July 22	15.5	12.3	40.8	53.1	24.5	26.9	72.0	68.6
	Forage Comparisons[5]							
Smooth brome (early vegetative)	23.0		48.0		27.0		70.0	
Alfalfa hay (early bloom)	17.0		48.0		38.0		60.0	

[1]Crude protein
[2]Neutral detergent fiber
[3]Acid detergent fiber
[4]In vitro dry matter disappearance
[5]CP, NDF, and ADF from Church (1984), IVDMD from Dr. B.E. Anderson, University of Nebraska-Lincoln, (personal communication)

Table 2. Forage quality of redroot pigweed (AMRE) and annual foxtails (SESP) foliage collected in 1988 from grazed paddocks of a new big bluestem seeding at Mead, Nebraska.

	CP[1]		*NDF*[2]		*ADF*[3]		*IVDMD*[4]	
Date	*AMRE*	*SESP*	*AMRE*	*SESP*	*AMRE*	*SESP*	*AMRE*	*SESP*
	%							
June 14	22.3	17.5	29.7	48.8	16.9	26.1	71.7	74.9
June 20	19.8	18.2	32.3	54.5	22.3	31.8	72.7	74.2
June 28	17.9	16.3	37.2	51.5	27.9	25.6	73.0	74.7
	Forage Comparisons[5]							
Smooth brome (early vegetative)	23.0		48.0		27.0		70.0	
Alfalfa hay (early bloom)	17.0		48.0		38.0		60.0	

[1]Crude protein
[2]Neutral detergent fiber
[3]Acid detergent fiber
[4]In vitro dry matter disappearance
[5]CP, NDF, and ADF from Church (1984), IVDMD from Dr. B.E. Anderson, University of Nebraska-Lincoln, (personal communication)

riod as plant maturity advanced (Tables 1 and 2). Redroot pigweed had a continual increase in NDF concentration while annual foxtails were relatively high early in the season and changed very little through the remainder of the sampling period. Redroot pigweed had less NDF than smooth brome, alfalfa, or annual foxtails. Redroot pigweed should have a higher voluntary intake, based on NDF values, than smooth brome or alfalfa while intake of annual foxtails should be similar to these forages.

Acid Detergent Fiber

Acid detergent fiber estimates cellulose and lignin and is negatively related to digestibility. Like NDF, ADF values in redroot pigweed increased and in annual foxtails remained nearly constant during the sampling period (Tables 1 and 2). Redroot pigweed had lower percentage ADF than annual foxtails early in the growing season. Both weed species had lower ADF values than early-bloom alfalfa. Averaging across dates, annual foxtails had similar ADF levels as smooth brome, and redroot pigweed was generally lower in ADF than smooth brome.

In Vitro Dry Matter Disappearance

Changes in percent IVDMD were slight through the grazing season. Redroot pigweed and annual foxtails were similar both years (Tables 1 and 2). The IVDMD of weed species was similar to early-vegetative smooth brome, and higher than in early-bloom alfalfa.

Nitrate

Amaranthus spp. are known to accumulate nitrate (Osweiler *et al.* 1985). Although concentrations were above the potentially toxic level (10,000 ppm NO_3), acute nitrate poisoning did not occur in 1987 (Table 3). Species composition of paddocks was primarily redroot pigweed and annual foxtails. Cattle did not exhibit preference for either redroot pigweed or annual foxtails when placed onto experimental paddocks. Ruminants have been shown to tolerate higher levels of nitrates when dosage is spread throughout the feeding period or mixed with the total diet (Osweiler *et al.* 1985). Dietary nitrates from pigweed may have been diluted by annual foxtails to reduce nitrate poisoning potential.

Table 3. Nitrate concentration (ppm NO_3) of redroot pigweed foliage and leaf samples collected in 1987 and 1988 from grazed paddocks of a new big bluestem seeding at Mead, Nebraska.

1987		*1988*		
Date	*Foliage*	*Date*	*Leaf*	*Foliage*
	ppm NO_3		---------- ppm NO_3 ----------	
June 11	16,677	June 14	—[1]	55,626
June 16	15,850	June 20	32,040	50,554
June 23	10,735	June 28	23,418	47,342
July 6	8,674		—	
July 16	11,367		—	
July 22	18,402		—	

[1]No data collected

Nitrate was higher in 1988 (Table 3) than in 1987. The growing season of 1988 was characterized by dry conditions, which often enhance nitrate accumulation (Osweiler *et al.* 1985). Species composition was primarily redroot pigweed, and plant densities were greater than in 1987. Consequently, continuous grazing was not attempted in 1988.

Management of the flash grazing plots was altered due to the extremely high levels of nitrate encountered in 1988. Since Osweiler *et al.* (1985) indicated that nitrates were generally greater in the stalk compared to the leaf, a grazing strategy was designed to minimize stalk grazing. High plant density and low to moderate stocking densities for short periods of time resulted in leaf consumption. Stems on the upper part of the plant were not grazed until forage supplies were low. Nitrate concentration in the leaves (Table 3) was much lower than foliage samples. However, nitrates in the leaves were still higher than the potentially toxic level for nitrate poisoning.

CONCLUSIONS

Redroot pigweed and annual foxtails have good potential as forage resources when grazing is used as a method to control weeds in grass seedings. Their crude protein, fiber, and IVDMD levels compared favorably to early-vegetative smooth brome or early-bloom alfalfa. However, redroot pigweed is a nitrate accumulator and can present a safety problem when nitrate levels are excessive, and it is the predominant vegetation. Continuous grazing under these conditions is not advised and flash grazing must be monitored carefully.

Grazing is not likely to control unpalatable species like velvetleaf or ragweed if they are present in large amounts. Also, grazing is not likely to be effective when weed densities are so high that cattle cannot control weed growth. However, grazing may be an effective management practice for weed control when the predominant weeds are annual grasses.

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