30TH KENTUCKY ALFALFA CONFERENCE PROCEEDINGS

Volume 30, Number 2
Garry Lacefield & Christi Forsythe, Editors

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Cave City Convention Center
Cave City, Kentucky

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

Schedule for the Day

8:00 a.m.	Registration, Visit Exhibit, Silent Auction
8:45	Welcome – Dr. Scott Smith, Dean, College of Agriculture, University of Kentucky Mr. Don Sorrell, President, Kentucky Forage & Grassland Council
9:00	Reflections after 30 Years – Dr. Garry Lacefield
9:15	Advances in Alfalfa Seed Coating – Mr. Bill Talley
9:30	Alfalfa: Value in Crop Rotations – Dr. Ray Smith
9:45	Alfalfa Hay for Horses – Dr. Bob Coleman
10:00	Break, Visit Exhibits, Silent Auction
10:30	Alfalfa Baleage – Dr. Gary Bates
11:00	Alfalfa for Grazing – Mr. Ken Johnson
11:30	Alfalfa Varieties for the Future – Dr. Joe Bouton
12:00	Lunch, Visit Exhibits, Silent Auction
1:00	Awards
1:20	Silent Auction Results
1:30	Alfalfa for Wildlife – Dr. Don Ball
2:00	How we Produce & Market Alfalfa Hay - Mr. Clayton Geralds
2:30	Blue Ribbon Panel featuring All Speakers
3:00	Adjourn

F O R E W O R D

This conference marks the thirtieth 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 thirty 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
XXX Annual Kentucky Alfalfa Conference

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
2010	Jeff Medlin	Charles Powell	Don Ball Joe Bouton
2009	Ken Carpenter	John McCoy	Ray Smith
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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KENTUCKY ALFALFA CONFERENCE
REFLECTIONS AFTER 30 YEARS

Garry D. Lacefield
Extension Forage Specialist
University of Kentucky

This event today marks the 30th consecutive year we have come together for a full day's conference featuring "Alfalfa - Queen of the Forages" as the theme and focal point. Only one other state (California) in the U.S. has such an annual event.

The Beginning – I have always had respect for alfalfa and even selected alfalfa as the crop that I did my Ph.D. work on at the University of Missouri. Warren Thompson had a very active and effective extension program in alfalfa throughout his career. Ken Evans and I had an active extension program on alfalfa during the seventies. Two key events during 1980 resulted in a renewed emphasis on alfalfa in Kentucky and the beginning of the Alfalfa Conference.

In the summer of 1980, I was invited by the Certified Alfalfa Seed Council to participate in a study tour of the alfalfa seed producing area in five western states. During that tour, I met, got to know, and visited with, some of the leading alfalfa experts in the U.S. Their experience and enthusiasm and the opportunities offered me during that tour resulted in me returning to Kentucky with a renewed enthusiasm for alfalfa and its role in Kentucky. At that time, Kentucky had approximately 150,000 acres of alfalfa. A University of Kentucky study conducted earlier indicated a million acre potential.

In the fall of 1980, and shortly after my trip out west, we scheduled a KFGC Board meeting in Louisville. I had made arrangements for some farm visits in Shelby County on the afternoon before the board meeting. Dr. Monroe Rasnake traveled with me from Princeton to Louisville. During check-in at the hotel, Charlie Schnitzler and Wallace Campbell came into the lobby after driving in from Lincoln County. I invited Charlie and Wallace to accompany us on the farm visits. They agreed and we were off to Shelby County on a beautiful fall day to visit alfalfa fields. Roy Catlett had several visits lined-up. I remember visiting several fields with Jack and Frederica Clore. We also visited other alfalfa fields on several farms in the county. It was a most enjoyable afternoon and I learned a lot from Charlie and Wallace as we traveled. During these visits, Roy and I discussed the possibility of having a winter meeting just on alfalfa since there was so much interest in the county. Charlie Schnitzler told me during our travels that he felt the opportunities for alfalfa in Kentucky were great, and he encouraged me to place greater emphasis on this high yielding, high-quality crop. As always, Charlie volunteered to help in any way.

Over the next few weeks I developed some plans for a statewide meeting and discussed them with Ken Evans, Warren Thompson, Monroe Rasnake, Charlie Schnitzler and several County Agents. Each of these people were most supportive and encouraged me to move ahead.

In January of 1981, we had our first Kentucky Alfalfa Conference in Shelbyville, and repeated it in Princeton. The attendance, participation, and feedback was excellent. In 1982, the 2nd Annual Kentucky Alfalfa Conference was held in Lexington and Princeton in conjunction with the National Alfalfa Symposium. In 1984, we met in Princeton, and with standing room only realized we had outgrown that facility. We continued to meet each year thereafter (Table 1) with attendance of 200 to over 400.

Table 1. Alfalfa Conference Dates and Locations

1981	Shelbyville/Princeton
1982	Lexington*/Princeton
1983	Cave City
1984	Princeton
1985	Elizabethtown
1986 & 1987	Cave City
1988	Mt. Sterling
1989 through 1997	Cave City
1998	Bowling Green*
1999 through 2005	Cave City
2006	Lexington
2007 through 2009	Cave City

*Held in conjunction with National Alfalfa Symposium

Program Content – A review of the programs over the past twenty-nine years indicates we have spent a lot of time on the basics. Soils, fertility, weed control, insect and disease control, establishment, varieties, harvesting, handling, storing, grazing, quality, marketing, economics, and alfalfa in livestock feeding programs have been frequent topics on past programs. Producers have been featured on many of the programs over the years, and it was a producer, Mr. Charlie Schnitzler, that served as our keynote speaker on our first conference program. In addition to the basics, we have complemented the program with timely, cutting-edge issues dealing with advances in seed coating, variety development, hybrid alfalfa, grazing tolerance, Roundup Ready, baleage, pest management, etc.

Hay Show – In 1989, we began the Hay Show in cooperation with the Kentucky Department of Agriculture and later joined by the Kentucky Pride Hay Growers Association. The contest was sponsored by Garst Seed Company. Approximately $3,000 in prizes and trophies were awarded. The program has changed over the past decade. At present, in cooperation with the Kentucky Forage and Grassland Council, University of Kentucky and Kentucky Department of Agriculture, we present awards for

the “monthly” highest quality alfalfa and alfalfa-grass hay tested through the Department of Agriculture.

