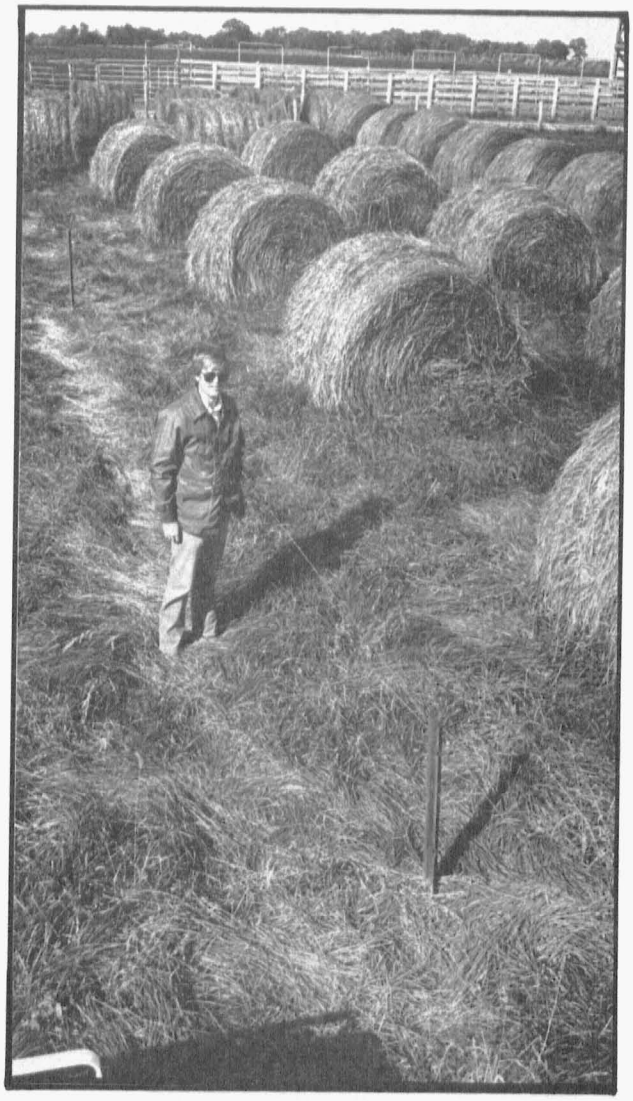
1981 Hay Day Report

Forage Systems
Research Center,
Linneus, Mo.



Special Report 267
College of Agriculture
University of Missouri-
Columbia

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INSECTICIDAL EAR TAGS

Karl Hartung
Extension Livestock Specialist

Improved methods of fly control have been needed for many years. Face flies have been associated with the incidence of and the spread of pinkeye. Many of the materials available in the past required that they be applied daily or at close intervals to be effective.

Several methods of application have been tried in prior years. The most logical device seems to be insecticidal impregnated plastic ear tags. A tag containing tetrachloroinphos (RABON®) has been commercially available for several years. This tag has given similar control as some sprays (50 - 70%) and has been effective for 13 - 14 weeks duration. This tag has similar results for both the face and the horn fly when applied at the rate of two tags per head. Results for horn fly control have ranged from 60 - 80% control. The control of face flies has been more sporadic, ranging from less than 35% to near 80%.

Two new tags containing fenvalerate (ECTRIN®) and permethrin (ATROBAN®) have shown much promise the past two years.

The tag containing fenvalerate (ECTRIN®) was available for special use in 1980 under the Special Local Needs (section 24C of F.I.F.R.A.) Registration. This tag is now federally registered and available locally, so the Special Needs (section 24C) has been cancelled. This tag is approved either as an 8% tag or a 3% tag. In research field trials, cattle tagged with one ECTRIN® tag per head gave 72.2% control of face flies. Cattle tagged with two ECTRIN® tags, every third animal gave 71.6% control of face flies. All ECTRIN® ear tag treatments resulted in over 90% control of horn flies throughout the test period.

Another tag treated with 10% permethrin (ATROBAN®) was research field tested in 1980. This tag was given the Special Local Needs (section 24C) Registration in April of 1981, and will be available for special local needs this year. In field research trials conducted last year, this tag, when used at one tag per head, gave 83.6% control of the face fly, while two tags per head gave 88.1% control. Those same tags gave 97.8% and 98.5% control, respectively, of the horn fly.

Since both the horn and the face fly are a migrating type of fly, research is indicating that two tags per every other head is more effective than one tag per every head. Two tags per every other head will give a stronger concentration per head and will get this chemical rubbed off on both sides of the animal. Since there are greater numbers of flies on bulls than on cows, all bulls should be tagged with two tags per head.

These tags may also be used as cattle identification tags by printing with the tube type of ink that becomes a part of the tag. From field research trials, this method of numbering of tags does not affect their use as a fly control device.

Summary

Insecticidal impregnated eartags are superior to either spraying or dusting of cattle for both face and horn fly control. The RABON® tag will give 50 - 70% control of face flies and 60 - 80% control of horn flies for 13 - 14 week periods.

The ECTRIN® or ATROBAN® tag will result in 70 - 90% control of face flies and greater than 90% control of horn flies for the full season. It also appears that two tags per every other head will be more effective than one tag per every head.

AGRICULTURE COMPUTER PROGRAMS

Clem Koenig
Extension Farm Management Specialist

Computers will become an ever increasingly important tool in farm decision making. Technology in the computer area is rapidly changing. What appears modern today may be obsolete tomorrow.

Computers can do many things for us. They are fast and accurate; they can store and retrieve information, and they can provide us with repeated uniform reports. These advantages make them a valuable tool in decision making.

It is possible to gain access to a computer located at the University of Missouri, right from your kitchen or living room.

The Remote Computer Planning System is a series of programs that reside on the University of Missouri Computer that can be accessed through data terminals. Access to the computer is through the time-sharing option (TSO) of the computer. Any remote terminal that can communicate with the computer TSO System can be used.

The Remote Terminals are portable, lightweight (13 pounds) devices that can be connected to a computer through a regular telephone handset. The terminal can both send and receive data from the computer. This permits the user to get an immediate answer to various analysis programs.

The following programs are currently available on the Remote Computer Planning System at the University of Missouri.

Program	Program Description
File Building and Maintenance Routines	
Catalog	List Names of Data Files Stored Under Your Userid
Delete	Delete Data Files
File	Routine for Building and Altering Data Files
Analysis Programs	
AUTO	Auto Cost and Expenditure Program
BCROP	Crop-Equal Return Analysis
DAY	Prints Day of Week for a Specified Date

FINAN	Annual Financial Analysis (Uses a Data File)
FTRAN	Transition Planning (Uses a Data File)
INVEST	Investment Analysis
LOANPAY	Calculates Loan Payment Schedule for Amortized Loan
LRPLAN	Long Run Financial Planning (Uses a Data File)
MACHINE	Machinery Cost Analysis
PIGFN	Pig Finishing Budget
PROGRAMS	Prints a List of Available Programs
SSPEND	Family Budgeting Model
SWRATN	Least Cost Swine Rations (Uses a Data File)
TAXMGMT	Income Tax Management Planner

The terminal can be used to access programs at Nebraska, Virginia and other universities. For more information on computer programs, contact your University of Missouri Extension Center.

BOVINE PINKEYE: EVALUATION OF AN AUTOGENOUS MORAXELLA BOVIS BACTERIN AND INVESTIGATION OF THE M. BOVIS CARRIER STATE IN LACRIMAL AND NASAL SECRETIONS.

J.J. Webber, L.A. Selby, T. Fairbrother and R.E. Morrow

SUMMARY

An autogenous Moraxella bovis bacterin did not reduce the incidence and severity of Pinkeye in vaccinated cattle compared to non-vaccinated controls. There was no difference in average daily gain between vaccinates and controls.

At initial sampling in April 1980, M. bovis was isolated from 11% of cows and none of the calves. All positive cultures were from nasal swabs. Frequency of isolation of M. bovis increased as the summer progressed and incidence of Pinkeye increased, with the majority of positive cultures from ocular swabs.

INTRODUCTION

Vaccination of cattle against Infectious Bovine Keratoconjunctivitis (IBK) or Pinkeye, with Moraxella bovis derived preparations has met with variable results under field conditions. This is in part due to the nature of the vaccine, and in part due to erratic vaccine administration, often in the face of a Pinkeye epizootic.

