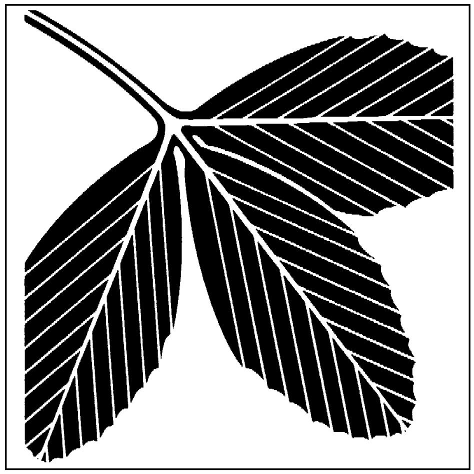

28TH KENTUCKY ALFALFA CONFERENCE PROCEEDINGS

Volume 28, Number 2

Garry Lacefield & Christi Forsythe, Editors

FEBRUARY 21, 2008

Cave City Convention Center
Cave City, Kentucky

Sponsored by
University of Kentucky● College of Agriculture● Cooperative Extension Service
Kentucky Forage and Grassland Council

Schedule for the Day

8:00 Registration, Visit Exhibits, Silent Auction

8:45 Welcome – Mike Barrett

9:00 Haymaking: A Trip Down Memory Lane – *Garry Lacefield and John Baylor*

9:20 Alfalfa: Back to Basics – *Ray Smith and Adam Probst*

9:40 Certified Weed Free Hay and Straw Program – *Kenny Perry*

10:00 Break, Visit Exhibits, Silent Auction

10:30 National Hay Association President's Perspective: What a Year to be President! – *Ron Tombaugh*

11:00 Alfalfa: Forage Crop of the Future – Neal Martin

11:50 Discussion

12:00 Lunch

1:00 Award Presentations & Silent Auction Results

1:30 Is There a Benefit to Alfalfa Balage? – *Gary Bates*

2:00 Alfalfa Hay and Balage: Testing for Quality – *Kim Field*

2:30 Hay Supply, Price and the Future – *Tom Keene*

3:00 Adjourn

F O R E W O R D

This conference marks the twenty-eighth consecutive year we have come together to address problems and potentials of alfalfa. We are certainly encouraged with the interest in and opportunities for alfalfa in Kentucky. We are optimistic that we will observe expansion in acres, yield, and markets. It is our hope that the information presented herein and the discussions of the day will be of value to each of you in your alfalfa program.

On behalf of the Program Committee, I would like to express our thanks to each of you for your faithful participation over the past twenty-eight years. I also want to thank all speakers, moderators, committee members, and workers for their many contributions.

My personal thanks to the Program Committee, the Kentucky Forage and Grassland Council, and the Kentucky Department of Agriculture for their encouragement and assistance. I also want to thank all the exhibitors for their important contributions and financial support. A special thanks is extended to Mrs. Christi Forsythe for her assistance in preparing and editing the program and proceedings.

Garry Lacefield
Program Chairman
XXVIII Annual Kentucky Alfalfa Conference

Don't forget to visit our Extension Forage Website

http://www.uky.edu/Ag/Forage

KENTUCKY ALFALFA AWARDS

The Kentucky Alfalfa Awards Program was initiated in 2000 at the 20th Anniversary of the Kentucky Alfalfa Conference. The Awards Program is funded annually from revenues generated each year for the Silent Auction during the Annual Conference.

Year	Warren Thompson Industry Award	Charlie Schnitzler Producer Award	Garry D. Lacefield Public Service Award
2008	Mike Phillips	Clayton Geralds	John Baylor
2007	Bret Winsett	Bill Payne	Dan Grigson
2006	Scott Cooper	George Eckler	Laurie Lawrence
2005	Barney Booher	Roy Reichenbach	Ken Johnson
2004	Gary Coughlin	Minos Cox	Mike Collins
2003	Phil Howell	Lee Robey	Monroe Rasnake Jimmy Henning
2002	Tom Keene	John Nowak	Billy Ray Smith
2001	Bill Talley	Larry Jeffries	Timothy H. Taylor W. C. Templeton, Jr.
2000	Warren Thompson	Sue Schnitzler*	Garry Lacefield

*Accepted on behalf of her father who was tragically killed in a farming accident on March 11, 1991.

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HAYMAKING: A Trip Down Memory Lane

Garry D. Lacefield & John E. Baylor
Extension Forage Specialist, University
and
Extension Forage Specialist, Emeritus, Pennsylvania State University

On a hot day in August, I climbed into the dust-free air-conditioned cab of a new tractor to assist in a hay baling demonstration during a field day. Hay yield was low as a result of the drought, so it was important that I get everything from the small windrow. I adjusted the volume on the surround sound stereo where I had just inserted a CD of the Eagles Greatest Hits. Now we're ready to bale – first let me check the GPS and get a check on the moisture of the hay coming into the bale chamber – moisture perfect. Now, let me pull up the local radar on my palm pilot to see if there are any "rain fronts" headed my way. Now, a quick cold drink from the cooler beside the seat and I'm ready to bale hay.

As I reflect on the above, I am quickly taken back to my childhood in Ohio County. My early memory of "haymaking" was watching my granddad cut hay with two mules pulling a mowing machine. I recall several phases of the harvesting operation including picking up loose hay with pitchforks, loading onto wagons, and hauling to the barn where it would be forked up into the barn loft – tramped down and stored for winter. I even remember having to put salt on the wet spots. When the barn was full, we would stack it in the field on poles and haul to the barn as needed during winter. I remember the dump rake, stationary balers (my first job was "punching wires"). I recall a neighbor getting the first AC Small Round Baler and we hauled the little round bales to the barn and stored.

All of the above experiences and more were brought home to me when I attended the American Forage & Grassland Conference in State College, Pennsylvania this past June. During my stay, I visited the Pasto Agricultural Museum and had time to visit and learn about "Haymaking History" from my longtime friend and mentor Dr. John Baylor. At the museum, visitors make a journey back in time when farmers used muscle power, both human and animal, to produce food and fiber for a growing nation.

Following that "museum" visit, I had the pleasure of spending time with Dr. John Baylor. Dr. Baylor is not a stranger to our Alfalfa Conference in Kentucky. I have used his material for over thirty years; I have quoted his data from high yield alfalfa, alfalfa quality and testing, and many areas of establishment and management. Many of you are also familiar with John because he did a sabbatic leave in Kentucky where he served as Chairman of the Board for the 14th International Grassland Congress when Kentucky hosted this event in 1981. Others are familiar with John as a "historian". John wrote the history of the American Forage & Grassland Council and the Pennsylvania

Forage & Grassland Council. What you may not know is his latest history project was specific to hay. Specifically, Dr. Baylor assembled and brought together in a very concise publication “300 Years of Haymaking”. In addition, he brought together a team of very talented people and equipment to put “300 Years” in a demonstration for the Pennsylvania Agricultural Progress Days. Pennsylvania Public Television captured this on DVD and is not available to the public.

The 300 years John chose was from 1640 to 1940. The year 1940 was a natural time to conclude this historical review sponsored by the Pasto Agricultural Museum, as quoted in their guidebook, “Visitors to the Pasto Agricultural Museum journey back in time where farmers used muscle power, both humans and animal, to produce food and fiber for a growing nation all items are BC and BE – before computers, before electricity and before engines.”

Haymaking – 1640-1940:

1640-Early 1700s

- Early pioneers had a few hay-consuming livestock, and cattle of colonial days were said to be small, scrawny, and unproductive. Most cleared land was cropped with grain – mostly wheat for human consumption. The few animals foraged in the woods on native grasses and browse.
- Swamps and marches yielded course hay (native wild grasses, sedges, etc.) for winter feed. Often the supply of hay was so inadequate that cows quit producing milk and frequently starved to death.
- In cleared areas (mainly areas burned-over by Indians to attract wildlife) native grasses were abundant and good for pasture and haymaking. Seeds of grasses brought from Europe were rarely sown.

1700-1750

- First seedings of mixed English grasses were mostly on unplowed land broadcast by hand or mixed with manure applied to open areas.
- First introduced species for hay and pasture (late 1600s and early 1700s) were red clover, white clover, and timothy.
- Hay tools consisted of sickle, scythe, wooden rake, and fork.
- The famous Lancaster County Conestoga Wagon was introduced around 1750.

1750-1800

- Timothy and red clover became dominant hay species. By 1790 “more than one-half of the arable land is generally in grass for pasture and hay, sown every third year with red clover and timothy seed.”
- Orchardgrass, bluegrass, and perennial ryegrass were grown for first time in Pennsylvania.
- Alfalfa (lucern) introduced by gentlemen farmers, but unsuccessfully, probably due to soil acidity, lack of inoculation, and low soil fertility.

- Little improvement in breeding and feeding of cattle (mainly meat) until after 1790. Dairy farming before 1800 was mainly for family consumption, no an organized industry.
- Marked increase in hay production beginning about 1790, along with increased beef production for the Philadelphia market. Beef cattle mainly finished on “the most luxuriant hay.”
- Before 1790 iron was scarce and costly. Many farm implements, including plows, harrows, forks, and shovels, were made mostly of wood. “Until about 1790 plows used by Pennsylvania farmers were little better than those used by their ancestors in Europe and Asia many years earlier.”
- 1790s: New breakthroughs in plow design, including moldboard shape and cast iron moldboard, among others. In 1798 Thomas Jefferson designed and introduced a lightweight plow with a curved metal shield moldboard, the “moldboard of least resistance.”

