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ENVIRONMENTAL FACTORS ASSOCIATED WITH SUMMER-AUTUMN GROWTH RATES OF CATTLE AND SHEEP

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SUMMARY
From this review it can be seen that there are many factors that could contribute to the depression in growth rates of young stock commonly encountered in the summer-autumn period. The fact that the occurrence and severity of "ill-thrift" are quite variable show the complex nature of the problem. Such factors as grazing management, husbandry practices and climate could influence the amount of available feed, the stage of maturity, the proportion of dead material, the botanical composition of the sward, the chemical composition of the herbage and the incidence of disease, fungal or parasite infection. Because no clinical symptoms of infection or deficiency are common, it is felt that the major cause is nutritional, and that the poor growth rates stem from inappetance and poor utilization of summer-autumn pastures. It can be easily envisaged that soil and climatic conditions vary from year to year sufficiently to affect the composition of the herbage, and that this in turn influences intake, digestion and utilization of the feed.

INTRODUCTION
The condition known as "ill-thrift" is characterized by negligible weight gains over variable periods in the autumn despite ample pasture, anthelmintic drenching and the correction of known mineral deficiencies (Clarke, 1959; Hight and Sinclair, 1965). Similar, although less well documented experiences have been reported with cattle in the summer-autumn period (During and Weeda, 1972; Joyce and Brunswick, 1975).

The purpose of this review is to define growth rates of cattle and sheep commonly achieved in the summer-autumn period and discuss possible causes of subnormal growth.

CATTLE
The performance of autumn-born cattle (Joblin, 1969) and that of yearling and 2-year-old animals on spring pasture (Everitt and Ward, 1974; Barton and Armstrong, 1974; Taylor, 1975) indicates that cattle are capable of growing at 1 kg or more per
day during their first and second years under suitable environmental conditions. This conclusion is supported by the performance of 18-month-old cattle under feedlot conditions (Williams and Farris, 1972).

With 4- to 9-month-old animals, gains approaching 1 kg per day have been achieved under pasture feeding. Friesian bull calves grazed at 3.1 beast/ha gained 0.89 kg/day over the period December to May (Everitt and Ward, 1974) (Fig. 1, Group C). This latter gain was similar to those for autumn-born calves on spring pasture in New Zealand (Group B) (Joblin, 1969) and England (Group A) (Tayler et al., 1974).

Although a growth rate of 0.95 kg/day was obtained with rising 2-year-old Friesian bulls over the December-March period (Carter, 1969) such gains may not be common. With 16- to 22-month-old cattle reported growth rates ranged from -0.02 to 0.79 (mean 0.53) and -0.10 to 0.61 kg/day (mean 0.26) for 20 groups of cattle in summer and 12 groups of cattle in the autumn, respectively (Walker, 1959; Joblin et al., 1970; Barton and Armstrong, 1974; Reardon, 1975). For shorter periods within each season negligible weight gains can occur. G. H. Davis (pers. comm.) at Invermay and G. H. Scales (pers. comm.) at Tara Hills have both recorded growth rates of between 0.0 and 0.3 kg/day for periods of up to eight weeks over the period January to March. These low gains were preceded and followed by gains of about 1 kg/day.
### TABLE 1: MINIMUM AND MAXIMUM AVERAGE LIVESTOCK GAINS IN SUMMER AND AUTUMN (kg/day) OF 4- TO 9-MONTH-OLD FRIESIAN CATTLE

<table>
<thead>
<tr>
<th>Stocking Rate (animals/ha)</th>
<th>Growth Rate</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summer</td>
<td>Autumn</td>
</tr>
<tr>
<td>3.71</td>
<td>0.6-0.9</td>
<td>0.6-1.0</td>
</tr>
<tr>
<td>3.71</td>
<td>0.5-0.7</td>
<td>0.2-0.7</td>
</tr>
<tr>
<td>4.13</td>
<td>0.5-0.8</td>
<td>0.6-0.8</td>
</tr>
<tr>
<td>4.82</td>
<td>0.8-1.0</td>
<td>0.3-0.7</td>
</tr>
<tr>
<td>5.39</td>
<td>0.6-0.8</td>
<td>0.4-0.7</td>
</tr>
<tr>
<td>5.8-7.2</td>
<td>0.5-0.6</td>
<td>0.6-1.0</td>
</tr>
<tr>
<td>7.41</td>
<td>0.4-0.5</td>
<td>0.5-0.6</td>
</tr>
</tbody>
</table>

Irrigated

For 4- to 9-month-old cattle, a high growth rate was reported in the autumn on a predominantly lucerne diet (Croy and Weeda, 1974). However, other data suggest that lower growth rates may be more usual (Table 1). The range in growth rates shown are the extremes over the years in which the experiments were carried out. Experiments ran for up to 4 years and growth rates quoted were for the lightest stocking rates in the summer (Dec.-Feb.) and autumn (Mar.-May).