Industry - A Valuable Assist – With only two exceptions, we have had exhibits at each conference. We value the support and contributions of all our exhibitors. Several exhibitors here today have been present at every conference. I have never asked one of the exhibitors for anything to which they didn't readily agree. Their financial contributions have helped us keep all our bills paid. Our surveys indicate that participants enjoy getting to visit with all the exhibitors and that exhibitors enjoy having the opportunity to meet and visit with Kentucky's leaders in alfalfa production, research, and education.

Awards – During the 20th Kentucky Alfalfa Conference and in cooperation with the Kentucky Forage & Grassland Council, the Alfalfa Awards Program was initiated. Since 2000, we have recognized outstanding achievement in the Producer, Public and Industry segments (Table 2).

Kentucky farmers have been the focus of the conference from day one. It was a farmer who helped me start this event. I have featured farmers on approximately 25 of the Conferences. Most of our AFGC National Forage Spokesman participants from Kentucky spoke at this conference including: Charlie Schnitzler, Larry Jeffries, Russell Hackley, John Nowak, Jason Sandefur, Jay Price, Bill Payne, Todd Clark, Barry Drury and Clayton Geralds. It has been farmers who have supported and encouraged me over the years. Farmers who came to me during two ice storms when attendance was low and said “Garry if you need money to help pay for the conference, let me know.” To this special group of “friends”, I say THANK YOU and wish you the very best.

Table 2. Kentucky Alfalfa Awards Recipients

Year	Warren Thompson Industry Award	Charlie Schnitzler Producer Award	Garry D. Lacefield Public Service Award
2009	Ken Carpenter	John McCoy	Ray Smith
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
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*Accepted on behalf of her father who was tragically killed in a farming accident on March 11, 1991.

Proceedings – We have been faithful in producing a comprehensive conference proceedings each year and having available at the conference. Christi and I want to say a special thanks to all speakers for providing their paper several weeks in advance. Proceedings have been distributed and used after the conference to many who couldn't attend, to University Forage classes and for numerous trainings and workshops. Since 2004 we have posted the proceedings on our website.

Media – We have received excellent support from many media outlets including T.V., radio, newspapers, magazines and newsletters. In addition to this valuable asset in promoting the conference, many have attended and written stories, made radio and television programs as well as follow-up conference reports and highlights at meetings.

Summary – It's hard to believe that when this Conference started, my oldest son was four years old. At the 24th Kentucky Alfalfa Conference he was a speaker. Now, he and my youngest son are both fathers and I am a Papa. Time indeed has passed fast. I have been involved in many different conferences, symposia, and meetings over the years, but this Conference has been special. It is special for two important reasons. Reason one is the plant – Alfalfa—Queen of the Forage Crops – has been a tried and true performer. It has proven its abilities to produce high yields and high quality forage and to be a money maker. The second reason is people – I have never come to this Conference without thinking of all the people that work so hard to make it happen. From my inspiration initially (Charlie Schnitzler) to this group of special friends that I have invited to speak here today, and all those in-between, I say THANK YOU. I am also appreciative of the exhibitors who have been so supportive, to all the County Agents who give unselfishly to ensure the Conference runs smoothly. I am thankful to all who have attended over the past 30 years from throughout Kentucky along with 38 other states and 15 countries. I also want to thank the Kentucky Forage & Grassland Council, the Kentucky Department of Agriculture, and the University of Kentucky Plant and Soil Science Department for their many contributions.

I want to give a special THANK YOU to our core committee members who have worked closely with me including: Mrs. Christi Forsythe, Dr. Monroe Rasnake, Mr. Bill Talley, Mr. Tom Keene, Mr. Ken Johnson, Mr. Phil Howell, Dr. Jimmy Henning, Dr. Ray Smith, Mr. Dan Grigson, Mr. John James, Mr. Gene Olson and the Mammoth Cave Extension Agents for Agriculture & Natural Resources. I also want to thank all the University of Kentucky faculty and staff as well as all County Agents who have contributed so much to the success of the Conference.

I extend a very special THANK YOU to Christi Forsythe, who has done the most to make this Conference such a success. Her attention to details in preparing programs, coordinating exhibits, editing proceedings, and keeping the records is much appreciated. I close by thanking my wife Cheryl and our son's Brian and Brad for their understanding and support for all the times I have been away from home working on this and many other conferences and meetings.

And now, after 30 years, where do we go from here?

ADVANCES IN ALFALFA SEED COATINGS

Bill Talley
President
Summit Seeds

The volume of alfalfa being sold as coated seed has been in the growth mode for several years. This growth is being fueled by greater acceptance from the producer, as well as the many value added components that are now labeled and being offered as seed treatments. Originally seed coatings were looked at as a better way to deliver rhizobia to insure plant nodulation. This is still one goal, but many more value added components are now labeled that offer better plant protection, increased water absorption, enhanced germination, and micro-nutrient availability, as well as insect and parasite control. Another area that is seeing expanded growth is in all natural organic coating. These coating components are all organically approved and or OMRI (Organic Materials Review Institute) certified.

Nodulation of alfalfa is still one of the most important first steps as the young seedling emerges. These nodules can only form if there is native rhizobium in the soil, or from the rhizobia that is applied as part of the coating or treatment. Proper nodulation of alfalfa can enable it to produce 200-300 lbs available nitrogen for the plant. Without nodulation it would take a great deal of commercial fertilizer to replace this free atmospheric converted nitrogen. Seed coating, due to the volume and accuracy of loading, can supply large numbers of rhizobia to ensure nodulation. The greater numbers that are initially loaded can also lead to a longer shelf life for the rhizobia to remain viable. The components of the coating are very friendly to rhizobia longevity. Some rhizobia strains are more effective than other selections. We have examined several strains to ensure maximum productivity. This is the main reason a pre-inoculated or hand inoculated seed should always be used at planting. The strains that may or may not be in your soil could not be highly effective ones. The commercially available strains have been tested to insure maximum productivity.

Water management as well as available water for germination of alfalfa seed can be very critical. The use of SHP (super hydrating polymers) is one of the areas of greatest growth in seed coatings. These polymers must be applied through a coating due to the accuracy and bulk that is needed for them to be effective. Initially these products were developed for use in the nursery container trade to decrease the amount and regularity of watering. They have since been developed into a soil treatment for use in some of the arid climates where water is a scarce commodity. We have worked with this technology for several years and have been able to develop this into an effective seed coating component. The turf trade has been the earliest adapter, and is

using these products on 40 million pounds plus pounds of grass seed annually. The adaptation and use of our alfalfa coatings has been much slower, but is being offered by some alfalfa seed companies. The market for these products is mainly the Western U.S. where water is more critical.