1800-1840

- Golden age of the drover: Driving beef cattle from western Pennsylvania and eastern Ohio to the Philadelphia market.
- Early 1800s: Birth of the dairy industry! By 1830 dairying became more profitable than beef production, followed by major improvements in cattle breeding. Initially, dairy products marketed were mainly butter and cheese. The fluid milk industry grew after 1840 with improved transportation – mainly the development of railroads.
- After 1800: Hay acreage increased rapidly. By 1840 clover and timothy hay were “one of most profitable crops in Pennsylvania for dairy, beef, and horses.”
- Early 1800s: Cast iron plow (moldboard, share, and landside cast in one piece) was patented. Farmers were skeptical because of high cost and because they believed “iron poisoned the soil and encouraged the growth of weeds.”
- Around 1819: Jethro Wood’s cast iron plow was patented with replaceable parts for those most exposed to wear. Considered a major advance, but farmers were still skeptical of metal moldboards.
- 1820: First mowing machine introduced, but it was not successful. First horse-drawn wooden rake introduced.
- 1835-1840: Horse-drawn, wooden-tooth hay rakes or “flop overs” became popular.

Mechanical Revolution on the Farm, 1840-1910

In 1840 haying was considered one of the most onerous jobs on the farm. While some advances in mechanical haymaking had been made prior to 1840, most seedings of hay species were still made by hand in the 1840s and grass was still cut mainly with the scythe and raked with a handheld wooden rake. The 70-year period from about 1840 to 1910 was the animal-power period in which most of the work on the farm that had been done by human labor before the 1840s was now done with the ox and horse. Advances in haymaking tools between 1840 and 1910 came rapidly and included the following:

- 1840: Steel-toothed dump rake introduced along with improved seeding tools.
- 1840-1860: Rapid advances in horse-drawn mowers.
- By 1845: Marketing hay into Philadelphia and other urban areas for horses used for transportation in the city grew in importance. Successful attempts to compress hay for transporting were made.
- After 1845: Barns were designed and constructed to accommodate hay storage and convenient hay feeding of animals.
- 1860: Steel-toothed riding dump rake was introduced.
- 1860-1870: Hay tedder was introduced.
- 1865: Barn hay forks were developed.
- 1875: Hay loaders and steam-powered engines appeared.
- 1880: First silos, built underground, were introduced.
- 1887-1900: Most silos moved above ground and round silos, mainly wooden, became more common.
- 1900: Side delivery hay rake was introduced.
- 1900: Alfalfa was first successfully grown in Pennsylvania.
- 1905: Panama stationary hay press (animal powered) was introduced.
- 1905: Gasoline tractor was introduced.

1910-1940

- 1900-1940: Alfalfa acreage in the state increased from 52 acres in 1900 to over 250,000 acres in 1940.
- 1925: Light, general-purpose gasoline tractor became popular and began to replace draft horse power.
- 1925: Electricity for hay use became available on some farms. However, electricity on the farm did not become widely available until after 1930.
- 1930: Supplemental air-drying of hay was attempted. Hay dehydration was introduced.
- 1932: Mower-crusher was developed experimentally to speed up field curing of alfalfa hay.
- 1935: Hay crop silage, especially for first cutting, gained interest.
- 1937: First automatic field string baler was introduced.
- 1940: Nearly two-thirds of Pennsylvania had electricity.

My thanks to Dr. John Baylor for capturing and preserving this part of our "forage history".

References

Baylor, John E. 2006. 300 Years of Haymaking in Pennsylvania. The Pennsylvania State University U. Ed. AGR 06-112.

Alfalfa: Back to Basics

S. Ray Smith and T. Adam Probst
Forage Extension Specialist
and
Forage Research Analyst

Introduction

In the past, many university research trials and on-farm demonstrations have determined a range of cutting intervals for alfalfa. Most researchers have agreed that the optimum harvest frequency is about every 35 days to ensure top yields, without sacrificing too much in the way of forage quality and stand persistence. Others use a strategy of harvesting at 10% bloom.

In the last few years many seed companies have developed and are marketing alfalfa varieties that can supposedly tolerate a more aggressive cutting schedule because they show more rapid regrowth. Theoretically a producer can achieve higher yields and higher quality by harvesting more frequently. This research indicates that these claims may be difficult to validate.

Forage Yield

We planted five alfalfa varieties in the spring of 2006 and placed them under schedules of 25, 30, 35, and 40 days between harvests. In 2006 (the establishment year), the 25 day interval was cut four times, and the other management groups were harvested only three times. There was a segregation of yield levels with the different cutting frequencies. Even with an additional harvest, the 25 day harvest interval had about 0.5 ton/acre less yield than the 35 and 40 day interval.

In 2007, the 25 and 30 day frequencies were cut five times, while the 35 and 40 day frequencies were cut only four. Again, the 25 day harvest frequency resulted in yields that were 1.18 tons/acre lower than the 40 day frequency. There was no significant difference between the yields for the other cutting schedules, however, the 30 day cutting frequency was harvested one more time than the 35 and 40 day interval.

Mean Annual Dry Matter Yield for Spindletop.

	--------------Tons/acre--------------		
Cultivar	**2006**	**2007**	**Total**
WL357HQ	1.86c	3.79a	5.65
Spredor 4	1.93c	3.81a	5.74
Attention	1.88c	3.26b	5.14
Pioneer 54V54	1.87c	3.26b	5.13
HybriForce 400	1.89c	3.34b	5.23
Frequency			
25 Day	1.63d	2.72b	4.35
30 Day	1.63d	3.81a	5.44
35 Day	2.12c	3.58a	5.7
40 Day	2.17c	3.90a	6.07

* - Values with the same letter are not significantly different at P<.05 level.

Number of Cuttings Per Year.

Frequency	2006	2007
25 Day	4	5
30 Day	3	5
35 Day	3	4
40 Day	3	4

Forage Quality

Although there were differences in yield, surprisingly there were no significant differences in forage quality based upon the two years of this study. It is important to note that harvest interval normally has less influence on quality during an establishment year and that drought during the second harvest year of this study may have reduced the likelihood of quality differences. More years of data or a broader range of harvest frequencies may be needed. This study will continue during the 2008 growing season.

Forage Quality Analysis For 2006 and 2007.[1]

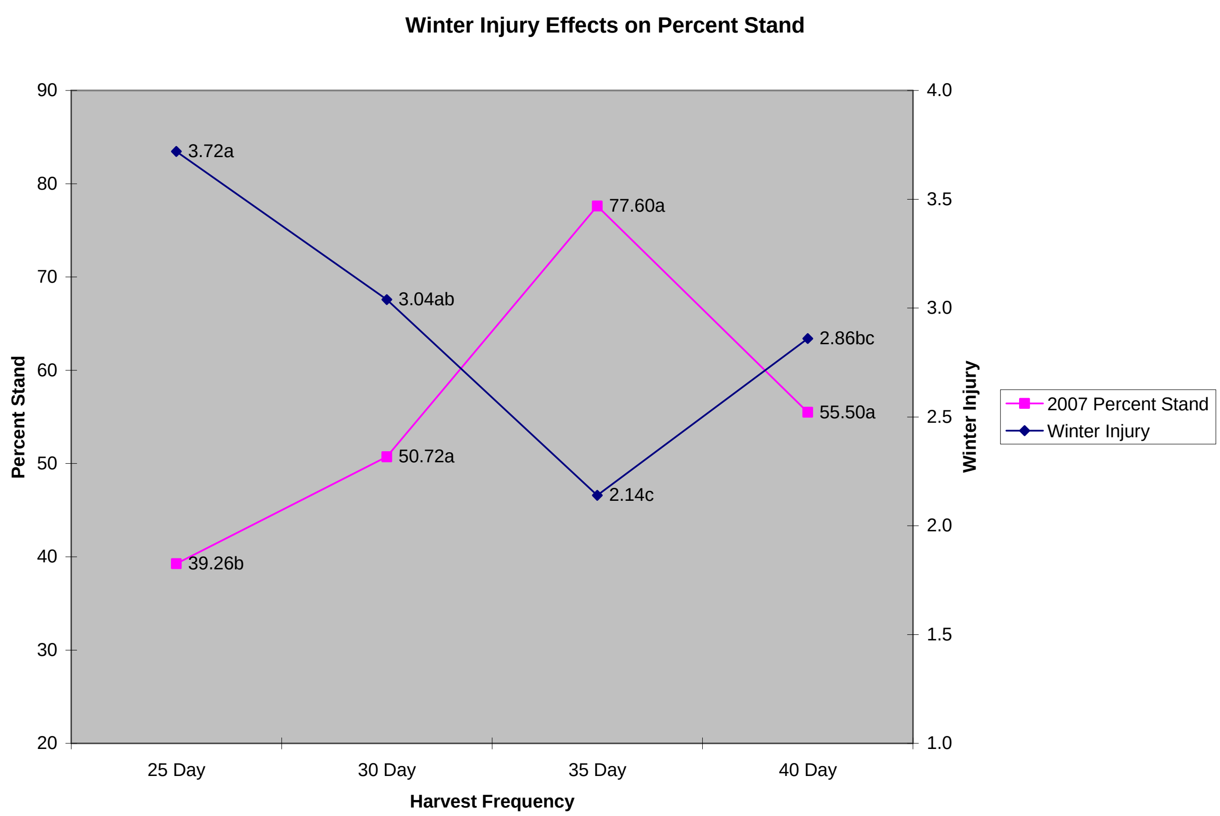
	------------------------------%------------------------------				
	ADF	NDF	CP	RFV	TDN
25 Day	26.84	39.53	20.33	164.12	69.96
30 Day	26.73	38.13	20.23	167.25	70.40
35 Day	27.72	38.94	19.96	163.39	69.03
40 Day	27.56	37.83	20.15	167.25	69.19

[1] - No significant differences between harvest frequencies at P<.05 level.

