ALFALFA HAY PRESERVATIVES AND DRYING AGENTS

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Conclusions:

These Northern California studies indicate that Preservative products are available that can prevent mold and heating of alfalfa when used at the appropriate time. With the exception of NH_3, the protection that these products afford is short lived if the treated hay is held in storage during lengthy periods of high humidity and low temperatures. With the exception of NH_3, all products examined require planning ahead, preparation and the purchase of special applicators which generally are not now readily available in California. NH_3 treatment of stacked alfalfa may require lower stacks than provided by automatic hay stackers and the purchase of gas tight tarps or plastic film. NH_3 can be applied at baling with less subsequent bale loosening, however, it is not recommended for standard two or three wire balers unless air temperature is low at that time and remains low until the hay is stacked. The performance of NH_3 in small bales may also be improved if the bale chute on the baler is enclosed to restrict gas loss. High density round balers can be used to baler-ammoniate moist forage in almost any climatic situation in California. Ammoniation of forages can increase crude protein levels 20% or more and improve digestibility in ruminants of some low quality roughages by an equal amount. All of the products evaluated utilize one or more substances that can be utilized by the ruminant animal as a source of energy or as a source of nitrogen for the development of protein. None of the treatments could be judged as good as a fast sun cure, but all were better than the alternatives--hay rotting in the windrow.

Hay drying agents have been found useful by various researchers in California and other states. These speed up drying by breaking down the wax coating on alfalfa stems that restrict moisture lost. This study indicated that moisture loss from windrowed alfalfa is primarily dependent on air circulation through the windrow. It was found during a more or less typical Glenn County summer that alfalfa laid down in windrow did not dry more rapidly when treated with a desiccant. However, speed of drying was so greatly improved by windrow "fluffing" for both desiccant treated hay and untreated hay that both could have been baled the third evening following cutting--24 hours sooner than hay drying in settled windrows. Hay yield was near 1.7 tons/acre.

STUDIES

Hay Preservative Studies Disodium Acetate vs. Urea--Don Toenjes

Ladder Ranch Willows April 17 - May 26, 1983 first cut new field. Mustard and grassy weeds contaminated the field of alfalfa. Ambient air temperature was under 80°F for six weeks following baling with numerous periods of precipitation. Hay stacked outside was rained on and stack fell. Bales became musty smelling although not obviously moldy. Two weeks after baling the stack was sold to owner of small dairyherd. He reported cows ate everything but mustard stems. Nine urea treated bales were held back covered with a canvas tarp and stored outside. They were monitored with a CR21 and thermistors for temperature changes every 60 seconds, core sampled for dry matter changes and evaluated for mold formation at feeding. All bales contained a white mold when fed free choice to yearling dairy cattle weeks after baling, however, animal acceptance was equal to sweet smelling rye grass--alfalfa hay put up without rain damage or mold. See specifics.

Limacher Ranch Orland May 22 to June 27, 1983 first cut of third year field of clean alfalfa. Hay baled with dew moisture. Daytime temperature increased during storage with periods of low humidity and moderate humidity. Hay squeeze stacked in barn with good air circulation, bales seven high. No mold formation heating or loosening of wires was observed. Stack temperature monitored at 60 second intervals. Each hay bale was cored twice, at baling and a second time 35 days later. See specifics.

California State University Chico - Don Toenjes, Dr. Ed DePeters, S. Young
80% Propronic Acid 20% Acetic Acid vs. NH

October 19 - The trial protocol called for an untreated control, however, the controlled hay had to be baled and removed from the field before stem drying was completed (bale moisture range 30 to 40%), due to an impending storm.

The three wire bales were sampled and tested for ash, crude protein and fiber. Fifty percent of bales were submitted for invitro digestion. Comparisons considered were pretreated vs. nine weeks following treatment. Bales were stacked nine high to simulate field conditions. Temperatures in each stack were monitored at three sites as in previous reported trials. Bales were cored four times. Twice at harvest and twice after nine weeks. All chemical test and statistical analysis have not been completed at the writing of this paper. However, some observations are reportable.

Stacks of alfalfa will not stand at nine bales high when ammoniated--five bales yes. Stack ammoniated bales will soften and wires loosen. Stem structural changes will cause difficulty in handling hay with hay hooks. Stacked ammoniated hay is more palatable than acid treated hay or some sun cured hay, however, all hays were readily consumed. No detectable mold on or in NH_3 treated bales. Hay was green after storage. NH_3 treatment increased crude protein levels in the alfalfa bales nearly 39%. No free NH_3 odor was present in bales or cored sample. The rest of the story, differences in dry matter loss, chemical analysis and invitro digestion will be reported later.

Acid treated bales retained shape and the stack stood. A white mold was apparent on a few of the interfaces of bales' contact surfaces and apparently grew inward in a few bales. Color of hay after storage was green. Hay was acceptable.

