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Increased Carrying Capacity with Perennial Forage Kochia

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Abstract: Carrying capacity can be increased on grass-dominated rangeland pastures by including perennial forage kochia (*Kochia prostrata*) as one of the plant components. The objectives of the study reported here were to compare the differences of traditional winter pastures versus pastures with forage kochia. Forage quality, production, and availability data were collected from pastures in Tooele County, Utah. Forage quality, production, availability, and carrying capacity were greater in pastures with forage kochia. Livestock winter grazing in the Great Basin is challenging for many reasons. Extension's role in assisting others to find solutions is as pertinent today as it has ever been.

Introduction

Utah State University Cooperative Extension and livestock producers in Tooele County have a long and intimate association. Tooele County's agricultural strength is winter grazing. In the early 1900s, nearly a half million sheep passed through the Tooele Valley on their way to and from seasonal pastures (Conservation History of Tooele County, n.d.). This repeated concentration of grazing resulted in a mini dust-bowl that severely affected nearby communities. A local soil conservation district was organized with the charge to remedy the situation and see that it never happen again.

Since that time, Extension county agents and specialists have been closely involved in grazing improvement in Tooele County. Local producers rely on Extension for up-to-date information, not only with grazing, but also with crop production, grasshopper and cricket infestations, wildfires, and other issues unique to Great Basin communities.

While the dust bowl was eliminated, the potential remains for it to happen again. With less than 10 inches of annual precipitation, many of the winter grazing pastures are highly susceptible to overgrazing, stocking rates are low, wildfires a serious threat, and winter feed costs high due to the need for protein supplementation.

Forage kochia (*Kochia prostrata*), a perennial half shrub native to the arid rangelands of central Eurasia, has been shown to improve winter grazing in the Great Basin (Waldron, ZoBell, Olson, Jensen, & Snyder, 2006). It is an important grazing species because it is relatively high in protein and has the ability to thrive in harsh climates. It is competitive against winter annuals such as cheat grass (*Bromus tectorum*) and, because it stays green throughout the summer, effective in stopping wildfires when planted in greenstrips (Harrison et al., 2002). Utah State University Extension agents and specialists, researchers from the USDA's Agricultural Research Service, local beef producers, and the Grantsville Conservation District teamed up to improve traditional grass pastures in Tooele County and record the benefits. The primary grass species in the study pastures was crested wheatgrass (*Agropyron desertorum*), an introduced, long-lived, drought-tolerant bunch grass.

Improving winter grazing is important economically because it can reduce costs associated with feeding stored hay (Waldron et al., 2006; Gade & Provenza, 1986; Waldron, 2004). Maximizing utilization of low-quality forage while minimizing use of expensive supplements is one way to reduce feed costs. Arthun et al. (1992) reported that a way to do this is to include forbs and shrubs in low-quality forage-based diets.

Otsyina, McKell, Malecheck, and Van Epps (1984) reported that shrubs are particularly important in winter grazing systems. During winter, dormant grasses are high in energy (fiber) but low in protein (Waldron et al., 2006; Cook, 1972). Simultaneously, shrubs such as forage kochia are low in energy and high in protein (Waldron et al., 2006; McKell, Otsyina, & Malechek, 1990). Combining grasses and shrubs can optimize protein and energy levels by meeting microbial crude protein requirements of 7% (Van Soest, 1994) during nutritionally stressful times (Arthun et al., 1992).

Objectives

The objectives of the study reported here were to compare the differences between traditional grass-dominated pastures and pastures improved with Forage kochia and to increase producer awareness of any benefits.

Specific traits measured were:

- Forage Quality
- Forage Production
- Forage Availability
- Carrying Capacity

Materials and Methods

Site Information

- Tooele Valley Ecological Site
- Location: 40° 34' 16.9" N, 112° 24' 25.74" W
- Soil Classification: Semi-Desert Alkali Loam (Black Greasewood)
- Elevation: 4300 to 5397 ft.
- Average Annual Precipitation: 10 to 12 inches
- Average Air Temperature: 45 to 52
- Average Frost Free Period: 110 to 140 days
- Average Total Dry Weight Forage Production: 635 lbs/acre

Kochia Establishment

A 108-acre pasture in the Tooele Valley was seeded with forage kochia in January 2005 at a rate of 2 lbs/acre of pure live seed. Establishment progressed more slowly than anticipated. Initially it was hoped that data collection could begin in late fall of 2006, but it had to be postponed until fall of 2007. In the spring of 2007, which was an unusually early and hot season, Forage kochia development progressed markedly. A nearby second replication at higher elevation was also ready for grazing in the fall of 2007 but was abandoned because of snow accumulation.

