USE OF A DESICCANT ON ALFALFA HAY TO REDUCE DRYING TIME

(A Progress Report)

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A number of good reasons exist for wishing to bale and bank hay out of alfalfa fields as soon as possible after cutting. These include:

1. Avoiding damage from rain or other inclement weather.
2. Minimizing wheel traffic damage to alfalfa regrowth.
3. Avoiding of bleaching of hay, thus retaining green color.
4. Avoiding excessive leaf loss that frequently occurs if hay remains in the field for long periods of time.
5. Getting water back on the alfalfa as soon as possible after cutting.
6. Avoiding damage to alfalfa regrowth caused by windrows shading alfalfa plants for long periods of time.

Rapid drying of hay didn't seem to be such a serious problem in the day of the mower and rake. Alfalfa laid down in a thin layer by the mower dried rapidly. Raking took place before leaf shatter occurred but after considerable stem moisture had evaporated. The modern day swather makes a 12 to 14 foot cut, gathering hay and laying it down in a concentrated and often ropelike windrow. Tightly windrowed alfalfa dries slowly, often requiring seven to ten days to reach baling moisture. A number of methods have been devised to speed drying, including the crimper that crushes or breaks alfalfa stems to allow stem moisture to escape. Equipment companies are manufacturing swathers with crimpers that deliver a wider, less densely packed windrows to speed drying. Preservatives or mold inhibitors have been used to preserve hay at higher than normal moistures but results have not always been positive.

Approximately ten years ago, in Australia, work was conducted using potassium carbonate to speed hay drying. The Australian workers, (Tullberg, Angus and Minson) (3) experimented with a method that had been utilized in drying grapes 2,000 years ago. They found that spraying potassium carbonate on hay, immediately after cutting, speeded the drying of alfalfa stems. Since then considerable work has been conducted using chemicals to speed alfalfa hay drying. Some of the most recent and complete work was conducted by Thomas, Johnson, Ahrens and Rotz at Michigan State University (1,2,5,6). These workers experimented with several materials or combinations of materials:

1. Potassium carbonate, Methyl lardate (or Methyl tallowate) plus an emulsifier.
2. Potassium carbonate alone.
3. Potassium carbonate plus Sodium carbonate.
4. Sodium carbonate alone.

They found combination number 1 to be most effective (in drying alfalfa stems) followed by numbers 2, 3 and 4.

Several commercial companies have experimented with materials similar to these and are now selling materials and equipment to utilize hay drying desiccants in commercial alfalfa fields.

Mr. George Fenn of Oregon, presented information on chemical drying of alfalfa hay during the 1981 California Alfalfa Symposium. He had developed a material, application equipment and a system for speeding the drying of alfalfa hay. The method had been successfully tested in Florida. Mr. Fenn's presentation stirred considerable interest in California and during the winter of 1981, Randal Reiff of Woodland approached Cooperative Extension, Yolo County, concerning the testing of this material. A field research experiment was designed to test application of a desiccant on a four year old alfalfa stand near Woodland, Yolo County. Because of the considerable difficulty involved in field scale testing, it was decided to use only the Fenn & Company product in the Reiff Farms experiment (I).

A healthy, uniform four year old alfalfa field was selected for the desiccant test.
Treatments were: 1. Treated (with a desiccant).
2. Untreated control.

Treatments were replicated four times in a modified paired plot design. Each of the eight alfalfa border checks used was approximately 1.4 acres in size for a total of 11.5 acres in the experiment. Mr. Walter Stirewalt, of Woodland, modified his 14 foot swather-windrower for use in the test. Modifications included: (1) Mounting a "pusher bar" just ahead and above the swather cutter bar. This device pushed the standing alfalfa forward allowing spray material to wet the stems in advance of cutting. (2) Mounting a spray bar above and behind the pusher bar to apply material to the uncut alfalfa. (3) Mounting holding tanks and a pump on the swather to deliver material to the spray bar. The desired spray volume was 22.5 gallons of water containing 8.5 pounds of desiccant applied to each ton of alfalfa.

Fenn Company and company technical representatives monitored the treated hay after cutting, testing moistures and drying conditions and advising on proper timing for raking and baling of treated hay. Mr. Stirewalt (an experienced, professional custom harvest contractor) raked and baled the untreated controls in the normal hay harvesting manner. Because of the very wet winter and late spring rains of 1982, the first cutting of alfalfa was delayed until May 5. Drying conditions at first cutting were very favorable with warm dry north winds occurring during and after swathing. Treated hay was raked and baled as stem moisture reached critical level (on the way down) rather than waiting for the hay to become completely dry and baling with dew. Untreated hay was handled in the customary fashion for the Yolo County area.