### TABLE 2: GROWTH RATES OF HOGGETS ON DIFFERENT FORAGE (g/day)

<table>
<thead>
<tr>
<th>Forage</th>
<th>Growth Rate</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crops</td>
<td>163</td>
<td>71-245</td>
</tr>
<tr>
<td>Lucerne</td>
<td>145</td>
<td>130-160</td>
</tr>
<tr>
<td>White clover</td>
<td>184</td>
<td>127-213</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>71</td>
<td>18-114</td>
</tr>
<tr>
<td>Mixed pasture</td>
<td>98</td>
<td>70-131</td>
</tr>
<tr>
<td>Spring pasture</td>
<td>173</td>
<td></td>
</tr>
</tbody>
</table>

1 Autumn-born lambs
FACTORS AFFECTING GROWTH RATE

Sheep

With concentrate feeding and good environmental conditions, average gains of 300 g/day or more have been obtained from birth to 6 months of age (Spedding et al., 1970; Orskov, 1973) and with 6- to 7-month-old store lambs over a 10-week period (Lodge, 1966). Such a performance is considerably superior to that of hoggets grazing autumn forages (Table 2). It might be argued that low growth rates of hoggets in autumn is due to the animal’s age. However, such an argument is not supported by the results of Clarke (1959) whose data suggest that autumn-born lambs grazed on spring pasture grow at a faster rate than indicated for spring-born lambs on mixed pasture in the autumn.

In addition to the low growth rates obtained for hoggets grazing various forages in autumn, there are periods during summer and autumn when growth can cease altogether. Such a situation was found by K. R. Drew (pers. comm.) using Romney × Suffolk hoggets (Fig. 2). In this case both the quality and quantity of feed appeared satisfactory.
GROWTH RATES OF SHEEP AND CATTLE

FACTORS AFFECTING GROWTH RATE

NUTRITIONAL FACTORS

No information is available as to the relative importance of factors known to affect growth rates. In this section possible nutritional causes are listed and an indication given of their potential effects on daily gain.

Quantity of Feed Available

Cattle

Data from two unpublished trials (T. F. Reardon, pers. comm.) indicate that the amount of pasture available can affect intake (Table 3). This work also shows that growth rate increases as pasture utilization decreases (Table 4).

The influence of pasture availability on animal growth rate has been verified by several stocking rate trials (Joyce et al., 1969; Everitt and Ward, 1974; Taylor, 1975). To determine the effect of stocking rate in different seasons on growth rate regression analyses were carried out on the original data from these latter trials. Stocking rates varied from 3.1 to 6.8 beasts/ha. The regression of growth rate per beast (kg/day) on stocking rate

<table>
<thead>
<tr>
<th>DM Offered (kg/head/day)</th>
<th>Pasture Utilized (%)</th>
<th>DM Intake (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0</td>
<td>45</td>
<td>6.8</td>
</tr>
<tr>
<td>22.5</td>
<td>33</td>
<td>7.3</td>
</tr>
<tr>
<td>33.8</td>
<td>25</td>
<td>8.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pasture Utilization Utilization (%)</th>
<th>Gain/Day Liveweight</th>
<th>Carcass</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>50</td>
<td>0.36</td>
<td>0.37</td>
</tr>
<tr>
<td>35</td>
<td>0.57</td>
<td>0.58</td>
</tr>
</tbody>
</table>
indicated that growth rate decreased linearly for each additional beast grazed per hectare, namely: Summer, $0.05 \pm 0.01^{**}$; autumn, $0.10 \pm 0.1^{***}$; winter, $0.10 \pm 0.01^{***}$; spring, $0.05 \pm 0.01^{**}$.

The deliberate policy of maintaining high stocking rates has quite marked effects on growth rates in autumn and winter. The sensitivity of growth rate in the autumn could, however, be expected to vary between years. In the autumn period Joyce and MacLean (1970) found growth rates of 0.15 and 0.72 kg/day in two consecutive years. These growth rates were associated with large differences in dry matter intake (Fig. 3), which probably reflected differences in feed availability.

