Grain feeding sheep in drought

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Introduction
Drought conditions in the New Zealand pastoral industries in the past several years have heightened interest in best practice approaches to emergency nutrition of ruminants when the pasture base runs out. While drought feeding strategies are well understood by farmers in Australia and elsewhere internationally on account of the frequency of the requirement for them to be used, the NZ sheep sector has had less exposure.

There are a number of strategies for emergency nutrition of sheep, using energy dense supplements of either sugar (e.g. molasses) or starch (e.g. grains) with and without additional nitrogen supply (e.g. urea). While conserved forages can be used, the reality in droughts is the price of these rises immediately to levels that can be above other available feeds, and by definition, the supply of these is limited. As in most cases the period of drought is restricted in NZ, to seasons rather than years, a common approach is therefore feeding cereal grains. This paper will outline the practical use of grain feeding to drought affected sheep in NZ.

Drought feeding
Drought feeding is the provision of energy and nutrients sufficient to maintain life in affected stock, typically to a body condition score (BCS) of an acceptable standard. In NZ, this will usually be a BCS of three or above (scale: 1-5), to meet current welfare legislation (Anon. 2010). While there are certainly feeding applications for liveweight gain used when pasture is exhausted, typically feedlotting, these are not a common feature of drought feeding in NZ. In most cases, drought feeding is the supply of energy alone, at approximately maintenance, with relatively little use of additional nitrogen supply. As a consequence, the desirable characteristics of a drought feeding energy source are: low cost; energy dense for reduced handling costs; easy, robust storage profile; uncomplicated use with stock; and a low animal health impact.

Cereal grains are high in dry matter, energy and starch, and relatively low in crude protein and fibre (Table 1). The metabolisable energy (ME) value of grains available in NZ is broadly 11-13MJ/kg DM. These attributes favour use as a drought feed as grain is inexpensive to transport, reliably stored in silos, and simple to deliver to stock on farm. However, it also means that grains are not an entire diet for sheep, and will have to be fed in a manner to include additional fibre in the total ration, with necessary introduction strategies, to avoid rumen carbohydrate overload. For some grains, and in younger stock, protein will also be limiting. Additionally, in NZ, no grains will be a low cost feed. The competition for use in human foods, and with the dairy industry, and the restricted area available for growing cereals here all conspire to maintain a price that is high by international standards. Nevertheless, the cost and requirement for effort and care when feeding them are universally outweighed by the ease of use and high energy supply compared to most alternatives in sustained drought. Therefore, grains will typically be the dominant drought feed in these cases.
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The different cereal grains differ in energy, starch and protein content, and the extent of protein complexes that slow down rumen degradation of starch. Wheat is the most rapid starch supply, then barley, then corn, then sorghum. Those attributes are reflected in the typical metabolisable energy (ME) values given to grains. The crop yields achieved and end use alternatives also rank the prices for feed grain in NZ, with an appreciable quantity available for stock contingent on the quality at harvest and the demand from human food manufacturers.

Strategy of use
Grains are used in drought feeding only as a temporary, partial energy remedy for feed deprivation, with a modest protein supply. Because of this, they are most commonly used to supply only a part of the maintenance energy requirements, and typically to limit liveweight losses or prevent pre-lambing ketosis rather than sustain normal production. Typical ME requirements for ewes and lambs are presented in Table 2. Note that the value of grains to pregnant ewes is high as dietary starch produces increased molar proportions of propionic acid for a given ME intake, leading to an increased glucose supply to the fetus and dam.

An important decision with drought feeding is when intervention should begin, and to which sheep. In the distant past, drought feeding was often initiated when sheep were already significantly reduced in BCS, as a last resort. This complicates transition to grains, and is not always very effective in maintaining a healthy nucleus flock. Early intervention, however, is not always cost effective, as maintenance requirements are obviously higher in heavier animals, so a compromise between those positions is best practice. In addition, selling off stock not integral to the operation mitigates the significant cost of grain feeding, so impacts on that decision.

As the low fibre content of grain necessitates additional fibre supply, the most common application is as a supplement fed on the existing (reduced) pasture mass to provide this, often 100-500g daily. Where no pasture is available, some fibre source – straw, hay, or silage – should be supplied at a minimum of 50g/head/day for best results, but it is possible to feed sheep solely grain diets with careful transition, and this is not uncommon in Australian systems. The conventional upper limit for all grains in drought feeding is 500-600g/head daily for adult stock, representing about 6-7 megajoules (MJ) of metabolisable energy (ME), or about 75% of the daily requirement (Table 2). In most cases, between 250g (dry) and 600g (lactating) daily is used for ewes. It is worth noting here that sheep can be transitioned onto ad libitum cereal grain intakes, so there is no hard and fast upper limit of grain feeding for rumen health reasons, more for practical economics.

The frequency of delivery can be from twice weekly to daily, and that depends on the stock numbers being

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Table 1. Composition of cereal grains (% of dry matter).

