

## ALTERING WINDROW WIDTH TO HASTEN CURING

Steve B. Orloff<sup>1</sup>

**Abstract:** Accelerating the drying rate of alfalfa has several potential benefits for California alfalfa growers. Data from several tests conducted in different areas of the country demonstrate that the drying rate of alfalfa can be accelerated by laying the alfalfa in a wider windrow than those customarily used. The use of a wide windrow reduced the time from swathing to baling by over 40% in two California studies. Swathers are now available with nine foot conditioners that enable growers to take advantage of more rapid curing with wide windrows.

**Keywords:** Alfalfa (Medicago sativa L.), Drying rate, Swather, Baling

### INTRODUCTION

The process of making baled hay is considered by many to be as much of an art as it is a science. Environmental conditions vary between seasons, and even from day to day, making baling conditions different each time. With these diverse conditions, it becomes difficult or impossible to develop a single "correct" system for making baled hay.

In general, we in California are blessed with weather conditions favorable to making baled alfalfa hay. In contrast, the conditions in many midwestern states are far from ideal. The relative humidity in the midwest is typically much higher than in California, and the likelihood of receiving rain while the hay is curing is far greater (as great as a 75% chance of hay being rained on in some areas). For this reason, most of the research on the "science of hay making" appears to have been conducted in the midwest. However, this does not mean that we in California could not also benefit from improved hay-making procedures.

A critical phase of the hay-making process is the curing phase which involves drying the cut alfalfa from a moisture content of approximately 80 percent down to approximately 16 percent or lower. Hay in California is usually baled anywhere from three to ten days after cutting, with probably four to six days being common for most of the year. If the number of curing days could be reduced, several benefits would occur. These advantages are enumerated and described below.

#### Advantages For Reducing Field Curing Time For Baled Alfalfa Hay

1. Reduction in respiration losses.
2. Lower probability of rain damage.
3. Reduction in the effects of windrow shading of alfalfa regrowth.
4. Minimization of the negative effects of wheel traffic on alfalfa regrowth.
5. The field can be irrigated sooner after cutting.
6. Avoidance of excessive leaf loss that can occur when alfalfa is left in the field to cure for long time periods.
7. Reduction in the amount of bleach that occurs, thereby retaining more of the green color.

Losses due to respiration are a factor that is often not considered. The alfalfa plant continues to respire after it has been cut until the plant dries down to approximately 40 percent moisture or lower. Respiration losses reported in the literature vary. One research study reported 3% dry matter losses occurring during the curing process, while another showed an overnight dry matter loss of between 7.2 to 11%. Respiration losses vary with both temperature and humidity. However, it is logical to assume that respiration losses could be lessened by reducing the amount of time required for the moisture content of the alfalfa to fall below 40 percent.

<sup>1</sup>Farm Advisor, UC Cooperative Extension, Los Angeles and San Bernardino Counties

Rain damage is not the common occurrence in California that it is in many other states, but nonetheless it does occur. Obviously, the likelihood of rain damage would diminish if the hay curing process was accelerated.

All alfalfa growers have observed the weakened and yellow appearance of alfalfa regrowth where a windrow laid. The effect of windrow curing time on alfalfa yields was quantified in some research conducted in Nevada (Table 1). Alfalfa yields were compared where windrows were and were not present. An average of four years of data showed a yield loss under the windrow of 5.0, 7.0, and 18.0 percent for two, four, and eight day curing times, respectively.

Several presentations have been given at the alfalfa symposium on the effects of wheel traffic on alfalfa yields and stand persistence. One of the primary negative effects of wheel traffic is the impact on regrowth shoots. A reduction in curing time would mean less traffic damage to the regrowth shoots. These, plus the other benefits mentioned above, demonstrate the distinct advantage of accelerated drying rates.

A simple practice to reduce the curing time is to lay the cut alfalfa in a wider swath. In an article written by Dwayne Rohweder et al. an analogy was drawn between hay curing and drying clothes. "Clothes will not dry when they are piled in the laundry basket; they need to be spread out on the line. In the same way, a narrow, thick windrow will not allow hay to dry as rapidly as will a wide, thin one that exposes more of the forage to sunlight and wind." In a study conducted in Wisconsin, a narrow windrow had a moisture content of 67 percent, whereas, the wider windrow (twice as wide and half as thick) had dropped to a moisture content of only 25 percent in the same time period.

