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Challenges of Stocking Small Ruminants in Grazing Plots with Dormant Browse Species

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CHALLENGES OF STOCKING SMALL RUMINANTS IN GRAZING PLOTS WITH DORMANT BROWSE SPECIES

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Abstract

Integration of browse species into the grazing system can increase the grazing/browsing opportunity; however, information is limited on their proper management for long-term use and persistence. The objective of the study was to determine whether it is safe to allow small ruminants to graze pastures consisting of dormant browse species. Katahdin ram lambs (9) and Kiko wethers (20) had access to the study plots containing four dormant browse species (mulberry, *Morus alba*; mimosa, *Albizia julibrissin;* white lead tree, *Leucaena leucocephala*; and bush indigo, *Amorpha fruticosa*) for two months. Type and extent of damage to the browse species were recorded once animals' access to the study plots was stopped. The extent of damage was the highest in mulberry followed by mimosa. The results suggest that small ruminants can pose a significant damage to the dormant browse species; so, their access to such browse must be avoided.

Key Words: Small Ruminants, Dormant Browse Species, Grazing/Browsing, Grazing System

Introduction

Herbaceous forages and browse species are important sources of diet for small ruminants. Integration of browse species in the grazing system helps to extend the grazing/browsing duration and diversify variety of diet for small ruminants. Browse species helps to fill the summer and winter gap when the grassland vegetation are limited or in dormant stage (Papanastasis et al., 2008). Inclusion of browse into the grazing system helps in minimizing internal parasite problem as parasitic larvae cannot reach the browse height (Norton, 1985). Browse is often considered important during winter grazing periods or in low rainfall areas as a reserve feed in times of drought (Wilson, 1969).

Small ruminant production is an attractive enterprise for farmers in southeastern United States because of increasing demand for its products and low cost of breeding stock (Glimp, 1995). These animals eat a variety of forages, including weed and bushes, and do not require high quality forages. Sheep (*Ovis aries*) are known to be natural grazers usually preferring to eat forbs and succulent grasses (Bryant et al., 1979), while goats (*Capra aegagrus hircus*) are considered browsers, where tree foliage constitute the major portion of their diet (Glasser et al., 2008).

Goats' diet usually constitutes 20-30% of grasses, 10-30% broadleaf weeds and legumes, and 40-60% browse plants (Ball et al., 2007). Goats are active and can even use their bipedal stance to gain access to the vegetation of their interest (Sanon et al., 2007). Similarly, sheep diets constitute 50% grasses and legumes, 30% weeds, and 20% browse species (Walker, 1994). However, under limited availability of other types of plants, sheep can be very efficient browsers as well (Valderrabano et al., 1996). Sheep, when intensively grazed on a pasture cause debarking of the trees to some extent (Sharrow et al., 1992a). Sheep also cause trampling damage to grasses and forbs (Laycock and Harniss, 1974). However, not much information is available on proper

management of the browse species for their long-term use and persistence once incorporated into the grazing system for small ruminants. The objective of the study was to determine whether it is safe to allow small ruminants to graze pastures consisting of dormant browse species.

Literature Review

Browse constitutes leaves, shoots, sprouts, tender twigs, and stems of woody plants consumed by livestock to meet their dietary need (Gutteridge and Shelton, 1993). Different browse species worldwide serves as an alternative feedstuff for livestock (Fayemi et al., 2011). These species play an important role in ruminant nutrition, providing proteins, minerals, vitamins, and energy, especially during the dry season of the year (Ouédraogo-Koné, 2008). Browse species help to lower the infestation of gastrointestinal parasite when incorporated in the grazing system as ruminants graze well above the ground surface, beyond the reach of nematode larvae (Hoste et al., 2001). Common browse species, such as mulberry trees (*Morus alba*) is a potential source of nutrient for ruminant animals (Shayo, 1997). Similarly, mimosa (*Albizia julibrissin)* is a potential tree legume that can be incorporated into production systems to provide high quality forage for small ruminants (Addlestone et al., 1999). White lead tree (*Leucaena leucocephala*) is a legume with high nutritive value for ruminant production (Babayemi and Bamikole, 2006), with higher content of proteins, vitamins, and minerals (Odeyinka, 2000). Bush indigo (*Amorpha fruticosa*) is another potential browse species that produces a high-quality forage during summer (Papachristou et al., 1999). Incorporation of these browse species in the grazing system can be very important for the sustainable production of small ruminants as these animals, especially goats, derive a significant amount of their diet from browsing.

