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Feeding frosted cereal grain to ruminants

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A severe frost late in the growing season may drastically reduce yield and quality of cereal crops. Frost-damaged crops, unsuitable for human consumption, are downgraded to stockfeed and may sell at a price below typical stockfeed values. Frost-damaged feed grains are assumed to have lower nutritive values, and tend to be discounted accordingly; however, recent research suggests that the nutritional value of frost-damaged wheat for ruminants is only slightly lower than non-frosted grain. Despite its poor appearance, it can be priced according to its feed value.

Nutritional information

Energy and digestibility

Grain is primarily fed to livestock to provide energy, as opposed to protein; therefore, determining the effect of frosting on the metabolisable energy (ME) of affected grain is vital. Digestibility is directly related to the energy content of a feed, and is therefore another useful measure of the nutritional value of frost-damaged grains.

Research to date has found that severely frosted cereal grains may have slightly lower energy and digestibility levels than unfrosted crops; however, in all cases, tested levels were within the acceptable range for valuable stockfeeds.

Trial results

In a trial conducted at Wagga Wagga, the physical properties and nutritional value of frosted wheat were compared with unfrosted wheat. These results are summarised below, in tables 1 and 2. The differences in appearance of lightly and severely frosted wheat can be seen in figures 1, 2 and 3.

Figure 1: Unfrosted wheat grain (Janz).

Figure 2: Lightly frosted wheat grain (Janz).

Figure 3: Severely frosted wheat grain (Janz).

The ME content of severely frosted wheat was found to be 0.8 megajoules per kilogram of dry matter (MJ/kg DM) lower than unfrosted wheat. In this case, the lowest estimated ME for wheat was still well within the expected range for feed wheat, which is 12.3–14.7 MJ/kgDM.

Similarly, results from a FeedTest conducted at Hamilton, Victoria indicate that barley affected by frosting still had energy and digestibility levels within the expected range.

Crude Protein

Although not as critical as energy, the crude protein content of a feed grain should not be overlooked. Frosted grains appear to have higher levels of crude protein than unfrosted grains. This is because frosting tends to reduce or prevent grain fill (resulting in less starch), thereby increasing the proportion of protein-to-starch (energy) in the grain.

Table 1. Physical properties of the wheat samples used in the Wagga Wagga trial.

Wheat	Test weight kg/hL	Screenings g/kg	Moisture g/kg	Falling number[a] seconds	Frosted[b] %
Unfrosted	85.5	4	104	607	1
Lightly frosted	77.5	70	94	383	21
Severely frosted	62.0	105	98	296	80

a. ‘Falling number’ indicates whether grain is sound or has suffered some degree of weather damage. It was designed to detect flour milled from weather-damaged wheat – the lower the number, the greater the amount of weather damage.
b. Percentage of grains greater than 2 mm that were frost damaged.

Table 2. Estimated digestibility, energy and crude protein of wheat grain varying in degree of frost damage.

Wheat	Digestibility per cent	Estimated ME (MJ/kgDM)	Crude protein (Nx6.25) (g/kg)
Unfrosted	91	14.3	124.8 (12.5 % CP)
Lightly frosted	89	14.0	156.2 (15.6% CP)
Severely frosted	86	13.5	166.4(16.6% CP)

Frost Damage

Frost damage may significantly reduce the yield of the crop; however, the quality of the grain for livestock feeding is not always adversely affected. The severity of the frost and the stage of crop development will largely influence the extent of the damage. Temperatures from 0°C to -1.5°C (-3.5°C plant temperature) may result in frost damage, with lower temperatures causing greater damage. Cereal grains are most susceptible to frost during flowering, and remain vulnerable right through until the mid-dough stage.

A severe frost during grain fill may prevent a significant proportion of the sugars from being converted to starch; therefore, frost-damaged grain may have a higher sugar and lower starch concentration.

The fibre and ash content may be higher in frost-damaged grain, probably due to a higher proportion of seed coat and a lower proportion of endosperm in the frost-damaged grains.

Identifying frost damage

It may be some weeks after a frost has occurred before the full extent of the damage can be determined – particularly if the frost occurs at the early milk or watery dough stage.

Frost-damaged feed grains tend to have a smaller kernel than unfrosted grains, and are often described as ‘shrivelled’ or ‘ugly’. The weight of the grain and falling number test are good indicators of the extent of frost damage – assuming that no other factors have harmed the grain, such as disease or water damage.

Harvest, graze or bale?

Frosted cereal grains, depending on the extent of frosting, will usually be downgraded to feed grain; therefore, the decision on whether to harvest the crop for stockfeed, graze it, or bale it needs to be made. In some cases, depending on the topography of the affected area, a combination of the above may be the most cost-effective option. Grading the crop may be worthwhile, particularly when the extent of the damage is uncertain.

Where it is certain that a crop has been completely devastated, grazing or fodder conservation are the only viable options.

Limitations

One issue for producers and stockfeed manufacturers using frosted grains is the difference in grain size, shape and hardness. Adjustments to milling equipment – particularly the rollers – may be necessary to ensure that the frosted grain is adequately processed.

The evaluation of frosted cereal grain, at the maintenance level of feeding, is the accepted way to assess the nutritive value of these feeds for ruminants. The use of frosted grains for production feeding, or when fed ad lib, has not been quantified.

Costing damaged grain

When deciding whether to buy or feed frost-damaged grain, it is important to cost and compare its nutritional value with unfrosted or alternative feeds on an energy basis. This means calculating an equivalent price per MJ of ME.

In the trial conducted at Wagga Wagga, the severely frosted wheat contained 0.8 MJ ME less than the unfrosted grain. In valuing the grain on an energy basis – with an equivalent price per MJ of ME – a price penalty of about $9/tDM for the severely frosted wheat would be appropriate, if there are no further effects from the frosting.

Testing and comparing feeds

A feed test is necessary to determine the extent of frost damage, particularly any changes to energy or digestibility. This can be done by sending a sample of grain to:

Feed Quality Service
NSW Department of Primary Industries
Locked Bag 701
Wagga Wagga NSW 2650

in one of the sample kit bags available from any NSW Department of Primary Industries office.

These sample bags are postage prepaid, and payment by credit/debit card is available.

To readily compare the costs of different feeds, a feed cost calculator is available free of charge on the NSW DPI website:
www.dpi.nsw.gov.au/reader/choosing-feeds/dai201b

Further Information

For further information, contact your Livestock Officer through your local office of NSW DPI
www.dpi.nsw.gov.au/aboutus/about/office

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