Table 2 shows the percent control of elevated growing points in each year by clipping at ground level or by treating with paraquat, both being imposed on May 20 of each year. In two of the three years, nearly all floral primordia were sufficiently elevated above the soil surface to be removed by clipping on May 20. Control of floral primordia with paraquat was poorer than clipping in every year, ranging from 50 to 87%.

**Discussion**

Paraquat treatments in June, which provide a cured herbage for late season grazing, did not cause a yield depression after three successive years of treatment. This agrees with Hyder (1961) who found clipping treatments during June to have little or no effect upon yield. This suggests that a relatively high degree of control may be possible if those factors influencing paraquat activity are known. Recent studies evaluating temperature, oxygen, humidity, and light combinations (Merkle et al., 1965; Brian, 1966; Putman and Ries, 1968) on the activity of paraquat offer possible solutions for increasing success of field applications.

Successful control of the growing point whether by grazing, clipping, or contact chemicals requires that the floral primordia be elevated to a susceptible height for removal or for contact in the case of a chemical. In 1964, cool April temperature and dry soils delayed plant growth and retarded floral primordia elevation. Only 75% of the reproductive stems produced in 1964 were removed by the clipping treatment on May 20. Increases in floral primordia control in that year could have been realized by delaying both the clipping and the chemical treatments.

Poorer control of floral primordia in all years resulted from paraquat treatments than from clipping. Yet, in 1965, paraquat applied on May 20 controlled 87% of the emerged growing points. This suggests that a relatively high degree of control may be possible if those factors influencing paraquat activity are known. Recent studies evaluating temperature, oxygen, humidity, and light combinations (Merkle et al., 1965; Brian, 1966; Putman and Ries, 1968) on the activity of paraquat offer possible solutions for increasing success of field applications.

Herbage removal by clipping during April and May has been shown to depress crested wheatgrass yield significantly in the year following treatment (Hyder, 1961). Lowest residual yields in this study, though not significantly different from the others, resulted from clipping on May 20 in three successive years. A similar depression of yield did not occur from the comparable chemical treatment probably because of the poorer control of the floral primordia.

**Floral primordia control with early spring treatments of paraquat appears possible; further research is needed to define guide lines for optimum effectiveness. Consistently high floral primordia control in May may cause subsequent yield reductions; thus, rotation of pastures used for two-stem cropping is suggested for counteracting a yield decline, if such occurs.**

**Literature Cited**


**Relationship Between Forage Intake and Gains of Grazing Steers**

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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.

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-Traditum 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):

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

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

\[ \text{Maintenance} (\text{lbs. of TDN}) = .0553 \times \left( \frac{\text{Body Weight in lb.}}{213} \right)^{3/4} \]

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:

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

### 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.

#### 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 variables was 0.96 (significant, P < .01).

### 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.

<table>
<thead>
<tr>
<th>Grazing period</th>
<th>ADG (lb.)</th>
<th>DDM%</th>
<th>DM intakeb (lb.)</th>
<th>DDM intakeb (lb.)</th>
<th>TDN intake above maintenanceb (lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>1.34</td>
<td>61.5</td>
<td>23.8</td>
<td>14.6</td>
<td>2.7</td>
</tr>
<tr>
<td>July</td>
<td>1.11</td>
<td>60.5</td>
<td>23.4</td>
<td>14.2</td>
<td>2.4</td>
</tr>
<tr>
<td>August</td>
<td>1.54</td>
<td>66.5</td>
<td>24.4</td>
<td>16.2</td>
<td>4.0</td>
</tr>
<tr>
<td>September</td>
<td>0.88</td>
<td>62.4</td>
<td>23.8</td>
<td>14.8</td>
<td>2.9</td>
</tr>
<tr>
<td>October</td>
<td>0.00</td>
<td>60.9</td>
<td>21.0</td>
<td>19.8</td>
<td>0.9</td>
</tr>
</tbody>
</table>

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* 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.

**Factors Influencing Germination in Beardless Wildrye**

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**Highlight**

The effects of pretreatment, strains, temperature and germination solutions on germination were studied in beardless wildrye. Rate of imbibition was also studied. Total imbibition was not influenced by either strains or solutions. For the two strains studied optimum conditions appear to be germination in distilled water with alternating temperatures of 15–20 C preceded by moist prechilling at 1.5 C.

Optimum conditions for germination in crop species are of interest to the grower because of implications in stand establishment, to the seedsman for accurate laboratory analyses of seed quality, and to the researcher because of the basic physiological and genetic processes involved. Optimum laboratory germination conditions have been identified for many cultivated crop species; however, there is an apparent lack of such information for many native forage species.

Dewey (1960) studied salt tolerance among 14 *Agropyron* species in field and laboratory tests. He detected wide differences among strains and suggested that differences in salt tolerance are inherited and that relative tolerance can be improved through plant breeding. He also noted a negative relationship between salinity and percent germination and between salinity and rate of germination: as salinity increased, both percent and rate of germination decreased.

The relationship between moisture availability and germination varies with species. Ayres (1952) reported a decrease in total germination and reduction in rate of germination with increasing moisture in onions. McGinnies (1960) reported a reduction in rate and total germination with moisture stress in six range grass species. In addition he noted that maximum laboratory germination occurred at 20 C and that both moisture stress and temperature influenced germination. In other laboratory studies, Ellern and Tadmor (1967) found that low temperatures (4–10 C range) delayed germination in pasture plants, notably in perennial grasses, and that high temperatures depressed total germination, but had little affect on rate of germination. According to Ellern and Tadmor (1966) speed of germination, not total germination, is influenced by unfavorable alternating regimes in laboratory studies. Palmer, Becker, and Chapman (1968) reported that rate, not total germination, was influenced by salinity.

**Materials and Methods**

Beardless wildrye (*Festuca triticoides* Buck.) is a native, rhizomatic, perennial grass of significant forage potential in Montana. It is usually found on moist or alkaline soils from Montana and Washington south to Texas and Baja, California (Hitchcock, 1951). To determine optimum germination conditions for this species, four factors and various interactions among them were studied in replicated growth chamber tests: (1) temperature (15 C constant, 20 C constant, 15 C–25 C alternating, and 15 C–30 C alternating), (2) pretreat-