Baler Ammoniation - Don Toenjes, Monte Bell, Dr. B. Jenkins & Dr. W. Garrett

These studies supported financially by the Rice Research Board and numerous commercial businesses involved questions surrounding the harvest of rice straw. However, the principals can be adapted to the baling of any high moisture forage crop including alfalfa.

Success depends on the use of a high density round baler that produces a uniform 4 foot wide bale and super cold NH_3 evenly distributed across the windrows as it comes into the baler by specially designed low pressure manifold. (The manifold is easily constructed in a farm shop.) The forage must be 20% moisture or greater to be effective. After holding eight months, dense NH_3 treated rice straw bales baled at 20 to 40% moisture exhibited no interval mold after being stored outside during a winter of 27" recorded rainfall. Dry matter loss as indicated by ash levels were significantly less for ammoniated bales than for bales baled at moisture levels of 10 to 14% moisture. Animal performance and invitro digestion studies showed a 20% improvement due to the NH_3 treatment. See specifics.

Hay Desiccant vs. Windrow Fluffing - Don Toenjes

Limacher Ranch Orland July 26-28, 1984. Four replications randomized block design. Desiccant was swather applied in manner outlined by seller. Recording thermostats constantly monitored ground surface temperatures under the windrow. Four hay samples were carefully cut from 16 windrows using 1-1/2 foot wide cross sections of the windrows. Dry matter determinations were derived from these samples. Hay windrows were fluffed by a tired PTO driven crimper that no longer seriously crimps stems, the day following swathing. No apparent leaf separation was induced by this operation.

The windrower, a 14 ft. Heston 620 model with crimper, in good operating condition, placed the hay in an uneven pattern with wadded hay evenly spaced in the windrow--a condition frequently observed in heavy yielding alfalfa hay fields at harvest. Hay samples were taken so that both wadded areas and thin areas were randomly included in measurements. The study supported the concept that uneven windrows deter hay drying and that windrow fluffing will reduce the effect of wadding. See specifics.

SPECIFICS

CSUC Hay Preservative Study 10/9 - 12/12 (Baled 10/9-12/12 - 10/10 Cored AM - 10/11 Gassed)

A - 60 bales treated with Protex I (80% propronic acid, 20% acetic acid) while baling at the rate of 40 lbs/ton, bales individually weighed, cored and stacked under cover.

B - 60 bales individually weighed, cored, stacked under cover, tarped and treated with 3 lbs of NH_3/100 lbs dry matter two days following baling.

Plot design: Randomized block. Temperature monitored in both stacks by thermister cables and a CR21 data logger set to accumulate reading at 60 second intervals and report high/low and average temperatures for 12 hour intervals.

Al bales were submitted for analysis of dry matter, ash ADF and crude protein.

Ammoniated hay stack collapsed second day following treatment. Restacked a week or so later.

Invitro digestion studies have not been completed nor has all the lab analysis, dry matter change or statistical analysis of the accumulated data.

The Trends

Crude protein levels 60 bales Protex II 10/9 Range 15-17%
Crude protein levels 16 bales Protex II 12/12 Range 15-17%
Crude protein levels 15 bales NH_3 12/12 Range 21-26%
Ash levels 60 bales Protex II 10/9 Range 7-8%
Ash levels 12 bales Protex II 12/12 Range 8-9%
Ash levels 60 bales 10/9 Range 8-9%
Ash levels 15 bales NH_3 12/12 Range 8-9%

Effect of Cold-flo Ammoniation High Density 4' x 5' Round Bale - Rice Straw 5 pounds NH_3 cwt. of dry matter distributed by manifold on baler pickup - October 1980.

Laboratory analysis of samples taken 12/14/80 from 14 ammoniated bales and 14 controlled bales baled in October showed higher total N in ammoniated bales 1.35% vs. .75% dry matter basis (1-N H_2SO_4) and 1.11% vs. .70% N dry matter basis oven dried samples. NH_4-N was higher in ammoniated bales 6.11 gm/kg vs. .26 gm/kg. Tilley-Terry tests to evaluate changes in dry matter showed a 29% improvement in ammoniated straw vs. untreated. TSAE tests to evaluate changes in the cellulose showed a 23% change ammoniated vs. non-treated. Group means for ash ranged 13-14%.

Laboratory analysis of samples taken 2/6/80 of 10 ammoniated and 10 controlled bales showed higher total N in ammoniated bales 1.27% vs. .70% dry matter basis (1-N H_2SO_4) and 1.15% vs. .69% dry matter basis oven dried samples. NH_4-N was higher in ammoniated bales 5.63 vs. .22 gm/kg. Tilley-Terry tests showed a 14% increase in dry matter disappearance due to ammoniation. TSAE were not run on these samples. Group means for ash in ammoniated samples 14.36 vs. 16.95 control.