Micro-nutrients and enhancers are another area that we are seeing market growth. The carrier for most coatings is a lime base. Working with western seed companies to develop a unique product for their specific soil types led to the development of a new coating. The ph of these soils can be quite high as compared to the typical Midwest and Southeastern soil. Gypsum and molybdenum were substituted, which showed dramatic results in both university and strip trials. Due to the uniqueness of this product a patent was issued. After extensive testing, a variation of this coating was marketed in the Midwest and Eastern areas. This coating contains the gypsum, molybdenum, and also includes optimize TM. This coating showed an advantage when you starting getting into the lower than optimal, or on the border ph ranges. The addition of optimize, which is a nodulation enhancer added to the benefit. This is being marketed under the Gold Treatment, Apex Plus, Five Star and some other proprietary seed company treatments.

The newest and next area that seed treatment will be moving toward is the use of an insecticide as part of the treatment and coating process. Some of these are already labeled and used extensively in South America for alfalfa. The chemical companies are applying to EPA at his time to expand their labels for use on alfalfa in the United States. This area of seed treatment will be very beneficial to alfalfa establishment. The possibility of the re-release of roundup ready or at least knowing the fate of GM in alfalfa will move alfalfa forward. There are many GM non roundup genes that could be very beneficial to the alfalfa grower. These have been at a standstill until the fate of Roundup Ready could be decided. The comment period and environment issue are being addressed and now it is up to the regulators to make their decision.

An area of growth for Summit Seed Coatings has been with the addition of an organically approved coating. This coating is different in that it uses no synthetic chemicals. These have been replaced with natural OMRI certified or approved components to meet the organic criteria. This has been well received by the organic grower as it gives him the choice to use a natural product to aid in the establishment of his alfalfa. This coating contains much of the same base components, but also has the addition of Mycohrizze to aid in the early development of initial rooting. We did change the synthetic components and our plant process to meet Organic Processor Certification. The use of legumes by the organic producer is a top priority since they are not able to use commercial fertilizer. Proper nodulation and strong stands can produce more nitrogen and increase their yields. This area is one that has the possibility for the increased market growth.

Seed treatment and coating are experiencing exceptional growth. This trend is going to continue as more chemicals and treatments are made available. Many of the new treatments will need the bulk of a coating to obtain the correct dosage, and a coating can be the most accurate way to apply. The coating equipment has changed dramatically and with upgrades in the new technology we are taking advantage of new chemistry that will be coming available.

VALUE OF ALFALFA IN ROTATION

Ray Smith
Extension Forage Specialist
University of Kentucky

There are about 23 million acres of alfalfa in the US. Alfalfa plus other hay is the most valuable crop in the US, behind only corn and soybeans. In Kentucky alfalfa is planted on over 300,000 acres and is an economically important crop for beef and dairy farmers, cash hay producers, and
provides tremendous benefits for subsequent crops. There are also many non-agricultural benefits to alfalfa.

Nitrogen Credit from Alfalfa Available to Subsequent Crops

Alfalfa offers many benefits to subsequent crops. Many consider free nitrogen (N) from N fixation one of the greatest benefits of alfalfa. The amount of N available to subsequent crops varies some with soil type, but good stands of alfalfa that have been allowed to regrow (> 8 inches) provide 140 to 190 lb N/acre for next year's crop (Table 1). Additionally, since alfalfa roots decay over time, alfalfa also provides approximately 50 lb N/acre for crops planted the following year. The nitrogen benefits can total close to 250 lb N/acre over 2 years. In contrast, soybeans are also legumes which fix nitrogen, but most of their nitrogen goes into producing that year's bean crop. Farmers gain only1 lb N/acre for each bushel of soybeans harvested up to maximum of 40 lb N/acre.

Table 1. Nitrogen available to subsequent crops following growing alfalfa.

Stand Density	Medium/Fine Soils		Sandy Soils	
	-----Regrowth after last cutting------			
	>8 inches	**<8 inches**	**>8 inches**	**<8 inches**
	----------lb nitrogen/acre----------			
Good, > 4 plt/ft²	190	150	140	100
Fair, 1.5 to 4 plt/ft²	160	120	110	60
Poor, < 1.5 plt/ft²	130	90	80	40

Economic Benefit of Alfalfa to Subsequent Crops

Equally as important, alfalfa increases profit of other crops in the rotation. The difference is especially dramatic for corn grain. As shown in Figure 1, when N was at $0.96/lb and using a value of corn at $4.18/bu, then corn after corn lost about $10 per acre due to high nitrogen costs. On the other hand, following alfalfa, corn production resulted in a profit of $310/acre because there is no need for nitrogen fertilizer (other than starter) and because corn yielded 10 to 15% more following alfalfa compared to corn following corn (Figure 2). Currently, N prices are lower, but free N produced by alfalfa and the 10 to 15% higher corn yield still makes alfalfa a tremendous value for corn grain yield.

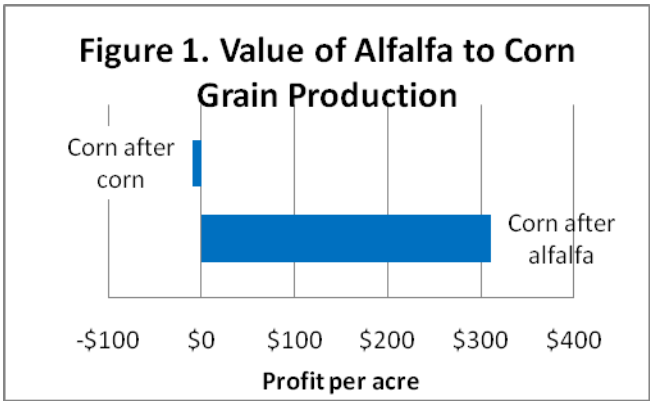
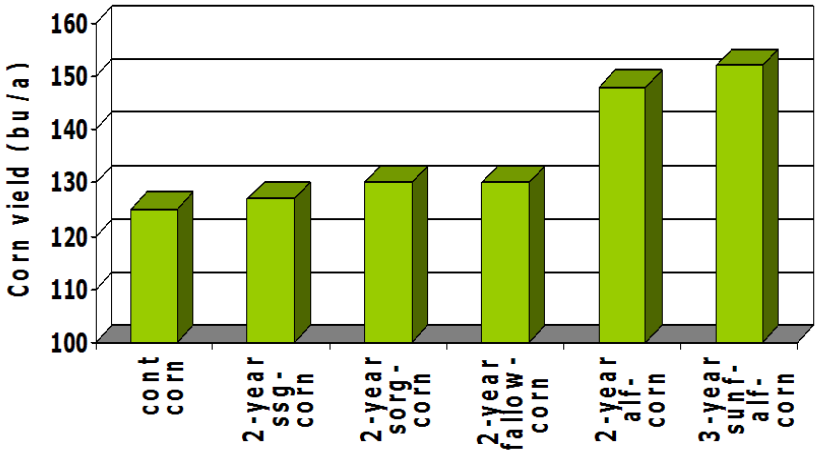