Cows and calves have been proven to harbor M. bovis in their lacrimal secretions for extended periods of time, in the absence of clinical disease. It has been postulated that the primary sites of M. bovis colonization are the sinuses and nasal cavities, and that infection of the conjunctiva is secondary to the former sites.

The objectives of this study were (1) to evaluate the efficacy, under field conditions, of an autogenous M. bovis bacterin and (2) to investigate the M. bovis carrier state in nasal secretions of cows and calves.

PROCEDURE

Vaccination: An autogenous M. bovis bacterin was prepared by Grand Laboratories, Irwin, Missouri, using a smooth hemolytic isolate of M. bovis that was cultured from the cattle at FSRC in July 1979. Cows (n=172), calves (n=170) and yearling heifers (n=20) were randomly assigned to vaccine and control groups. Cows and heifers were vaccinated with 5 ml and calves 2 ml subcutaneously on the lateral aspect of the neck. Initial vaccination was administered on April 22 and a booster given 2 weeks later. All cattle were examined once weekly for evidence of keratoconjunctivitis; the severity of any lesions was recorded using the scoring system listed in Table 1.

Carrier State: All the cows and calves in Rep 2 had nasal and conjunctival swabs taken every 28 days from April through September. Swabs were streaked on to 5% bovine blood agar for isolation of M. bovis. Identification of M. bovis was done by the direct fluorescent antibody test. All cattle in the 2 herds in Rep 2 were examined twice weekly for evidence of clinical keratoconjunctivitis, and the results recorded.

Data Analysis: Data was summarized, coded and key-punched onto cards for analysis using statistical programs available in the Statistical Analysis System (SAS).

RESULTS AND DISCUSSION

Vaccination: The incidence of Pinkeye in cows and calves at FSRC in the summer of 1980 is shown in Table 2. Overall, 24.1% of cows and 34% of calves developed moderate to severe Pinkeye. Herd 7 had the highest incidence of Pinkeye in cows (51% with moderate-severe). This herd also contained 20 yearling heifers. Herds 3, 5, and 8 had the highest incidence of Pinkeye in calves (52%). The incidence of moderate-severe Pinkeye within each herd for vaccinated and control cattle is presented in Table 3. There was no difference in either incidence or severity of Pinkeye between vaccinates and controls. Similarly, there was no difference in average daily gain over the study period between vaccinated and control cattle (Table 4).

The vaccine used in this trial was ineffective in reducing the incidence and severity of Pinkeye when vaccinated cattle were compared to those given a placebo. This further emphasizes the importance of using virulent, antigenic strains of M. bovis for bacterin production. No reliable markers of virulence have been identified and described for M. bovis.

Carrier State: When cattle from Rep 2 were cultured for the first time in April, hemolytic M. bovis was isolated from 5 of the cows (11%), and none of the calves. All positive cultures were from nasal swabs. As the summer progressed, the frequency of isolation of M. bovis from cows and calves increased, with the majority of positive cultures from ocular swabs. While these findings need further investigation, there is a suggestion that cows can harbor M. bovis in the nasal passages during the winter months, and that these cows can then be a potential source of infection, for other cows in the herd, and for the newborn calves.

TABLE 1

Code for Scoring Pinkeye Lesions - Cornett Farm 1980

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0 = Normal eye

1 = Mild pinkeye (includes any of the following)
lacrimation with no corneal lesion
photophobia with no corneal lesion
small ulcer covering less than 1/3 of corneal surface

2 = Moderate pinkeye
lacrimation and a corneal ulcer or blemish that covers 1/3 to 2/3 of corneal surface

3 = Severe pinkeye
lacrimation, with an ulcer or blemish that covers more than 2/3 or corneal surface

4 = Healing
less lacrimation, accompanied by ingrowth of blood vessels and shrinkage of lesion

5 = Healed
small or no lesion, with no tearing or discomfort

9 = Cancer eye

TABLE 2

Incidence of Pinkeye at FSRC Cornett Farm 1980

			Incidence and Severity of Pinkeye			
			Cows (%)		Calves (%)	
Herd	Rep	Past	None/Mild	Moderate/Severe	None/Mild	Moderate/Severe
1	1	1	91	9	77	23
2	1	2	72	28	88	12
3	2	1	77	23	48	52
4	2	2	88	12	72	28
5	3	1	83	17	48	52
6	3	2	100	0	83	17
7	4	1	49	51	48	52
	Overall		75	24	66	34

TABLE 3

Incidence of Pinkeye in Vaccinated and Control Cows and Calves

Cornett Farm 1980

	% with moderate-severe Pinkeye			
	Cows		Calves	
Herd	Vacc	Control	Vacc	Control
1	0	16.7	27.3	18.2
2	23	33.3	25	0
3	27.3	18.2	54.5	50
4	7.1	20	30.7	25
5	16.7	20	38.5	70
6	0	0	16.7	16.7
7	55	48	46.7	57.1
Total	23.1	25.9	35.3	32.9

TABLE 4

ADG of Cows and Calves at FSRC Cornett Farm

April - September 1980. Vaccinates and Controls.

	ADG Cows (lb)		ADG Calves (lb)	
Herd	Vacc	Controls	Vacc	Controls
1	-0.25	-0.20	1.35	1.36
2	-0.30	-0.34	1.32	1.26
3	0.27	0.35	1.51	1.50
4	0.34	0.32	1.44	1.43
5	-0.17	-0.07	1.62	1.72
6	-0.16	-0.01	1.46	1.44
7	0.21	0.26	1.63	1.57

ESTABLISHING LEGUMES IN GRASS SOD

Bud Motsinger
Agronomy Specialist, Green Hills Extension Area

Legumes can increase a pasture's productivity and the quality of the forages produced. In addition, legumes also provide nitrogen from the air to the companion grass. The legumes will help to produce more forage during July and August to offset the decrease in production of the grasses at that time.

The success of getting legumes established in existing sod depends upon the adequate moisture, light and fertility as well as controlling the competition.

The first step in establishing legumes is to test the soil. Take soil test early so that if lime is needed it can be applied prior to the seeding. Legumes should not be seeded into fields with a pH of less than 5.5 and in most cases a pH of 6.0 is more desirable. Legumes also require phosphorous and potassium, which should be determined by the soil test. Do Not apply nitrogen when establishing legumes into grass sods. The nitrogen will increase the growth and vigor of the grass and increase the competition for the new legume seedling.

Using certified seed is recommended, as it insures variety purity and proven performance. Innoculating the seed with nitrogen fixing bacteria will also increase the success of the seeding.

When possible, match the right legume to the grass stand, the soil characteristic and to the use of the forage. Trefoil and alfalfa are easier to establish in bluegrass, orchardgrass and timothy. Red clover and ladino clover are more aggressive and use better choices of legumes to establish in fescue. Ladino and alsike clover will grow well in wet areas. Alfalfa and trefoil will grow best on moist, but well drained soil types. Birdsfoot trefoil does have the advantage that it is one of the most drought tolerant legumes, will grow on a variety of soil types and does not cause bloat in cattle or sheep.

There are several methods used in establishing legumes into existing sod. The most popular method is to overgraze the grass during the preceding fall and early winter. Apply lime, phosphorous and potassium as needed, and broadcast the legume seed in February over the top of the grasses. The freezing and thawing action of the soil will help to cover the seed. It is very important to graze the early grass growth immediately in the spring to reduce the competition and let the legume seedlings become established. Continue to graze the new seedlings in the spring until the livestock begin to bite off the young legumes. Then remove the livestock for 4-5 weeks and practice rotational grazing throughout the rest of the summer.

Legumes may also be established by tilling the sod to disturb 40-50 percent of the grass, then broadcasting or drilling the legume seed into the remaining sod. Seeding may also be done with a no-till seeder by using chemicals such as paraquat to retard the grass growth in bands where the legume is interseeded.

The seeding rate of the legume will depend upon the type of legume used and the method of establishment. Less seed is required if drilling into a prepared seedbed. For broadcasting seed on undisturbed soil, the following rate/acre is recommended:

Red clover 10 lbs., Ladino 1½ lbs., Alfalfa 10 lbs., Trefoil 8 lbs., Lespedeza 25 lbs.

For more information about specific varieties, seeding rates and specific types of legumes contact the County University of Missouri Extension Centers throughout the State of Missouri.