![Fig. 3: Liveweight gains and dry matter intakes of 3- to 16-month-old cattle.](image)
A further factor which could influence feed availability in autumn is the policy of slowing down rotation lengths to conserve winter feed.

**Hoggets**

As with cattle it is highly probable that quantitative feed shortages have been responsible for some of the very poor performances recorded as demonstrated in stocking rate experiments (J. P. Joyce, pers. comm.). Under hill country conditions inadequate supply of feed of reasonable digestibility may well be the principal cause of very low growth rates.

However, other factors are also involved. The inappetance of hoggets on autumn-grown pasture first described by Clarke (1959) is illustrated in Fig. 4. The dramatic effect of type of feed on voluntary intake was matched by corresponding effects on growth rates. The line Spring Rest refers to a group fed on spring pasture at the level of intake of the hoggets fed autumn pasture. Much higher intakes on clover than on ryegrass have also been recorded by Sinclair et al. (1956) and Joyce and Newth (1967). These differences in voluntary intake are probably a major cause of ill thrift problem on improved pastures.
Nitrate

Because relatively high levels of nitrate were usually found in autumn feed when ill-thrift occurred, it was postulated that this caused the depression in intake (Butler, 1959; Clarke, 1959a). However, subsequent field and indoor trials failed to substantiate the theory (Clarke, 1959a; Hill, 1960).

Minerals

Apart from well-known deficiencies of Se, Co, I and Cu and the more recent work on Na with lucerne (Joyce and Brunswick, 1975) the contribution of imbalances or subclinical deficiencies such as P, Zn, Cu or Mg are virtually unknown. However, several of these have been implicated recently (J. P. Joyce, K. R. Middleton and I. R. Cornforth, unpub.), and in areas of marginal Co deficiency marked seasonal differences have occurred to Co supplementation, with unsupplemented lambs losing weight in one year while growing as well as supplemented lambs in another (Andrews, 1961).

Perloline

Recent work in the U.S.A. (Boling et al., 1975) with perloline, an alkaloid present in perennial ryegrass, and which reaches peak concentration in summer, has shown that addition of this alkaloid to the diet of lambs led to a depression of digestibility of several nutrients in the feed, lowered nitrogen retention, lowered VFA levels in the rumen, and increased body temperatures. Both the inhibitory effects on digestion, and increased heat load at higher environmental temperatures could lead to reduced intake, while the poor N retention could lead to lower liveweight gains.

Stage of Pasture Maturity and Composition of the Sward

As summer progresses pasture species start to mature, with a subsequent decline in nutritive value. This is shown in Table 5 for ryegrass and paspalum. In addition, less nutritious summer-growing species, such as Paspalum dilatatum in the North Island, may become dominant as the season progresses and would lead to a lowering in overall digestibility of the herbage (Table 5).

In some circumstances, the pasture may become clover-dominant which would be beneficial because of the higher intakes achieved and more efficient utilization of metabolizable energy from clover than from ryegrass (Joyce and Newth, 1967; Rattray and Joyce, 1974).
TABLE 5: EFFECT OF STAGE OF GROWTH ON COMPOSITION AND DIGESTIBILITY

<table>
<thead>
<tr>
<th>Stage of Growth</th>
<th>Composition (%)</th>
<th>Digestibility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CP</td>
<td>CF</td>
</tr>
<tr>
<td>S3 Ryegrass (Waite et al., 1964):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young leafy</td>
<td>18.5</td>
<td>21.4</td>
</tr>
<tr>
<td>Late leafy</td>
<td>15.2</td>
<td>24.7</td>
</tr>
<tr>
<td>Head emergence</td>
<td>13.8</td>
<td>25.9</td>
</tr>
<tr>
<td>Seed setting</td>
<td>9.6</td>
<td>31.4</td>
</tr>
<tr>
<td>Paspalum dilatata (Coup and Dunlop, 1951):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>16.6</td>
<td>24.3</td>
</tr>
<tr>
<td>Intermediate</td>
<td>10.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Mature</td>
<td>7.4</td>
<td>31.2</td>
</tr>
</tbody>
</table>

Accumulation of Dead Material and Length of Pasture

A considerable amount of dead material accumulates during late spring and summer, especially under conditions of low utilization and can reach levels as high as 50% of available DM in February (Campbell, 1964, 1966; Hunt, 1970, 1971; Taylor, 1975). This could contribute to the sharp decline in pasture digestibility (of 10 to 15 units) encountered in irrigated and non-irrigated pastures during this period. (Hutton, 1962; Joyce, unpub.; Taylor, 1975).