Figure 2. Improved Corn Yield from Alfalfa

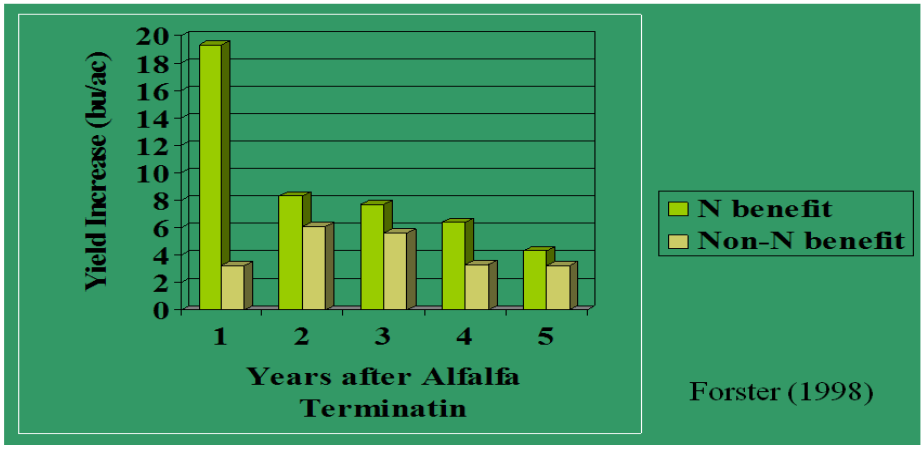


Wheat Yield Increase after 4 Years of Alfalfa

Corn is not the only crop that benefits from alfalfa in rotation. Research by Forster as reported in Entz (2002) showed that wheat yields following alfalfa were significantly higher than wheat following wheat (Figure 3). Alfalfa in the rotation not only benefited the next years wheat crop, but continued to produce higher wheat yields for

up to 5 years. The N benefits for subsequent wheat crops were obvious and expected, but the non-N benefits to wheat yield were also significant.

Figure 3. Rotational benefit of alfalfa to wheat yield.

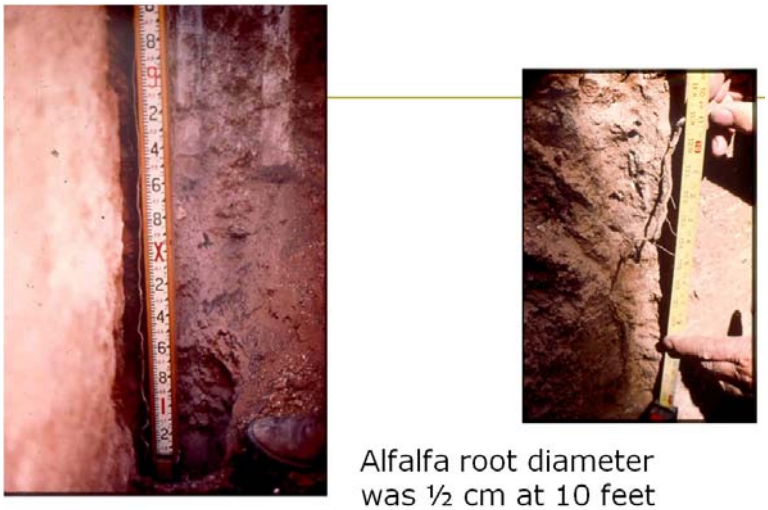


Breaks disease and insect cycles

There are many non-N benefits of including alfalfa in rotation. Examples include the reduction in nematodes for succeeding crops. One of the most dramatic is the reduction in soybean cyst nematode when alfalfa is included in rotation with soybeans.

Improves soil condition

Alfalfa is the most deeply rooted of all commercial agricultural crops. Alfalfa roots have the potential to grow 3 to 4 feet deep per year. It is not uncommon for a 4 year stand of alfalfa to have roots 15 feet deep. Not only is this a benefit for water uptake, but this deep root system improves soil tilth. Additionally, nutrients that have leached below the surface root zone of most agricultural crops can be utilized by alfalfa. These deep nutrients contribute to alfalfa yield and quality, but they are also returned to the surface soil layer for use by following crops. The photos below provide an example of rooting depth and indicate that it is not uncommon for an alfalfa root at 10 feet to still be ½ cm in diameter.

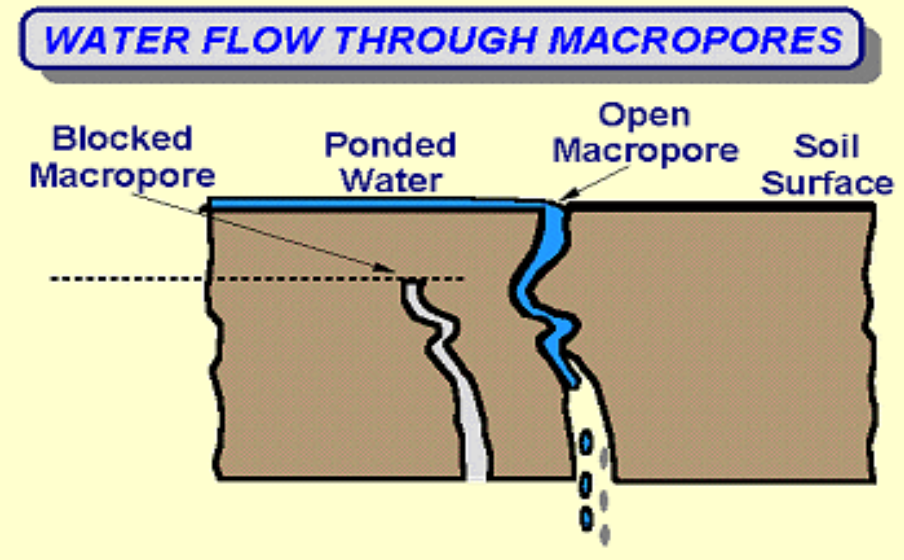


Alfalfa root diameter was ½ cm at 10 feet

Improved Water Infiltration

Alfalfa should not be planted on poorly drained soils, but water infiltration can be dramatically improved by cropping alfalfa on moderately drained soils. After an individual alfalfa plant dies or is sprayed out, its tap root decomposes producing a macropore (Figure 4). Each macropore provides a channel that improves soil drainage. When using zero or minimum tillage, macropores can last for several years after the termination of an alfalfa stand. Alfalfa also decreases soil bulk density and the potential for soil compaction by increasing organic matter. Exudates released by alfalfa roots allow colonization by fungal hyphae which in turn lead to the development of well defined soil aggregates.