Forage Evaluation

Samples were collected and analyzed for forage quality (crude protein), forage production (pounds of useable forage), and forage availability (species). Forage production samples were collected using the double sampling method, which consists of an initial visual estimation then actual sample collection and separation and weighing of individual plant species. The pounds of useable forage (excludes plant species not used by livestock) was used to determine carrying capacity, which is the average number of animals that may be sustained on a particular range over time, usually expressed as an Animal Unit Month (AUM), (Holechek, Pieper, & Herbel, 1998). An AUM gives a value that determines the number of mature cows (approximately 1000 lbs with or without a calf up to 6 months of age) that can be sustained on a unit of area, usually acres or hectares for 1 month.

In the study reported here, carrying capacity was determined by multiplying the total usable pounds of forage by a pre-determined utilization coefficient of 0.45, which was then divided by 30 days multiplied by twenty-five pounds of intake per day (Formula 1).

Formula 1.

$$\begin{aligned} &(\text{Total lbs. of usable forage}) \times (.45 \text{ utilization}) = \text{lbs of forage} \\ &(\text{lbs. of forage}) \div (30 \text{ days} \times 25 \text{ lbs of intake per day}) = \text{AUM} \end{aligned}$$

Statistical Analysis

Data were analyzed using the mixed procedure of Statistical Analysis Software (SAS).

Results and Discussion

Forage Quality

Forage kochia tested 7.3 percentage points higher in crude protein (CP) than did crested wheatgrass. Average crude protein values were not tested for statistical significance but are highly significant when considering cow protein requirements as mentioned in the introduction.

Table 1.
Average Crude Protein (%)

Created Wheatgrass	Forage Kochia
2.5	9.8

Forage Production

Forage production was nearly seven times greater for the treatment than for the control, with 3002 lbs/acre compared to 442 pounds/acre.

Table 2.
Forage Availability (lbs/acre)

Species	Control	Treatment
Crested wheatgrass (<i>Agropyron desertorum</i>)	411	166
Cheatgrass (<i>Bromus tectorum</i>)	21	70
Forage Kochia (<i>Kochia prostrata</i>)		2730
Bulbous bluegrass (<i>Poa bulbosa</i>)		26
Sandberg bluegrass (<i>Poa secunda</i>)	10	10
Total	442	3002
Totals are significantly different (P < 0.001)		

Carrying Capacity

Estimated carrying capacities were 0.265 AUM/acre for the control and 1.80 AUM/acre for the treatment, a nearly seven-fold increase.

Table 3.
Carrying Capacity (AUM/acre)

Control	Treatment
0.265	1.80

Implications

Forage kochia has the ability to produce well in arid conditions and can meet animal requirements for protein. For these reasons, high winter feed costs associated with protein supplementation can be reduced by including it as a component of rangeland grazing. When combined with crested wheatgrass, which meets requirements for energy, it can significantly increase carrying capacity. In the study reported here, forage production and carrying capacity were almost seven times greater for the treatment than for the control. From the time of seeding in January 2005 until samples were taken in late fall of 2007, precipitation was lower than average 2 out of 3 years (Utah Division of Water Resources, 2009). Based on range site descriptions (USDA, 1997), forage production was at or lower than average for the control pasture, but in the pasture with forage kochia, production exceeded average normal expected production.

While forage kochia is a species that evolved in an arid ecological region and has very specific geographic and climatic applications, the development and establishment of new and introduced plant species to solve difficult problems is of universal application. Livestock producers in the Great Basin region struggle with winter feeding. Costs of supplemental protein are extremely high and availability of good quality winter grazing is limited. Forage kochia has potential to not only lower costs and increase grazing options, but

competes well with winter annuals and has potential to slow and even stop wildfire.

This research project is another example (Rogers, 1998) of Extension organizing and coordinating efforts with federal, state, and local entities and private landowners to find successful and meaningful solutions to current grazing land issues.

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