ASSESSMENT OF GRAZING PROCEDURES IN THE EVALUATION OF PLANT BREEDING MATERIAL

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ABSTRACT
Four stocking densities (2, 3, 5 and 9 sheep/18 m² for one hour) and two times of grazing (morning or evening) were imposed on spaced plant nursery of nine red clover (Trifolium pratense L.) populations of varying growth habit, in order to optimize measurement of sheep grazing preference. Plant height, spread and leafiness were measured before and after each of three grazings. Sheep preference was viewed multivariately, using combined measurements of these plant characteristics. MANOVA revealed that the effect of stocking density was significant (P<0.05), but that of time of grazing was not. The plant, population and overall heritabilities were non-significant (P>0.05) for before-and-after grazing differences for all characteristics, and also for leafiness after grazing. Overall heritabilities for after-grazing spread and height were significant at 0.37 and 0.30, respectively. Sampling reliability at the 5 sheep/18 m² stocking density was 94%, which was superior to the lower grazing intensities; this stocking density was considered to be the best for subsequent evaluation work. Either morning or evening grazings could be used.

KEYWORDS
Red clover, plant breeding, diet selection, germplasm evaluation, sheep preference

RESULTS AND DISCUSSION
Average grazing height for the group of semi-erect populations was 24.3 cm., close to the target of 25 cm. None of the characters measured before each grazing differed significantly (P>0.05) among the four stocking densities or the two times of grazing. This was expected for the first grazing period (which preceded treatment imposition). The result for later grazings showed that the “post-treatment” grazing was effective in maintaining uniform starting conditions for subsequent grazings. Characters measured after grazing and before-and-after grazing differences were significantly (P<0.05) different for stocking density, but only post-grazing spread and differences in spread and leafiness differed significantly between times of grazing (P>0.05). MANOVAs confirmed that the effect of stocking density was highly significant (P<0.05), but that time of grazing was not significant.

The situation after the four stocking densities were imposed is illustrated in Figure 1. There was a significant (P<0.05) reduction in all characters when the intensity of defoliation increased, showing that the treatments were causing their expected effect. Leafiness was the character most responsive to stocking density.

The variances before and after grazing at the plant and population level for each character were compared at the four stocking densities, since post-grazing variation provides the basis for selecting each grazing. Sheep were then re-introduced to defoliate all treatments to a uniform hard level.

Sampling intensity was determined using the differences between measurements before and after grazing. If any plant had a smaller spread, height or leafiness after grazing than before grazing, it was considered grazed.

The three plant characteristics were analyzed jointly in order to examine grazing “profiles” (MANOVA). Subsequent ANOVAs provided variance components for heritability estimates, and for indication of variability amongst and within populations.

Plant, population and overall heritabilities were considered using the usual restricted definition of phenotypic variance (Allard, 1960), which excludes several environmental variances. Standard errors of heritabilities were calculated following Osborne and Paterson (1952) methodology. Two other experiments examined the same populations, but used clones to partition plant variance into genetic (g) and environmental components. Their mean g-ratios were used to partition plant variance in this experiment, the values used for spread, height and leafiness (after-grazing) being 0.36, 0.25 and 0.0 respectively. Plant genetic variances (g) for the before-and-after differences were 0.0 for all characters.
for animal preference. No contrasts were statistically significant (P>0.05), so no conclusion could be drawn on the basis of usable variability.

Another criterion of usefulness is that all plants be sampled, but not over-grazed. The sampling intensity at the 2, 3, 5 and 9 sheep/18 m² stocking densities was 70, 83, 94 and 98%, respectively. Considering these values, the 5 sheep/18 m² stocking density was chosen as optimum because of high sampling intensity (94%), without the risk of excessive uniformity (loss of discrimination).

Therefore, in further studies of grazing discrimination/preference in breeding nurseries of red clover, it is recommended to use an equivalent stocking density to 5 sheep/18 m² for one hour. Either morning or evening grazings could be used.

### REFERENCES


### Table 1

<table>
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<th>Plant Population Overall</th>
<th>Plant Population Overall</th>
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<tr>
<td></td>
<td>Differnces between Spread before and after grazing</td>
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<tr>
<td></td>
<td>Height</td>
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<tr>
<td></td>
<td>Leafiness</td>
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<tr>
<td>After Grazing Spread</td>
<td>0.0907 **</td>
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<tr>
<td>Height</td>
<td>0.0576 **</td>
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<tr>
<td>Leafiness</td>
<td>0.0000 NS</td>
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</table>

1See Methods for details

2Standard error of Heritability

3Not significantly different from zero (P>0.05)

4Significantly different from zero (P<0.01)

### Figure 1

Height (cm), spread (cm) and leafiness (%) after-grazing by sheep for different stocking densities levels with red clover (bars of the same characteristic followed by the same letter do not differ significantly, P>0.05).