Studies comparing windrow widths have also been conducted under conditions more similar to those found in California. John Arledge, from New Mexico State University, compared drying rates of alfalfa harvested with the New Holland 1499 mower conditioner (Haybine) to hay harvested with a conventional Case 560 swather windrower. The Haybine deposited the 12 foot swath in a windrow 9.5 feet wide, while the conventional swather deposited the 12 foot wide swath in a 3.5 foot windrow. Alfalfa cut with the Haybine dried significantly faster than the conventional swather (Table 2). Approximately 32 hours after cutting, the Haybine-cut alfalfa was at 16% moisture, while the conventionally-cut alfalfa still contained 44% moisture.

Similar results were obtained in a study conducted in Fresno County by Bob Sheesley. The study was conducted during the first hay cutting. A 14 foot conventional swather crimper was compared with a swather with full-width conditioner. The alfalfa laid in the wide windrow with the full width conditioner was raked in 2.5 days and baled in 4.5 days. In contrast, the conventional swath was not ready to rake until the 5th day, windrow turned on the 7th day, and baled on the 9th day.

#### MATERIALS AND METHODS

A study was conducted this summer in the high desert of San Bernardino County (Newberry Springs) to determine the feasibility and potential advantages of using this wide windrow system in an extremely arid environment. The trial was conducted during the 5th cutting (August 31 - Sept. 3). The field was circular, irrigated with a center pivot irrigation system. The plots were concentric windrows in the 2nd and 3rd to the last spans of the center pivot. The alfalfa was mowed with either a conventional 16 foot swather, or with a pull-type Haybine with a 12 foot header. The conventional swather produced a 3.5 foot windrow and the Haybine produced a 6 foot windrow. (Though the Haybine had a narrower header than the conventional 16 foot swather, the windrow drying rates could be compared, as the windrow thickness with the Haybine was comparable to that which is formed with wider Haybines.) Eight windrows were made with each swather. Each windrow was considered a plot or a replicate. The plots were mowed between

11:00 am and noon. The windrows made with the Haybine had dried sufficiently so that they could be raked and combined that evening, approximately eight hours after mowing. Half of the conventional windrows were raked and combined the following morning, and the other half were left to be baled directly out of the windrow, the standard practice for the area. In these arid conditions, there was no significant difference in the drying rate between raked and non-raked windrows for the conventional windrow. Therefore, data for the raked and non-raked conventional treatments were averaged. The drying rate was determined by hand cutting a one foot wide slice across the entire windrow. The sample was placed in a paper bag, and then in a plastic bag. The samples were then oven dried to determine the moisture content. Windrows were sampled in the morning (approx. 7 - 8:00 am) and the evening (approx. 7 - 8:00 p.m.).

## RESULTS AND DISCUSSION

Alfalfa mowed with the Haybine and laid in the wide, thin windrow dried significantly faster than the conventional windrow (Table 3). The wide swath averaged 47.6 percent moisture approximately 8 hours after mowing, compared to 65 percent moisture for the conventionally mowed plots. The same difference was apparent the following morning, when the wide windrows were at 35 percent moisture compared to 59 percent for the conventional windrows. The wide windrows were baled in the evening the day after cutting (32 hours after cutting). The conventional windrows were baled on the third morning after cutting, but could have been baled the previous evening (56 hours after cutting). The wide windrows dried to a moisture content suitable for baling about 40 percent faster.

Many would question the advantage of reducing the curing time in an arid area where there is often insufficient dew moisture to bale. The hay seems to dry too fast already. The main objectives sought after with faster curing is not solely rapid drying, but uniform drying as well. Studies have shown that the moisture content of hay on top of the windrow may be as low as 10-15%, while areas within the windrow may have moisture contents as high as 60-70%. The main limiting factor as to when a windrow is dry enough to be baled safely is not the average moisture content of the windrow, but rather, the moisture content of the wettest portion of the windrow. Probably every hay grower has experienced "slugs" in a bale. The wide windrows not only dried faster, but they appeared to dry more uniformly as well. The conventional windrows averaged slightly less than 16% moisture the evening after cutting and the following morning. However, they were not ready to bale as there were still uncured areas near the center and the bottom of the windrow. While waiting for the uncured portions of the windrow to cure, the average windrow moisture content had dropped to 8.4 percent by the time the alfalfa could be baled (too dry to bale without significant leaf shatter).