After baling of the first cutting it was discovered that treated hay must be packed more tightly than untreated hay in order to maintain bale integrity. Although both treated and untreated bales were approximately the same weight (134 pounds per three wire bale) the untreated bales tended to shrink. The loose bales were difficult to handle and stack with an automatic bale loader. This problem was solved on subsequent cuttings by baling treated hay at a higher density (140 pounds versus 120 pounds for untreated hay). During each of the next five cuttings, treated hay was allowed to dry an additional few hours and baled with evening dew coming in or with morning dew decreasing. Untreated hay was handled according to harvesting practices customary or normal to the Yolo County area.

Allowing the treated hay to dry an additional period of time and baling with evening or morning dew seemed preferable to baling as stem moisture decreased (15 to 25%) during the day, with no dew present. Several tons of baled hay from the desiccant treated lot and from the untreated (control) lot were purchased from Reiff Farms (with grant funds) and delivered to University of California and University of Nevada feedlots for feeding tests. Results of feeding tests are not yet available.

Dry down cruves from two cuttings (July and September) were chosen as representative of similar curves from all cuttings. (Figures 1 and 2.) Moisture samples were taken in early morning and late afternoon of each day following the day of cutting. Samples were oven dried to determine moisture content. The letters "R" and "B" on dry down curves (Figures 1 and 2.) represent time of raking and baling. Time intervals are indicated on the horizontal axis (Figures 1 and 2.) Day 1 is the date of cutting, (and in the case of untreated hay) day 7 is the day of baling.

For each of the six harvests, treated hay dried much more rapidly than untreated hay and was ready for baling within approximately 60 hours of cutting. Untreated hay did not reach a safe baling range until almost twice as much time had elapsed. Baling of untreated hay was delayed (at some cuttings) due to lack of favorable raking and/or baling conditions. Drying curves show that moisture content of windrowed hay varies greatly from morning to afternoon.

Windrowed hay dried rapidly during the day but picked up considerable moisture during the night. Treated hay at the July cutting (Figure 1.) was baled before it had an opportunity to absorb moisture from night time dews. Moisture content of treated hay alternately rose and fell with the evening dews and daytime heat. The September harvest treated hay was allowed to remain in the field an additional night after having dropped below the critical baling moisture (15%). As a result, the moisture content increased from 10% in late afternoon to 30% the following morning. This indicates that desiccant treated hay will absorb as much or more moisture from heavy dews as wil untreated alfalfa hay.

Hours to baling for the treated and the untreated alfalfa hay are presented in Table 1. In each instance the desiccant treated hay was ready for bailing in approximately half the time required to dry untreated alfalfa hay to moisture contents felt safe for baling.

Yield Determinations:

After baling, the alfalfa was banked out of the field as rapidly as possible. Four cuttings were removed within six hours of baling, two cuttings remained in the field for 24 hours after baling due to equipment problems. Total bales from each check were weighed on portable (Highway Patrol) scales as the automatic bale loader was leaving the field. Core samples were taken from approximately 1/3 of the bales from each plot using a Pennsylvania core sampler mounted in an electric drill. Core samples were oven dried for moisture and submitted to a laboratory for chemical analysis. Alfalfa hay yields are shown by cutting and total for the six cuttings. (Figure 3.) Yields are expressed on a 90% dry matter (10% moisture basis).

In this trial, hay yields for the season favored desiccant treated hay over the untreated control by a little over 1/3 of a ton per acre. The seasonal yield difference is statistically significant at the 5% level of probability. Yield differences for individual cuttings were statistically significant at only the third and fourth cuttings. This test should be repeated with similar results before a great deal of confidence is placed in the yield differences.

Hay Quality:

As is mentioned in the title, this paper is a progress report. Not all chemical analyses have been completed at the date of this writing. Analysis are available from cuttings one through three. (Table 2.) Results of the analyses are similar for all three cuttings. On cutting number one, modified crude fiber predicted a slight advantage in TDN (Total Digestible Nutrients) and digestible protein for the desiccant treated hay over the control. Analysis of crude protein (nitrogen x 6.25) indicated no difference between the two lots.