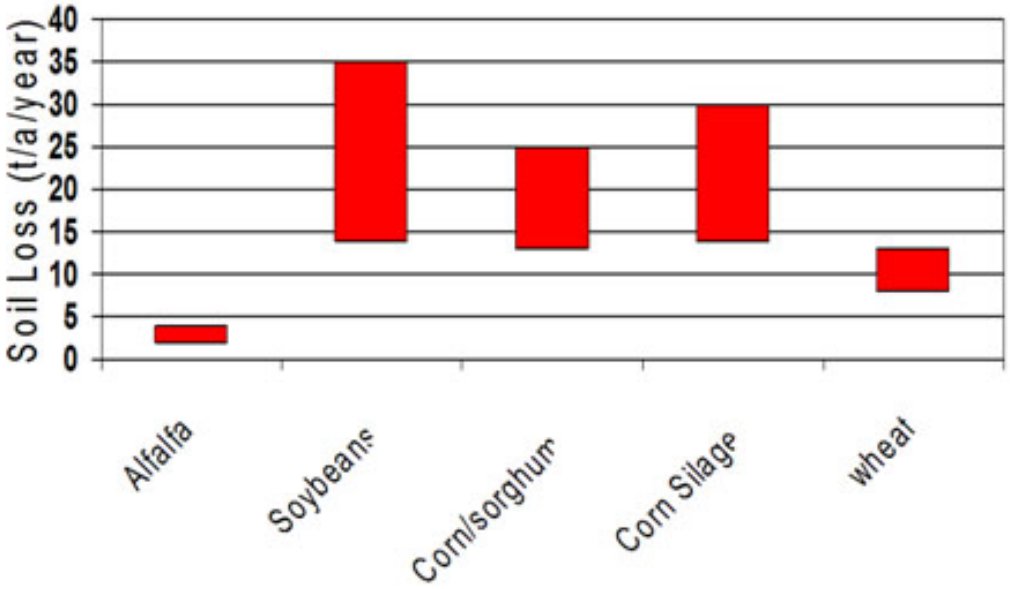
Figure 4. The development of large macropores following alfalfa.



Reduced Erosion from Alfalfa in Rotation

Most people do not think of alfalfa as a crop to plant to reduce erosion, but research reported by Jackobs in Missouri showed that erosion from an alfalfa field is essentially zero compared to values for corn or soybeans. No-till cropping will reduce erosion of corn and soybeans, but not as low as planting alfalfa.

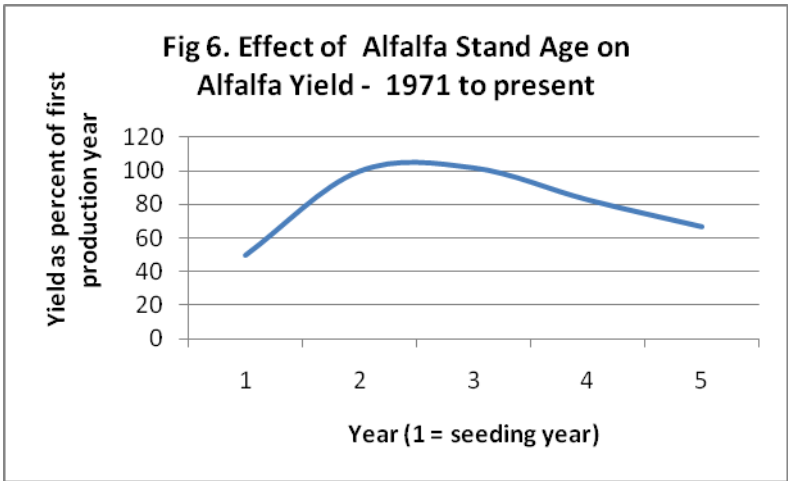
Figure 5. Erosion from crop fields including alfalfa, soybeans, corn, and wheat.



SOURCE: Dr. Dan Undersander, University of Wisconsin.

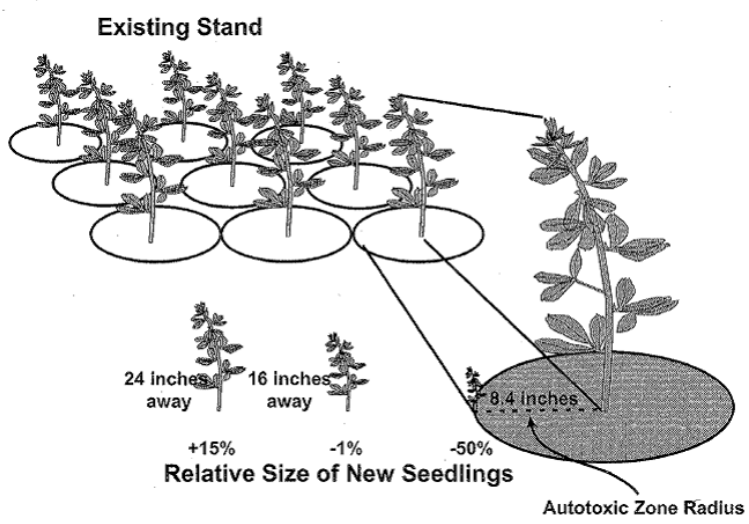
The Value of Younger Stands vs. Older Stands

Long term studies in Wisconsin show that one of the challenges to alfalfa profitability is decreasing yield as the stand ages. The declining yield is due to the environmental stresses, wheel traffic and diseases that build up over time. As Figure 6 shows, average yield decline of alfalfa in the Midwest is 17% in the third production year and 34% in the fourth production year. Declines were generally greater east of the Mississippi River and slightly less to the west of the Mississippi, unless under irrigation. Therefore, producers are encouraged to consider shorter term rotations on their alfalfa fields. The convenience of keeping alfalfa for "one more year" may be outweighed by the yield benefit of planting a new stand.



