Relationship Between Forage Intake and Gains of Grazing Steers[1]

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Highlight

Based on a study utilizing total feces collection to estimate forage intake of grazing animals, the "animal gain—forage intake" relationship can be improved by removing a maintenance factor from the intake estimates. These data indicated that differences in digestible dry matter intake explained much of the variation in body weight gain of steers grazing both tall fescue-lespedeza and orchardgrass-clover pastures.

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The objective of this experiment was to study the relationship of the body weight changes of beef steers grazing orchardgrass-clover and tall fescue-lespedeza with forage intake expressed in different ways. It was postulated that the "animal gain-forage intake" relationship should be improved if forage digestibility and animal maintenance requirements were included in the intake measurement, thus obtaining an expression of forage intake more highly correlated with animal gains than forage dry matter intake alone.

Experimental Procedure

Two Hereford steers averaging 540 pounds were placed on each type of pasture, one orchardgrass-clover (*Dactylis glomerata-Trifolium repens*) and one tall fescue-lespedeza (*Festuca arundinacea-Lespedeza striata*) and grazed without supplemental feed for five months during the 1967 experiment beginning in June and ending in October. There were five monthly grazing periods for which individual animal gains were calculated. Forage samples representative of available forage in each pasture were taken in the middle of each period. In vitro dry matter digestibility of these forage samples was determined by the method of Tilley and Terry (1963).

Also in the middle of each grazing period, each steer was fitted with a feces collection harness and bag. The feces bags were removed after 24 hours and the wet feces were weighed and dry matter (DM) content was determined.

Forage dry matter intake (I) was calculated by the following equation of Moore (1966):

$$I = \frac{E \times 100}{100 - D}$$

Where:

I = intake of dry matter/24 hours

D = digestion coefficient of dry matter

E = excretion of dry matter/24 hours

After forage dry matter intake was calculated, it was converted to digestible dry matter (DDM) intake which is the product of dry matter digestibility and dry matter (DM) intake. This was converted to total digestible nutrient (TDN) intake with the following equation modified from Heaney and Pigden (1963):

$$\text{TDN intake} = (5.81 + .869\ \text{DDM}\ \%) \times \text{DM Intake}$$

An estimate of TDN intake above maintenance was calculated from the maintenance component of Winchester and Hendrick's (1953) formula:

$$\text{Maintenance (lbs. of TDN)} = .0553\ (\text{Body Weight in lb.})^{2/3}$$

The TDN required for maintenance of each animal was deducted from total TDN intake in order to estimate TDN intake above maintenance.

The actual DM intake of each steer was also used to calculate Nutritive Value Index (NVI) proposed by Crampton et al. (1960) as the product of relative intake (RI) and in vitro dry matter digestibility, where:

$$RI = \frac{\text{actual DM}}{80\ (W_{kg.})^{3/4}}$$

Results and Discussion

Average Daily Gain, Forage Intake and In Vitro Dry Matter Digestibility.—The average daily gain (ADG) of steers grazed in the 1967 experiment and in vitro dry matter digestibility associated with tall fescue-lespedeza (FL) and orchardgrass-clover (OC) pastures in each of five grazing periods are reported in Table 1. Digestibility of forage from fescue pasture increased during the third grazing period at approximately the same time that lespedeza reached a grazable height suggesting the importance of this legume in compensating for the lower dry matter digestibility of the tall fescue.

Table 1. Average daily gain (ADG), in vitro digestible dry matter (DDM), dry matter (DM) intake, digestible dry matter intake, and total digestible nutrient (TDN) intake above maintenance.