Van Soest (1982) has classified goats as intermediate browsers and sheep as grazers. Grasses dominated sheep diet, while goats preferred browse species along with similar grasses when they were allowed to graze on a range condition with grasses, forbs, and browse species (Bryant et al., 1979). However, sheep diet consisted of 20% browse species (Walker, 1994). Sheep, when allowed to graze on a natural pasture with different browse species, reached up to the height of 0.87m (Sanon et al., 2007). Sheep have the capacity to select diets with higher nutrient content and digestibility as compared to other grazing animals (Hodgson et al., 1991). Besides utilizing the browse species, studies have reported damaging behavior of small ruminants on trees present in the system. For instance, when sheep were allowed to graze on silvopasture planted with pine trees (*Pinus pinaster* and *Pinus radiate*), stripped bark from 35% of the trees at low tree density and 5% of trees under high tree density, most prominently smaller trees. This damage most probably caused stem distortion and growth retardation, and even death of the trees (Anderson et al., 1985). A study to determine the feasibility of using sheep and goats to suppress one-seed juniper (*Juniper monosperma*) sapling encroachment was done by co-grazing goats and sheep at high stocking density; debarking of the branches on the taller saplings was the most common impact in the spring. Branch mortality due to debarking was 13-22% (Cibils et al., 2014).

The ultimate results of the damaging behavior of small ruminants would depend on the severity of the damage and the number of affected trees. Sharrow et al. (1992b) reported that there was no overall detrimental impact of sheep grazing on the growth or mortality of douglas-fir (*Pseudotsuga menziesii*) trees although sheep debarked some trees (<13%). Total tree mortality attributable to sheep grazing during the study was only 0.9%. Another study reported that intensive grazing by sheep caused the debarking of 2-7% of trees to some extent (Sharrow et al.,

1992a). Lewis (1980) stated that the growth of trees would not be affected by debarking unless more than half of the girdling of the tree has occurred.

Possible damage to trees by small ruminants documented in the previous studies was conducted during the time when browse species were having plenty of green vegetation on them. Browse species available in the Southeast are mostly deciduous, which remain dormant starting late fall to late winter or early spring. Information on the safety of dormant browse species present in the grazing system of small ruminants is still lacking.

Methodology

Study Site

The current study was conducted at the Browse Research and Demonstration site, Tuskegee University, Tuskegee, Alabama, United States (32°26′00.24″N, 85°42′56.63″W; 125 m elevation). Study site consisted of three plots (0.4ha each) planted with four browse species: mulberry, mimosa, white lead tree, and bush indigo, and one control plot (no browse planted). Browse species were grown in the greenhouse and transplanted to the study plots in a randomized block design with three replications in late fall 2014 (Figure 1). Each species was planted in a duplicate of double row sets with plant-to-plant distance within a row and the distance between adjacent rows 1.5 m, and the distance between two double row sets 3 m. The distance between the two adjacent duplicates of double row sets was 8 m. White lead tree was replanted in early spring 2016, as it could not survive the killing frost that occurred immediately after the first transplantation. The height of the browse species ranged from 84-149 cm (SE 4.7) and canopy diameter 76-141 cm (SE 5.8) in fall 2016 before they went to dormancy. Bush indigo was the highest (149±4.7 cm), and mulberry had the widest canopy diameter (141±5.8 cm). MaxQ tall fescue (*Schedonorus arundinaceus*) and crimson clover (*Trifolium incarnatum*) were planted in the alleys (≥3 m). Other plant species present in the study plots were bahiagrass (*Paspalum notatum*), bermudagrass (*Cynodon dactylon)*, broomsedge (*Andropogon* spp.), nutsedge (*Cyperus* spp.), brier (*Rubus* spp.), tall fescue ((*Schedonorus arundinaceus)*, and different kinds of weeds. Most of these plants were dead or dormant during the time of study.