Several studies have shown that growth rates of hoggets were greater on long pasture, than on short (Clarke, 1959a; Hight and Sinclair, 1965, 1967). The effect of ryegrass length on growth rate has not yet been fully explained, but this could be due to a larger amount of available feed leading to a lower utilization, a greater opportunity for selective grazing and to higher intakes of more nutritious material. Hight and Sinclair (1967) reported a higher proportion of dead material in short pasture. The work of Tainton (1974) supports this and also shows a higher proportion of stubble (stem) in shorter material. Intakes and digestibility are lower on the stubble than on leaf material (Pearce et al., 1962) owing to dead matter content and because stems contain more structural carbohydrates (Butler and Bailey, 1973). Alternatively, as suggested by Hight and Sinclair (1965), the shorter pasture with its high dead matter content may promote facial eczema.

In some cases the longer pasture had a higher clover content (Hight and Sinclair, 1965).
Studies with dairy, sheep and irrigated pastures have shown that digestibility declines during the summer to reach a minimum level in January-February, which coincides with minimum CP and maximum CF levels (Hutton, 1962; Hutton et al., 1965; J. P. Joyce, unpub.; Taylor, 1975). In autumn CP levels rose to a maximum and CF levels fell. This seasonal trend could be due to accumulation of dead material, changes in botanical composition, or to changes in the CP or carbohydrate levels of the ryegrass and clovers. Autumn pasture (ryegrass and clover) has low soluble carbohydrate levels, relatively low cellulose and high CP levels compared with spring pasture (Joyce and Newth, 1967; Butler et al., 1968; Rattray and Joyce, 1969). These seasonal differences could be due to soil conditions and climatic factors influencing differentially photosynthesis, respiration, maturation and growth, such as they do in causing diurnal and regional variations in composition (Kingsbury, 1965; Ludwig et al., 1965; Butler et al., 1968; Butler and Bailey, 1973). Lucerne, at similar growth stages, also has lower digestibility and supports lower intakes in the summer and autumn than in the spring (Joyce and Brunswick, 1975). The most marked differences between New Zealand autumn and spring pasture were in soluble carbohydrate and CP levels (Table 6) (Joyce and Newth, 1967; Rattray and Joyce, 1969). Overseas workers have also implicated soluble carbohydrate levels in the utilization of ME from spring and autumn pastures (Corbett et al., 1966; Blaxter et al., 1971). The various carbohydrates would influence rate of fermentation and

### TABLE 6: COMPOSITION OF AUTUMN AND SPRING PERENNIAL RYEGRASS AND WHITE CLOVER

<table>
<thead>
<tr>
<th>Composition (% DM)</th>
<th>Autumn</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clover</td>
<td>Ryegrass</td>
</tr>
<tr>
<td>Crude protein</td>
<td>29.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Water-soluble sugars</td>
<td>5.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Hemi cellulose</td>
<td>7.0</td>
<td>14.1</td>
</tr>
<tr>
<td>Cellulose</td>
<td>17.5</td>
<td>27.6</td>
</tr>
<tr>
<td>Lignin</td>
<td>6.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Ash</td>
<td>10.2</td>
<td>9.5</td>
</tr>
<tr>
<td>kJ/g</td>
<td>18.32</td>
<td>17.93</td>
</tr>
</tbody>
</table>

1 Joyce and Newth (1967)
2 Rattray and Joyce (1969)
digestion, rate of passage and the proportions of VFAs produced, which in turn would influence the utilization of the end products of digestion (Bailey, 1964). Beever et al. (1972) have shown that spring ryegrass leads to a 25% greater production of propionic acid and a lower production of acetic acid than autumn grass. The findings of Hight et al. (1968), comparing shaded versus unshaded autumn herbage support this theory, in that hogget liveweight gains were substantially higher on unshaded pasture, which contained 2 to 3 times higher levels of soluble carbohydrates and lower levels of cellulose and lignin. The explanation is definitely not as simple as suggested, however, as Hight and Sinclair (1965) obtained no response from molasses supplements to hoggets grazing short grass. Whatever the actual cause, it does appear that the end products of digestion are utilized more efficiently from spring herbage. Table 7 shows for both New Zealand and overseas work with sheep and cattle that ME from spring pasture is utilized more efficiently for maintenance ($K_m$) and gain ($K_f$) than ME from autumn herbage.