WEATHER MONITORING AND PEST/CROP MODELING IN MISSOURI

Dr. Rodney H. Ward, Assistant Professor,
Department of Entomology
Dr. Wayne L. Decker, Chairman and Professor,
Department of Atmospheric Sciences
Dr. Mitchell E. Roof, Assistant Professor, State Extension
Integrated Pest Management Director, Department of Entomology

A STATEWIDE WEATHER MONITORING SYSTEM AND NETWORK AND A COMPUTER-BASED WEATHER INFORMATION ACQUISITION AND DELIVERY SYSTEM IS BEING SET UP IN THE STATE THIS YEAR. SUCH A SYSTEM WILL PERMIT US FOR THE FIRST TIME TO IMPLEMENT WEATHER/PEST/CROP MODELING ON AN ON-LINE REAL TIME BASIS. AN EXTENSION INTEGRATED PEST MANAGEMENT INFORMATION DELIVERY SYSTEM CURRENTLY BEING DEVELOPED WILL, FOR THE FIRST TIME, PROVIDE TIMELY, UP-TO-DATE WEATHER/PEST/CROP NEWS IN COMPUTER ACCESSIBLE FORM.

For the past year, a new concept in research has been under development. That is, to design, test, and implement an automated, on-line, real-time environmental monitoring system and network, and a computer-based weather information acquisition and delivery system to operate within the State of Missouri. This project has been initiated to meet the needs of predictive weather/pest/crop modeling efforts in support of statewide pest management activities. This research transfers the emphasis to studies of production variabilities to the out-state regions where production problems and issues of environmental quality exist. This is a cooperative project among the Departments of Entomology and Atmospheric Sciences at UMC and the National Weather Service.

This micro/macroclimate weather station at the Forage Systems Research Farm (Cornett Farm) is one of two automated weather monitoring stations that is being set up this summer. At this station, hourly ambient air temperatures will be recorded (including daily maximum and minimum air temperatures), soil temperature at the 4 inch depth, precipitation, relative humidity, soil moisture, wind run and direction, total daily solar radiation, and leaf wetness. This weather data will be stored daily at both stations in electronic memory associated with a microprocessor (CR 21 Micrologger). Once each day, a microcomputer in Columbia, Missouri will automatically call up the weather station microprocessor and the information will be retrieved and stored daily.

Eight touch tone pads for entering weather data into the National Weather Service Computer over a phone line have been installed at each of seven University of Missouri research farms at locations in Spickard, Novelty, Linneus, New Franklin, McCredie Farm 30 miles east of Columbia, Mt. Vernon, Portageville and at the Southwest Missouri

State Fruit Experiment Station in Mt. Grove. The information from the Linneus station will be integrated with information from these 7 other touch tone stations and 26 National Weather Service reporting stations in Missouri and 24 stations from states bordering Missouri. The resulting composite of daily weather data from these 58 stations will provide a statewide, as well as a 9 state regional perspective of weather data for Missouri growers, researchers, extension personnel, and private industry.

Weather data from these stations will be entered into a computer, stored into files, and processed through various pest development and crop growth models on a daily basis. These models are driven by accumulating degree days above a base threshold of development in accordance with algebraic developmental rate equations for the pest insect instars and stages of development and crop growth from date of planting. An example of the use of this concept is research that is underway this year by Kris Simpson, a graduate student, and Dr. Rodney Ward on validation of the European corn borer model in Missouri for both the Northern and Coastal biotypes of this insect. Average age of the developing population of borers will be determined from field sampling in Atchinson, Boone, and Pemiscot counties on a 3-day or weekly basis. This biological information will be matched with accumulated degree days at these locations and compared to several historical data bases of biological and weather information for Missouri and neighboring states. An estimate of goodness of fit of the model(s) will be determined and if considered accurate within certain specifications, the model(s) will be adopted and implemented statewide. If it is not accurate enough, it will be refined and tested again. Early seasonal indications this Spring suggest that the present model for the Northern biotype is quite accurate. The outcome of this project will be a day-to-day statewide phenology of the European corn borer based on degree days complemented with actual biological monitoring program data from statewide pest management scouting programs as this data becomes available in an on-line, real-time basis. Coupled with projected 3-5 day, degree day accumulation forecasts for any area of the state and damage threshold information, a much more accurate timing schedule will be provided for initiating control practices (insecticide applications). Finally, an economic analysis of European corn borer control will be developed for field by field decision making taking into account a number of crop management and farm management concepts. Optimizing resource allocations with planned outputs will provide a useful decision making tool for European corn borer management. This will be particularly useful when integrated with a total corn pest management cost analysis program and this information is integrated into a corn crop management and farm management program. These latter aspects are being investigated presently in the Midwest.

The information delivery aspect of the system is currently being developed and the first phase will be implemented by mid-June with the remaining phases to be completed within the next year. Access to the weather/pest/crop news and alerts will be possible by a computer terminal or a computer as well as by the present means: newsletters, phone-tapes, and radio and TV.

UMC

Science and Technology

GUIDE

Published by the University of Missouri - Columbia Extension Division

Making and Storing Quality Hay

Howell N. Wheaton
Agronomy Department
College of Agriculture

The most important factors affecting the quality of hay are 1) moisture content at baling and time of storage, 2) stage of maturity at baling, 3) storage conditions, and 4) the forage species, of course. This guide has information on the first three factors as well as on hay preservatives. It does not deal with forage species.

Some forages, such as alfalfa, orchardgrass, red clover, and so forth, have higher feeding values than some other forages. If you have questions on forage species, call your county University of Missouri Extension Center.

Moisture Content

When forage plants are cut, the plant continues to breathe until the moisture content of the plants falls below 40 percent. Dry matter is lost during this process, and in some cases the loss may be as high as 15 percent. However, respiration losses are usually about 5 or 6 percent of the total dry matter. In normal hay curing, you cannot eliminate these losses.

When the moisture content of hay drying in the field reaches about 40 percent, further dry matter losses are due to raking and baling. Losses from these operations range from 10 to 25 percent, with most losses averaging about 15 percent. Dry matter losses from raking and baling are especially severe because most of these losses come from the most valuable part of the hay—the leaves.

Using hay crimpers and crushers can greatly reduce dry matter loss. Their use reduces curing time in the swath, exposure to the weather, leaf shattering, and respiration losses. All serious hay producers use crimpers and/or crushers.

The key to keeping dry matter losses of hay to a minimum are (1) bale at a moisture level low enough to prevent excessive heating and (2) prevent infiltration of moisture into the hay after it has been baled.

When hay is baled, it should not be higher than 20 to 22 percent moisture. When it contains more than this, there is danger of excessive heating, molding, and in severe cases, spontaneous combustion.

Although there is no danger of burning buildings when large hay bales are stored in the field, excessive heating and molding can still occur. Therefore, hay to be stored outside also should not be baled until the moisture level reaches 20 to 22 percent range. See Table 1.

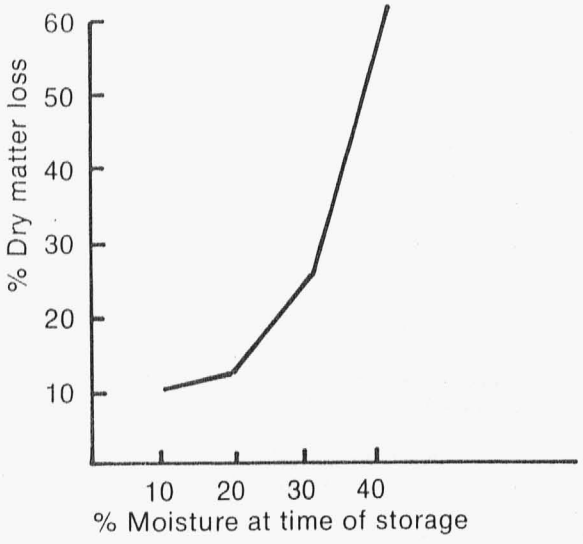
During storage, hay will usually lose an additional 5 to 10 percent dry matter, even if it is originally baled and stored below 20 percent moisture. However, hay that is baled too wet reaches high temperatures and losses can become phenomenal. See Figure 1.

Table 1. Dry matter losses of alfalfa-grass in big bales under different storage conditions.

Type Hay	Moisture at baling	Storage	Dry Matter Loss
1st cutting	36%	Inside	17.8%
		Outside	26.6%
2nd cutting	24%	Inside	12.2%
		Outside	15.2%

H. David Currence - University of Missouri

Figure 1. Spoilage loss in bales made from alfalfa-grass at different moisture levels.