For cuttings 2 and 3, differences in modified crude fiber were not statistically different, and the crude protein analyses were very similar. Bale core samples were also analyzed by the acid detergent fiber and the neutral detergent fiber methods. These tests indicated no quality differences between treated and untreated samples of the baled hay.

Results of the chemical tests were a little surprising. It had been anticipated that untreated hay remaining in the field for longer periods of time might lose additional leaves and be of lower quality than desiccant treated lots.

Summary:

The following points or conclusions are valid only for this particular test. Additional replicated trials should be conducted to verify or invalidate these results

In this trial, spray application of a desiccant immediately ahead of the swather cutter bar caused rapid drying of alfalfa. Time from cutting to baling was decreased by nearly 50% over normal hay harvest practices.

2. Desiccant treated hay retained a higher level of green color at baling than untreated hay. (The probable reason is less time exposed to sunlight during the drying process.)

3. Desiccant treated hay yielded slightly greater total tonnage than untreated hay (.05 level of significance). However, yield differences were not significantly different at each cutting.

4. Alfalfa regrowth in treated plots was observed to suffer less damage from wheel traffic than regrowth in untreated (control) plots.

5 In this test there were no differences in hay quality between treated and untreated hay lots for the first three cuttings. Hay quality was estimated by chemical analysis of bale core samples. Analysis for the fourth, fifth and sixth cuttings were not available at time of this writing.

6. Treating alfalfa with a desiccant did increase costs. Increased costs are due to material applied, application equipment and increased labor involved in mixing and loading materials.

In the opinion of the authors, hay desiccants have definite promise for speeding the drying of alfalfa in the field. Quick removal of harvested alfalfa can lessen damage to alfalfa regrowth from wheel traffic and decrease detrimental effects of alfalfa windrows remaining in the field for long periods of time. However, added costs required for materials and application must be weighed against potential benefits. This must be determined by each hay grower for his own operation.

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Randall Reiff of Reiff Farms for providing the opportunity to conduct this trial on his farm and for his demonstration of support and patience over the entire season.

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To George Fenn of Fenn & Company for grant funds utilized in the conduct of this and other hay desiccant experimentas and to technical representatives of Fenn & Company for professional assistance in the conduct of the test.

(I) It is unusual for U.C. Cooperative Extension to experiment with any particular commercial material without complete knowledge of its chemical content or to test only one material when several similar materials may be available. An exception to this general policy was made in the Yolo County experiment due to high interest in chemically drying alfalfa hay and because of the considerable difficulty involved in testing several materials on a field scale basis. The University of California does not by implication recommend any one desiccant over another, nor does U.C. Cooperative Extension and/or its employees have any interest in any of the commercial products currently on the market.

Table 1. ALFALFA HAY DESICCATION TEST - REIFF FARMS

Cutting Date	Hours Cutting to Baling Treated	Hours Cutting to Baling Control
May 5	47	128
June 3	60	160
July 6	60	136
August 5	56	130
September 1	81	130
October 9	55	108

Elapsed time from swather to bailing of desiccant treated and untreated hay.

Table 2. HAY QUALITY AS PREDICTED BY CHEMICAL ANALYSIS OF BALE CORE SAMPLES (Desiccant Treated Versus Untreated Alfalfa Hay)

	Cutting	Modified Crude Fiber	Predicted Percent TDN	Predicted Percent Digestible Protein	Crude Protein (N x 6.25)
Untreated	1	22.3	53.9	15.5	23.9
Treated	1	23.6	52.9	14.8	24.1
LSD.05		1.0			
Untreated	2	20.8	55.2	16.3	26.0
Treated	2	20.1	55.7	16.7	25.8
LSD.05		NS			
Untreated	3	24.1	52.3	14.6	22.6
Treated	3	25.1	51.5	14.0	22.1
LSD.05		NS			

Chemical analysis of bale core samples from desiccant treated and untreated alfalfa hay cuttings 1 through 3.