**TABLE 7: UTILIZATION OF METABOLIZABLE ENERGY FROM SPRING AND AUTUMN HERBAGE**

<table>
<thead>
<tr>
<th>Species</th>
<th>Season</th>
<th>Digestibility</th>
<th>$K_m$</th>
<th>$K_f$</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clover and</td>
<td>S</td>
<td>75</td>
<td>63</td>
<td>40</td>
<td>Rattray &amp; Joyce (1974;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unpub.)</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>A</td>
<td>79</td>
<td>50</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>S</td>
<td>66</td>
<td>72</td>
<td>44</td>
<td>Corbett et al. (1966)</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>66</td>
<td>65</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Ryegrass</td>
<td>S</td>
<td>76</td>
<td>70</td>
<td>45</td>
<td>Blaxter et al. (1971)</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>70</td>
<td>71</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

1. $S = Spring$, $A = Autumn$.  
2. Digestibility of gross energy.  
3. $K_m$ and $K_f$ = efficiency of utilization of ME for maintenance and gain, respectively.

The CP levels, on the other hand, can influence the maintenance requirement because of the energy cost of excreting excess N. Garrett (1970) found that feeding a high protein ration to beef cattle increased the maintenance requirement by 20%. Maintenance requirement of sheep has been found to be 12 to 14% (Corbett et al., 1966) and 50% higher (Rattray and Joyce, unpub.) on autumn pasture than on spring pasture. This could be due to the excretion of excess N, lower $K_m$ or some other factors such as an alkaloid like perloline increasing heat production.
**Non-nutritional Factors**

*Internal Parasites*

Worms can have severe effects on growth in young stock. In the case of lambs, suppressive drenching was shown to increase daily gains compared with control groups (Brunsdon, 1963, 1964 and 1966) (Table 8). However, results of drenching trials summarized by Robertson (1963) and Brunsdon (unpublished data) show that the response to drenching can be very variable, indicating that worms sometimes have little effect on growth rates.

An example of the effects of drenching on the growth of young dairy weaners is shown in Table 9 (from Brunsdon, 1968). As

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**TABLE 8: THE EFFECTS OF FORTNIGHTLY (i.e., SUPPRESSIVE) DRENCHING ON LIVEWEIGHT GAIN OF LAMBS OVER THE JANUARY TO MAY PERIOD**

<table>
<thead>
<tr>
<th>Drenching Programme</th>
<th>Approximate Liveweight Gain (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-drenched</td>
</tr>
<tr>
<td>Fortnightly</td>
<td>45</td>
</tr>
<tr>
<td>Fortnightly</td>
<td>0</td>
</tr>
<tr>
<td>Fortnightly</td>
<td>15</td>
</tr>
<tr>
<td>Monthly</td>
<td>56</td>
</tr>
<tr>
<td>6 drenches</td>
<td>50</td>
</tr>
<tr>
<td>3 drenches</td>
<td>49</td>
</tr>
</tbody>
</table>

1 Drenching carried out from approximately October until lambs 12 months old.

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**TABLE 9: THE EFFECTS OF BOTH SUPPRESSIVE AND STRATEGIC DRENCHING ON THE LIVEWEIGHT PERFORMANCE OF JERSEY AND JERSEY × FRIESIAN WEANERS**

(from Brunsdon, 1968)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Approximate Liveweight Gain During</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Liveweight (kg)</td>
</tr>
<tr>
<td>Suppressive drenches 3-weekly 68</td>
<td>0.45</td>
</tr>
<tr>
<td>5 drenches at least 1 month apart 68</td>
<td>0.35</td>
</tr>
<tr>
<td>No drenching 68</td>
<td>0.27</td>
</tr>
<tr>
<td>% Suppressive drench &gt; control 67</td>
<td>67</td>
</tr>
</tbody>
</table>

1 15 animals per treatment.
with sheep, roundworms can severely depress growth rates, although responses to drenching vary (K. Cottier and G. C. Cairns, pers. comm.).

*External Parasites*

Studies on the effects of lice on the growth rate of young stock (Kettle, 1974; Kettle and Pearce, 1974) suggest that contrary to overseas works there is no significant advantage from lice control in sheep and cattle as either yearlings or 2-year-olds.