When hay begins to heat, molds develop. When molds begin to form, heat generated by the activity of the organisms further increases the temperature of the hay. Molds usually develop between 113 and 149°F. If temperatures increase to above 150°F, there is danger of spontaneous combustion.

Molds and heating consume hay dry matter. Storage

losses during heating and mold development are proportional to the moisture content above 20 percent.

The feeding value of hay is greatly reduced if it heats to 110 to 150°F or more for as long as 12 hours. There is some deterioration of hay quality and direct dry matter loss if temperature within the hay exceeds 105°F. If the hay contains more than 20 to 22 percent moisture at baling time, temperature will usually exceed 105°F.

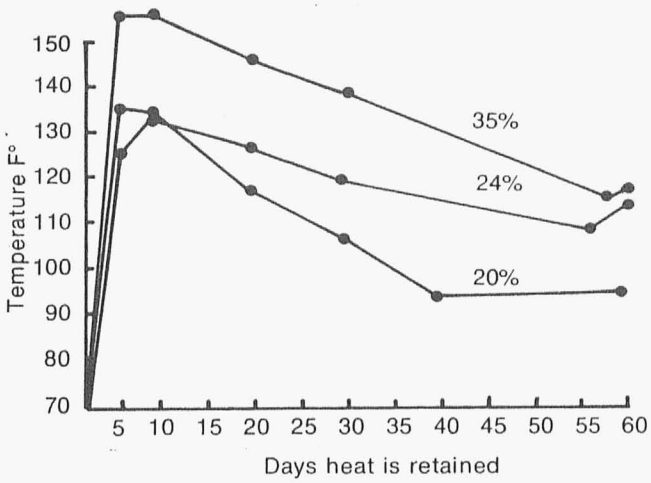
Farmers often report dark brown hay with a caramel-candy smell that cattle consume readily. When excessive heat is present in hay, the protein and carbohydrates combine to form an undigestible compound. This phenomenon is called the *browning reaction* and creates the caramel smell. Hays that have undergone these changes are extremely low in digestibility, and in particular, very low in digestible protein.

Large bales tend to retain internal heat much longer than conventional size bales. The implications of this are far reaching. Hay bales that remain above 120°F for 20 days or longer definitely lose excessive amounts of dry matter and suffer extreme losses in digestibility of protein and energy. These bales often will lose more than half of the original digestible protein. This is a serious loss, especially with grass hays that are borderline in protein content at cutting time.

If you are storing or sheltering some of your big bales, this long-term heat retention affects the proper time to move big bales into storage. See Figure 2. Hay baled with more than 22 percent moisture should probably not be put into storage for at least 30 days. This is especially true if bales are to be stacked several layers deep.

With the threat of barn fires removed by outside hay storage, many operators of large round balers try to bale hay with too much moisture. But excessive heating and molding can cause the loss of as much as one-third of the feeding value of hay baled at 28 percent moisture.

Figure 2. Effect of moisture at baling time on heat retention in big bales.



University of Missouri

Stage of Maturity

The stage of maturity at time of harvest is one of the most important factors affecting forage quality.

Most forages will have a 20 percent loss in TDN (total digestible nutrients) and a 40 percent loss in protein by a delay of only 10 days past the most desirable stage of harvest. For instance, alfalfa-grass mixtures cut when the alfalfa is in the late bud to early bloom stage will often contain 65 percent TDN and 18 percent protein. Contrast this to cutting at the 1/2 bloom stage or later, with 48 to 50 percent TDN and 12 percent protein. This is a 20 percent loss in the value of the hay.

Grasses, which are somewhat lower in feed potential than legumes to start with, follow the same decreasing pattern in feeding value as they mature. Grasses such as fescue and orchardgrass will often be as low as six percent crude protein after blooming when the seeds are beginning to form.

Legume-grass mixtures should be harvested when the legume reaches the desired stage of maturity regardless of the growth stage of the grass.

If the plants are not under stress conditions, the recommended stages of maturity for harvesting common forage plants in Missouri are:

- Alfalfa: bud to 1/10 bloom
- Red clover: 1/4 to 1/2 bloom
- Timothy: late boot
- Bromegrass: heads emerged
- Orchardgrass: bloom
- Reed canarygrass: heads emerged
- Tall fescue: boot stage

Overall losses due to late hay making can reach staggering proportions. Shattering and wilting losses are always proportionately higher with late-cut than with early-cut forages. Such an economic loss affects the profit of livestock farms.

The four major contributors to feed value losses in hay are:

- Late cutting losses in digestibility: 20%
- Wilting losses in the swath: 5%
- Shattering of leaves: 20%
- Too high moisture at time of baling: 15 to 25%

Storage Losses

If hay is baled with a moisture content of 20 to 22 percent, loft or mow-stored hay should not lose more than five percent of its original dry matter during the first year of storage. It will lose very little of its digestible nutrients during that time or in succeeding years. One exception: the hay will suffer some loss of carotene, the precursor of vitamin A, following one year of storage.

Large bales stored outside will suffer extremely variable losses, depending upon a combination of factors. These factors are: moisture of the hay at baling time, amount of rain and snow during the storage period, internal drainage of the soil on which bales are stored, amount of space between the bales, type of hay (grass or grass-legume), and the skill of the operator making the bales.

There are two types of storage losses suffered during outside storage. The easiest to see and the one that has been measured in many experiments is the total dry matter loss. This represents the weight loss between the beginning of storage and the time the hay is fed. While this loss is quite variable between experiments, it is usually in the range of 6 to 15 percent of the total hay stored, with the norm much closer to 15 percent than to 6 percent. See Table 2.

The second type of loss in outside storage is the loss in digestibility of the weathered portion of the hay. Just because the cattle eat most of this portion does not mean that it is as high in feeding value as the unweathered part. In fact, the loss of feeding value in the weathered portion of the hay usually is a greater source of loss than that from total dry matter loss. When these two types of losses are added together, the loss of total feed during storage will usually approach 25 percent.

WRONG way to store hay, with bales against each other, is shown by author Howell Wheaton.

RIGHT way to place hay allows plenty of room for air to circulate and dry hay.

Table 2. Total feed loss in big bales stored outside.

	Dry matter in bale	% Digestible	Total nutrients available
At harvest	1,000 lbs	56%	560 lbs
At feeding	930 lbs	48%*	446 lbs
	70 lbs (7% loss)	Lbs loss: 114	
		TOTAL % LOSS: 20.2	

*Loss due to weather-damaged outside portion of bale that was lower in feeding value but that cattle ate anyway.

A loss of 20.2 percent of the original feeding value of the hay was lost during storage, but the original dry matter loss was only seven percent. If the original dry matter loss during storage had been 15 percent (an average loss that occurred in several recent experiments), then the total feed nutrient loss would have been 27 percent. This is a high price to pay for outside storage, especially if hay is high quality.

Select your storage area carefully. Store bales on well drained areas. Some farmers place them on poles or crushed rock to minimize losses on the bottom of bales. Some research has shown that these techniques reduce storage losses by 15 percent. Always place bale rows in the same direction as the prevailing winds.

There does not seem to be much difference in storage losses of bales set side-by-side versus those set end-to-end. One note of caution: Bales placed end-to-end should be the same size. Cone-shaped bales or bales of different diameters placed end-to-end will often cause excessive spoilage on the ends of bales.

Some general guidelines can help reduce outside storage losses:

- Always store bales on a well drained area.
- Use a minimum of three feet between bale rows for air circulation. The more space, the better.
- If bales are stored side by side, leave at least 24 inches between bales.
- Avoid storing bales under trees and in the shade of buildings.
- If space is available, store some of the bales inside, especially the higher quality hays that should be used near the end of the feeding period.

Hay Preservatives

Farmers in the past often applied salt to hay as it was stored in the barn to prevent mold and heating. This practice had some merit. But the amount of salt needed for hay of very high moisture content would be so great that the salt would be extremely expensive and in many cases would lower the palatability of the hay.

Most recent research to prevent storage losses of hay has involved organic acids. The ones receiving the most attention have been propionic and acetic acid and formaldehyde. In general, these have been successful as far as the keeping and feeding values of the hay are concerned. The major drawbacks have been cost and application problems. The organic acids probably operate as fungicides to prevent molds from

forming in the hay. Formaldehyde kills bacteria and binds protein in a manner that prevents a decline in hay feeding value.