<table>
<thead>
<tr>
<th>Grains</th>
<th>Crude protein</th>
<th>Neutral detergent fibre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>7.5-15</td>
<td>13-15</td>
</tr>
<tr>
<td>Barley</td>
<td>7-13</td>
<td>18-23</td>
</tr>
<tr>
<td>Maize</td>
<td>7-9</td>
<td>9-10</td>
</tr>
<tr>
<td>Triticale</td>
<td>8-14</td>
<td>6-8</td>
</tr>
<tr>
<td>Oats</td>
<td>6-14</td>
<td>28-31</td>
</tr>
</tbody>
</table>

* Adapted from Curnow (2014), Kolver (2000), Fox et al. (1997)

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Table 2. The Daily Metabolisable Energy (MJ/kg DM) Requirements of Ewes and Lambs.

<table>
<thead>
<tr>
<th></th>
<th>Dry</th>
<th>Lambing</th>
<th>Lactating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewes</td>
<td>-</td>
<td>8-10</td>
<td>13-17</td>
</tr>
<tr>
<td>Lambs</td>
<td>6-10</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* The range represents mid-large size ewes, and weaners with a daily weight gain of 50 grams.
Adapted from Curnow (2014).
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fed. For large flocks, daily delivery is impractical, and the Australian experience is that two or three times weekly is a satisfactory frequency. Obviously the amounts delivered are then proportionately higher each time, but this is not problematic after sheep have been properly transitioned to the diet.

Grains are not required to be cracked for sheep, and can be fed onto the ground in strips of 100-200mm from a hopper on a vehicle, allowing about five adult sheep a metre. The utilization of grains fed in this manner is high, typically above 90%. Where the higher end grain inputs (e.g. 500g/day) are used, it is common to include about 1% by weight of limeflour as cereal grains are calcium deficient (<0.4% DM) but phosphorus adequate (>0.3% DM). There is no credible evidence that rumen modifiers (e.g. sodium bicarbonate, monensin, lasolocid, or virginiamycin) significantly improve outcomes in properly managed drought fed sheep commensurate with the cost and delivery issues associated with them, and there is no reason to automatically include them.

Transitioning

Transitioning sheep to grains is done by starting at 50-100g a day, and increasing that by a maximum of 50g a day, and as a broad rule a week is a safe introductory period, and longer is better. If eventual feeding frequency will be at intervals of more than a day (e.g. twice weekly), use 10-14 days of daily feeding before switching to longer intervals. Best practice is to avoid hungry sheep having access to grains during transition, for example by pasture or silage feeding first, which may be a challenge. As grains are palatable, there is usually little delay in getting a mob onto the feed, but younger stock may require more patience, and the space requirement of a metre for five sheep for equal access is important. Salt (2% by weight) mixed with grains can entice younger stock to begin eating, and anecdotal industry experience suggests lambs ‘learn’ grain feeding better if the ewe is eating it with them before weaning, so in drought prone regions this approach is sometimes used as a precaution.

Younger stock

Unlike older stock, medium term management priorities for lambs and hoggets will typically require sufficient energy supply to keep them moving forward in all but the most severe droughts, at low gains (e.g. 50-100g/day).

Weaner lambs can be safely fed grains, but have a protein requirement (c.15% dry matter) higher than adults that grains will not meet. Consequently, higher pasture (or silage, or protein meal) inputs are used. In practice, this amounts to capping the grain inputs to about 200g daily and judiciously using remaining pastures. Fed this way, growth rates will be low, and anecdotally industry averages of 50-100g liveweight daily or less are common. Hoggets have a lower protein requirement (c.10% DM) and can be fed slightly greater amounts of grain daily to achieve similar liveweight gains.

Troubleshooting

The principal risk to animal health with grain feeding is rumen acidosis. The starch content of grains is rapidly available for rumen fermentation, and true lactic acidosis can be easily provoked by feeding even 300g to stock unaccustomed to the diet. After appropriate transition, sheep will satisfactorily regulate their grain intake to prevent this.

Sheep display fewer obvious clinical signs when affected by this condition than cattle, but early and mild signs are inappetance and lethargy, progressing to vocalization and teeth grinding, then recumbency, severe dehydration and metabolic collapse. There is routinely rumen stasis early in the development, and as a consequence, typically mild hypocalkaemia, but in acute cases, death may precede any scouring. Treatment of severe cases is typically unrewarding. Other issues associated with grain feeding sheep are more commonly seen in ‘long fed’ scenarios, when grain becomes the primary diet for extended periods, particularly if drought feeding encourages high stock densities, and they are broadly what is experienced in lotfed sheep internationally. In general, the prevalence is not high. These include polioencephalomalacia, sudden death (clostridial), frothy bloat, urinary calculi, pink eye, vitamin A deficiency, pneumonia, and salmonellosis/inanition.
Summary
Cereal grains are an energy dense feed of a form that allows ready transport, storage and feeding to drought affected sheep. While relatively expensive compared with standard feeding costs of pasture based sheep, in drought situations they often are considered an economically viable feed choice that is suitable for preserving the nucleus of the flock by mitigating liveweight loss. There is ample international knowledge and experience with the safe and effective use of grains in drought for the NZ sheep industry to have confidence in their use. In general terms, the animal health risks with feeding grain can be readily mitigated with informed management.

References

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Fox DG, Tylutki TP, Pell AN, Van Amburgh ME, Chase LE, Pitt RE, Rasmussed CN, Tedeschi LO, Durbal VJ. The net carbohydrate and protein system for evaluating herd nutrition and nutrient excretion. Model Documentation, Cornell University, New York, USA, 1999