Avoid Thickening Up Old Alfalfa Stands

Although alfalfa shows tremendous benefits to subsequent crops, it is imperative to use other crops as a break between alfalfa stands in the same field. When alfalfa is replanted or overseeded into an existing alfalfa stand, the original alfalfa plant severely limits the growth of the newly seedlings. This is called autotoxicity, and extensive research by Jennings has shown that individual alfalfa plants severely limit the growth of new seedlings in an 8 inch radius around the original plant (Figure 7). New seedlings are weaker than normal up to 16 inches away and maximum growth of new seedlings does not occur until a full 2 feet away from the original plant.



Although the focus of this paper has been the benefit of alfalfa in rotation with annual crops like corn and wheat, alfalfa also provides many other benefits including:

Providing Significant Wildlife Habitat. Alfalfa is the beginning of a food chain, and contributes valuable habitat for hundreds of species of herbivores and animals of prey. It hosts several endangered species, plus many familiar ones.

Efficiency in Water Use. Alfalfa is a relatively efficient user of water; it produces high tonnage of dry matter in proportion to the available moisture. This is due to its season-long growth habit, its high yield, and the fact that all the above-ground portion of the plant is harvested. Alfalfa's deep-roots assure that a large proportion of available water is used by the crop.

Mitigating Contamination Problems. Alfalfa has been used to mitigate several environmental problems including absorbing nitrates from groundwater, recycling dairy or municipal wastes, and mitigating industrial compounds that could contaminate groundwater.

In Conclusion

Alfalfa has long been known as “The Queen of Forages” for its high quality and yield, but the tremendous benefits of alfalfa in rotation make alfalfa one of the most important crops in the world.

Special Thanks to Dan Undersander, Extension Forage Specialist, Univesity of Wisconsin. Many of the tables and figures used in this paper were taken from his presentation “Alfalfa in Rotation”.

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Alfalfa Hay for Horses

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When horse owners consider hay for their animals, a number of criteria are generally considered. Of major importance is the hay must be free of mold and dust. It needs to contain nutrients needed by the horse and it must be palatable. If these criteria are met, the type of hay should not matter. However, that is not the case with many horse owners. When discussing the selection of hay, many owners first consider the type of hay. Can it be alfalfa or should it be a grass or how about a mix of grass and a legume. If a group of horse owners were to be polled the results would reflect some who felt alfalfa was the best hay for horses, some would suggest it never be fed and a few would ride the fence being neither strongly for or against alfalfa hay.

It is widely know that alfalfa hay is an excellent source of nutrients. In table 1, there is a comparison between a mid bloom alfalfa and a mid bloom timothy hay. From the comparison, it is evident that the alfalfa can supply more digestible energy, more crude protein and calcium than the timothy hay. If alfalfa hay is comparatively priced with grass hay, cost per unit of nutrients makes it a better buy.

Table 1. A comparison of nutrient content of Alfalfa Hay and Orchardgrass hay (on Dry Matter Basis)

	DM %	DE Mcal/kg	Crude Protein %	Calcium %	Phosphorus %
Mid Bloom Alfalfa	91.0	2.28	18.7	1.31	0.24
Mid Bloom Timothy	86.0	1.99	9.7	0.48	0.23

Adapted from the Nutrient Requirements of Horses. Fifth Revised Edition 1989.

So why is the horse owner reluctant to feed alfalfa hay? For some horse owners, they feel that alfalfa hay will provide too much in the way of energy and protein for the horses they are feeding. In table 2, there is a comparison of the percentage of required nutrients supplied by a specific daily intake of hay. In the examples, the daily intakes were held to 2% of body weight or less. For a horse at maintenance, eating alfalfa hay at 1.65% of its body weight per day, both digestible energy and protein requirements

are met. In fact, the protein requirement for that horse is greatly exceeded. The same horse being fed the timothy hay in the example would need to be fed more hay in order to meet its nutrient requirements or have a supplemental concentrate added to the program. For some horse owners feeding more forage per day is the preferred situation as the extra time spent eating hay may keep the horse from developing certain behaviors that have been linked to boredom. For the maintenance horse, eating such a small amount of alfalfa hay each day the total time spent eating will be short and this may lead to horses developing bad habits such as wood chewing.

Table 2. The percentage of Nutrient Requirements provided to a 1100 lb (500 kg) horse fed either with a Mid Bloom Alfalfa Hay or Mid Bloom Timothy Hay % of Requirement Provided.

Horse Type	Hay Type	Hay Intake *	DE	Crude Protein
Maintenance	Alfalfa	18	102	118
	Timothy	18	88	60
Lactation**	Alfalfa	22	73	118
	Timothy	22	62	60
Light Work***	Alfalfa	18	82	169
	Timothy	18	70	86

* as fed
** first 3 months of lactation
*** Horses used for pleasure riding and showing.

Based on Nutrient needs for a 1100 lb (500 kg) Horse as published in Nutrient Requirements of Horses. Sixth Revised Edition 2007

A more common concern for horse owners using alfalfa hay is providing more nutrients than the horse requires. Again using the maintenance horse eating 1.65% of its body weight could easily eat 2.0% or more of good quality alfalfa hay. The result of this scenario is an overweight horse if access to feed is not restricted. The reality is horses can get fat on alfalfa hay but it is because the owners will not limit the intake of the hay.

In all examples found in table 2, those horses consuming the alfalfa hay will have crude protein intakes that exceed their requirements. This excess protein will be excreted resulting in greater water needs by the horse and wetter stalls. It is not uncommon for a farm feeding alfalfa hay to horses in the barn to have a significant ammonia problem because of the excessive protein intake.

As with any feeding program, the selection of the feeds to be used should reflect the nutrient needs of the horses being fed. As noted in table 2, the lactating mare's

requirements for protein are met with fed alfalfa hay. The intake indicated in the table also provides over 70% of the mare's digestible energy needs as well. If the grass hay is the basis for the lactating mare's diet, a concentrate that includes a higher level of protein plus more digestible energy would be needed to meet requirements. The alfalfa based diet allows the horse owner to use a concentrate with lower protein content and generally feed less concentrate to the horse.