The preservative is usually applied to the hay as it enters the baler. Some farmers have had difficulty obtaining accurate application rates of the acids because of differences in windrow size and baling techniques. The acids are also corrosive to equipment.

About 20 pounds of actual acid should be applied per ton of hay if the moisture content of the hay ranges between 25 and 30 percent moisture. Hay between 30 and 35 percent moisture will need at least 40 pounds of acid per ton to prevent heating and mold formation.

If hay is baled at 25 percent moisture or slightly lower, about 10 pounds of actual acid per ton should control heating and dry matter losses. Higher application rates may be needed to prevent heating in large bales. Ohio State reported that stacks that contained more than 25 percent moisture at stacking time heated excessively, regardless of how much acid was used.

Anhydrous ammonia has recently been used experimentally as a hay preservative. When anhydrous gas equivalent to one percent of the weight of the hay was diffused into hay baled at 30 to 35 percent moisture, it effectively prevented mold and losses in digestibility. Since much of the ammonia is retained in the hay, it will also increase the crude protein percentage to some extent. In addition, the ammonia treatment seems to increase the digestibility of the cell wall fiber portion of the hay.

Anhydrous ammonia may have a much greater potential value as a preservative than the organic acids because it costs less and it actually improves the product by increasing crude protein and the digestibility of fiber. *However, practical methods of application must first be devised before the use of anhydrous ammonia as a hay preservative can become widespread.*

Bales treated with preservatives are extremely heavy and in most instances need to be handled mechanically. When the bales dry, the strings and wires become loose, making them difficult to handle. Re-baling may be necessary if hay is sold and needs to be rehandled and transported.

Should you use preservatives? There is no firm yes or no answer. First, consider the value of the final product. Adding $5 to $10 per ton in preservatives' cost to a ton of high quality alfalfa hay worth $65 on the market is much more economically feasible than adding the same amount to fescue hay worth about $25 to $30 per ton on the market.

Preservatives will reduce the time needed for hay to cure in the field and, thus, will reduce the risk of rain damage to the hay. And if properly used, preservatives substantially reduce storage losses of high moisture hay.

Weigh these benefits against the original cost of the preservative, the extra labor required to apply it and to handle the heavier hay, and the value of the end product before making a decision to use or not to use a hay preservative.

Another factor to consider is preservative's potential damage to haying equipment. The acids are corrosive to equipment, and you must take care to wash balers, bale wagons, etc., to prevent permanent damage.

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4575 *New 6/80/8M*

SURVEY OF FORAGE HARVESTING IN MISSOURI

James C. Frisby, Agricultural Engineering Department

1577 responses were sorted by primary economic enterprise. Enterprise categories included:

Beef--980 responses

Swine--263 responses

Dairy--139 responses

Grain--64 responses

Hay--32 responses

The forage harvesting systems in general use were baling (small square, small round and large round) and ensiling, which was primarily used by dairymen. The order of preference for swine and grain enterprises was large round, small square, and small round. For all other economic enterprises, the order was small square, large round and small round.

All enterprise categories report use of the large round baler. Of all baled hay reported, 42.3 percent was in large round bales. Reduced labor seems to be the main incentive for use of large round bales. The large round bales are more difficult to haul long distances--which may account for limited use by commercial hay producers.

Much hay is stored outside. Even commercial hay producers and dairymen, who were expected to be most concerned about feeding quality, stored some hay outside.

There was considerable variation among hay harvesting systems. Some involve many people and machines; others get by with barely adequate machines and as little labor as possible.

A typical hay harvesting system for small square bales was:

2 tractors (30 pto hp and 50 pto hp)

1 sickle-bar mower

1 side delivery rake

1 baler

1 truck with automatic bale-loading attachment

A typical hay harvesting system for large round bales was:

2 tractors (35 pto hp and 75 pto hp)

1 trailed windrower-conditioner

1 side delivery rake

1 baler

1 bale-moving device (usually a 3-point attachment for the larger tractor or an attachment for a pick-up truck)

It seems that many farmers use more than one hay harvesting method. Many own one kind of baler (usually small square) and custom hire another (usually large round). Some own both round and square balers. Square bales are often stored inside as a hedge against an unusually high need for forage or an unfavorable forage year. The bales may be stored more than one year.

Round bales are often used for lower quality forage. The low labor requirement is definitely an incentive. Some apparently do not realize how much hay they are losing by storing large round bales outside. Written comments indicate that others recognize the loss and are willing to accept it for reduced labor and ease of feeding.

WINDROWS: HOW THEY AFFECT LARGE ROUND BALES

William G. Hires
Department of Agricultural Engineering, University of Missouri

Windrows are an important part of field curing of hay crops. Properly made windrows have the small-stemmed, quick-drying, leafy portions of the plant surrounded by the course-stemmed, slow-drying part of the plant. This aids in uniform drying of the hay.

The direction of travel of the rake should be in the same direction as the mower. The top parts of the plant fall backwards over the mower's cutter bar and lie pointing in a direction opposite to mower travel. The top parts of the plant are then rolled into the center of the windrow. The courser, slower drying parts of the plant are placed in the outer layer of the windrow where they are dried by the sun and air.

The windrow should rest on raked ground and not on unraked hay.

Raking should be completed before the moisture content of the whole plant drops below 40% or the point where leaf shatter occurs.

A windrow that is uniform in width and depth is essential for producing cylindrical large round bales of uniform density. Uniform bales are easier to transport, store easier and suffer lower losses when compared to barrel or cone-shaped bales. Windrow width just under the width of the baler pick-up is best. Tractor tires should not run on the outer edges of the windrow while baling as it will cause barrel-shaped bales to be produced. If the tractor wheels cannot be adjusted wide enough to straddle the windrow, attachments are available to fluff the windrow edges to help in producing cylindrical-shaped bales.

Low yielding hay crops present a problem of light narrow windrows. If this is a problem, two windrows are combined. It should be done above 40% moisture so excessive leaf shatter will be at a minimum. During baling, a sharp zigzag or wearing pattern on light windrows causes bales to be barrel-shaped; driving continually on one side of the windrow will cause cone-shaped bales. A skilled operator will operate the baler on one side of the windrow and then move to the opposite side long enough to produce a perfect cylindrical-shaped bale.

PROPER SHAPE OF LARGE-ROLL BALES

Stan Bell, Southwest Missouri Center, University of Missouri
F.A. Martz, Dairy Science Department, University of Missouri

SUMMARY: The proper shape of large-roll bales is uniform and dense enough to prevent squatting, smooth surfaced and tied to prevent excessive weathering, and of low moisture to prevent overheating and molding. All large-roll balers will make a satisfactory bale if properly operated and adjusted. The operator of a large-roll baler is the key to making good, properly shaped, weathertight bales. Slowing groundspeed when a large-roll bale is within 6 inches of completion will usually make a denser outer layer. Twine wraps every 3 inches will hold the surface uniformly and prevent excessive weathering without using any more twine than with square bales. Second cutting and early cut grass hays will usually shed more water than late cut stemmy hays. Hay baled below 20 percent moisture will heat less, shrink less, and keep better than hay baled at higher moisture levels.

The proper shape of large-roll bales is the same as the old Allis Chalmers Roto bale only 10 to 30 times larger. All makes of large-roll balers will make satisfactory bales if properly adjusted and operated. Some large-roll balers make better bales than others, depending upon which dealer or farmer is doing the talking. Baler operator, kind and maturity of hay, and moisture at baling are the three most important factors in making properly shaped, weathertight, large-roll bales.

The baler operator's goal is to turn out bales that are as uniform from end to end as an undented tin can. The outside layer should be dense enough and tied so the bale doesn't squat or flatten excessively when it hits the ground. To get a uniform bale, the operator must move the baler across the windrow occassionally to fill the ends of the bales. The tendency is to spend too much time over the middle of the windrow which results in an egg-shaped bale. Once the bale is started, it is better to drive on one side of the windrow, then cross over rather quickly and drive awhile on the other side. The other alternative is to use a twin rake which can be adjusted to make a uniform windrow the exact width of your bale chamber.