Animals and Grazing

Nine Katahdin ram lambs (11-12 months old, 58.3±3.99 kg BWt) were stocked in the study plots from November 21, 2016 to January 20, 2017, when all browse species were dormant and devoid of any leaf. Animals had free access to all study plots during the study period, and were provided with hay, clean drinking water, and minerals, ad libitum. Besides sheep, 20 Kiko wethers (128.5±1.76kg BWt, 24-26 months old) had limited access (4-5 hours) to the plots for multiple times (15-20) throughout the study period. During the rest of the time, all goats were kept in a nearby plot and provided with supplements to avoid overstocking of the study plots. At the end of the study, animals were taken out of the study plots and any further access was blocked.

Data Collection

Damage imposed by small ruminants on browse species was recorded using a pre-formatted data sheet. Damage types were classified into four categories: branch broken, debarked, tip of the main stem eaten, and tip of the branches eaten. Also, intensity of damage was categorized in the scales of 0-4 as listed below:

0- No damage to the plant
1- Some damage that would not affect significant plant performance

2- Heavy damage, but plant will survive
3- Severe damage that would cause plant death

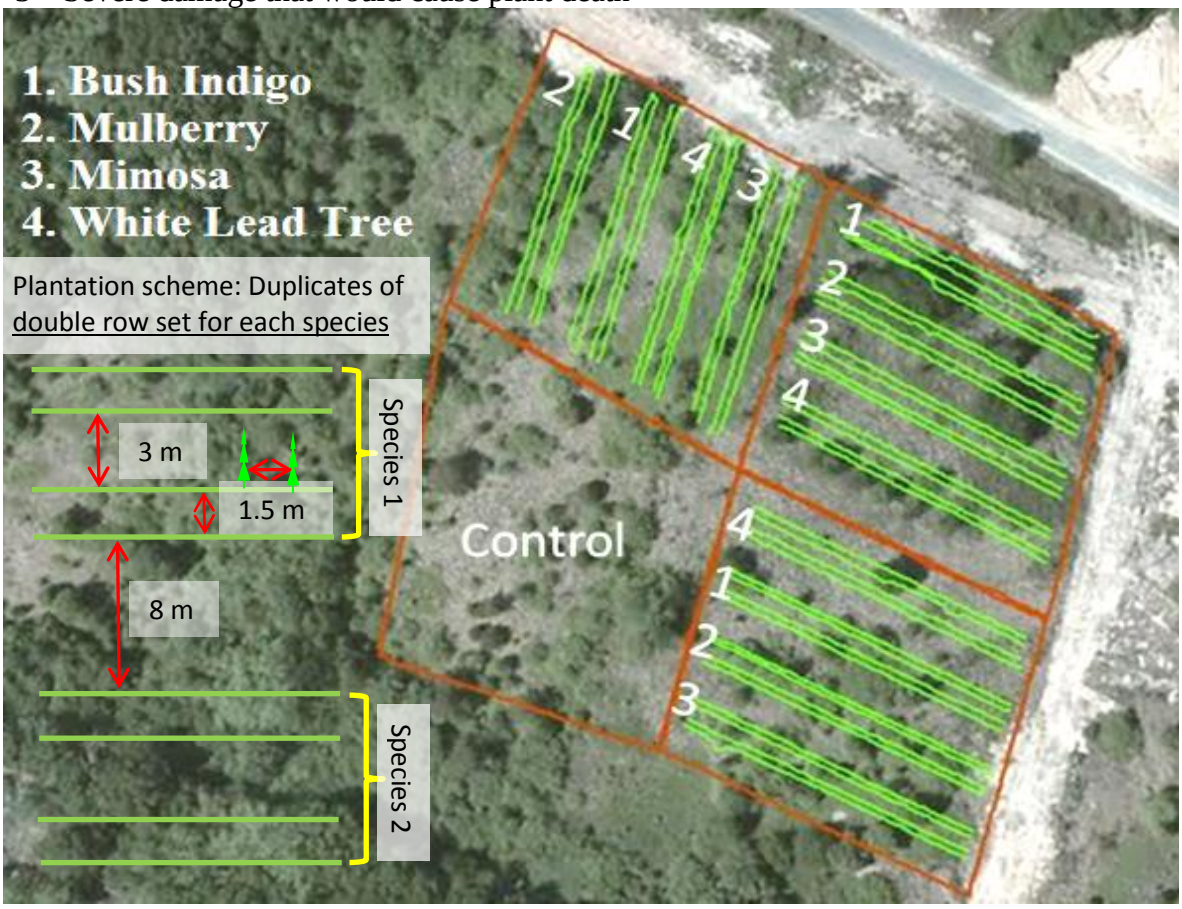

Figure 1. Study Plots with Rows of Planted Browse Species and Plantation Scheme, November 2016-January 2017, Browse Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, USA

Data Analysis

All data were analyzed using version 9.4 of SAS software (SAS Institute Inc, Cary, NC). Type of damage data was analyzed by GLIMMIX procedure using a logit link function and assuming a binomial distribution. The severity of damage data was analyzed using GLM procedure. The level of significance was set at 0.05. When the omnibus f-test indicated differences among the species Tukey's HSD procedure was used to compare the species means.

