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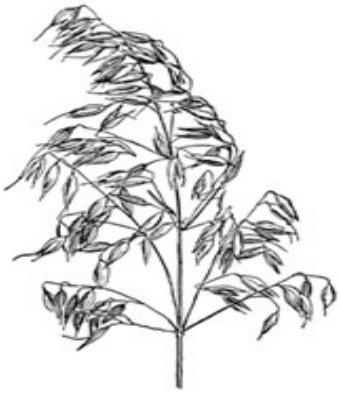

"It is the crops that feed the cows that make the milk which creates the money."

Advanced Ag Systems
Research, Education, Consulting

Same Day Haylage
And 300 More Pounds of Milk In Every Ton Of Dry Matter

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Traditional haylage is cut directly to narrow windrows; allowed to set for 2 – 3 days drying, and then chopped. It is dry as baled hay on the outside and wet as fresh mowed on the inside. This appears practical, but it flies in the face of how forages dry for silage and **exacts a high price in digestible components you have lost**. The farms using this traditional system are making haylage by composting methods.

Silage does not dry the same as hay. The factors that affect the drying of forages are assumed to be the same from start to finish. **This is not true.** Drying occurs in three phases. Phase I is a very rapid loss of moisture down to 60 – 65% moisture (35 to 40% dry matter), the level at which silage is made. Phase II is a slower process, down to approximately 40% moisture. Phase III is the longest phase with moisture levels ultimately safe for storing dry hay.

Phase I At the start of drying, moisture moves **along the stem and through to the leaf** as the primary pathway in the early stages of drying. It is driven by **leaf photosynthesis** that directly converts moisture into milk-supporting digestible carbohydrates. At least 35 - 40% of the moisture contained in the alfalfa stem at cutting exits the plant through the leaf by photosynthesis during field drying. This is similar for grass leaves. The younger and more tender the plant, the more moisture is removed through the leaves. The more the leaves are exposed to the sunlight, the more moisture is used by photosynthesis. The more the leaves are attached to an undamaged stem, the greater the volume of moisture removal throughout the whole plant.

Phase II is a drier moisture than that at which silage is made. This loss of moisture out through the side of the alfalfa stems is 10X less than the movement along the length of the stem and out through the leaves. Breaking the epidermis by conditioning can increase the drying rate for below 50% moisture in the forage. This middle stage of drying is more typical of the popular understanding of the mechanism of drying, with heavy reliance on mechanical conditioning. It is only beneficial at moisture levels at dry hay levels. It is counterproductive for silage.

Phase III This removes the tightly held water. Phase III is well below 50% moisture and continues until forage is dry enough to store for hay. It is highly dependent on weather conditions.

The **primary method for moisture loss is through the leaves by photosynthesis**, and secondarily, from evapotranspiration through the stomata. Photosynthesis is where the plant, when exposed to sunlight, takes carbon dioxide from the air and water from within the plant, to make highly digestible carbohydrates and oxygen that we breathe. It removes moisture at an incredible rate. On a sunny day, haylage can get to over 40% dry matter in 2 hours. Stomata are pores in the plant leaf where carbon dioxide and oxygen can freely pass, and moisture, drawn from the stem, can also leave the plant. Stomata respond to light, temperature, water availability, and other stimuli. They close at night or in the shade of a narrow windrow and open during the day and sunlight. Closing shuts down photosynthetic drying. For this reason, Whitney et. al., 1969, found the drying rate of intact forage plants is considerably greater than that of equivalent amounts of detached leaves and stems. Plant moisture is 57 – 65 % (35 – 43% dry matter) at stomata closure, well within the range for making excellent silage. Thus, **loss through photosynthesis and the stomata is THE PRIMARY MECHANISM for reducing plant moisture to silage-making levels**. Rotz, 1995, found field curing is relatively inefficient compared with the natural evapotranspiration of the crop.

Traditional haylage making focused on field curing based on old dry hay practices, to the detriment of highly effective evapotranspiration. Mowing into narrow swaths immediately shaded the majority of the forage, stopping the rapid moisture loss from photosynthesis and closing the stomata rather quickly. Both stop the primary mechanism for moisture loss in silage and lose feed value through respiration. Spreading the swath to the full width of the cutterbar maximizes exposure to sunlight. Sunlight interception is critical to drive photosynthesis, which uses up moisture at a very rapid rate. Leaves exposed to light consume and lose moisture quickly. This is the most critical factor in accelerating drying for silage. Sunlight keeps stomata open until moisture falls below silage levels. Laying a cut swath at **greater than 85%** of the cutterbar width in our research **received three times more sunlight** than the narrow swath. This both stimulates moisture loss from the plant growing, increases the plant's feed quality by producing digestible components, because of the greater leaf area subjected to incoming radiation.