With some large-roll balers, ground speed can be important in turning out a dense, uniform bale. Generally, the slower the hay is fed into the baler, the tighter or denser the bale. However, the slower the hay is fed into the baler, the more turns the bale makes in the chamber and the greater the leaf loss. So, with legume hay, you need to drive as fast as possible to reduce leaf shatter. Whether baling grass or legume hay, it is important to slow groundspeed when the bale is within 6 inches of being complete. By volume, 36% of the hay in a 5-foot diameter bale is in the outer 6-inch layer. Slow groundspeed will form a denser, more weathertight layer around the outside of the bale.

The bale is now ready to be tied and the question is how much twine to wrap around the bale? Research at the Southwest Missouri Center at Mt. Vernon shows that water penetrated deeper into bales where the twine was spaced 8 to 10 inches apart and pulled grooves into the bales. By spacing the twine wraps about 3 inches apart, the entire surface is held uniformly tight and there is less tendency for the twine to pull a groove into the bale when it is released from the bale chamber. Twine usage is not increased over square bales if you figure 20 square bales measuring 3 feet x 16 inches in a large-roll bale. The square bales would use 17 feed of twine per bale or 344 feed for the 20 square bales. A 5½-foot diameter large-roll bale would use 17 feet of twine per wrap. Twenty wraps of twine on a 5-foot long bale would also use 344 feet of twine, and the wraps would be spaced 3 inches apart.

Kind and maturity of hay has a large effect on how well large-roll bales retain their shape and shed water. The first hay we rolled into large-roll bales was second cutting orchardgrass. Even the untied Hawk Bilt bales had a weathered layer of no more than one inch after 30 inches of rain. A few years later, orchardgrass-red clover bales had weather layers as deep as 14 inches after 36 inches of rain. Generally, the leafier the hay, the smaller the weathering losses. First cutting grass hay cut in the boot stage has a small amount of stems compared to leaves and generally will turn more water than grass hay cut later. I've seen alfalfa hay bales that turned water and some that didn't. Sudan hays cut early will generally turn more water than later cut, more mature hay.

Moisture at baling is more critical with large-roll bales than with square bales. Hay baled at 20 to 22% moisture will dry out to 12 to 15% moisture or a 5 to 10% shrink whether it be large-roll or square bales. Hay in large-roll bales will heat more and maintain a higher temperature longer than square bales. Excessive heating can cause greater dry matter losses. Big bales made with hay at too high a moisture will squat or settle more than bales made with hay at 15 to 18% moisture. The denser the bale, the dryer the hay needs to be. Alfalfa hay baled at 18% moisture molded at the core of dense bales made at the Southwest Center.

Proper shaped large bales are necessary to prevent excessive weathering when large bales are stored outside. The baler operator must use his driving skills to produce a uniform bale. Good bales have a dense outer layer and are tied with enough twine to prevent squatting when the bales hit the ground. A uniform surface, free of twine grooves, will weather better than rough surfaced bales. Kind of hay and maturity affect ease of making good bales and how well the bales will weather outside. Hay should be below 20% moisture at baling.

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Large Round Balers

Bill Hires
Agricultural Engineering Department
College of Agriculture

The continuing search for a labor-saving method of hay harvest led to the development of the large round baler. At this time, there are 13 manufacturers selling 23 balers of three different types that produce large round bales of 850 to 1,900 pounds in size. These bales appeal to cow-calf farmers since they resist weather damage and can be stored outside, thus reducing labor requirements.

Types of Large Round Balers

Three baler types are produced: 1) ground roll, 2) carried bales formed in an expandable chamber, and 3) carried bales formed in a fixed chamber. The most popular bales are the ones with the carried bales formed in either the expandable or fixed chamber.

Ground Roll Baler. There are two ground roll balers being produced. Following are some of their characteristics. The bale rolls on the ground on top of the incoming windrow. The upper portion of the bale in one ground roll baler is confined by a series of cables and rollers while the other baler confines the bale by revolving chains and slats (raddle). Ground roll bales have a lower density than other bales, averaging six to eight pounds per cubic foot. Baler capacity is also lower than other balers, averaging one to six tons per hour. Tractor power takeoff (PTO) horsepower requirements are in the 35 to 40 horsepower range.

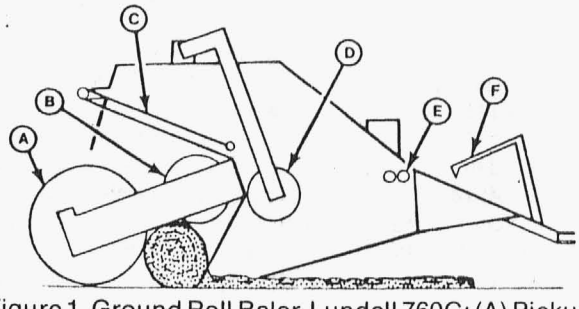

Figure 1. Ground Roll Baler. Lundell 760C: (A) Pickup, (B) Bale Forming Roller, (C) Bale Forming Cables, (D) Bale Forming Roller, (E) Twine Rollers, (F) Second Bale Starter.

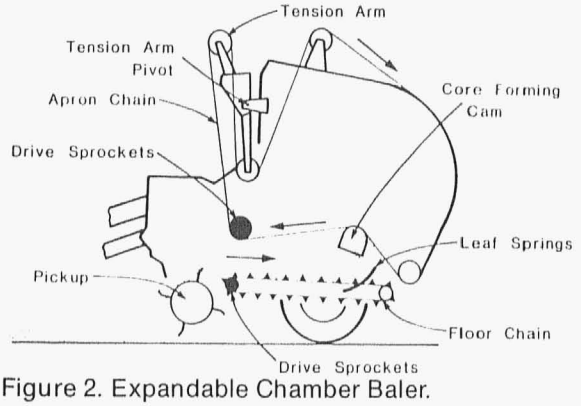

Figure 2. Expandable Chamber Baler.

Expandable Chamber Balers. Bales formed in these balers have tension applied by either belts or chains and slats commonly called raddles. Tension is applied to the bale as the core is formed until the bale is completed. Some of the balers of this type produce a bale with a uniform density, while others produce a bale with a density at the outer diameter that is about double that at the center. Whole bale density averages from 7 to 13 pounds per cubic foot, and production averages from 3 to 13 tons per hour. Tractor PTO horsepower requirements vary from 50 to over 100 hp.

Carried Fixed Chamber Balers. These balers tumble hay within the bale chamber until the last stages of

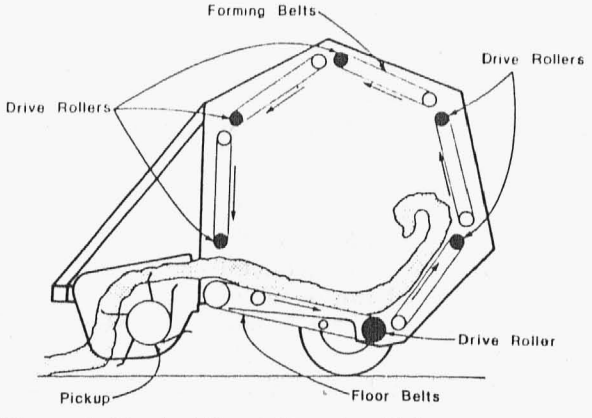

Figure 3. Carried Fixed Chamber Baler.

formation, when tension is maintained by hydraulic pressure. The baling chamber is a series of belts or rollers. The operator reads a hydraulic pressure gauge to determine when a bale is done. These bales have a low density or soft-core center and an outer diameter density about double that of the center. Whole bale density averages 7 to 13 pounds per cubic foot, and production capacity is about 3 to 13 tons per hour. PTO power requirements are about 60 to 75 hp.

Work Quality

Ground Roll Balers. These balers produce a low density bale with irregular surfaces. Nonuniform windrows cause poor quality bales. Irregular and low density bales result in severe weathering with high moisture penetration. Pickup and bale-chamber losses are impossible to measure because hay is rolled on the ground, and all losses appear on the ground behind the pickup.

Carried Expandable Chamber Balers. Good bales are easier to make when windrows are large and uniform. Occasionally, the bale core is hard to start and might even need to be discharged and a new bale started. Bale formation is usually easier if an extended weave pattern is followed while baling. (See Guide 1955 for a diagram of this pattern.) These balers can be used to produce bales varying in weight. Bales tend to be uniform in shape and density. Under most conditions, you back up the baler before discharging the bale. Take care in lowering the rear gate or door, as expensive damage can occur if the gate strikes the unloaded bale as it closes. Drive forward before closing the gate to prevent this. One baler has an optional attachment that will cause the bale to move away from the rear gate. Twine consumption varies with bale size and number of wraps. From 150 to 450 feet per ton is needed as compared to small square bales that need 670 feet per ton.

