

## DRYING HAY

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The need for rapid wilting or drying of forage crops in the field is widely recognized. The plant structure, swath structure (wet soil under the swath slows drying by allowing moisture to move into the swath), and soil/weather conditions all restrict drying. In the Midwest, weather is often the most restricting factor. Of all weather influences, solar radiation level is the most important since the sun's energy is required to evaporate and move moisture out of the plant. Drying of hay requires the removal of about three tons of moisture for every ton of hay, requiring 7 billion joules of energy (the equivalent of 70 gallons of fuel oil). Warm air temperature and low humidity also aid drying.

While the crop is drying in the field, dry matter losses and quality changes occur, including plant respiration, rain and machine induced losses. Plant respiration is a natural process which continues after the plant is cut. Respiration converts carbohydrates stored in the plant tissue to carbon dioxide, heat and moisture, causing a DM loss. Plant respiration ceases when the crop dries to below 40% moisture, so rapid drying early in the field curing process can reduce this loss. Since this loss is primarily readily digestible carbohydrates, the loss increases the fiber content and reduces the energy content. Losses range from 3-15% depending on drying conditions.

### MAKING THE WINDROW

There are two things growers can do with their existing equipment to improve drying rate. First, make a wide swath at cutting and then rake into a windrow immediately before chopping or when the hay is at 40% moisture. The graph shows how much water must be evaporated to dry hay to 12% moisture at different windrow widths. Hay will need half as much pan evaporation (dry twice as fast) when it covers the entire cut area (windrow width/mowed width = 1) as compared to covering one fourth of the cut area (e.g. a 12' swath vs. a 3' wide windrow); this is the most important thing a farmer can do to make hay dry faster.

Second, keep the windrow off the ground while it is drying (though often forgotten, this can make a big difference). When the windrow is on the ground (especially wet ground), it will soak up moisture from the soil. When the windrow is off the ground, wind can blow underneath it and increase drying rate. Keys to keeping the windrow off the ground are having a dense stand (large number of cut stems will hold the windrow up) and being careful not to force the windrow down into the cut stems with rakes, inverters, etc.

As the top of the forage swath dries more rapidly than the bottom, the drying process can be sped up by moving the wetter material to the upper surface (Rotz, 1995). Swath manipulation can also improve drying by spreading the hay over more of the field surface, increasing exposure to the radiant solar energy and drying air. There are three operations used in haymaking to manipulate the swath:

**Tedding.** Tedding can be used anytime during field curing, but is best to do so before the crop is too dry (above 40% moisture content). Stirring or fluffing the forage typically reduces field-curing time up to half a day. Tedders are sometimes used to spread a narrow swath (formed by the mower-conditioner) over the entire field. If done shortly after mowing, the average field-curing time is reduced up to 2 days. Tedding also tends to create more uniform drying, reducing swath wet spots.

Disadvantages include increased losses and increased costs (i.e. fuel, labor, machinery). When done on a relatively wet crop (>50% moisture), the resulting loss is less than 3%; however, applied late in the drying process, loss can be greater than 10%. Tedding will also increase raking loss. When a light crop (less than 1 ton/acre) is spread over the field surface, raking loss can be more than double that when raking narrow swaths. Spreading the hay may promote bleaching of hay color which does not affect the nutritive value but often affects the market value. When comparing tedding costs to benefits received, routine tedding is difficult to justify, particularly for alfalfa. Occasional use under difficult drying conditions may bring greater economic benefit.

**Swath Inversion.** Swath inversion machines gently lift and invert the swath, exposing the wetter bottom which speeds drying, reducing the average field-curing time a few hours. Swath inversion is not as effective as tedding, but shatter loss is very low. With less drying benefit, there is less potential for reducing rain and respiration losses. The added labor, fuel and machinery costs of the operation are generally greater than the benefit received.

**Raking.** Raking tends to roll the wetter hay from the bottom of the swath to the outer surface of the windrow, which improves drying. Following the initial improvement, increase in swath density can reduce drying rate, making the crop moisture content at raking important. Raking also causes dry matter and quality loss which relates to crop moisture (2% when wet to 15% in very dry alfalfa). The best moisture content to rake for low loss and good drying is between 30-40%. In dry weather periods, hay can be raked in the evening or early morning when leaves are moist and less prone to shatter. Raking at the proper time can reduce field-curing time a few hours to allow an earlier baling start.

The best recommendation is to dry hay rapidly, using mechanical conditioning and spreading high-yielding crops into wide swaths. Tedding may be useful in drying grass crops, but it should be avoided with alfalfa, particularly after the crop has partially dried. In silage making, drying is less critical. Wilting in narrow swaths can reduce raking loss, particularly for low yielding harvests. Raking can be used to improve harvest capacity. A substantial economic benefit can often be obtained by rolling swaths together to allow large balers or forage harvesters to operate more efficiently.