Stand Persistence

Many producers try to keep alfalfa stands in production for 4-5 years, and some are able to maintain stands for 6 years or more. Stand persistence is key reason to maintain alfalfa plant health by allowing sufficient time between harvests for the rebuilding of root carbohydrates. Under the adverse weather conditions in Kentucky last winter and early spring, the 25 day harvest frequency treatment showed reduced stand persistence.

Plots were scored in mid-April for winter injury, and later in May for percent stand. Although there was a negative relationship between harvest frequency and stand persistence at 25 days, there were no significant differences between the 30, 35, and 40 day harvest frequency for percent stand. Nevertheless, the 25 day cutting frequency had only a 39% stand in the spring of 2007.



What Should We Do?

The results of this research provide an important reminder on the “basics” of managing alfalfa. An aggressive cutting schedule of less than 30 days can really impact stand persistence and percent cover regardless of variety. Higher yields are rarely achieved, and based upon these preliminary results, there may be little or no advantage in forage quality.

Based upon rates collected by U.K.’s Farm Management Specialist, Greg Halich, one extra harvest can cost approximately $30 per acre for 1200 pound round bales, and $74 per acre for 50 pound small square bales at a yield of 1.3 tons per acre. Therefore, the hay harvested every 25 days will cost more to produce based upon less yield, and an extra trip over the field. When determining the optimum harvest frequency for your operation, be sure to also look at the cost of an extra harvest.

The 40 day harvest frequency would logically be the most efficient, however, there was more lodging with this harvest frequency. Since lodged plants are more difficult to harvest, the optimum cutting interval from the two years of this research would be the 35 day harvest frequency.

We will continue this research for a third harvest season and expect that under normal growing conditions quality will show more decline with the longer harvest frequencies, at least with some of the varieties. When the study is completed we will publish a complete extension report with final results and recommendations.

Certified Weed Free Hay and Straw Program

Kenny E. Perry
Graves Co. ANR Extension Agent

There is a growing demand in North America for the use of certified weed free hay and straw as a preventative program to limit the spread of noxious weeds. This voluntary certification program is designed to assure that hay and straw sold with proper certification identification meets minimum standards designed to limit the spread of noxious and undesirable weeds. Buyers are provided assurance that hay and straw certified through this program meets these minimum standards.

Kentucky Seed Improvement Association (KSIA) has been in the seed certification business since its inception in 1939. This longstanding tradition of providing quality control services to the seed industry will be helpful as they implement a Weed Free Hay and Straw Program. KSIA was designated as the official provider of this program for the state by the Kentucky Department of Agriculture in 2007.

Kentucky's certification standards comply with the Weed Free Forage Certification Standards developed by the North American Weed Management Association (NAWMA). NAWMA has established minimum standards to allow uniform participation by states and provinces in the program. Hay and straw certified under KSIA certification with proper certification markings attached will be eligible to be shipped into restricted areas in the United States and Canada where only hay and straw certified under the NAWMA Standards can be used.

This program is designed:

- to limit the spread of noxious weeds through hay and straw.
- to provide assurance to producers and buyers that hay and straw certified through this program meets specific standards.
- to provide uniformity between different states and provinces involved with this program.

The name of the program is somewhat of a misnomer as the certified product will not be completely free of all weeds, but there will be no seeds, tubers, rhizomes, etc… whereby the spread of noxious or undesirable weeds may occur.

The field and storage site inspections are at the core of this program and will be administered by experienced KSIA inspectors located throughout the state. However, the production and distribution of certified products also depends on the integrity of those participating in the program.

In other Midwestern states this program has been used as an additional marketing opportunity for hay and straw producers. Potential markets include customers seeking clean hay, people needing certified hay for their horses on visits to national parks and contractors using straw for road construction erosion-control projects.

The following steps are key to producing Weed Free Hay and Straw:

1) Producers will submit an application to Kentucky Seed Improvement Association. Field inspection applications for straw should be received no later than May 15th, while hay field inspection applications should be received 4 weeks prior to cutting.

2) KSIA will forward an inspection report to one of its inspectors who will contact the producer to locate the field(s), storage site(s) and get an approximate cut date.

3) Within 10 days of harvest, the inspector will go to the field(s) and storage site to determine the presence or absence of noxious and/or undesirable weeds. Fields harvested prior to inspection are not eligible for certification. All fields and storage sites should be free of those noxious weeds and undesirable plant species listed in appendix A. The field and storage sites include the surrounding ditches, fence rows, roads, easements, grass waterways, or a buffer zone surrounding the field.

4) Fields or storage sites that contain noxious weeds or undesirable plant species (as identified in Appendix A) may be certified if the following requirements are met:
   a. The noxious weeds and undesirable plant species in the field in which the hay or straw is being produced were treated to prevent seed formation or seed ripening to the degree that there is no danger of dissemination of the seed or the propagating parts of the plant capable of producing a new plant.
   b. The noxious weeds and undesirable plant species were treated in the vegetative growth stage prior to the rosette to bud stage (or boot stage for grass species classified as weeds) prior to cutting or harvesting.
   c. The treatment method can include but is not limited to:

      i. Burning
      ii. Mowing or Cutting
      iii. Rouging
      iv. Herbicides

   d. If noxious weeds have not been treated and are present in areas adjacent to the field, an isolation/buffer strip should be established between the crop to be harvested and the area infested with noxious weeds. This strip must be no less than 10 feet wide, and can be established by mowing or cultivation.

5) Producers may identify their product using colored twine, tags or a transit certificate for shipping.

6) An inspection certificate shall be issued by KSIA indicating that the above requirements have been met based upon field inspection.

7) The applicant must keep accurate records of the amount of hay or straw harvested from each field including where the hay or straw is stored after harvest. The following records must be maintained:

   1. The number and average weight of bales harvested.
   2. The exact location of the inspected site where bales are stored.
   3. Date of harvest.
   4. Field number(s) and location(s) of the field(s) where the product was produced.
   5. Copies of all certification documents.
   6. Current inventory records.

Records must be made available upon request by KSIA.

APPENDIX A

The following weeds have been designated as noxious or undesirable in the NAWMA Weed Free Forage Certification Standards (Kentucky weeds have been added to the listing):

1. Absinth wormwood (*Artemisia absinthium*)
2. Bermudagrass (*Cynodon dactylon*)
3. Buffalobur (*Solanum rostratum*)
4. Canada thistle (*Cirsium arvense*)
5. Common burdock (*Arctium minus*)
6. Common crupina (*Crupina vulgaris*)
7. Common tansy (*Tanacetum vulgare*)
8. Dalmatian toadflax (*Linaria dalmatica*)
9. Diffuse knapweed (*Centaurea diffusa*)
10. Dyers woad (*Isatis tinctoria*)
11. Field bindweed (*Convolvulus arvensis*)
12. Hemp (marijuana) (*Cannabis sativa*)
13. Henbane, Black (*Hyoscyamus niger*)
14. Hoary cress (*Cardaria spp.*)
15. Horsenettle (*Solanum carolinense*)
16. Houndstongue (*Cynoglossum officinale*)
17. Johnsongrass (*Sorghum halepense*)
18. Jointed goatgrass (*Aegilops cylindrica*)
19. Leafy spurge (*Euphorbia esula*)

