Technical Note

Feed Dry Matter Testing

Why test Dry Matter?

Dry Matter (DM) refers to the weight of feed as harvested forage or silage after removal of all moisture, expressed as a % of the fresh weight. An accurate assessment of dry matter is important for three main reasons:

- Forages are often traded on a dry matter basis.
- Dry matter content is used to develop feed rations (along with other feed quality parameters).
- Dry matter content is required to measure herbage production per area from field plot trials.

Where forage is traded on a dry matter basis, there can be large financial transactions involved so it is essential that error in DM measurements is minimised. Error can arise from poor field-sampling technique, poor sub-sampling of material that is often not very uniform and inappropriate dry matter test procedure e.g. not drying fully.

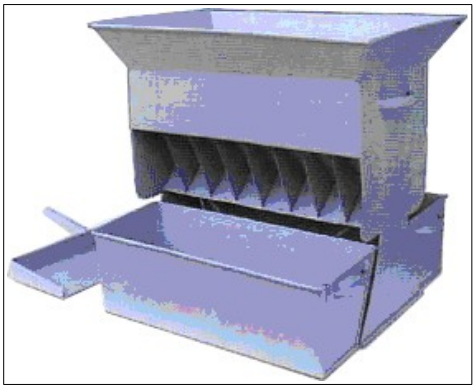
Field Sampling

Field sampling protocols have been developed by some industry groups (Ref 1) in order to achieve agreed levels of accuracy. Forage dry matter percentage varies according to paddock differences, plant variety, plant growth stage, plant part sampled, growing conditions and harvest process. Sufficient field samples to adequately represent the harvested crop should be combined and reduced to obtain a sub-sample to send to the laboratory. For sampling of baleage or silage a sampling auger is advised, whereby several plug samples are obtained and combined for one laboratory sub-sample. Hand-scoops of silage are adequate if sufficient are collected from a stack and if correct technique to minimise loss of grain or fines is adopted. Sampling from the edges of bales or stacks should be avoided as this material will have some deterioration and not be representative.

Sub-sampling

For ease of handling, approximately 1 kg samples should be sent to the laboratory for DM testing. Sample reduction can be done by either:

- Use of a riffle box splitter if available (Fig 1)



- or by combining collected material on a clean plastic tray (in a clean environment) and dividing by using the quartering technique. Mixed sample is spread evenly on the tray then divided into quarters; opposite diagonal samples are separated out and the remaining sample is re-mixed and spread then quartered again – this process is continued until a laboratory sample of ~ 1kg is achieved.

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The laboratory uses either of these techniques to reduce the sample size for the DM test. A minimum of 250-300g is advised for most feeds but 500g of maize silage (and other grain-based silages) is required due to the heterogeneous mix of the matrix. Sub-samples should be placed in solid plastic bags with air excluded and sealed well before sending by courier to the laboratory. Samples should be chilled if retained overnight.

Test Methods

Research has shown (ref 2) that there is no single dry matter method that will be an exact measurement for all feed types. However, standard oven-drying methods have been developed (ref 3) that compare very well with the direct measure of water by titration (Karl Fischer method) for most forages and have been adopted in commercial laboratories due to their ease of use and cost-effectiveness.

The method used by Hill Labs for all Feedstuff samples is oven-drying at 105°C for 24hrs (forced-air drying ovens).

Dry Matter (DM%) is then calculated as (weight of dry sample/weight of fresh sample) x 100.

For fermented silages, volatile acids and alcohols are lost during oven-drying and so corrections are made for this according to reference equations (Ref 4).

Accuracy

Quality systems in the laboratory mean that documented procedures are followed by trained staff using calibrated balances and drying-ovens. Laboratory error will in general be the lowest error when it comes to dry matter testing – field-sampling and subsequent sample handling have much larger associated risk factors but these can be reduced by following well-established principles. Accuracy will be improved by taking a sufficient number of field samples as shown in the following graph for maize forage sampling (Fig 2).