*Facial Eczema*

This disease, even in the absence of clinical symptoms, will depress liveweight gain. Sinclair (1961) found that liver damage grade \((0 = \text{nil} \text{ to } 5 = \text{severe damage})\) was negatively correlated with liveweight gain \((r = -0.80)\). Later work by Campbell and Wesselink (1973) showed that, for every unit increase in liver-damage grade, lambs gained, on average, 21 g/day less liveweight.

*Other Fungal Diseases*

Screening trials by di Menna and Parle (1970) indicated that, in addition to *Pithomyces chartarum*, *Fusarium vivale* and *Myrothecium* spp. were among the most commonly occurring toxic fungi on pasture and reached greatest levels in the summer and autumn. In one trial, levels of *Myrothecium* spp. on pasture were found to be too low to cause disease in grazing animals (di Menna et al., 1973). However, where sheep were dosed with *Myrothecium* growth rate was depressed for several weeks but subsequently recovered while dosing continued indicating the development of tolerance to the toxin (Mortimer et al., 1971).

In a review on pasture diseases Blair (1973) stated that the ingestion of ergotized seed-heads can result in ergot poisoning. Although ergot levels are highest in late summer in pasture that has been allowed to run to seed, evidence of a growth-inhibiting effect has yet to be shown.

At Manutuke (Anon., 1963) there was no relation between the numbers of *Puccinia* (common rust), *Cladosporium*, *Helminthosporium*, *Epicoccum* and *Alternaria* spores on pasture and weight gains of hoggets.

A small improvement in the liveweight gain of lambs was obtained by Joyce and Brunswick (1975) when lucerne was sprayed with the fungicide benomyl. G. H. Davis (pers. comm.)
observed a similar non-significant improvement in the liveweight gain of steers. At this stage, therefore, the role of fungi on stock performance remains obscure.

**Ryegrass Staggers**

There is little information on the effects of ryegrass staggers on liveweight gain.

Lancashire and Ulyatt (1973) suggested that staggers in sheep could depress liveweight gain. However, Brougham *et al.* (1975) obtained high growth rates in Friesian weaners despite extensive staggers during the summer.

**Pneumonia and Pleurisy**

This disease can occur anywhere in New Zealand (Porter, 1970). Examination of lines of sheep in a freezing works has revealed up to 70% of the animals showing evidence of pneumonia (Manktelow, 1970). In a survey of more than 3000 lambs over 5 years, moderate to severe pneumonia, which occurred in 6.5% of lambs overall, reduced the carcass weights of the infected animals by just over 0.45 kg (Kirton *et al.*, 1976). The prevalence of pneumonia increased as the season progressed from January to March/April.

**Barley Grass**

Barley grass infestations can severely depress lamb growth rates over the January-March period, especially during seed-shed (Hartley and Atkinson, 1972; Atkinson and Hartley, 1972; Hartley and Bimler, 1975). The major factor involved appeared to be physical damage, especially to the eyes.

**Temperature and Water Stress**

(a) **Heat Stress**

Evidence from Blaxter *et al.* (1959) suggests that sheep with fleeces have wide thermoneutral zones with heat production constant over the range 15 to 35°C. With cattle, Ittner *et al.* (1958) found that the depressive effects of heat began with temperatures of about 25°C. At high temperatures, appetite and weight gains declined, although this did not occur with daytime temperatures of around 45°C provided the temperature at night dropped to 16°C.
Climatological data (N.Z. Meteorological Service, 1972; Gerlach, 1974) indicate that heat stress is probably not a significant factor in the performance of young stock in New Zealand. During the few days when maximum temperatures of 30°C are recorded, relatively cool nights are experienced and stock may adjust grazing habits.

(b) Water Stress

Water supply may affect stock growth in very dry years. Bircham and Crouchley (1976) found that when temperatures were high lambs deprived of water and fed herbage of a high dry matter content were about 5 to 6 kg lighter than their watered counterparts. Water quality did not affect growth. This is somewhat at variance with evidence presented by Clark and Jay (1975) suggesting that sheep can adjust to water deprivation during periods of normally low requirements and can produce satisfactorily in its absence.

Other Factors

Other diseases could be responsible for poor autumn growth. These include scabby mouth, foot rot, pink eye, rickets, sarcocystis and salmonellosis. However, information on the incidence and effects of these is not available.

REFERENCES

GROWTH RATES OF SHEEP AND CATTLE