20. Matgrass (*Nardus stricta*)
21. Meadow hawkweed complex (*Hieracium caespitosum [H. pratense], H. floribundum, H. piloselloides*)
22. Meadow knapweed (*Centaurea pratensis*)
23. Medusahead (*Taeniatherum caput-medusae*)
24. Milium (*Milium vernale*)
25. Musk thistle (*Carduus nutans*)
26. Orange hawkweed (*Hieracium aurantiacum*)
27. Oxeye daisy (*Chrysanthemum leucanthemum*)
28. Perennial pepperweed (*Lepidium latifolium*)
29. Perennial sorghum (*Sorghum almum*)
30. Perennial sowthistle (*Sonchus arvensis*)
31. Plumeless thistle (*Carduus acanthoides*)
32. Poison hemlock (*Conium maculatum*)
33. Puncturevine (*Tribulus terrestris*)
34. Purple loosestrife (*Lythrum salicaria*)
35. Quackgrass (*Agropyron repens*)
36. Rush skeletonweed (*Chondrilla juncea*)
37. Russian knapweed (*Centaurea repens*)
38. Scentless chamomile (*Matricaria perforata* or *M. milaceum*)
39. Scotch broom (*Cytisus scoparius*)
40. Scotch thistle (*Onopordum acanthium*)
41. Sericea Lespedeza (*Lespedeza cuneata*)
42. Silverleaf nightshade (*Solanum elaeagnifolium*)
43. Skeletonleaf bursage (*Ambrosia tomentosa*)
44. Spotted knapweed (*Centaurea maculosa*)
45. Squarrose knapweed (*Centaurea virgata*)
46. St. Johnswort (*Hypericum perforatum*)
47. Sulfur cinquefoil (*Potentilia recta*)
48. Syrian beancaper (*Zygophyllum fabago*)
49. Tansy ragwort (*Senecio jacobaea*)
50. Toothed spurge (*Euphorbia dentata*)
51. Wild oats (*Avena fatua*)
52. Wild proso millet (*Panicum miliaceum*)
53. Yellow hawkweed (*Hieracium pratense*)
54. Yellow starthistle (*Centaurea solstitialis*)
55. Yellow toadflax (*Linaria vulgaris*)

Additional weeds designated as Restricted or undesirable in Kentucky:

56. Annual *Bromus spp.*
57. Black Nightshade (*Solanum ptycanthum*)
58. Bull Thistle (*Cirsium vulgare*)
59. Cocklebur & Spiny Cocklebur (*Xanthium strumarium & spinosus*)
60. Corncockle (*Agrostemma githago*)
61. Dodder (*Cuscuta spp.*)

62. Giant Foxtail (*Setaria faberi*)
63. Hemp Dogbane (*Apocynum cannabinum*)
64. Ryegrass, Annual and Perennial (*Lolium multiflorum and perenne*)
65. Spiny Amaranth (*Amaranthus spinosus*)
66. Wild Garlic (*Allium vineale*)

For more information, contact Kentucky Seed Improvement Association at (859)281-1029 or by email kyseed@prodigy.net.

National Hay Association President's Perspective: What a Year to be President

Ron Tombaugh
President
National Hay Association

Over the years, I have had the opportunity to attend the Kentucky Alfalfa Conference in Cave City. Usually it was combined with a trip to deliver hay into Kentucky to either a dairy, beef, or horse customer. This is an excellent event.

The following is my "acceptance" speech given in September 2007 in Columbus, Ohio, when I was installed as President of the National Hay Association.

> "In 2005 when the Convention was in Lexington, KY, I had a lot going on at home, and forgot to pack a tie. I figured this was no big deal, since I might not be able to stay for the Saturday night banquet. Graciously, you elected me as the incoming VP, so I didn't dare leave. Had my wife been there, she probably would have just gone shopping and solved the problem. But, not being a shopper, I shared my dismay to the photographer who responded, "That's ok! We're just hay farmers!"
>
> Yes, we are hay farmers! Whether it is making small bales for the horse and dairy markets in the northeast, making grass round bales for beef cattle in the southeast, making mid-size and large square bales of dairy hay from the heartland, or repackaging grass and alfalfa hays in the west for export markets across the pond. Yes, we are hay farmers! Combine the land uses of our hay crop with that of rangeland, pastureland, and meadows across this great country, and the acres covered with forages makes it the largest resource in the country, totaling nearly 55% of the land mass of the contiguous US, far exceeding the 22% that represents timber, our closest acre total. Add to this, the commerce that is accomplished when our hay products are sold and traded to support the livestock industry of horses, and cattle, and specialty markets, makes the cash hay crop #3, behind corn and soybeans.
>
> On Thursday, NHA went provided a bus trip to the Farm Science Review. After getting off the bus, and looking at the show program, I saw the whole jest of the Farm Show. Across the front of the program, it said, "This is not your Daddy's Farm Show!" Likewise, this is not Daddy's National Hay Association! Wow! Isn't that the truth?

I love this organization. We applaud our predecessors who established our charter 112 years ago. Our predecessors had great vision which was a response to the challenges of their day.

NHA has established its presence by doing things the right way: with honesty, integrity, and fair trade. I want to thank all of the previous Presidents of NHA for their insight and leadership.

We have new challenges today. Our Daddies did not have to deal with things like higher commodity prices for corn, soybeans, and wheat competing for hay acres; uses of hay for cellulosic ethanol; pharmaceutical uses; an Easter Freeze that eliminated a vast amount of hay acres from the High Plains across the Corn Belt; widespread drought in the southeast; competition from CRP acres released for haying and grazing; Roundup Ready Alfalfa; Carbon Credits for hay acres; pesticide residues on export products; and higher fuel prices affecting higher transportation costs worldwide. Just to name a few!

While these items may seem like obstacles in some circles, it really is just opening the doors to more opportunities to the hay industry, in general, and NHA in particular. With the many very talented people in NHA, NHA is able to maintain being the voice of the hay industry. But, because many of these same issues affect, or are affected by, other commodity or forage groups, it is my vision that NHA move to enhance those relationships. In these relationships, we need to understand that NHA and the other groups will not agree on all of the issues. But by airing our similarities, and finding common ground, we can synergize, and become mutually beneficial. I believe that if you are going to be a player, you have to be at the playground!!!!

This morning, I handed out the committee assignments to the NHA Board of Directors, and a few others. I let them know that we will be having bi-weekly conference calls for the Executive Committee. A few selected Committee Chairman will be invited to participate on these calls, and all of the Committee Chairs will be invited to call in on a monthly call basis. I feel that with increased communication, and participation, the BOD can be much more productive, and in turn provide a better value to the membership of NHA.

The Board is going to make it a priority to get timely committee reports posted on the website so that you can have the info quicker. Also, we are going to have a blog area where the Board or committee can ask the membership for its opinion, and the membership can respond. You will want to see this for yourself.

We are planning a Strategic Planning Session at the Winter Board Meeting in Louisville, in January. It was decided to get together and spend a day as a Board and brainstorm to get mission and vision statements. We also would discuss the values, goals, and objectives of NHA, hopefully giving NHA a plan (road map) for the future.

In an upcoming issue of Hay There, you will all receive a questionnaire as to the things that are important to you, as members of NHA. What things you feel we are doing well, and those, maybe not so well! Your input will be important to the discussions when we head Louisville.

For those of you who are here tonight, you are showing your deep passion and support of NHA. If I have overlooked you as a member of a committee, let your interest be known. Contact me or Don, and relay your interest in one of the many committees. If you have a special interest in a topic that we don't have a committee for, we may appoint an ad hoc committee. There is a place for the energy and the passion of each of you who would offer their volunteer services.

I want to especially thank E. J. Croll and Richard Larson for the past two years as members on the Executive Committee.

Are these ambitious goals for the coming year? Probably! Are they realistic? We are only limited by our own imagination! Can we get them accomplished? Come to Chicago next September and find out!!!!!!!!!!!!
THANK YOU!!!!!!"

Alfalfa: Forage Crop of the Future

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FORAGE TRENDS

In 2007, U.S. farmers harvested 23.6 million acres of alfalfa. Alfalfa harvested as hay and haylage produced 82.8 million tons valued at approximately $9.4 billion, ranking behind only corn and soybeans. Alfalfa hay supports dairy, beef, sheep, and horse production in the U.S. as well as a growing export market.

Alfalfa production has increased in the west to support an expanding dairy industry. Lactating dairy cows fed physically effective alfalfa fiber are healthy and very productive. Western dairy operators have demanded higher quality alfalfa, often at the expense of yield. However, quantities of alfalfa hay fed to dairy cattle have declined in recent years, often being replaced by corn silage and by-product feeds. We believe scientific capacity is available to genetically engineer alfalfa to solve current limitations in its production, its utilization by high producing dairy cows, and its use for renewable energy.

Determining what plant modifications are needed to increase alfalfa's role in any one dairy enterprise requires a holistic approach. Alfalfa traits that should be modified depend upon: crop growing environment; how it is harvested, stored and fed; its nutritive and economic value relative to the availability, quality and consistency of other feed ingredients; the type of diet in which it is fed, the animal and its nutrient requirements, its value in crop rotations and environmental impacts. For example, the ideal characteristics for grazing alfalfa may be quite different for alfalfa grown for hay production and sale.

CURRENT ROLE OF ALFALFA IN DAIRY DIETS

Forages are the foundation upon which good dairy nutritional programs are built. The intake and digestibility of forage by dairy cattle directly affect their meat and milk production as well as rumen function and animal health. Corn silage and alfalfa are the main forages providing energy, protein, digestible and effective fiber, minerals, and vitamins to dairy cattle. Alfalfa, often called the "Queen of Forages," is the most important forage legume for dairy cows. It is relatively low in fiber and high in protein compared to other forages and typically results in high intakes and levels of milk production. In addition to its excellent nutritional properties, crop rotations utilizing alfalfa have a positive environmental impact in terms of stabilizing soils, decreasing nutrient inputs, and increasing wildlife habitat. The major disadvantages of alfalfa are low yields when compared to corn silage and the need for multiple harvests. Multiple harvests not only increase the labor and equipment costs for alfalfa, but also expose the forage to multiple harvesting environmental risks, such as rain damage, that increase the variability in nutritional quality. Intensive cutting schedules may also be the root cause of poor stand survival and reduced yields.

