Response of summer-active tall fescue to nitrogen in late-autumn and winter

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Introduction
In the Western District of Victoria, the growth of summer-active tall fescue (Lolium arundinaceum syn. Festuca arundinacea) may be inhibited over late-autumn and winter due to a lack of soil nitrogen (N). This is because declining temperatures reduce soil mineralisation (Andersen and Jensen, 2001; Wang et al., 2006), which is the process where soil microorganisms break down organic materials to release N in a form that can be utilised by plants.

Therefore, pasture availability from summer-active tall fescue over late-autumn and winter is often limited. However, maximum demand for feed from pasture often occurs during this time due to calving or lambing.

The strategic use of N fertiliser may be a cost-effective way to improve pasture production from summer-active tall fescue over late-autumn and winter. This paper presents results from a study being undertaken at Hamilton, Victoria, as a component of the EverGraze project.

Materials and Method
The experiment was located at the DPI EverGraze site at Hamilton, Victoria (37°49’S, 142°04’E; altitude 200 m). The region has a temperate climate with a mean annual rainfall of 684 mm (1962 – 2007). The long term (1965 – 2007) average maximum and minimum daily temperatures in the warmest month (February) are 26°C and 11°C, and in the coolest month (July) are 12°C and 4°C, respectively. Monthly rainfall and temperatures are shown in Figure 1.

The soil was a darkish grey brown clay loam (Northcote, 1979). Analysis of the top 10 cm indicated a pHwater of 5.2, phosphorus (Olsen) of 22 mg/kg, potassium (Skene) of 230 mg/kg and sulphur (CPC) of 15 mg/kg.

A summer-active tall fescue (cv. Quantum)/subterranean clover (Trifolium subterraneum cv. Leura and Gosse)/white clover (Trifolium repens cv. Mink) pasture was established in November 2004. Five N treatments, replicated three times, were imposed in a randomised complete block design in September 2006. They were 0 (control) and strategic applications of 25, 50, 100 and 200 kg N/ha applied as urea on 14 September 2006 and 27 April 2007. Merino ewes rotationally grazed the sward when approximately 2000 kg DM/ha had accumulated, to a residual height of 1000 kg
DM/ha. Grazing mob sizes were managed to achieve the target herbage utilisation within a five day period of each rotation.

![Temperature Graph](image)

**Figure 1.** Mean monthly maximum (▲) and minimum (■) temperatures and rainfall (black bars). Long term averages are indicated by the lines and white bars.

Pasture consumption was measured using a calibrated falling plate meter (Bransby *et al.*, 1977). The plate meter was calibrated monthly by cutting 15 to 40 circular 0.1 m² quadrants to ground level and relating the actual pasture mass to the plate meter value by regression analysis. The pasture mass of each plot was then assessed from eight fixed points per plot. Pasture consumption was the difference in herbage mass between pre-grazing and the subsequent post-grazing.

Analysis of variance was used to identify differences between treatment means for pasture consumption using Genstat (GenStat Committee, 2003). Residuals were checked for normality.

**Results**

The production of the summer-active tall fescue sward between May and July 2007 in response to N applied on 27 April 2007 are shown in Table 1.

The application of 25 kg N/ha after rain in autumn increased pasture consumption (*P* < 0.05) relative to the control over late-autumn and winter. Increasing the N
application rate above 25 kg N/ha did not result in any further increases in pasture consumption during this time.

The lack of any further increase in pasture consumption as the N application rate increased above 25 kg N/ha resulted in a decline in N-use efficiency; from 45 kg DM/kg N at an application rate of 25 kg N/ha to 2 – 14 kg DM/kg N at application rates of 50 or more kg N/ha.

Table 1. Pasture consumption (kg DM/ha) for May - July 2007. The extra pasture consumed (kg DM/ha) relative to 0 kg N/ha, N response efficiency (extra kg DM/kg N) and cost of extra pasture (c/kg DM) are also shown.

<table>
<thead>
<tr>
<th></th>
<th>Pasture consumed (kg DM/kg)</th>
<th>Extra pasture consumed (kg DM/kg)</th>
<th>N response efficiency (kg DM/kg N)</th>
<th>Cost of extra pasture @ $750/t urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 N</td>
<td>2626</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 kg N/ha</td>
<td>3757</td>
<td>1131</td>
<td>45</td>
<td>4</td>
</tr>
<tr>
<td>50 kg N/ha</td>
<td>3340</td>
<td>714</td>
<td>14</td>
<td>11</td>
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<td>100 kg N/ha</td>
<td>3111</td>
<td>485</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>200 kg N/ha</td>
<td>3028</td>
<td>402</td>
<td>2</td>
<td>81</td>
</tr>
<tr>
<td>l.s.d (P=0.05)</td>
<td>621.6</td>
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</table>

Based on the May 2008 cost of urea ($750/ t, GST excluded but including freight and spreading; source, Landmark Ltd) the additional pasture consumed over late-autumn and winter would cost 4 c/kg DM following the application of 25 kg N/ha in autumn. The additional pasture would, however, have cost 11 – 81 c/kg DM at application rates of 50 or more kg N/ha.

Discussion
This research found that summer-active tall fescue is very efficient in converting low rates of applied N (25 kg N/ha) into dry matter during late-autumn and winter. Applying 25 kg N/ha following autumn rains resulted in a N-use efficiency of 45 kg DM/kg N between May and July 2007. This more than doubles the N-use efficiency reported from perennial ryegrass based swards in the district, which typically only produce 8 – 15 kg DM/kg N applied (Eckard and Franks, 1998; McKenzie et al., 2003).

Increasing the N application rate after autumn rains from 25 to 50 or more kg N/ha resulted in N-use efficiencies over late-autumn and winter that declined from 45 to 2 – 14 kg DM/kg N. Diminishing returns from N have previously been reported from applying above 45 kg N/ha to perennial ryegrass based pastures in north-western Tasmania (Eckard and Franks, 1998) and above 50 kg N/ha in Victoria (Mundy, 1996) and New Zealand (Roberts et al., 1992).
Fertiliser prices have increased substantially over recent years and are likely to continue to increase. This means that achieving efficient N use is becoming more important for sustaining profitable pasture production. Based on current urea prices, applying 25 kg N/ha is a cost-effective way of increasing pasture consumption in late-autumn/winter. However, higher N application rates are unlikely to be cost-effective.

**Conclusion**

This research has shown that applying N fertiliser to summer-active tall fescue after the autumn rains increased pasture consumption during late-autumn and winter. The largest increase in pasture consumption, and the most cost-effective use of N, was achieved with an application rate of 25 kg N/ha. There were no further increases in pasture consumption and marked declines in N-use efficiency with higher N application rates. Therefore, the application of 25 kg N/ha following the autumn rains is a cost-effective way of increasing pasture availability from summer-active tall fescue over late-autumn and winter.

**References**