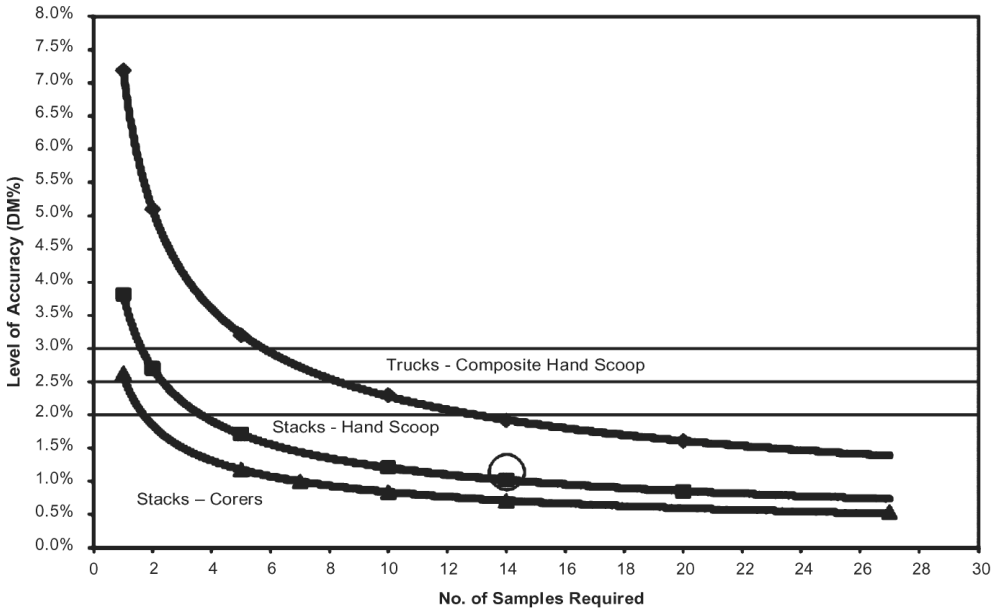

Fig 2. Change in level of accuracy with numbers of samples taken (adapted from Code of Practice for the Trading of Maize Forage, ref 1)

Samples received for DM analysis are often very heterogeneous due to variation in stem, leaf or grain content and the chopping method used at harvest. The laboratory attempts to minimise this variation by thorough pre-mixing and chopping larger sample pieces down to a uniform size where possible. Sending replicate samples and averaging the results is one way to overcome the innate variation for some sample types.

The following table shows a worked example of the financial impact with variance in measured DM from the 'true' DM for maize silage in terms of the grower return or dairy end user.

Difference from True DM%(1)	Difference in calculated DM yield (kg Dm/ha)(2)	Difference in return to grower ($/ha)(3)	Difference in value of forage to dairy end user ($/ha purchased) (4)
± 1.0%	± 571	± $91	± $229
± 3.0%	± 1714	± $274	± $686
± 5.0%	± 2857	± $457	± $1143

Table 1. The Impact of level of accuracy on returns to growers and dairy end users (adapted from FAR Code of Practice for the Trading of Maize Forage, version 1)

(1) Difference is taken from a true DM of 35%

(2) Base yield is 57,140 kg/ha wet weight, and 20,000 kg DM/ha

(3) Grower return is based on 16c/kg DM

(4) Calculated assuming 100g MS (Milk Solids)/kg DM consumed and a payout of $4.00/kgMS.

DM Losses in Silage

The above sections focus on sampling and testing of forage (particularly within the terms of the Code of Practice for Forage Trading).

It is important to understand however, that tonnes of dry matter harvested will usually be higher than tonnes of silage in the stack (and tonnes that will actually be consumed by cows).

This is due to the inevitable losses that occur during the ensiling process and the more manageable losses that occur once the stack is opened for feed-out. These losses can range from 10-20% and the obvious conclusion is that practices that keep these to an absolute minimum mean a higher resultant tonnage of silage.

The following table shows the range of losses possible in any silage – with some being more predominant than others depending on crop type. For instance respiration, fermentation and aerobic deterioration are the main culprits for maize, whereas wilting is a non-issue for this direct-cut crop and effluent not a big problem unless the maize was harvested at too low a dry matter (<30%).

Potential Losses During Ensiling	%
Respiration	1 – 2
Fermentation	3 – 8
Effluent	0 – 7
Wilting	2 – 5
Surface Wastage	1 – 10
Aerobic Deterioration	1 – 10
Total Losses	8 – 30+

Source: *Reducing the Cost of Silage* by Trish Lewis, (adapted from "The Silage Fermentation" by Dr Mike Woolford)

Practices to achieve a fast fermentation and effective stack management (harvesting at right time, set chop length according to DM, use of good inoculant, stack sizing, compaction and sealing of stack, management of face at feed-out) will help reduce these dry matter losses.

References

1) Code of Practice for the Trading of Maize Silage, Version1. www.far.org.nz

2) Haslemore, R.M., Warrington, I.J. and Roughan, P.G. *Influence of drying method and post-harvest conditions on total nitrogen, soluble sugar and starch levels in plant tissue.* NZ Journal of Agricultural Research 23 (1980): 355-9.

3) National Forage Testing Association Procedures Manual, Methods 2.1 and 2.2

4) Alderman G. 1993. Energy and Protein Requirements of Ruminants (An advisory manual prepared by AFRC Technical Committee on Responses to Nutrients). CAB International, Wallingford, UK. p45

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