Traditional mowing to a narrow swath accelerates the negative effect of shading in narrow windrows. Even worse is the conditioning which was developed for dry hay. It breaks the capillary flow from the lower stem to the leaves due to mechanical crushing. **Conditioning is counterproductive for drying for silage.** Tine conditioners are even greater horror shows because they not only break capillary flow in the stems but also remove the leaves, which are the critical site for converting water into carbohydrates. **Conditioning reduces drying for silage**. Adding insult to injury, conditioning is not very effective on 3rd, 4th, and 5th cutting with their smaller diameter stems. Adding to the negative effect is the density of the narrow swath. Laundry does not dry in a pile, nor does haylage. The rate of water loss was dependent on the weight of grass per unit area of ground, and Wright et al. 1997, found this factor had a greater impact on the rate of water loss than conditioning, mixing, or turning the mown swath. The narrow swath covered 18% of the ground compared to almost 100% for the wide swath. This resulted in a narrow swath that was 5.5 times denser than the wide swath.

How you dry directly affects forage quality reaching the cow, by impacting water-soluble carbohydrates (energy) in silage. Immediately after cutting, the plant tissue continues to respire until the cells are no longer alive. The greatest change that occurs is the respiration loss of carbohydrates (Nel). This highly digestible material makes even small respiratory losses important, representing about 14% of the total dry matter losses for wilted silage. Under wet and humid conditions, respiratory losses may be 15% - 30% of the initial dry matter. This condition exists in the center of a narrow swath of haylage in the field. The better the forage quality is, the greater the respiration losses. Respiration ceases when the dry matter reaches 35 – 40%. Each hour the silage sits in a narrow windrow in the field, you are losing energy. Simpson found that **crushing** actually **increased the respiration rate of alfalfa 15%** higher than uncrushed stems. Respiration occurs whether the plant is in the sun or in the shade. Tine conditioner impact adds the insult of stripping leaves, which have the most digestible components and do the most drying. As mentioned above, the wide swath has more than three times as many plants exposed to sunlight. Thus, in a **wide swath, they can actually gain milk producing carbohydrate from photosynthesis more than that lost by respiration**. This reduction of respiratory loss by photosynthesis ceased when the forage reached 40 - 50% DM, past the time to chop for silage. Cutting in the evening in order to have higher sugars in the forage does not work in the humid east, where nighttime maintains the swath at 100% humidity, thus prolonging respiration.

The author's field research found the **narrow swath decreased in potential milk production** (as measured by Milk 2000) from the time it was cut until it was dry enough to chop for silage. **The wide swath consistently INCREASED potential milk production/ton dry matter** as photosynthesis produced readily digestible carbohydrates in excess of that consumed by respiration. The majority of this showed up as starch rather than sugars (starch is composed of 2,000 to 200,000 sugar molecules). Owens et al 1998, further found that starch levels decreased by 57% in red clover and 56% in alfalfa during narrow wilting. This is a significant loss of readily digestible carbohydrates between mowing and ensiling. It reflects what the author found in the consistent loss of milk where narrow swath forage had to stay in the field overnight until it achieved moisture levels necessary for ensiling the following day.

Owens also found that 73 to 94% of the sugar in wilted forage was used during ensiling. The majority of starch was degraded during wilting rather than during ensiling. Prolonged wilting from narrow swaths and conditioning can reduce the concentration of sugar to levels below that required for successful fermentation, thus causing a change in the concentration and distribution of fermentation products in the silo—the ratio of lactate to acetate. We found that the wide swath consistently had better lactic to acetic ratios than the narrow swath. Thus, prolonged wilting may further reduce silage quality and bunk life from narrow swaths. The loss of sugar substrate allows Clostridia to ruin the feed value and increase butyric acid in the forage. A proper inoculant added at the chopper will also reduce this from happening as long as there is sugar substrate. This followed through to feeding in that fermented samples from rapidly dried **wide swath contained 300 more potential pounds of milk/ton of dry matter than the forage produced by the slower drying narrow swaths.**

FIELD RESULTS: Research has clearly shown that wide swath can produce proper moisture for haylage (<68% moisture) in an hour for first cut grass and two hours for first cutting alfalfa. The mower that dried the fastest was the sidebar sickle mower. NO, we are not recommending going back to sidebar mowers. You need to adjust today's mowers to lay a uniform swath >85% of the cutterbar. What this does show is that for silage swath width matters more than anything for rapid dry down. It also clearly shows that conditioning is NOT needed and does NOT help the phase I dry down for silage.

Bottom line: Width matters more than conditioning for silage. You are not getting the majority of the wide swath benefit unless your mower leaves a swath greater than 85% of the cutter bar width. If your mower does not allow this, then open it as wide as you can to achieve as much drying benefit as possible (until you can get the right mower). If you have a 13-14 foot mower that can only leave a swath of 6 feet, then the added cost of tedding will be beneficial until you can trade in for the proper mower. Some farmers have added bars to the back of their mowers in order to re-spread the swath to the full width of the cutter bar. On triple mowers, remove all deflection shields, especially those at the front of the machine. Yes, you drive on a small portion of forage, but cutting at a 3 – 4 inch height raises the forage back off the ground after the tractor passes. The final caution is if you utilize the double or triple windrow aspect of managing wide swath. The silage will come in much faster than ever before. You will need to upgrade the tractor weight on the silo to keep packing at the correct level. If not all the savings in wide swath forage quality will be lost by spoiled silage from insufficient packing.
Note: this system will not work if there is no sun!

Sincerely,

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