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Abstract

Grazing animals depend on a variety of physical and chemical cues when selecting which plants they will eat. The soluble energy in the plant may serve as a primary factor for selection. Management and plant breeding strategies should use soluble carbohydrate levels as likely indicators of animal grazing responses.

Introduction

Grazing animals eat an array of plants, but often prefer some and avoid others. These preferences or aversions are responses to certain physical and chemical senses of which touch, smell and taste are of greatest importance for ruminants (Arnold and Hill 1972, Bate-Smismell lellvp TJ-2.4 -1.2 TD-0.0004 Tc0.1203 Tw[interaction of]-132.4(pr]-12.4(e- and post-absor)-12.4(pti)23.6(v)12.3(e)2.2(factors)40.3 (Fisher et al. 1999). Dairy cows produce more milk when fed a total mixed ration containing 40% alfalfa when that hay was cut at 4 in the afternoon rather than 6 in the morning (Kim 1995, Mayland et al. 1998). Physical Cues

Color

It is generally accepted that ruminants see varying shades of gray, but are unable to distinguish between the primary colors. This is not to say that visual cues are not important in foraging (Howery et al. this volume).

Plant texture

Grasses and especially forbs may have physical attributes that discourage grazing. Plants with pubescent leaves have greater resistance to some insect pests. These characteristics may have similar effects on ruminants. However, we (Rumbaugh et al. 1993) found that trichome density of globernallow (*Spaeralcea* spp.) leaves was positively related to accession preference by sheep. Thus other cues or factors were of greater importance in determining sheep preference.

Sward structure

Ungar et al. (1991) summarized results from several studies indicating that sward heights below 4 inches are often related to significant depressions in intake by cattle. They reported significant (99%) reduction in number of bites and total dry matter intake by steers as the sward height was reduced below 4 inches. Laca et al. (1992) and

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Presented in "Grazing Behavior of Livestock and Wildlife." 1999. Idaho Forest, Wildlife & Range Exp. Sta. Bull. #70, Univ. of Idaho, Moscow, ID. Editors: K.L. Launchbaugh, K.D. Sanders, J.C. Mosley. Distel et al. (1995) showed that cattle graze most efficiently and expend more time where forage density allowed the most rapid intake rate. That was not supported by Ganskopp et al.(1997) who found that steers did not seek out the highest density forages.

Prehension

Prehension is the act of seizing or grasping forage with the tongue and then tearing it from the plant as might be done by ruminants. Energy expended in this action is quantified by measuring tensile breaking strength. Grazing behaviorists have not explored this factor as a potential grazing cue.

Prehensile strengths

Prehensile strength is the energy required to bite or tear the forage from the plant. Herbivores, like horses that have incisors on top and bottom jaw impose a cutting or shearing action on forage. Ruminants use a combination of tear and shearing action. Energy requirements are characterized as either shear or tensile breaking forces.

The intrinsic shear strength is calculated as the force required to shear a leaf, divided by the length of the cutting blade in contact with the leaf material (Henry et al. 1997). Differences in these forces among forage cultivars has not been related to grazing preferences.

Mastication

Mastication is the act of reducing particle size of ingested feed. For monogastrics there is one opportunity to do this whereas ruminants have a second chance because they regurgitate fiber boluses and chew the cud.

It is theorized that rate of mastication and particle size reduction by ruminants may affect consumption of forage. Troelsen and Bigsby (1964) reported that 88% of variability in hay intake by sheep was explained by similar variability in particle size indexes determined by combination of maceration and sieving. This idea has been pursued by others (Balch 1971, Chenost 1966) using more automated and quantitative methods. A proposed index of 'fibrousness' in ruminant diets would have units of minutes/pound of food. Values for the index increases as water content decreases and plant maturity increases.

Water content

Some have speculated that livestock preferences are positively associated with moisture content of forages

(Gesshe and Walton 1980). However, Ganskopp et al. (1997) did not support this hypothesis.

Sight

Observation. Range-conditioned ewe sheep were used to evaluate palatability of various globemallow (Sphaeralcea) taxa (Rumbaugh et al. 1993) in a spacedplant nursery. The plots in each of 4 pastures, contained 2400 spaced plants of which 85% were 'Hycrest' crested m05(turit-12.8(cPt(Spc0.1247nt)**T**Joq0043 Tc she135.6--12.22 Hocrenta

quantified in these tall fescue cultivars representing the full range in preference (Mayland et al. 1999).

Alkaloids

Alkaloids in grasses and legumes are sometimes of plant origin and sometimes produced by parasitic fungal endophytes growing in the plant stem and transmitted in the seed.

Marten et al. (1973) identified three alkaloids; gamine (3-dimethylaminomethyl-in-dole), N,N-dimethyltryptamine, and 5-methoxy-N,N-dimethyltryptaine in Reed canarygrass (Phalaris arundinacea L.). Total basic alkaloid concentrations of clones were highly correlated (r = 0.90)with each environments. Palatability ratings of clones grazed by sheep were highly correlated. Total alkaloid concentrations and palatability rating of clones were also highly correlated (r = 0.87 to 0.94).

Summary

The reviewer may readily see the complex set of signals that plants may present to grazing animals. Knowing our responses to the odor of lilacs, the taste of ice cream, the texture of chopped nuts, and the flavor of cappuchino, we soon appreciate the potential array of cues awaiting the grazing herbivore. Nevertheless, they must and do make choices. These choices may be made on basis of odor, taste, feel, flavor etc., but these are ultimately linked to the post ingestive feedback mechanism built into the animals' system (Early and Provenza 1998). As we learn more about these relationships, we will be able to do a better job of forage and animal management.

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