Results

Among the entire plant population in the study site, 53% of the plants were damaged to some extent. Mulberry incurred the highest scale of damage followed by mimosa, bush indigo and white lead tree (Table 1). Mulberry had the highest number of branches broken, while white lead tree had the least broken branches (Table 2). Similarly, debarking was most severe in mulberry and mimosa. The tip of the main stem eaten was the highest in mimosa followed by mulberry. Animals did not chew the tip of bush indigo. The tip of the branches eaten was the highest in mulberry followed by bush indigo (Table 2).

Table 1. Scale of Damage on Different Browse Species while in Dormant Stage

Browse Species	Damage Scale
Bush Indigo	0.59 ± 0.045^{c}
White Lead Tree	0.44 ± 0.051^{d}
Mimosa	1.36 ± 0.053^{b}
Mulberry	1.85 ± 0.090^{a}

[abcd] Means not followed by a common letter differs (Tukey, $P<0.05$)

Table 2. Type of Damage on Different Browse Species while in Dormant Stage

SN	Browse Species	Type of Damage			
		Branch Broken	Debarking	Tip of Main Stem Eaten	Tip of the Branches Eaten
1	Bush Indigo	0.30 ± 0.025^{b}	0.09 ± 0.016^{b}	0^{d}	0.21 ± 0.022^{b}
2	White lead tree	0.17 ± 0.023^{c}	0.08 ± 0.017^{b}	0.03 ± 0.011^{c}	0.02 ± 0.008^{c}
3	Mimosa	0.30 ± 0.029^{b}	0.48 ± 0.032^{a}	0.32 ± 0.035^{a}	0.03 ± 0.011^{c}
4	Mulberry	0.73 ± 0.048^{a}	0.48 ± 0.054^{a}	0.13 ± 0.036^{b}	0.67 ± 0.051^{a}

[abcd] means not followed by a common letter differs (Tukey, $P<0.05$)

Discussion

Small ruminants, while grazing in the study plots, damaged about 53% of the planted browse plants (dormant). Mulberry incurred the most damage with the highest score for three out of four damaged categories. Barks of mulberry being reasonably digestible with CP concentration higher than those of pasture and crop residue available during the dry season (Shayo, 1997) may be the reason for most damage imposed by small ruminants on this species. Mimosa acquired the second most damaged with the highest score for two out of four damage categories. Previous studies have reported the debarking behavior of sheep and goats while grazing in the system containing non-dormant trees or shrubs. Scogings and Macanda (2005) found goats debarking 37% of the *Acacia karroo* while grazing for three weeks in subtropical savanna. Co-grazing of goats and sheep resulted in the debarking of the branches on the taller saplings of one-seed juniper (*Juniper monosperma*) (Cibils et al., 2014). Karki et al. (2017) reported Kiko wethers' debarking of southern pine trees, especially longleaf pines, while grazing in the silvopasture system.

It will be useful to evaluate other breeds, age, and sex of small ruminants to determine if any of them can be used to utilize the available vegetation in the grazing lands without inflicting any untoward effects on the dormant browse. Moreover, it will be valuable to explore the reason for different types and extent of damage, such as nutrient and bioactive compound present in different parts of these plants.

Conclusion

The current study has established that the four dormant browse species (mulberry, mimosa, white lead tree, and bush indigo) are susceptible to the possible damage by Katahdin ram lambs and

Kiko wethers. About 53% of the plant population was damaged to some extent and mulberry was the browse species with the highest scale of damage followed by mimosa. To avoid such damage, access of small ruminants to pastures consisting of the aforementioned dormant browse species must be avoided. Further studies are needed to assess the long-term impact of such damage on the growth and performance of these browse species, and also to understand the reason for such damage.

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