ABSTRACT
Perennial grasses are well adapted to the northern U.S.A. and Canada, but the potassium (K) content of grass forage is a major concern in regard to dairy cattle nutrition. Our goal was to identify factors influencing potassium content of grasses, so that a grass management strategy for controlling potassium content could be formulated. Separate experiments were conducted with several perennial cool-season grass species and varieties. Nitrogen fertilization and harvest management also were evaluated. Aside from the obvious positive effect on K concentration caused by commercial K fertilizer or by animal manure application, K concentration was influenced by grass species, grass maturity, time of season and N fertilization. Orchardgrass (Dactylis glomerata L.) was consistently high in K content, while timothy (Phleum pratense L.) and smooth bromegrass (Bromus inermis Leyss.) were up to 10 g kg⁻¹ lower in K concentration. Reed canarygrass (Phalaris arundinacea L.) remained high in K content until inflorescence emergence and then declined. Grass regrowth was consistently lower in K content than primary spring growth.

RESULTS
Trial 1. Potassium concentration in reed canarygrass did not change throughout May in 1994 or 1995, averaging 28.5, 31.8, and 34.2 g kg⁻¹ DM for 0, 56, and 112 kg N ha⁻¹ fertilizer rates. Potassium increased linearly with increased N fertilization in May. Concentration of K declined in June and averaged 22.0 g kg⁻¹ by June 13, with no differences in K among the three N fertilizer rates.

Trial 2. Potassium concentration in orchardgrass varieties was considerably higher than timothy varieties (Table 1). Potassium declined significantly in regrowth, compared to spring harvest. There were no significant differences among varieties within a species.

Trial 3. Grass harvested at heading contained 23.5, 26.2, 26.4, 31.0, and 27.7 g K kg⁻¹ for smooth bromegrass, timothy, reed canarygrass, orchardgrass and tall fescue, respectively, in 1994. In 1995, grass contained 22.2, 22.3, 24.7, 23.6 and 23.5 g K kg⁻¹ for smooth bromegrass, timothy, reed canarygrass, orchardgrass and tall fescue, respectively.

Trial 4. Nitrogen fertilization increased K uptake in both reed canarygrass and timothy (Figure 1) in general. This effect did not carry over beyond the cutting that received the N fertilizer, except at high N fertilizer rates. Concentration of K declined later in the growing season.

Trial 5. Potassium concentration in reed canarygrass was 21.0, 18.8 and 14.3 g kg⁻¹ for 0, 56, and 112 kg N ha⁻¹ fertilizer rates, respectively, for the June harvest. For the September harvest, K concentration was 13.5, 11.0, and 7.8 g kg⁻¹ for 0, 56, and 112 kg N ha⁻¹, respectively. There was a significant linear decline in K concentration with increased N fertilization.

DISCUSSION
While N concentration in grasses declines consistently in the spring, K concentration in maturing grass did not decline until the end of May (Trial 1). Potassium concentration declined in regrowth harvests compared to spring growth (Trials 2, 4 and 5), agreeing with published data (Brown et al., 1969; Allinson et al., 1992). Concentration of K did not differ among varieties within a species (Trial 2), but did vary among grass species (Trials 2, 3, and 4). An exception to this is the moisture-stressed spring growth of 1995 (Trial 3), where K concentration was low and did not differ among species. Reed canarygrass plots that received a range in N fertilization rates in past years (Trial 5) exhibited a completely different pattern than other trials. Potassium content was low and declined with increased N fertilization, because soil K was lower in high N plots (data not shown), due to high K removal rates in the past. This agrees with data on K content of reed canarygrass that was fertilized with N, but not K (Allinson et al., 1992).

Based on historic and current data, it appears that timothy and smooth bromegrass forage are significantly lower in K content than orchardgrass. Varieties within a species likely do not vary in K content. Spring grass growth harvested at anthesis or later will be considerably lower in K content than less mature grass. Grass regrowth will be lower in K content than spring growth, at similar levels of fiber in the forage. The above factors can be manipulated to produce a low K forage for non-lactating dairy cows.

REFERENCES
Table 1
Potassium concentration in timothy and orchardgrass as influenced by harvest date in 1994

<table>
<thead>
<tr>
<th>Harvest Date</th>
<th>K, g kg⁻¹</th>
<th>Harvest Date</th>
<th>K, g kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 3</td>
<td>35.4 a</td>
<td>May 31</td>
<td>45.9 a</td>
</tr>
<tr>
<td>July 12</td>
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<td>July 8</td>
<td>35.7 a</td>
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<tr>
<td>Aug. 29</td>
<td>23.8 c</td>
<td>Aug. 23</td>
<td>29.5 b</td>
</tr>
<tr>
<td>Oct. 27</td>
<td>23.5 c</td>
<td>Oct. 27</td>
<td>29.7 b</td>
</tr>
</tbody>
</table>

*Average of four replicates and six varieties.

*Timothy varieties were Chazy, Climax, Mariposa, Mohawk, Richmond and Tiller.

*Orchardgrass varieties were Benchmark, Dawn, Haymate, Okay, Pennlate, and Axiom.

*Means within a column that do not have common superscripts differ (P<0.05).

Figure 1
Potassium content of timothy forage fertilized with five rates of N and harvested either three or four times in 1994. Values above bars indicate the amount of N fertilizer (kg N ha⁻¹) applied before the harvest.