High quality alfalfa is palatable and often maximizes intake and production by dairy cows. Alfalfa's low fiber and high protein content makes it an excellent complement for grains and other forages in dairy rations. Although there are genetic differences in nutritional value among alfalfa varieties, currently the nutritional quality of alfalfa is established primarily by harvest management. Although there are differences among seasons and cuttings, the composition and dry matter digestibility (DMD) of alfalfa is related primarily to plant maturity at harvest.

Table 1. Typical composition (% of dry matter) of alfalfa hays varying in fiber content (adapted from Mertens, 2002).

Forage description	CP[a]	EE[b]	Ash	NFC[c]	Star[d]	Pec[e]	aNDF[f]	ADF[g]	ADL[h]
Exceptional quality	25.4	2.7	10.4	31.5	3.1	14.2	30.0	24.0	4.53
Very high quality	24.0	2.6	9.9	29.4	2.9	13.2	34.1	27.0	5.38
High quality	22.5	2.5	9.5	27.4	2.7	12.3	38.2	30.0	6.23
Good quality	21.0	2.4	9.1	25.3	2.5	11.4	42.2	33.0	7.08
Fair quality	19.5	2.2	8.7	23.2	2.3	10.5	46.3	36.0	7.93

[a] Crude protein
[b] Ether extract or crude fat
[c] Nonfiber carbohydrates calculated by difference (NFC = 100 – CP – EE – Ash – aNDF)
[d] Starch
[e] Pectin, estimated from NFC
[f] Amylase-treated neutral detergent fiber determined with sodium sulfite and amylase
[g] Acid detergent fiber
[h] Acid detergent lignin using 72% sulfuric acid

Immature alfalfa is high in protein, but the protein is rapidly fermented in the rumen to ammonia and not used efficiently. Because alfalfa protein is used inefficiently, dairy rations containing predominantly alfalfa forage are formulated to contain 1 to 3 percent-units more protein than required. When used as the sole forage source, the high protein and low fiber concentrations in immature alfalfa can make it difficult to formulate rations that meet the protein, energy, and fiber requirements of dairy cows. As alfalfa matures, the proportions of crude protein and non-fibrous carbohydrates

(NFC) decrease. The main NFC in alfalfa is pectin of which 10 to 20% is not extracted by acid detergent causing the difference between aNDF and ADF to underestimate hemicellulose in alfalfa. Because pectin ferments rapidly and completely without a decrease in ruminal pH, it may be desirable to maintain or increase its proportion in alfalfa because alfalfa is relatively deficient in rapidly fermentable carbohydrates when compared to corn silage.

As in other forages, the proportions of fiber and lignin increase with maturity in alfalfa. Alfalfa fiber contains a high proportion of lignin relative to grasses resulting in low fiber digestibility relative to grasses. Whereas 60 to 80% of grass fiber is potentially digestible, the potential extent of digestion of alfalfa fiber is only 40 to 60% due to its high lignin content. However, alfalfa has a great advantage over grasses because the rate of digestion of its potentially digestible fiber is 2 to 3 times that of grasses. It also appears that the indigestible fiber in alfalfa disintegrates into particles that rapidly pass out of the rumen. The higher intake and digestibility often observed with alfalfa-based diets compared to those containing grass is not due to greater digestibility of alfalfa fiber, but due to alfalfa's low fiber content and the rapid rates of digestion and passage of that fiber. The fiber component of forage represents a major source of energy; however, less than 50% of this fraction is readily digested and utilized by the animal. If a 10% increase in fiber digestion was obtained, the dairy industry could realize a benefit of $380 million in milk and meat sales while reducing manure solids by 2.5 million tons and grain input into dairy rations by 3.3 million tons.

ATTRIBUTES OF IDEAL ALFALFA

An ideal alfalfa would contain a better balance of protein and rapidly fermentable carbohydrate. At an optimum aNDF concentration of about 40% (DM basis), it would be desirable to have about 18% crude protein, less ash, and about 30% NFC. It would also be beneficial to have a better balance of amino acids in the protein and with a slower rate of degradation in the silo or rumen to minimize its losses as ammonia. Increasing the fat to 4% might also be energetically advantageous to dairy cows. The rate of digestion and passage of alfalfa fiber is excellent when compared to other forages and nothing should be done to diminish these attributes. However, it might be desirable to improve the potential extent of fiber digestion by modifying lignin content or characteristics. For grazing or green chop purposes, removal or suppression of the bloat- causing properties would be beneficial. Above all, the yield of alfalfa should be enhanced with a reduction in the number of cuttings needed to produce dairy-quality alfalfa forage.

REDESIGNING ALFALA FOR LIVESTOCK DIETS

Over the past fifty years, great advances have been made in the development of varieties with improved winter hardiness and pest resistance (insects, nematodes, and pathogens), providing even greater potential utilization in modern farming systems. To develop alfalfa varieties with physical and biochemical properties that fit the needs of the high producing dairy cow (i.e., greater cell wall digestibility, less protein degradation during ensiling, increased by-pass protein, increased yield without quality loss, insect and pathogen resistance, herbicide tolerance, reduced bloat, and winter hardiness) requires input from several disciplines. Strategies that embrace traditional genetic selection methods as well as precision breeding and other biotechnology tools may be needed to move a desirable trait into the elite germplasm in a timely manner. The goal is to have alfalfa varieties that can meet the needs of the dairy enterprise and at the same time maximize their use in farming systems that improve alfalfa's environmental benefits (N fixation, excellent nutrient sink, stand longevity, etc.). Developing alfalfa that could retain nutrition quality with fewer cuttings, increased yields, and better water use efficiency would be a major improvement in the profitability of alfalfa production.

Yield. Although quality has improved, alfalfa yield increases have not kept pace with corn. This is becoming more of an issue as land, labor, and energy costs continue to rise placing a greater burden on obtaining sufficient value from the harvested crop. Developing germplasm that has greater pest resistance and winter hardiness and selection for increased quality under a frequent cutting regime has accompanied most recent gains in yield. There would seem to be sufficient genetic diversity to select for much larger plants that would provide significantly higher yields per acre (JoAnn Lamb, personal communication), but forage quality cannot be sacrificed. There are other opportunities for improving total biomass production that involve specific tissues of the alfalfa plant such as leaves and stems.

Reducing leaf loss has potential for enhancing biomass and quality. One of the problems with large plants in a typical seeding pattern is the loss of leaves that are shaded in the lower portions of the crop canopy. A solution to the problem could involve genetic selection for increased leaf retention or possibly using a molecular approach to disable genes that are responsible for leaf drop. This would require identification of specific cell wall hydrolases involved in the disruption of cells in the attachment area of alfalfa leaves to the stem. For other plants it has been shown that cellulases and pectinases are critical for leaf drop. If plants could maintain leaves after they have passed senescence this would increase total biomass. The animal would readily utilize the digestible cell walls of leaves even though the senesced leaves would not contain much protein or soluble carbohydrate. Increasing the mechanical strength of leaf attachment may also improve harvest recoveries of leaves.

Harvesting techniques can greatly impact biomass recovery. Harvest losses with conventional haymaking equipment are typically in the range of 6 to 19 percent. Utilizing haylage versus hay probably has the greatest single impact both in terms of preserving total biomass and quality. Even though more alfalfa haylage is being produced in the Midwest as a rain damage alleviator, production and marketing of haylage outside the dairy enterprise is difficult. The U.S. Dairy Forage Research Center has discovered technologies such as alfalfa maceration that improve alfalfa production by preserving biomass yield and improving quality at the same time. A macerator mat harvester could keep harvest losses well below the current 6 to 19% loss.

Weeds in alfalfa are a major challenge. They can inhibit successful stand establishment, reduce yields, lower forage quality, reduce stand life, and be toxic to livestock. Current weed control products have a narrow window of application; relatively long pre-harvest intervals; crop injury risks; requirements for soil incorporation; a narrow weed control spectrum; and crop rotation restrictions. With the development of Roundup Ready® alfalfa, growers can spray alfalfa fields with glyphosate herbicide to control more than 200 species of weeds without injuring the alfalfa crop or negatively affecting the quality of the forage. Use of this product is currently under a court ordered injunction that prohibited new seeding after March of 2007.

Fiber Digestibility. Fiber digestibility is an important component of forage having an impact on intake and digestibility by the dairy cow. Lignin is a phenolic compound found in most plant secondary cell walls that is indigestible and cross-links with other cell wall components resulting in decreased cellulose digestibility. Lignin content increases, and cell wall digestibility decreases, as alfalfa plants mature. Almost every enzyme involved in the synthesis of lignin monomers has been investigated in one species or another with variable impacts upon the concentration of the final lignin polymer deposited within the cell wall matrix. Some have had dramatic effects upon the total lignin (>50% reduction) leading to improved animal performance.