As with the maintenance horses and the broodmare, the horse at light work consumes a greater portion of its nutrient requirements, when alfalfa hay is the basis for the feeding program. However concerns with feeding levels of protein in excess of the horse's requirements and concerns with wet stalls and ammonia in the barn may cause horse owners to select grass type hay and not pure alfalfa hay.

A concern with performance horses fed more concentrated diets is the risk of ulcers. It has been reported that stabled horses in training have a greater incidence of ulcers when compared to horses maintained on pasture. The amount of hay offered has been implicated in this increased risk of ulcers. Horses are grazers that eat small amounts of feed on a frequent basis. This continuous consumption of forage has horses chewing more which results in more saliva production which aids in buffering stomach acids. While feeding high quality alfalfa hay may result in a lower feed intake, research has shown that alfalfa hay can reduce the incidence of ulcer formation. Researchers in Tennessee reported a reduction in the incidence of ulcers when horses were fed alfalfa hay verses grass hay. More recently, Texas researchers have reported that feeding alfalfa hay resulted in a reduced incidence of ulcers in yearling horses. The benefit of alfalfa hay is related to its buffering capacity due to the higher levels of protein and calcium in comparison to grass hay.

Horse owners are or should be concerned about the presence of mold in the hay they are feeding regardless of what type of hay it is. It has been noted by some horse owners that there is an increase presence of mold in alfalfa hay. While there is potential for this to be true, the mold may be the result of the hay producers putting up hay with slightly higher moisture content in order to preserve the leaf content of the hay. The presence of the mold is more a function of hay production, not the fact it is alfalfa. For horse owners, alfalfa hay can be an effective feed, however, it is important that intakes of nutrients are controlled for certain classes of horse in particular, those horses with lower nutrient needs.

For those supplying hay, what does the horse owner want?

1) A hay that is free of mold and dust. Moldy hay has been implicated as a cause of the respiratory condition called heaves. The moldy hay causes an allergic reaction which affects the horse's ability to exhale. The hay fed to horses must be free of mold.

2) A consistent product. Hay that is green, leafy with a fresh odor. In addition, bales need to be consistent throughout the lot of hay. Not always easy to do if a mixed hay is produced.

3) Free of trash and other potentially harmful things.

4) A bale size that is consistent with the management practices of the horse owner. If the horse owner does not have equipment to move larger packages of hay or appropriate places to store hay, then a small square bale may be the package most desired. It is difficult for the owner to change how they care of feed their horses to accommodate large hay packages.

The bottom line is alfalfa hay does have a place in feeding programs for horses. It is generally a hay that is well accepted by the horse and provides significant levels of nutrients. Alfalfa hay and horses are a good mix when good feed management is provided.

Is There a Benefit to Alfalfa Balage?

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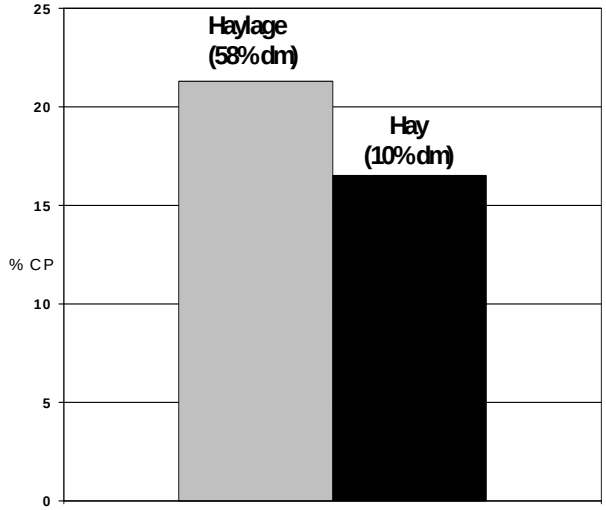
Making hay in the mid-South has always been a difficult process. High humidity and rainfall often make drying a long, tedious, if not impossible proposition. Over the last few years there has been an increased interest in making round bale silage, or balage, from forage crops. Fermenting alfalfa for 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 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 is used, there may not be as good of fermentation. Research in Kentucky has shown that four layers is adequate to produce good quality balage.

Do's and Don'ts in Grazing Alfalfa

Ken Johnson
Tompkinsville, KY

I want to discuss some of the issues in a talk I presented nearly twenty years ago. At that point we had been grazing Alfalfa about eight years and made some general remarks about the concerns I had at the time. I will look at these as presented then and how the thoughts may have changed.

Bloat – *Past comment, I don't consider bloat to be a major problem*.
-- Right and wrong. Not considering bloat as a serious potential problem is asking for trouble. Bloat can cause disastrous consequences if not managed for, and it will likely be fast, before the landowner has time to correct the problem. Management is the key, you can manage around bloat quite successfully.

Stand Life – *Past comment, grazing hasn't seemed to shorten stand life.*
-- Again right and wrong. Although proper rotational systems will maintain stand life close to hay systems, the potential for errors is great. Small errors, grazing to long, on wet soils, to late in the season, etc. will greatly shorten stand life.

Gain – *Past comment, one of alfalfa's strong points is summer grazing, making gains of 1.5 to 2 pounds per day possible.*
-- Still correct, maybe even more in some years.

Fertility – *Past comment, fertilize at half the normal hay rate*.
Wrong, in a rapid grazing rotation, manure is spread fairly uniformly. We have found over the years that very little annual fertilizer is needed. Soils tests may be more critical in this situation that normal pastures, to prevent over fertilizing.

Shade – *Past comment, shade has to be provided during the summer months*.
Shade is great and should be provided if possible. However, it should not be the factor that determines if you are going to graze alfalfa. Several research studies since my first article

have indicated that although beneficial, shade is not necessary for good gains.

Insects – *Past comment, you must spray for insects, i.e. weevils*. This is partially true, you will likely have to spray some of your paddocks, but a fast rotation in the spring will do a pretty good job controlling weevils on at least a third of the area.

In the past I considered grazing alfalfa to be a profitable enterprise. I believe this even more so today. With higher fertilizer and land prices, low cost of gain on as few acres as possible has the potential for even a greater affect on profitability.