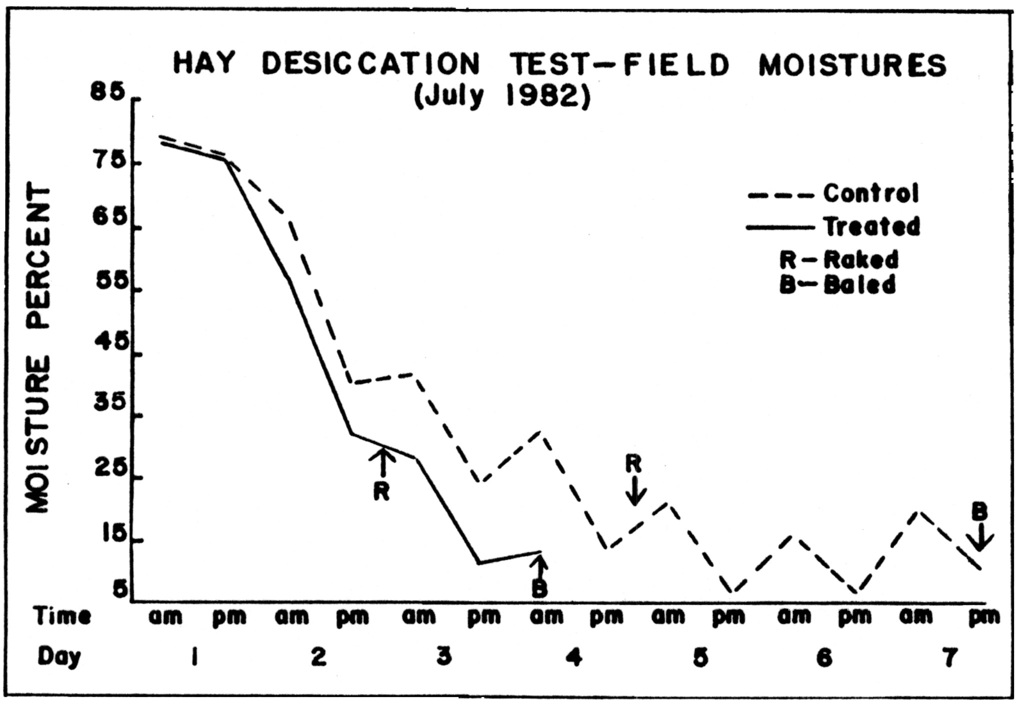

Figure Percent moisture of windrowed hay from desiccant treated and untreated plots. Samples taken at 7 a.m. and 4 p.m. daily.

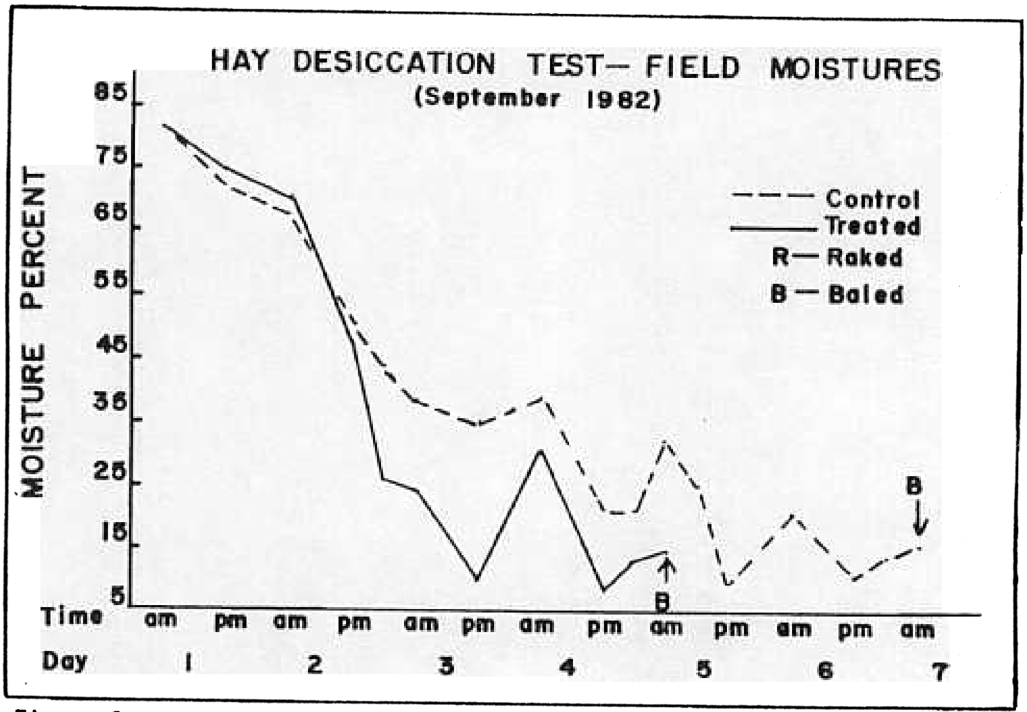

Figure 2. Percent moisture of windrowed hay from desiccant treated and untreated plots. Samples taken at 7 p.m. and 4 p.m. daily.