An alternative way to improve digestibility is to selectively increase specific carbohydrates that make up alfalfa cell walls such as pectin. Alfalfa stems typically contain 10-12% pectin as a component of the cell wall matrix. Pectic polysaccharides are rapidly degraded by rumen microbes producing acetate and propionate, but do not result in acidosis like rapidly fermented starch. The U.S. Dairy Forage Research Center has been collaborating with alfalfa breeding companies to select for increased concentrations of pectin in alfalfa stems. Through two cycles of selection, the total stem pectin concentration has been increased by 15-20%. Preliminary results indicate that in vitro total dry matter digestibility was increased. However, additional work must be done to determine what other changes have occurred within the plant because an increase in one component requires the decrease in some other component. It is encouraging that selection can be made for specific cell wall components.

Alfalfa cell walls also contain xylans and cellulose with vastly different digestibility. The xylans in alfalfa stems (20-25% of total) have a slow rate and low extent of digestion. Replacing at least part of this cell wall fraction with another polysaccharide could have major impacts upon total fiber digestion. Increasing the cellulose content without increasing lignin should result in a wall matrix that has a greater extent of degradation. The impact of manipulating xylan or cellulase upon the function of the alfalfa plant is unknown at this time.

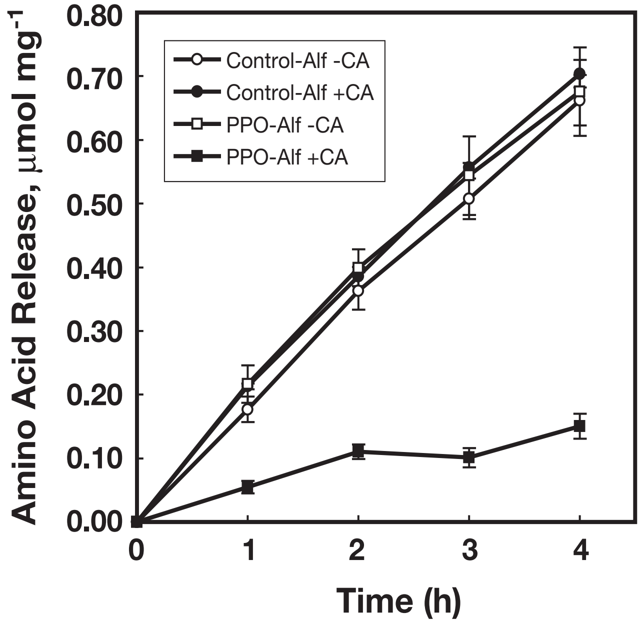


Figure 1. PPO inhibits postharvest proteolysis in an o-diphenol-dependent manner. Amino acid release during a 4-hour incubation at 37°C was used to measure proteolysis in extracts of control or PPO1-expressing alfalfa as indicated in the presence (+CA) or absence (-CA) of 3 mM caffeic acid. (Sullivan and Hatfield, 2004).

Protein. The full benefit of alfalfa protein is not realized due to its poor utilization by the animal. Ruminal microbes degrade alfalfa protein too rapidly resulting in excessive excretion of nitrogenous waste by the animal. In addition, protein breakdown during ensiling can magnify the problem. This loss is due to plant proteases that degrade 44 to 87% of forage protein into ammonia, amino acids, and small peptides during silage fermentation. These nitrogen fractions are rapidly degraded and lost by the animal in urine, resulting in losses of up to $28 per acre for alfalfa. Decreasing protein degradation during ensiling and in the rumen would decrease the need for supplemental protein and reduce the loss of nitrogen to the environment on the dairy farm.

Red clover has been found to have up to 90% less proteolysis than alfalfa during ensiling. This observation suggests that red clover should be an ideal legume for ensiling. Yet the widespread use of red clover is limited due to its poorer agronomic characteristics such as low stand persistency and yield, and its slow drying rate in the field. Lower extent of proteolysis is not due to differences in the inherent proteolytic activity in red clover versus alfalfa, but rather is related to the presence of a soluble polyphenol oxidase (PPO) and *o*-diphenols in red clover.

Recently, the U.S. Dairy Forage Research Center has successfully tested the hypothesis that PPO and *o*-diphenols inhibit proteolysis in plant extracts. Researchers have further demonstrated the role of PPO in proteolytic inhibition using a transgenic alfalfa system. To demonstrate the role of PPO and *o*-diphenols in inhibition of proteolysis, a cloned red clover PPO gene (*PPO1*) was constitutively expressed in transgenic alfalfa (PPO1-alfalfa). Proteolysis was inhibited in leaf extracts of the PPO1-alfalfa when the *o*-diphenol caffeic acid was added, **Figure 1**. No inhibition was observed when caffeic acid was omitted. Substantial proteolysis was observed in leaf extracts of control alfalfa lacking a PPO transgene, even if caffeic acid was added to the extract, indicating that caffeic acid alone does not result in *in vitro* proteolytic inhibition. The extent of proteolytic inhibition seen for PPO1-alfalfa extracts with added caffeic acid was comparable to that seen for red clover extracts. These results clearly demonstrate the major role of PPO and *o*-diphenols in post-harvest proteolytic inhibition in red clover and that expression of the PPO gene in other forages can inhibit proteolysis when an appropriate o-diphenol is added.

Using PPO and *o*-diphenols to slow the rate of alfalfa protein degradation in the rumen is more difficult. There is some evidence that PPO generated o-quinones interact with proteins in red clover providing some protection in the rumen creating greater bypass protein. However, tannins may more easily provide protection of plant proteins from ruminal degradation. Tannins are phenolic compounds that generally bind with proteins, decreasing the rate and extent of protein digestion. Forage legumes (e.g. birdsfoot trefoil) that produce tannins in leaves or stems have increased stability of the protein in the rumen, thus more protein escaping degradation in the rumen. An optimum level of tannins supported an increase of 11 pounds per day of milk from cows fed normal tannin containing birdsfoot trefoil over alfalfa silage, **Figure 2**. Unfortunately, alfalfa does not produce tannins except in the seed coats.

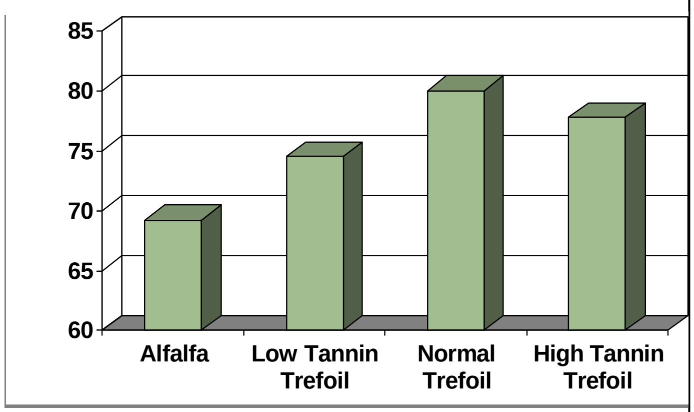


Figure 2. Comparison of alfalfa and birdsfoot trefoil silages on milk yield (pounds per day). SOURCE: Hymes Fecht et al., 2005.

With new knowledge about tannin biosynthesis (Dixon group, Noble Foundation), it may be possible to engineer alfalfa to produce tannins that provide protein protection in the rumen and may also lead to less bloat. Because many of the "raw materials" needed to produce the building blocks of tannin polymers are already being produced by alfalfa; it's just a matter of diverting some of these into a new pathway.

GROWING ALFALFA FOR RENEWABLE ENERGY

The United States is experiencing an economic shock due to recent hikes in the price of oil and natural gas. For farmers, the prices of nitrogen fertilizer and fuel have risen to unprecedented levels, putting profits at risk. The President, Congress, industry, and the public are all calling for independence from imported oil. Ethanol produced from cellulosic biomass may be a sustainable and achievable alternative to help fuel America's transportation system. At the same time, biomass crops must help support profitable agricultural systems, vital rural towns, and public demand for environmental protection.

Alfalfa has considerable potential as a feedstock for production of ethanol and other industrial materials because of its high biomass production, perennial nature, ability to provide its own nitrogen fertilizer, and valuable co-products. Unlike other major field crops like corn and soybeans, which are commonly refined for production of fuel and industrial materials, refining of alfalfa remains underdeveloped. Instead, alfalfa is primarily processed and used on-farm as livestock feed. Although alfalfa remains tied with wheat as the third most important field crop after corn and soybeans, declining dairy cow numbers and shifts in feeding practices have caused a reduction in alfalfa acreage over the last 25 years. The end result has been an increase in continuous row cropping of corn and soybeans with little rotation to perennial forages. As a result, the risks of soil erosion, contamination of surface and ground water by nitrate and pesticides, and loss of valuable soil organic matter have increased. Growing more alfalfa for biofuel production would contribute to making the United States energy independent, improving our natural soil resource, reducing greenhouse gas emissions, and protecting water quality.

