

What really affects the curing rate of hay?

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For each 1 tonne of hay cured down to 12 per cent moisture content, about 1.7 tonnes of water must be removed! The quicker this occurs, the lower are the dry matter (DM) and quality losses due to plant respiration initially, and microbial activity in the latter stages of curing.

We need to dry down hay as quickly as possible to reduce the above losses but equally important, to reduce the potential damage caused by rain. Losses due to a heavy down pour are bad enough but are much worse in extended showery weather.

So what factors influence the curing rate and what can we do about these?

1. Physical form of the forage: Leaves dry faster than the stems and nodes so stems should be crushed or crimped by a conditioner to speed up their curing compared to the leaves. If possible, try to leave the majority of the stems near the top of the swath and leaves the facing downwards if using a roller mower-conditioner.

2. Temperature: As temperature rises from 5⁰C to 30⁰C so does the curing rate, but its relative impact is marginal compared to other factors described later.

3. Sunshine and Wind: As the amount of solar radiation (sunshine) increases the curing rate is only slightly affected. However, wind makes a very large difference. A combination of sunshine and even a light breeze is best because the moving air takes the evaporating moisture away from the windrows, allowing more moisture to escape.

4. Humidity. As hay dries down, the water evaporates out of the stems and leaves and the humidity rises to 100% humidity very quickly close to the plant material in the windrow. Slight or high wind speed will remove this “wet” air and replace it with low humidity or “drier” air, which allows continued curing.

Humidity is the second to wind as the most important factor in curing hay. If the relative humidity (RH) is at, say 60%, the driest that a hay can be harvested at is approximately 16% moisture no matter how hot or how windy or how sunny. There will be minimal drying until the RH drops to below 40%, if the target moisture is 12%.

If the crop has been windrowed and the RH is not likely to decrease, consider applying a hay preservative.

The effect of a 20% change in curing rate on a crop of lucerne (Figure 1) indicates the following:

- Increasing the temperature by 20% had some difference
- Increasing wind speed by 20% had a major effect
- 20% more sun increased drying only slightly
- Decreasing the humidity almost doubled the drying rate on lucerne

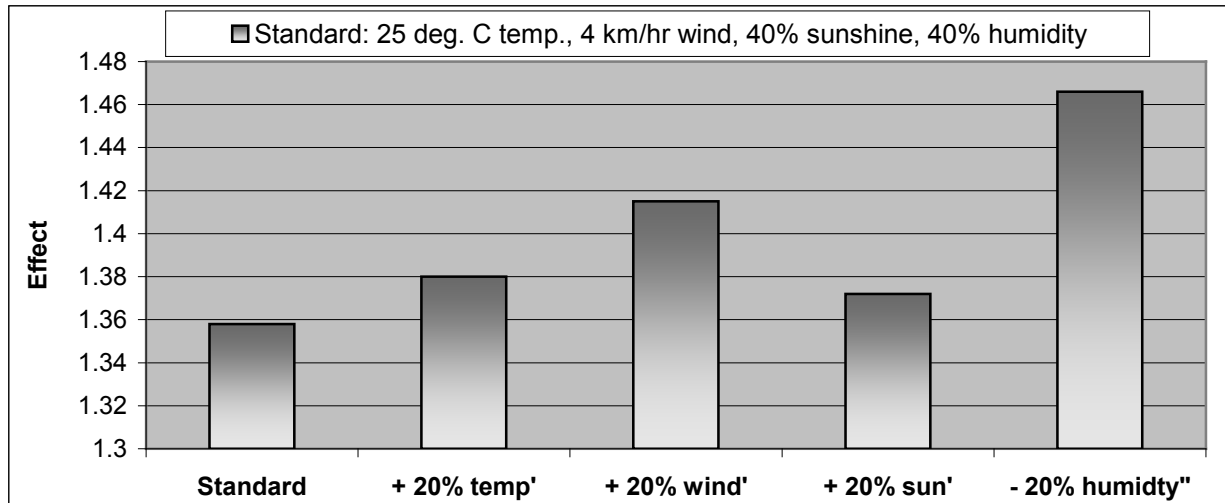


Figure 1. Effect of 20% change in weather on curing rate

Source: Dan Undersander. University of Wisconsin

5. Options to increase curing rate.

a. Drying agents. Potassium carbonate can increase the drying rate of lucerne, but not grasses, by spraying it onto the plant stems at mowing. The chemical breaks up the outer waxy layer of the plant stems allowing a faster water movement outwards. The better the coverage, the more even and quicker the drying rate.

b. Hay conditioning and tedding. Roller-type mower-conditioners and conditioners break the waxy layer of the stem to increase curing rate. The research shows little difference between steel or rubber rollers. The spacing should be set per machinery guidelines to ensure enough crushing of the stems for increased drying. Two settings are used: roller pressure and roll spacing. Usually altering one setting requires the adjustment in the other.