Two bales were split with a chain saw in March and samples taken from various cross sectional zones. Means of samples tested for NH_4 N 252 ppm center, plus 6" - 413 ppm, plus 12" - 338 ppm, plus 18" - 226 ppm, plus 24" - 282 ppm, outside layer 56.2 ppm. At the time of sampling moisture was 19% and 25%. Color difference was obvious within zones of the bales. No visual signs of mold. Variability in NH_4 N indicates need for manifold redesign.

A third bale was split in July. Ammonia smell was obvious when layers were separated. No observable mold or other spoilage in interior after nine month unsheltered storage and a record season total of 27" of rain in the area.

Plastic Sleeves

Four covered vs. six uncovered ammoniated bales were core sampled in July, nine

months after baling. Mean % NH_4-N in H_2SO_4 dry basis uncovered .355 vs. .562 covered for 158% increase over uncovered. Percent total N in H_2SO_4 extract dry basis .525 vs. 0.772 for a mean increase of 147% for covering. It should be noted that plastic sleeve covers had disintegrated by June.

Limacher Hay Preservative Study
May 22 - June 27

Disodium acetate (Crop Cure @ 5 lbs/ton)
Urea @ 30 lbs/ton dry matter
Baled 7 to 9 AM May 22. Temp. 70-80° F. Rel Humidity 50%
Stems did not peel. Bale wts. 123-151 lbs. Ave moisture 30%
Study design-randomized block
Bales picked up in two hours placed in tight squeeze stacks of 54 bales
Bales cored for dry matters within two hours of baling and identified
Bales recored after 35 days
Temperatures constantly monitored with CR21 micro-logger and seven thermistors.
Averages, highs and lows were recorded.
Peak day temperatures 90-101° F Rel Humidity 20-50%

	*°F High Max Temp	°F Low Max Temp	Moisture Loss%	Moisture End%	Moldy Bales
Crop Cure	91.5	70	19.5	9.8	0
Urea	94.5	70	20.8	10.3	0

*Recorded first 12 hours of storage.

	MCF Day 1	MCF Day 35	Ash Day 1	Ash Day 35	ADF Day 1	ADF Day 35
Crop Cure Ave 21 Bales	24.52	26.2	8.51	8.58	33.8	34.6
Urea Ave 21 Bales	23.58	24.1	8.47	8.59	32.5	33.6

Ledder Hay Preservative Study
Alfalfa, Mustard, Bur Clover & Grass
April 17 - May 26

Disodium acetate (Crop Cure) @ 5 lbs/ton
Urea @ 30 lbs/ton dry matter
Baled 7-10 PM 4/17/83. Temp 50° F. Rel Humidity 80%
Stems green, bale wts. 123-149 lbs. Moisture in bales 24-32%
Bales cored 4/18/83 in stack. Rained 3" on uncovered stack
Stack sold two weeks. No data Crop Cure

Urea Treatment (9 bales)
4/17 to 5/26/83

Temp. 1st Peak Day 16-17 °F High Max	°F Low Max	2nd Peak Day 38 °F High Max	°F Low Max	Moisture Loss %	Moisture% End	Moldy Bales
103	73	10	85	-14	16-24	9

Temperature monitored constantly averages & highs & lows recorded.

	Ash Day 1	Ash Day 39	C Protein Day 1	C Protein Day 39	ADF Day 1	ADF Day 39
Urea Ave 9 Bales	11.2	11.6	24.6	24.3	29.0	26.6

Limacher Hay Drying Study
July 26-28, 1984

Treatments - 4 replications randomized block design
1&2 Conservit @ 3.5 and 7 lbs/acre in 27-30 gallons of water
3 Control
4 "Extra Crimp" PTO driven, tired windrow crimper
14' Heston 620 with crimper operative on all treatments
7 Day thermographs to record under windrow temperatures

Hay samples cut from all windrows at 4-time intervals
A line parallel to the field boundry was drawn across al windrows to determine each sampling site.

Weather Data

	7/26	7/27
Rel Humidity 8:30 AM	50%	28%
10:30 AM	39%	---
1:00 PM	30%	38%
5:00 PM	21%	24%
Air Temperature Max°F	100	102

Temperature Max°F Under Windrow

	7/26	7/27	7/28
Conservit 3.5 lb	80	88	93
Conservit 7 lb.	80	92	98
"Extra Crimp"	80	90	96

MOISTURE

	Time of Sampling	Conservit 3.5 lb/A Low	Conservit 3.5 lb/A High	Conservit 7 lbs/A Low	Conservit 7 lbs/A High	Extra Crimp Low	Extra Crimp High	Control Low	Control High
7/26	7 AM	Cut	---	---	---	---	---	---	---
	12 PM	59	78	70	78	66*	74*	64	74
	5-6 PM	49	74	44	66	57	68	53	64
7/27	5-6 PM	12	44	23	48	18	53	19	41
7/28	5-6 PM	8	51	10	29	8	18	12	24

*Extra crimp took place after this sample was taken.
Field yielded 1.66 tons/acre