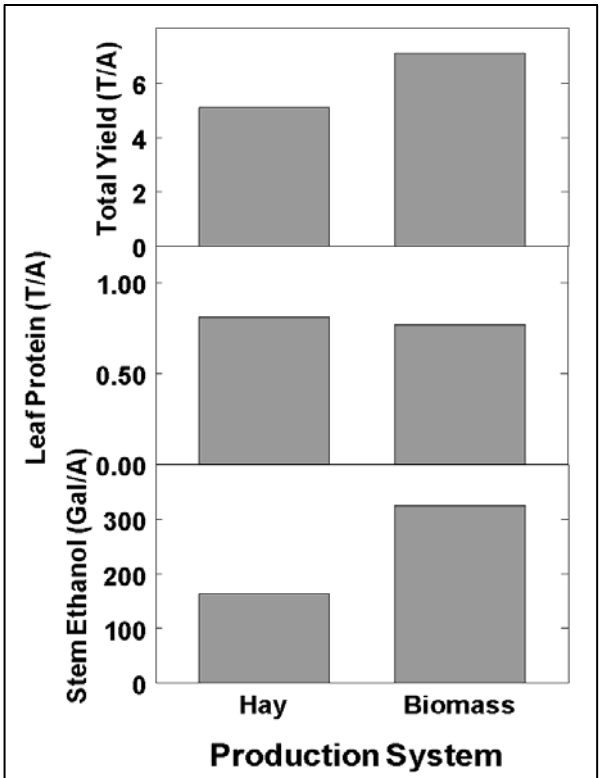
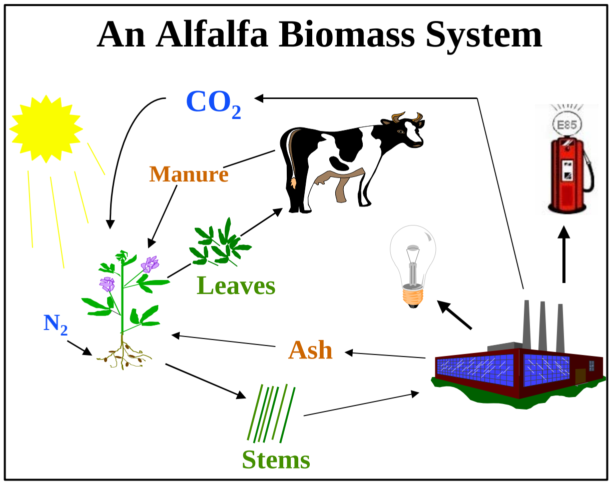


Figure 3. Dry matter, leaf protein, and theoretical ethanol yield from stems of hay-type alfalfa grown under conventional hay management compared to biomass-type alfalfa grown under a biomass management system. SOURCE: Lamb et al., 2007.

The USDA-Agricultural Research Service is actively researching many potential biomass crops. The Plant Science Research Unit (PSRU) in St. Paul, MN has been actively involved in alfalfa biomass energy research since 1993 in collaboration with the University of Minnesota. The PSRU has developed a biomass-type alfalfa that is taller and does not lodge at later maturity stages. These traits allow less frequent harvesting than conventional forage-type alfalfa, reducing harvest costs, and protects nesting birds in early summer. When biomass-type alfalfa is grown under a biomass management system with less dense seeding and only two harvests per year, compared with standard hay-type alfalfa production practices, total yield of alfalfa increases 42%, leaf protein yield is equal, and potential ethanol yield from stems doubles, **Figure 3.**

Alfalfa produces high net energy yield – that is, the energy required for production is far lower than the total energy contained in the crop. This is due, in part, to biological nitrogen fixation. Unlike corn and other grass crops, alfalfa can obtain nitrogen from the air. This saves the farmer money, but also represents a tremendous energy savings. Furthermore, alfalfa leaves enough plant-available nitrogen in the soil to meet the needs of the next crop of corn. In many cases, there is even enough nitrogen to satisfy one-half the need of the second crop of corn. Clearly, inclusion of alfalfa in rotation with corn increases the efficiency of energy production from corn.



To maximize energy yield, cellulosic biomass production and processing likely will need to be locally based. Recently, PSRU scientists analyzed the spatial distribution of net energy yield for soybeans, corn, and alfalfa in a prospective fuelshed, and the results demonstrate how net energy yield varies with soil type and decreases with distance from processing facilities. This approach has shown how biofuel facility planners can minimize costs and maximize energy production by contracting with nearby, high-producing farms. In addition to the many environmental benefits of growing a perennial legume, the efficiency of energy production by alfalfa is 2 to 3 times better than corn grain or soybeans. Below are examples for specified biomass yields in fields located 15 miles from a processing facility.

Crop (yield)	Energy input	Delivered energy	Ratio of output:input
	Million BTU/acre		
Soybean (40 bu/a)	2.3	18.3	7.1
Corn grain (180 bu/a)	6.0	59.0	8.8
Corn stover (3.6 tons/a)	2.6	51.1	19.7
Alfalfa (6 tons/a)	3.0	78.2	***25.0***

In contrast to new crops and native perennials, production practices and machinery are well developed for alfalfa. There is agronomic expertise available in most states through the Extension service and private consultants. Additionally, several value-added products can be produced from alfalfa leaves before conversion of the rest of the crop to fuel or energy. Examples are feed and food grade proteins, and nutriceuticals such as lutein. Scientists in the PSRU have produced bio-degradable plastic in alfalfa leaves.

Fuel or Adhesives in Wood Products. U.S. Dairy Forage Research Center scientists have identified a potential high value by-product from bacteria fermenting alfalfa fiber for ethanol. This material is the glycocalyx, a sticky resin formed by the bacteria that adhere to the fiber Fermentation residues (consisting of incompletely fermented fiber and adherent bacterial cells with their glycocalyx material) were obtained by growing the anaerobic cellulolytic bacteria *Ruminococcus albus* 7 or *Clostridium thermocellum* ATCC 27405 on a fibrous fraction derived from alfalfa. Dried residue served as an effective co-adhesive for phenol-formaldehyde (PF) bonding of aspen veneer sheets to one another. Testing of resulting plywood panels revealed that the adhesive, formulated to contain 30% of its total dry weight as fermentation residue, displayed shear strength and wood failure comparable with those of industry standards (plywood normally contains 55 % by weight of PF). Microbial glycocalyx has potential to replace phenol-formaldehyde resin currently used in forming plywood panels.

Further research on alfalfa germplasm improvement, development of valuable co-products, and providing guidelines for the most environmentally beneficial deployment of alfalfa in cropping systems will strengthen the economic and environmental benefits to be gained from using alfalfa to provide the future energy needs of the United States.

CONCLUSIONS

Alfalfa is a key forage to build effective diets for livestock producers. Enhancing the nutrient utilization of alfalfa in dairy diets offers potential performance enhancements for beef, horse, and sheep producers. Research into improving biomass yield and conversion of biomass to liquid fuel via fermentation or gasification can generate new products and expanded acreage. Past progress relying on traditional breeding has enhanced alfalfa's quality, but yield improvements have been limited and alfalfa does not possess certain special attributes, such as tannins, that could dramatically enhance the crop. With the modern biotechnology tools, rapid advancement of alfalfa with improved agronomic and nutritional traits, along with the addition of novel traits, should lead to more efficient and environmentally friendly dairy and hay enterprises.

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Is There a Benefit to Alfalfa Balage?

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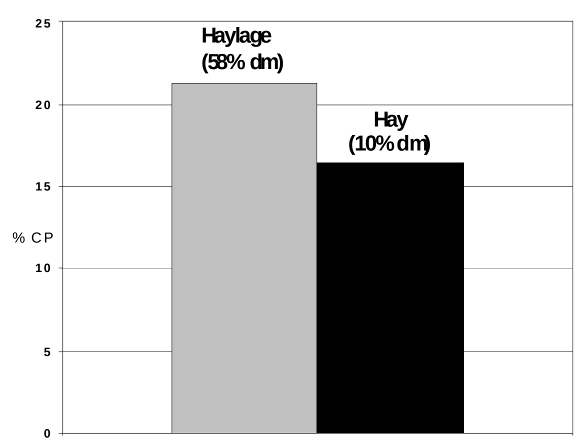
Making hay in the mid-South has always been a difficult process. High humidity and rainfall often make drying a long, tedious, if not impossible proposition. Over the last few years there has been an increased interest in making round bale silage, or balage, from forage crops. Fermenting alfalfa for storage has several advantages and disadvantages over regular haymaking systems.

Understanding the Fermentation Process

During fermentation, bacteria use carbohydrates found in the plant, and produce lactic acid. This lactic acid causes the pH to drop, eventually to a level at which microbial activity stops and the crop can be safely stored for an extended period of time. The process of fermentation in an anaerobic process, meaning that the bacteria function in an environment that does not contain oxygen. For the first few days after the alfalfa is baled, there is oxygen present. Fermentation will not adequately begin until that oxygen is depleted, creating the anaerobic condition. The initial oxygen is used by other species of microbes, as well as plant cell respiration.

The amount of lactic acid needed to drop the pH will be directly proportional to the amount of moisture in the crop. Higher moisture contents will need more lactic acid to drop the pH to a stable level. Most forage crops will require wilting to drop the moisture content before they can be baled and wrapped. Generally only 1-2 days is required to drop the moisture content to an acceptable level for balage, compared to 3-5 days for dropping the moisture content to an acceptable level for hay production.

