Agriculture Notes

Dry matter content of conserved forages: Measurement of DM content

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This Agriculture Note discusses several options for measuring the dry matter content of material being prepared for or stored as conserved forage (silage, hay).

The sample taken for measurement must be truly representative of the material in the paddock or storage site. Refer to Agriculture Note AG…. Dry matter content of conserved forages: Representative sampling for guidelines to ensure sampling is truly representative.

Knowing the dry matter (DM) content of cut material in the paddock before and during harvest is essential. Silage has to be harvested and stored in the correct DM range for the specific type of silage being ensiled (forage harvested vs baled) to ensure a satisfactory fermentation quality and to avoid aerobic deterioration.

Hay must be cured and stored at minimum moisture levels to minimise continued respiration and to prevent mould growth and heating. If hay is baled too moist, or even if some bales contain pockets of moisture, plants continue to "live", ie. respire and cause some heating. Then heat resistant bacteria and mites activity commences and generates more heat and eventually, heat generating chemical reactions can result in spontaneous combustion (fire).

If forage is conserved too wet or too dry, both DM and quality is lost due to one or several of the following:- continued plant respiration, leaf loss and shatter, aerobic deterioration, poor fermentation, mould growth and heating.

Techniques for measuring DM content

The need and use of the DM content of standing, mown and stored material will vary according to the:-

- need for a rapid determination (eg. deciding when to harvest)
- accuracy required (egs. payment of contractors, selling of standing crop and forage)

There are currently four techniques for measuring the DM content of freshly mown and conserved forages. There are:-

1. Hand squeeze test
2. Micro-wave ovenr test
3. Moisture meters
4. Feed testing laboratories

1. Hand squeeze test

This is a quick and easy method to use in the field and, with experience or by calibrating yourself using the microwave test (see below), should be accurate enough for deciding when to begin to harvest silage, and when to stop. The Hand Squeeze test is more accurate for determining when to harvest silage than the "wringing" or "twisting" test often used for hay. Further aids for determining hay DM include the brittleness of stems, whether plant material is lifted when scratched and wrinkling of the plant nodes.

The Hand Squeeze test is suitable for pastures and most other crops in the vegetative stage such as lucerne and millet. However, it may not be suitable for thicker stemmed crops such as sorghum and cereal crops after the stem elongation stage.

The method involves:

1. Collecting the representative sample of material.
2. Mixing and sub-sampling if excess is collected.
3. Cut the forage into 1 – 3 cm lengths to allow some moisture to escape from the plants.
4. Very tightly squeeze a handful of the sample into a ball for at least 30 seconds, preferably longer. See Figure 1. Do not release the pressure over this period.

Figure 1 Hand squeezing silage sample. Moisture on fingers.

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5. Open your hand quickly and observe how quickly the ball opens out and how wet your hand is.
6. Estimate the DM content from Table 1.

Table 1. "Hand squeeze" technique for estimating DM content

DM content	Ball shape and hand moisture observations
Below 25%	Ball holds its shape. Free moisture runs through fingers. Lot of free moisture on hand.
25% – 30%	Ball just holds its shape. No free moisture runs. Hand is moist.
30% - 40%	Ball falls apart slowly. No free moisture. Little moisture on hand indicates lower end of range. NO moisture indicates higher end of range
Above 40%	Ball springs apart quickly

Note: At the same DM content, stemmy forage will tend to feel drier than leafy material, eg. lucerne and grasses will feel drier than white and sub clovers. Also forage with surface water (dew, rain) will feel wetter than it actually is.

2. Microwave oven test

This method will provide a reasonably quick (5 – 30 mins.) measurement of DM, depending on how wet the sample is. Experience in using the oven for this purpose will soon reduce drying times to the minimum required. The final result should be accurate to within 1% – 3% percentage units but is less accurate for very dry samples, ie. above about 80% DM such as baled hay.

Required is a microwave oven with at least 500 watts, suitable microwave proof container (preferably flat), scales that will measure accurately to at least the nearest gram, glass and supply of cold water, a calculator.

Follow the following procedure:-

1. Follow points 1 and 2 of the above method.
2. Cut the forage into lengths of 1- 3 cm, the shorter the better for more accuracy.
3. Tare the container or record its empty weight if a tare option is not available.
4. Place a glass of water in the back corner of the microwave oven. This helps to reduce the odour produced and minimises the possibility of the sample catching fire in the later stages of drying. If the sample is reasonably wet (<25% DM), then the glass of water may be left out for the first drying down phase.
5. Weigh between 100 - 500 grams of material. Record this as the **initial wet weight**. The arithmetic is greatly simplified if exactly 100 g is weighed out.
6. Place the sample in the oven and dry for several minutes. For a wet sample (wilting material which is still green and obviously containing a lot of moisture, <25% DM), use full (high) power for 3 to 5 min. intervals initially. This period will be affected by chop length, sample size and initial DM content. Total drying period may be 8 – 12 mins. but longer until experience in the method is gained.
7. After the initial drying, reweigh the sample and record the weight to the nearest gram. Turn and fluff up the sample and replace and reheat for a shorter time on a lower power setting. Replace the water when it becomes hot.
8. When the difference in recorded weights are becoming much smaller, dry for 20 - 30 second periods. Change water.
9. When the sample weights do not alter after a couple of drying periods, it should be 100% dry (within 1 – 3%). This is the **dry weight.** If the sample chars or burns, use the previous weight. Don't forget to allow for the plate weight if the scales were not tared originally.
10. See Table 1 to calculate the DM content.

Table 1. Calculation of dry matter content

$$\frac{\text{Final Dry Weight (g)}}{\text{Initial Wet Weight (g)}} \times 100 = \ldots\ldots\ldots\% \text{ Dry Matter}$$

Eg. 1. $\frac{35g}{100g} \times 100 = 35\%$ DM

Eg. 2. $\frac{53g}{122g} \times 100 = 43.4\%$ DM

3. Hay Moisture meters

Forage moisture meters were initially designed for testing the moisture content of hays. However some manufacturers have further developed their moisture meters to measure a wider range of moisture contents. Some now claim that their meters can measure DM contents in the silage range although they also state that the accuracy, at best, may be within approximately 3%.

Accuracy of their readings could be checked with a microwave oven test, remembering that these also have an accuracy of within 1 – 3%. Ultimately an accurate moisture (or DM) test using a feed testing laboratory would be the most accurate method of verifying a moisture meter reading.

4. Feed testing laboratories

The DM of samples can be very accurately measured at Feed testing laboratories or other facilities using proper forage drying ovens. Unfortunately there will usually be quite a delay between sample submission and reporting of results due to a 24 hour period of drying required, plus the presenting of the report via fax, phone, email or post.

However, their accuracy could be used to determine the future use of the moisture meter and whether some allowance or adjustment should be made for the meter readings.

The lab test could also be very useful for verifying the "hand squeeze" test or whether your interpretation of the "hand squeeze" test needs modifying.

However, when doing any of the three on-farm moisture tests, several samples or measurements need to be taken and the decision based on the average. Unfortunately, the expense of laboratory tests may preclude submitting the

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required number of samples to determine an “average” reading.

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