Carried Fixed Chamber Balers. Windrow size and shape is not as critical for these bales, and an extended weave is not needed when starting the bale as the hay tumbles loosely in the chamber. When the outer part of the bale is being formed, an extended weave driving pattern will be needed on irregular or light windrows, as the hay is under tension and will not move across the chamber. For ideal bales, use the maximum bale chamber capacity.

Baler Attachments

Attachments available depend on the particular manufacturer. Devices such as horns or lights mounted on the tractor are available to signal when the bale is done. One manufacturer offers bale sensing instruments that warn of an improperly shaped bale. Manual, electric, or hydraulic twine feeding mechanisms may be used. Automatic and dual twine feed mechanisms are also available. These speed up tying and make faster baling possible. Tedder devices are being used to fluff up windrows mashed down by tractor tires or to bring wide windrows to the same width as the baler pickup. Bale ejectors can move the bale away from the tailgate. Bale counters are standard equipment in most cases. Two attachments available on some machines or from outside manufacturers are wrapping equipment for applying plastic completely around the bale and hay preservative equipment for metering chemical preservatives into the bale as it is formed.

Ground Roll Balers

model or series designation	Hawk Bilt Col 580	Lundell 760
maximum weight of bale—pounds	1200	1400
bale diameter or width x height—inches	36-72	to 66
bale length—inches	80	60
bale wrapped with twine?	yes	yes
number of twine knotters	none	none
number of twine wraps around bale	2-4	varies
type of twine recommended	baler	baler
baler capacity—tons per hour	15	6-10
pick up width—inches	—†	60
pick up type—tine bar, other	—	—
bale compression method—belts, packer arms, raddle, other	raddle	rollers
baler overall height—inches	111	78
baler overall width—inches	114	96
baler overall length—inches	230	196
baler shipping weight—pounds	4918	3700
tractor size required—PTO horsepower	35	30+
tractor PTO rpm required—540 or 100	540	none*
tractor minimum hydraulic pressure—psi	none	—
tractor minimum hydraulic flow rate—gpm	none	—
recommended field travel speed—mph	4½ to 5	to 5

†—means data not available
*ground driven

Comments

Large round balers, like all other farm machines, require a skilled operator and the correct operator's manual. Statements here are not meant to take the place of any operator's manual or related publication. All maintenance, lubrication and adjustments should be made only after reading the operator's manual.

Carried Fixed Chamber Balers

model or series designation	McKee Round Baler	New Idea AVCO 456	Owatonna Mft. Co. 595
maximum weight of bale—pounds	1760	1800	1500
bale diameter or width x height—inches	71	72	72
bale length—inches	59	60	60
bale wrapped with twine?	yes	yes	yes
number of twine knotters	none	none	—†
number of twine wraps around bale	8-12	varies	varies
type of twine recommended	*	*	—
baler capacity—tons per hour	13	to 14	10 to 15
pick up width—inches	59	60	66
pick up type—tine bar, other	tine bar	tine bar	tine bar
bale compression method—belts, packer arms, raddle, other	belts	belts	rollers
baler overall height—inches	96	96	108
baler overall width—inches	99	99	96
baler overall length—inches	189	189	174
baler shipping weight—pounds	3638	3630	4365
tractor size required—PTO horsepower	60	60+	70+
tractor PTO rpm required—540 or 1000	540	540	540
tractor min. hydraulic pressure—psi	—	1500	1500
tractor min. hydraulic flow rate—gpm	—	—	—
recommended field travel speed—mph	—	2-6	6

*sisal or plastic
†—means data not available

Carried Expandable Chamber Balers

	John Deere		Ford		Gehl	
model or series designation	410	510	551	552	RB1400	RB1600
maximum weight of bale—pounds	850	1700	900	1500	900	1500
bale diameter or width x height—inches	60	72	60	72	60	72
bale length—inches	48	63	45	60	45	60
bale wrapped with twine?	yes	yes	yes	yes	yes	yes
number of twine knotters	none	none	none	none	none	none
number of twine wraps around bale	varies	varies	7	7-10	8-10	varies
type of twine recommended	*	*	baler	baler	baler	baler
baler capacity—tons per hour	12+	15+	4-6	8-10	8-10	8-10
pick up width—inches	60	72	45	60	45	60
pick up type—tine bar, other	tine bar	tine bar	tine bar	tine bar	tine bar	tine bar
bale compression method—belts, packer arms, raddle, other	belts	belts	belts	belts	belts	belts
baler overall height—inches	100	109	94	107	94	107
baler overall width—inches	82	98	80	96	80	96
baler overall length—inches	157	169	139	165	139	165
baler shipping weight—pounds	2935	3880	3600	3980	3600	4200
tractor size required—PTO horsepower	40+	70+	40	50	40	50
tractor PTO rpm required—540 or 1000	540	540**	540	540	either	540
tractor min. hydraulic pressure—psi	1000	1000	1000	1000	1000	1000
tractor min. hydraulic flow rate—gpm	2	2	5	5	5	5
recommended field travel speed—mph	2-6	2-6	varies	varies	varies	varies

*sisal or plastic
**belts with hydraulic tension

Carried Expandable Chamber Balers

model or series designation	Hesston 5500	Hesston 5540	Hesston 5580	Hesston 5800	Int. Harv. 2400 bigroll
maximum weight of bale—pounds	1100	1200	1500	1500	1500
bale diameter or width x height—inches	60	72	72	72	72
bale length—inches	60	47.3	60	60	60
bale wrapped with twine?	yes	yes	yes	yes	yes
number of twine knotters	none	none	—†	none	none
number of twine wraps around bale	8-10	8	8	8-10	varies
type of twine recommended	baler	*	*	baler	baler
baler capacity—tons per hour	to 8	to 10	to 12	8-10	—
pick up width—inches	60	54	66	60	60
pick up type—tine bar, other	tine bar	tine bar	tine bar	tine bar	tine bar
bale compression method—belts, packer arms, raddle, other	belts	belts	belts	belts	belts
baler overall height—inches	100	102	103	105	102
baler overall width—inches	95	83	95.8	92	96
baler overall length—inches	146	147	147	158	156½
baler shipping weight—pounds	3620	3800	4215	3910	3350
tractor size required—PTO horsepower	55+	40+	45+	55+	45
tractor PTO rpm required—540 or 1000	540	540	540	540	540
tractor minimum hydraulic pressure—psi	1500	—	—	1500	1200
tractor minimum hydraulic flow rate—gpm	—	—	—	—	6
recommended field travel speed—mph	2-6	2-6	2-6	2-6	2-6

†—means data not available
*sisal or plastic

Carried Expandable Chamber Balers

model or series designation	Massey-Ferguson MF-450	Massey-Ferguson MF-1560	Sperry New Holland 846	Sperry New Holland 851	Vermeer 403F	Vermeer 504F	Vermeer 605F
maximum weight of bale—pounds	1000	2000	850	1500	650	1500	1900
bale diameter or width x height—inches	60 maximum	72	54	66	to 48	to 60	to 72
bale length—inches	48	60	54	66	36	47	60
bale wrapped with twine?	yes	yes	yes	yes	yes	yes	yes
number of twine knotters	none	none	none	none	none	none	none
number of twine wraps around bale	7-8	varies	varies	varies	varies	varies	varies
type of twine recommended	baler	baler	baler	baler	baler	baler	baler
baler capacity—tons per hour	—	10-12	6-10	9-13	to 8	to 12	to 15
pick up width—inches	60	60	56	72	36	48	60
pick up type—tine bar, other	tine bar	tine bar	tine bar	tine bar	tine bar	tine bar	tine bar
bale compression method—belts, packer arms, raddle, other	belts	*	raddle	raddle	belts	belts	belts
baler overall height—inches	94	104	92	105	86	94	104
baler overall width—inches	81	95	91	96	80	84	95
baler overall length—inches	152	170	155	162	148	162	170
baler shipping weight—pounds	3090	4380	3300	4200	2850	3600	4370
tractor size required—PTO horsepower	35	60	40-60	55-75	40	60	60
tractor PTO rpm required—540 or 1000	540	either	540	either	either	either	either
tractor min. hydraulic pressure—psi	1000	1600	1200	1500	1000	1000	1000
tractor min. hydraulic flow rate—gpm	4.5	4.5	6	6	4.5	4.5	4.5
recommended field travel speed—mph	2-6	2 to 6	3-5	3-5	3-5	3-5	3-5

*Belts with hydraulic tension

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. Leonard C. Douglas, Director, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.