Figure 1. Crude protein level of alfalfa as either hay or balage. (Han and Collins. 2004. Crop Science. 44:914.)



Is Balage Higher in Nutritive Quality?

Most producer's experience is that balage is higher quality than hay. This has been shown in various research projects as well (Figure 1). It is important to realize that making balage does not improve the quality of the forage. The higher nutrient content of balage is the result of less exposure of the forage to the environment, and less degradation or loss of the nutrients that were contained in the alfalfa when it was first cut.

Immediately after alfalfa is cut, there is a slow (or sometimes rapid) loss in protein and energy in the crop. There are several factors that cause this loss in nutrients. First, and most dramatic, is rainfall. Rain on a crop during the drying process is disastrous for the nutrient content. With balage, it takes fewer days to achieve to the desired moisture content, so there is less chance of getting the crop wet from rain. A second factor in nutrient loss is in damage to leaves and leaf loss. Since the crop is raked and baled at a higher moisture content, there is less leaf loss.

Key Points For Successful Balage Production

Cut alfalfa at the proper maturity. The forage quality of the alfalfa balage can be no better than it is when it is first cut. Everything that is done to it from that point will only cause leaf loss and a decrease in forage quality. It is important to not delay harvest, but cut at the right maturity to get a high quality crop. The decrease in drying time for balage should make it easier to cut in a timely manner.

Wilt to approximately 50 percent moisture. Research and experience have shown that there is a wide range of moisture content that can produce good fermentation with balage. Research conducted by Hancock and Collins made acceptable alfalfa balage from 37 to 61 percent moisture. The best recommendation is to aim for wilting alfalfa to approximately 50 percent moisture. The early bales will be higher in moisture and the last bales will be lower, but a wide range (40-60%) in moisture will still produce acceptable fermentation and a stable balage product.

Wrap the bales as soon as possible after baling. The alfalfa bales need to be wrapped as soon as possible after baling to reduce the heating that will occur and speed up the beginning of the fermentation process. It is best to begin wrapping within a few hours of baling.

Keep bales air-tight. The bacteria that convert carbohydrates in the plant to lactic acid only live in oxygen-free environments. It is important to wrap the bales as soon as possible after baling, then periodically inspect the wrap for punctures or holes. If any or found, cover them when some type of thick tape. Holes in the plastic will allow oxygen back into the wrap, and spoilage will occur in the area around the hole.

Use at least 4 layers of plastic. As has been stated several times, it is important to keep the alfalfa in an oxygen-free environment. In the past, a silo was used to keep out oxygen. In the case of balage, the plastic wrap replaces the silo. If only two layers of plastic are used, there may not be as good of fermentation. Research in Kentucky has shown that four layers are adequate to produce good quality balage.

Alfalfa Hay and Balage: Testing for Quality

Kimberly Field
Program Coordinator
Forage Testing Program
Kentucky Department of Agriculture

Kentucky Department of Agriculture

Forage Testing Program

Kimberly Field
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Forage Testing Program

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Mike Phelps - Western
Tina Garland – Eastern / Frankfort Lab
Kimberly Field – Eastern / Frankfort Lab
Mac Stone – Director
Michael Judge – Executive Director
Richie Farmer – Commissioner of Agriculture

Our Goal: To Educate the Producer on the Benefits of Testing Their Forage

Benefit: Maximize Production / Minimize Cost

Forage Testing Program

Why Test Your Hay?

- **By knowing the percentages and protein levels you can increase/decrease the amount of supplements needed from your analysis report and will help the producer set feeding rations**
- **If you do not know what you have in your forage <u>you are</u> over or under feeding your livestock – therefore affecting the health of your animal and your pocket book**

Forage Testing Program

Forages We currently Test for Energy and Protein

- Legume Hay
- Mixed Hay
- Grass Hay
- Legume Haylages
- Mixed Haylages
- Grass Haylages
- Cornstalk Hay
- Soybean Hay

Forage Testing Program

- The Producer calls and makes an appointment
- We visit the farm and pull random core samples
- Each sample is $10.00 (same field/same cutting)
- Each sample is processed and analyzed within 10 business days
- An analysis report is mailed to the producer and emailed to the Extension agent
- The Producer uses the analysis to balance a ration
- For Sale Website – If you have excess hay and would like to sell it; we have a free service to advertise your hay. If you need hay this website brings the consumer and producer together
- Hay Hotline – the unknown quality hay that is posted from producers from Kentucky or other states that have hay for sale; this hay has not been tested by the Forage Testing Program.

Forage Testing Program

Forage Samples Analyzed Per Year in the Lab and Van

2004 - 1242
2005 - 3550
2006 - 2776
2007 - 3843

Forage Testing Program

Commissioner Richie Farmer

- Secured funding for updated computers and software to bring the lab up to date
- Secured funding for a new Mobile Forage 8' x 18' Unit with a new NIR Analyzing System, Grinding Mill and a Computer with Printer
- Instrumental with drought relief in lifting the wide load size limit ban to have roll hay bales brought into Kentucky from neighboring states
- Instrumental with Disaster Declaration from USDA Secretary
- Education efforts with the University of Kentucky
- Worked with Legislators / Agriculture Development Board
- Hay Hotline

Forage Testing Program

Mobile Forage Van

- **The Mobile Forage Van is equipped to and has tested forages at Hay Contests, Farm and Field Days, State and Local Fairs, Hay Auctions, Young Farmers Meetings, and The Murray, Western, and Eastern KY Junior Livestock Shows**
- **The "Farmer Sample" is processed in the van and the producer receives his/her analysis report on site**
- **Talk to your Extension Agent to set up a Field Day**
- **There is no charge for the Mobile Forage Van**

Forage Testing Program

Questions?

Thank you!

Hay Supply, Price and the Future

Tom Keene
Hay Marketing Specialist
University of Kentucky

As we prepare for the 2008 hay crop, it's probably a good time to look back and see what the '07 crop brought to us and wonder if it will have any bearing on the upcoming 2008 crop.

We entered the '07 hay year with little or no carryover in Kentucky of the '06 crop due to extreme drought conditions in the southeast. Many Kentucky producers had shipped hay south during the previous fall and winter which left our carryover hay at next to nothing here in the state. Nationwide carryover supplies were low as well due to drought and other issues as well.

We now have the ethanol and alternative energies phenomenon that is sweeping the country which has greatly impacted the supply of hay. Although, hay acres remain somewhat constant there is no push to seed additional acres of hay especially with grain and commodity prices at their current levels. Even with supplies being as low as they are and prices being as high as they are, there seems to be no great ground swell to put in new hay acres.

The drought of '07 only exacerbated the hay situation for the '07 – '08 hay feeding season. Plant material got off to an early start due to warmer than normal temperatures in March but were frozen back dramatically with our "Easter" week freeze. This left forage plants stressed and they were slow to recover and some stands even perished totally. Then it turned dry in May and June and hay yields statewide were at 50% levels or below. Some sporadic rains came in July but then more drought in August and September. So many producers were feeding hay as early as June and certainly many more were feeding in August and September. This early feeding depleted inventories that were already diminished due to the freeze and early drought not to mention we had no carryover. Needless to say, the hay supplies were very short entering the typical hay feeding season starting in late November and December.

If you have had to buy any hay this year you know full well that the price is up….up dramatically. The hay market is like most agriculture commodity markets in that prices are usually driven by supply and demand. But the supply and demand theory continues to be clouded with other issues also. The export market continues to grow almost exponentially, producers in other parts of the country are having to battle environmentalist as well as major urban areas for water rights and of course more good farm land continues to be swallowed up by developers at a rapid rate. All of these issues along with the ethanol picture continue to jeopardize hay acres nationwide.

Other concerns also continue to drive the price of hay upward. The price of fuel for instance has to be factored in the equation. No 2 diesel fuel remains at over $3.00 per gallon. That diesel is used to swath, ted, rake, bale, store and transport the hay. And then if you factor any amount of travel distance between where the hay is grown and then utilized it can substantially increase the price of the hay. For example, if you are shipping hay 2000 miles via tractor trailer and you get 5 miles to the gallon that means it's going to take 400 gallons of fuel to move the hay. At $3.00 per gallon that is $1200 total just for the fuel that doesn't take into consideration permits, insurance, wear & tear and maybe even a little something for the driver to make a decent living. So, if there is 15 tons of hay on the load then the fuel alone cost $80 per ton for that particular load of hay.

We've talked about fuel prices going up and that also has a great bearing on fertilizer prices. As fuel prices increase, so does the price of fertilizer. It's an accumulative effect….a snowball effect.

So needless to say, it's not the "same ol' hay business that your Dad used to be in". Dynamic changes continue to shape and mold a "new" hay industry that will be more exciting, more challenging and more diverse than ever before. All the components that we have visited about previously will all play important roles as to how this industry changes but I think that it is safe to say old pricing schemes, old packaging, poor storage, etc. will not be able to bear up under the new hay landscape. Producers will have to be diligent and forward thinking in order to succeed in this new "hay making" environment.

It is an exciting time to be in forage agriculture. The winds of change seem like they are almost at hurricane force. So jump in and hang on…it's going to be a wild and exciting ride.