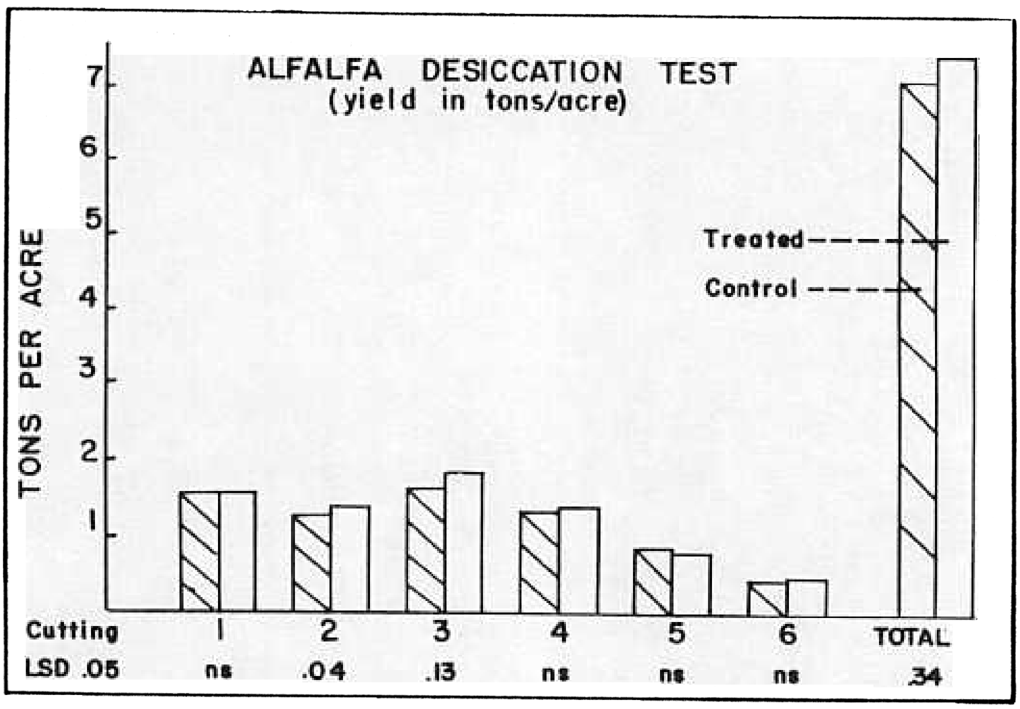

Figure 3. Alfalfa hay yields converted to 90% dry matter basis - by cutting and total by the season.

Articles on Use of Chemicals
to Hasten Hay Drying

1 Thomas, Johnson, Ahrens, Rotz. 1981. Hastening hay drying. National Hay Association Bull. #116. 12/10/81.

2. Thomas, Johnson, Wieghart, Hansen, Tesar and Helsel. 1981. Hastening hay drying. Proceed. XIV International Grassland Congress.

3. Tullberg and Angus. 1972. Increasing drying rate of lucerne by the use of chemicals. J. Austral. Ins. Agr. Sci. 38:214.

4. Tullberg and Angus. 1978. The effect of potassium carbonate solution on the drying of alfalfa. Laboratory studies. J. Agr. Sci. 91:551. Field Studies 91:557.

5 Wieghart, Thomas and Tesar. 1980. Hastening drying rate of cut alfalfa with chemical treatment. J. Animal Sci. 51:1.

6. Wieghart, Thomas, Hansen. 1982. Acceleration of alfalfa drying in the field by chemical application at cutting. Crop Science.

<u>Abstracts:</u>

1. Wieghart et al. 1978. J. Dairy Sci. 61:143 (suppl. #1).

2. Wieghart et al. 1979. J. Animal Science, Abstract page 175.

3 Wieghart et al. 1980. J. Animal Science, Abstract page 252.

4 Johnson et al. 1981. J. Animal Science, Abstract page 275

5. Johnson et al. 1981. J. Animal Science, Abstract page 281.