THE INFLUENCE OF AMMONIA TREATMENT OF FESCUE HAY ON INTAKE, NUTRIENT DIGESTIBILITY, AND ANIMAL PERFORMANCE.

R.T. Brandt, J.A. Paterson and D.K. Bowman

SUMMARY

Two laboratory trials, a lamb intake and digestion trial, and a calf growth trial were conducted to evaluate the effects of anhydrous ammonia (NH_3) treatment of poor quality tall fescue hay on nutrient digestibility. The calf growth trial was conducted to measure rate of gain as well as to determine the potential use of NH_3 as a means of reducing supplemental protein needs for calves consuming treated fescue. For the laboratory trials (1 and 2) NH_3 treatment of fescue decreased cell wall content and increased both the rate and extent of *in vitro* dry matter disappearance compared to the untreated hay. Ammonia treatment increased the crude protein equivalent from approximately 5% to 13%. When fed *ad libitum*. lambs consumed more NH_3 treated fescue hay than untreated fescue hay ($P<.05$). Both dry matter digestibility and cell wall digestibility were higher ($P<.05$) for lambs fed NH_3 treated fescue hay than for lambs fed untreated hay. Calves fed NH_3 treated fescue gained 15% faster ($P<.05$) than those fed untreated fescue, even though they received 35% less supplemental protein than the calves fed untreated fescue hay.

INTRODUCTION

With the advent of increasing production costs and often negative profit margins in the livestock industry, researchers and producers are challenged to develop more efficient and inexpensive feeding systems. This is particularly true for cow maintenance and calf backgrounding production programs. There is tremendous potential for accomplishing these goals due to the ability of the ruminant animal to utilize low quality roughages such as grain crop residues, feed byproducts, and low quality grass hays.

The inherent problems with poor quality forages are: 1) a lack of adequate amounts of protein for rumen microbial synthesis, 2) a low energy availability, associated with forage maturity and a high degree of cell wall lignification, and 3) low levels of intake, primarily due to the previous two factors exerting negative effects on the rate and extent of ruminal forage digestion. Beef stocker gains from low quality forages could be significantly improved if crude protein content, energy availability, and level of intake could be increased.

One of the current methods used for improving crop residue feeding quality is the application of anhydrous ammonia to baled or chopped

roughages. Ammonia treatment has been shown to increase digestibility of low quality forages, probably through (1) the breaking of lignocellulose bonds or hemicellulose hydrogen bonds (Van Soest, 1980) and (2) possibly through the physical swelling of the plant fiber, allowing for a greater extent of microbial attachment. In addition, NH_3 provides a non-protein nitrogen (NPN) source to the rumen microorganisms. Energy required by the microorganisms to convert NPN to microbial protein may be supplied through the increased availability of forage cell wall carbohydrates. Increasing the availability of energy and in addition providing a nitrogen source for rumen microorganisms should enhance both microbial numbers and microbial activity. The result is a greater rate and extent of fiber digestion in the rumen, allowing the animal capacity for higher levels of intake, and subsequently increased performance.

The objectives of this investigation were: (1) to evaluate the effects of NH_3 treatment on cell wall (NDF) and crude protein equivalent(CP) content, availability of nitrogen, and rate and extent of *in vitro* dry matter disappearance (IVDMD) of tall fescue hay; (2) to determine differences in dry matter intake, dry matter digestibility, and cell wall digestibility for NH_3 treated vs. untreated fescue hay; and (3) to measure performance of calves fed either NH_3 treated or untreated fescue and evaluate the potential of NH_3 treatment as a technique for reducing supplemental protein needs.

Table 1. Fescue hay analysis for laboratory trial 1.

Item	Treatments			
	Untreated		3.5% NH_3	
	inner ½	outer ½	inner ½	outer ½
Dry matter, %	92.2	90.6	90.0	88.8
NDF, %	73.1	71.4	67.8	62.2
ADF, %	43.4	44.7	43.5	43.0
IVDMD, %	41.6	38.4	51.9	64.1
kIVDMD %/hour	3.08	2.49	3.08	4.76
CP (N x 6.25), %	5.2	5.4	12.3	13.5
N in ADF, %	.34	.38	.47	.44
Estimated digestible protein, %	4.3	4.3	11.0	12.3

Table 2. Average lamb intake and digestibility data for trials 2 and 3.

Item	Treatments			
	Untreated		3.5% NH_3	
	inner ½	outer ½	inner ½	outer ½
No. lambs	6	6	6	6
Ad lib. DMI, lbs/day	1.14	1.33	1.54	2.12
DMD, %	51.2	48.1	53.7	56.0
NDF Dig. %	46.6	46.9	51.5	54.2

Table 3. Performance of calves fed untreated and NH_3 treated fescue

Item	Treatments	
	Untreated	3.5% NH_3
No. calves	16	16
Initial wt, lbs.	409	415
Daily gain, lbs	.73	.84
Total gain, lbs.	57	66

Table 4. Protein supplement composition for calf growth trial

Item	Treatments	
	Untreated	3.5% NH_3
Whole shelled corn, lbs/hd/day	2	2
Total fed, lbs.	2496	2496
Dyhydrated alfalfa, lbs/hd/day	2	1
Total fed, lbs.	2496	1248

Table 5. Fescue hay analysis for fescue samples (Trial)

Item	Treatments			
	Untreated		3.5% NH_3	
	inner ½	outer ½	inner ½	outer ½
NDF, %	73.3	74.8	71.5	70.3
ADF, %	41.4	44.3	41.2	43.9
IVDMD, %	53.5	45.8	60.9	62.6

Effects of Roughage Level with Milo and Corn on Animal Performance for Finishing Cattle[1]

J. E. Williams

The use of roughages in finishing rations for beef cattle is dictated by the price of grain. In recent years, grain prices have favored the use of a minimal amount of roughage during the finishing phase. Most studies have revealed that corn prices have to exceed $4.00/bushel before the cost of producing beef is lowered by shortening the time on grain in the feedlot. However, the price of corn is expected to approach $4.00/bushel by 1982 and may exceed this price in the coming years. With this in mind, more research needs to investigate the effects of different roughage levels on animal performance and the economics of finishing cattle in the feedlot.

The present study looked at the effects of flaked milo and cracked corn with different levels of ground alfalfa hay in a finishing ration for beef cattle. Sixteen steer calves weighing approximately 430 pounds were allotted to either a flaked milo or cracked corn diet containing 10%, 20% or 30% ground alfalfa hay. Steers remained on these rations for approximately 221 days at which time they were slaughtered. Average daily gain (ADG), average daily feed (ADF), Feed/100 lb. gain, feed costs/100 lb. gain and carcass characteristics were examined during the trial.

With flaked milo as the grain source, feed requirements for the three levels of alfalfa were similar. As expected, the 30% alfalfa level had the highest feed requirement which was 2% greater than the 20 and 10% levels. Average daily gain was higher for the steers receiving 20% alfalfa hay. It would appear that feed intake on flaked milo rations is low if the ration contains only 10% alfalfa. Carcass characteristics were not influenced by alfalfa levels.

Feed requirements increased as the alfalfa level increased from 10 to 30% of the ration containing cracked corn as the grain source. The increase in feed requirements was consistent with an average of 24 pounds of additional feed needed per 100 pounds of gain with each 10% increase in alfalfa. Average daily gains were not affected by the different levels of alfalfa in the ration. In the case of corn fed steers dressing percentage was not influenced by alfalfa level. However, fat thickness and yield grade were lower for those steers receiving 30% alfalfa in the ration. The quality grade of steers receiving milo and corn with different levels of alfalfa was high good. The quality grade was slightly higher in the steers receiving milo with the higher alfalfa level, while those receiving corn had a higher quality grade at the 10 and 30% alfalfa level. It would appear that alfalfa hay was utilized to a greater extent with flaked milo than with cracked corn.

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[1]This research is summarized from a study by W. H. Hale et al., 1980. Various alfalfa levels with milo and corn for finishing cattle. Arizona Research Rept.