Our eventual goal is to produce "hay in a day" -cut one morning and bale the next. Judging from these preliminary results, it appears that this will be achievable. This trial was conducted August 31 through September 3 after the summer weather had cooled. Also, the field was cut near noon. Perhaps if a wide windrow was used in mid-summer, and if the field was cut earlier in the day, it would be possible to bale hay in a day, though, this may necessitate the use of a hay preservative. If a preservative is needed, it is believed that it would be more effective with hay at a uniform moisture content that is slightly above the customary safe level than it would be on hay of highly variable moisture. The combination of a wide swath and a preservative may prove to be the solution to the leaf shatter problem in the desert which is caused by dry baling conditions. If hay could be baled at a uniform stem moisture content of around 20%, rather than relying on dew, maybe leaf shatter could be minimized.

Because new equipment takes advantage of both full-width crimping and the flexibility of altered windrow widths, I am not advocating a return to the old days of a sickle bar mower and rake. Self-propelled swathers with standard header widths and nine foot conditioners that are capable of laying

down a wide uniform windrow are now available. Growers can also benefit from wider windrows with standard swathers by removing or widening the swath deflector shields. Windrow spreaders can also be used to improve windrow uniformity. This concept of wider windrows warrants further experimentation by growers and researchers in California to determine the optimum windrow width for different environmental and yield conditions.

This concept of laying the cut alfalfa in a wide swath to accelerate the drying rate is logical and not a revolutionary idea. This practice has not yet been widely utilized in California, however, and I feel that this approach has practical implications for growers throughout most of the state. There are obvious benefits to reduced curing time including lower respiration losses, less windrow and traffic effects on regrowth, sooner irrigation after harvest, and less chance of rain damage.

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Table 1. Effect of windrow curing time on yields of alfalfa hay  
E.H. Jensen and D.E. Gilbert (Univ. of Nevada)

	Days of Curing Time			
	0	2	4	8
	(Tons per acre)			
<b>1st Season - 1975</b>				
In Windrow	3.6	3.5	3.3	2.8
Outside Windrow	4.1	4.1	4.1	3.8
% Loss	12.0	15.0	20.0	26.0
<b>2nd Season - 1976</b>				
In Windrow	4.2	3.7	3.6	3.1
Outside Windrow	4.1	3.8	3.7	3.8
% Loss	-1.0	3.0	3.0	18.0
<b>3rd Season - 1977</b>				
In Windrow	4.8	4.7	4.5	4.0
Outside Windrow	4.7	4.8	4.6	4.7
% Loss	-1.0	2.0	2.0	15.0
<b>4th Season - 1978</b>				
In Windrow	5.4	4.7	5.1	4.6
Outside Windrow	5.3	5.1	5.1	5.4
% Loss	-1.0	8.0	0.0	15.0
<b>Average</b>				
In Windrow	4.5	4.2	4.1	3.6
Outside Windrow	4.6	4.4	4.4	4.4
% Loss	2.0	5.0	7.0	18.0

Table 2. Windrow moisture in hay harvested with the Haybine system as compared to a conventional harvester swather-windrower during August, 1982, Southeastern Branch Station, Artesia, New Mexico. John Arledge

Date	Time	Harvesting Method	
		Haybine	Windrow
(percent moisture)			
August 11	4:00 p.m.	71	78
	12 m.	53	67
August 12	4:00 a.m.	48	62
	8:00 a.m.	37	58
	12 n.	28	52
	6:00 p.m.	16	44
	12 m.	20	43
August 13	6:00 a.m.	27	48
	9:00 a.m.	26	49
	12 n.	Baled	50
	4:00 p.m.	13	39
	8:00 p.m.	Baled	33
	12 m.	-	38
August 14	4:00 a.m.	-	40
	8:00 a.m.	-	40
	12 n.	-	30
	2:00 p.m.	-	24
	4:00 p.m.	-	18
	8:00 p.m.	-	12
	12 m.	-	18
August 15	4:00 a.m.		25

\*Hay cut between 9:00 and 11:00 a.m., August 11, 1982.

Table 3. Windrow moisture in hay harvested with Haybine compared to a conventional swather-windrower. Newberry Springs, CA

Date	Time	Windrow Type	
		Wide	Conventional
(percent moisture)			
August 31	12 n. (at cutting)	77.5	77.5
	p.m.	47.6	65.0
1	a.m.	34.9	58.6
	p.m.	11.6 (baled)	15.9
Sept. 2	a.m.		15.4
3	a.m.		8.4 (baled)