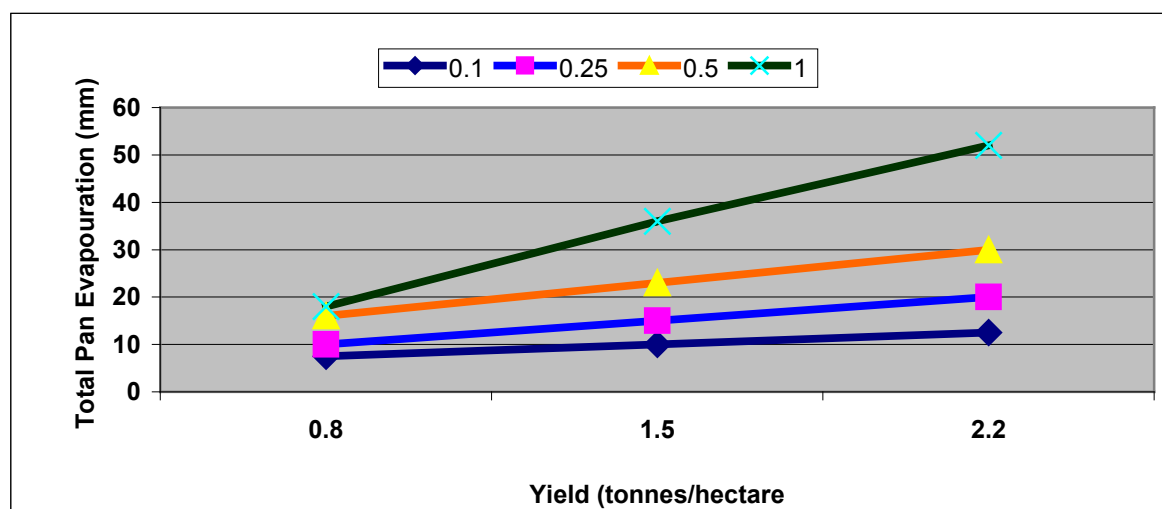
This type of conditioner is most suited to larger stemmed plants such as lucerne and sorghums.

Flail type conditioners tend to bruise and crimp the stems and leave fluffier windrows than the roller types. This type is more suited to smaller stemmed species such as pastures.

Super conditioners, albeit expensive to buy and operate, will increase drying rate at a greater rate than conditioners only in most situations and extreme caution is needed in leguminous crops, in particular.

Tedding will greatly assist by spreading the material over 100 per cent of the ground thus leaving a much less dense swath which will dry quicker. A fear of using a tedder is that more hay will be bleached compared to conditioners. Tedding immediately after mowing will increase the drying rate by up to 20 – 30% compared to conditioning in many crops. Tedders are not so beneficial in heavy crops and large stemmed species or where there is a danger of picking up soil through the tedding itself.

c. Windrow Management. The wider the windrow is left, the more rapid is the rate of curing due to solar radiation and wind action on the forage (Figure 2). However, this effect is significantly more so as the crop yield increases and the windrow are left wider at mowing. In Figure 2, the windrow width of 1.0 is where the forage was dropped at full width. A windrow at 0.5 represents the 50 per cent of the mower width being covered and 0.25 is 25 per cent and common for many hay bines. 0.1 is only 10 per cent of the cut area.



Source: Dan Undersander, University of Wisconsin

Figure 2. Evaporation required to dry down from 80% to 20% moisture with varying windrow width

d. Soil Moisture. When soil is damp, capillary action moves moisture up into the drying forage as it is drying. This results in dry material in the middle and top of the windrow, but still wet at the bottom. Ideally do not cut when the soil is wet, or leave a higher stubble to keep material off the ground. This avoids most capillary movement and also allows for better circulation of air around the windrow. Cutting higher will reduce yield slightly but may also increase quality very slightly.

e. Effect of wheel traffic on yield. Wheel traffic can cause potential damage to the next cut of lucerne, in particular, due to stem breakage. The longer the curing period and possibly increased number of passes by tractors and equipment over all the harvesting activity such as mowing, raking, baling and cartage, the greater is the amount of potential stem breakage.

Unfortunately, no research of this type has been carried out in Australia. In the USA, research has measured 30% reduction in yield of the following crop five days after mowing, and in some incidences as high as 70%. Up to 50% of plants will be affected by wheel traffic.

A three year study in Wisconsin also found major differences between lucerne varieties in their ability to withstand wheel damage. Twenty varieties were studied and reduction in yield range from 1 to 18% although, in another study involving six USA states, the reduction ranged from 0 to 52%. The researchers concluded that a yield reduction in the follow up crop, due mainly to stem breakage, will be about 7% per day for each you wait to bale after cutting.

Pasture plants have not been measured and yield reduction could be expected to be at much lower levels.

To reduce yield losses due to wheel damage in practical terms, if possible:-

- Use the smallest tractor with duals wheels removed, front end loader off, etc.
- Merge windrows where possible to reduce baler and cartage travel
- Use larger equipment
- Take the most direct route to the gateway, next bales to be loaded, etc.

Summary to increase curing rate

a) Rapid curing

- i. Reduce respiratory losses, improved yield and nutritive value
- ii. Reduces risk of rain damage
- iii. Increases yield at next cutting

b) Management to increase curing rate

- i. Cut higher to keep windrow off the ground
- ii. Use drying agent on lucerne
- iii. Use conditioners and leave wide windrow as wide as possible
- iv. Use tedder immediately after mowing, rake into windrows a day or so later
- V. Rake at 40% moisture