Grazing period	ADG (lb.)	DDM[a] (%)	DM intake[b] (lb.)	DDM intake[b] (lb.)	TDN intake above maintenance[b] (lb.)
			Orchardgrass-clover		
June	1.34	61.5	23.8	14.6	2.7
July	1.11	60.5	23.4	14.2	2.4
August	1.54	66.5	24.4	16.2	4.0
September	0.88	62.4	23.8	14.8	2.9
October	0.00	60.9	21.0	12.8	0.9
			Fescue-lespedeza		
June	0.88	57.1	24.5	14.0	2.2
July	0.99	53.9	24.3	13.1	1.4
August	0.53	60.9	21.5	13.1	1.2
September	1.41	60.1	24.0	14.4	2.5
October	0.59	61.3	23.5	14.4	2.5

[a] Estimated using the in vitro digestion technique of Tilley and Terry (1963).
[b] Adjusted to a constant metabolic size (MS) of 220 pounds.

Dry matter intake of forage within each period, also illustrated in Table 1, was adjusted to a constant metabolic size ($W_{lbs.}{}^{2/3}$) of 220 pounds in order to compare steers of different weights on an equal basis. Dry matter intake of steers grazing fescue-lespedeza pastures was higher than of those grazing orchardgrass-clover in all periods except the third, but one must also consider the amount of digestible dry matter that was ingested. When digestibility and dry matter intake were both considered, intake of digestible dry matter of orchardgrass-clover was greater than that of fescue-lespedeza. The greater digestible dry matter intake of orchardgrass-clover forage was reflected in greater gains of the animals grazing on that forage as compared to those grazing tall fescue-lespedeza.

Relationship of ADG and Nutritive Value Index.—Table 2 shows the relationship between NVI and daily gain. The NVI was calculated because it was a method of expressing digestible dry matter intake that allowed a comparison of present data with earlier work. Crampton et al. (1960) found simple correlations between this index and daily gain to be as high as 0.85. In the present study, the same coefficient obtained from orchardgrass-clover pastures was 0.90 (significant, $P < .01$) and that obtained from fescue-lespedeza pastures was 0.50 (not significant).

Relationship of ADG and Dry Matter Intake.—The relationship between adjusted dry matter intake and gain is also shown in Table 2. With orchardgrass-clover pastures, the coefficient of simple correlation between these two

Table 2. Coefficients[a] of simple correlation between ADG and different expressions of forage intake.

Variable	Pasture type: Orchardgrass-clover	Fescue-lespedeza
Nutritive value index	0.90**	0.50
Dry matter intake[b]	0.98**	0.62*
TDN intake above maintenance[b]	0.96**	0.70*

[a] Based on 10 observations.
[b] Adjusted to 220 pounds metabolic size.
* $P < 0.05$.
** $P < 0.01$.

variables was 0.98 (significant, $P < .01$) and with fescue-lespedeza pastures this coefficient was 0.62 (significant, $P < .05$). Compared to the previously observed relationship between NVI and ADG, the correlation coefficient was increased from 0.90 to 0.98 with orchardgrass-clover and from 0.50 to 0.62 with fescue-lespedeza.

Relationship of ADG and TDN Intake Above Maintenance.—Body maintenance is a requirement that must be satisfied before nutrients are available for body weight gain. Therefore, an attempt was made to arrive at an expression of forage DM intake more closely related to gains than DM intake by including the maintenance and digestibility factors. In fescue-lespedeza pastures, the coefficients of simple correlation between ADG and TDN intake above maintenance shown in Table 2 were increased from 0.62 to 0.70, while in orchardgrass-clover pastures the coefficient was not improved since it was already very high (*viz.* 0.98) when adjusted dry matter intake only was considered.

Conclusions

The results of this experiment indicated that digestible dry matter intake is a better index to animal gain than dry matter intake alone when steers are grazing orchardgrass-clover and fescue-lespedeza. As postulated initially, the method of expressing forage intake has an effect on the predictive efficiency or the reliability of intake as a predictor of average daily gain. In orchardgrass-clover pastures, the relationships between daily gain and each of the three expressions of forage intake were consistently high. TDN intake above maintenance explained 92 percent of the variation in gains. In fescue-lespedeza pastures, there was more variation in gains which could not be accounted for on the basis of the various indices considered in this study. Nutritive value index explained only one-fourth of the variation in body weight gain of steers grazing FL pastures while adjusted dry matter intake explained 38 percent, and one-half of the variation in gains was explained by TDN intake above maintenance.

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