ALFALFA VARIETIES FOR THE FUTURE

Joe Bouton
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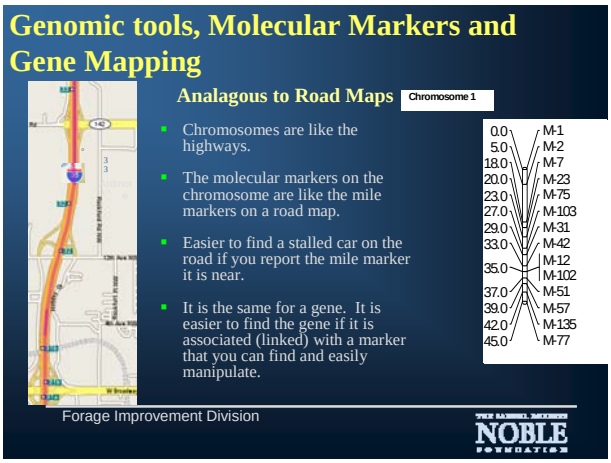
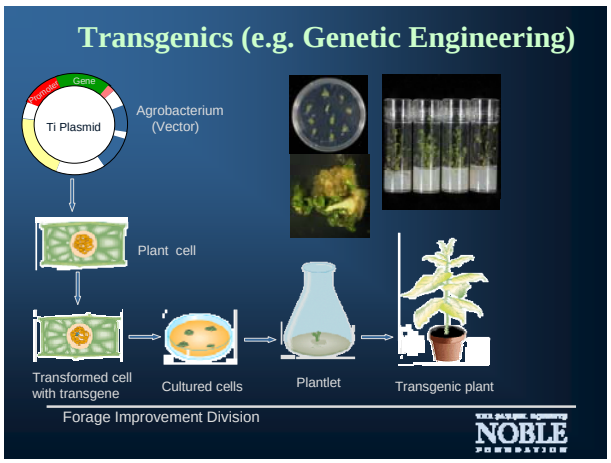
The Samuel Roberts Noble Foundation

When breeding tomorrow's alfalfa varieties, most groups employ a model of combining traditional plant breeding with biotechnology tools in order to incorporate useful traits. In this model, the conventional variety development process will be the method of choice for most traits where breeders have traditionally made progress such as adaptation, heading date, disease and insect resistance, general persistence conditions such as grazing and traffic tolerance, and even yield. It has been very successful in adding economic value to the forage and livestock operations of many producers (Bouton 2007). These traditionally developed varieties will also be used as the germplasm platform on which to add or incorporate the new and exciting traits to be discussed in this presentation. Finally, traditional breeding will also be the method of choice where the sales and on-farm value of the species do not justify the use of biotechnology (Bouton, 2007).

Some traits are complex to locate and manipulate, or possibly not even contained in a species' primary germplasm. When this happens, molecular tools are an option for trait incorporation and/or validation through more efficient gene discovery, tagging, and even genetic engineering. These tools are coming mainly from research in new scientific research areas called genomics and transgenics.

In genomics, DNA sequencing data, combined with high throughput machinery and data analysis (e.g. bioinformatics), allows more accurate determinations of species relationships and gene expression. Genomics-based gene discovery programs are also finding thousands of candidate genes that control numerous value-added traits. From this understanding, new and innovative methods for improving crops are evolving such as marker assisted breeding.





Transgenics involve the movement of specific and useful genes into the crop of choice and is sometimes referred to as genetic engineering. Scientists using the transgenic approach have already shown success in introducing genes (many found through the above mentioned gene discovery programs) which have already made many important row crops resistant to insects, viruses, and herbicides. There are literally now millions of acres planed to new corn and soybean varieties with these types of biotech traits. Transgenics is also useful in creating unique plants that allow basic research to be conducted on physiological and biochemical pathways.

Although the use of genomics is not controversial, there has been controversy surrounding the use of transgenes for crop improvement; especially when transferring genes between two unrelated organisms. Although the Roundup Ready® gene was successfully deployed as the first biotech trait in alfalfa, it was re-regulated by court injunction in order for an Environmental Impact Statement (EIS) to be developed to address sensitive hay markets (e.g. primarily organic and export). This EIS is now open for public comment. However, this episode is a good example of both the rigor and cost of the regulatory process for deploying transgenic traits in alfalfa. When coupled with the inherent costs of obtaining freedom to operate for using the gene and the enabling technologies, it also explains the high cost for bringing a transgene into the alfalfa seed market. This in turn makes the price of the final product high to the grower, so each trait must be of such impact that the grower is willing to pay these high prices.

Current Research

Biotechnology research in forage crops, especially to study and/or incorporate complex traits, is in a time of increased emphasis and success throughout the world. For example, at the past International Symposia on Molecular Breeding of Forage and Turf held in Hamilton, Victoria, Australia in 2001 (Spangenberg, 2001), Dallas, Texas in 2003 (Hopkins et al. 2003), Aberystwyth, Wales in 2005 (Humphreys 2005), and in Sapporo, Japan in 2007 (Yamada and Spangenberg, 2008), there were hundreds of scientists in attendance at each meeting from many countries. Research talks at these

symposia as found in these proceedings were mostly on the many aspects of basic biotechnology in forage grasses and legumes including alfalfa.

The North American Alfalfa Improvement Conference (NAAIC) likewise meets every two years and publishes a “Use of Biotechnology Research in Alfalfa Improvement” report in conjunction with that meeting (Brummer et al. 2006). This research report, and many others like it, is proof that research in this area is intense and growing for alfalfa.

From all of these reports, one can conclude that research areas receiving emphasis are accurate genomics techniques to more rapidly identify and manipulate important genes (molecular markers and marker assisted selection breeding), breeding for animal, human and environmental welfare, transgenics, bioinformatics, population genetics, genomics of the model legume *M. truncatula*, and field testing and risk assessment as well as intellectual property rights.

New Traits for Tomorrow’s Alfalfa

From these same conference and symposia reports, the traits receiving emphasis are herbicide tolerance (especially expression of the Roundup Ready gene in alfalfa), drought tolerance, resistance to disease and insect pests, tolerance to acid, aluminum toxic and/or saline soils, tolerance to cold or freezing injury, expression of plant genes controlling nodulation and nitrogen fixation, increasing nutritional quality of alfalfa via down regulation of lignin genes, flowering control, increased biomass yield, and reducing bloat and bypass protein via incorporation of genes to express condensed tannins in legumes.

Again, the traits being investigated are ones that breeders have made little progress for improvement through conventional breeding. Another aspect is the potential high impact for farmers of the traits under investigation. This impact will be necessary in order to justify the patent, development, and regulatory costs of the final cultivar.

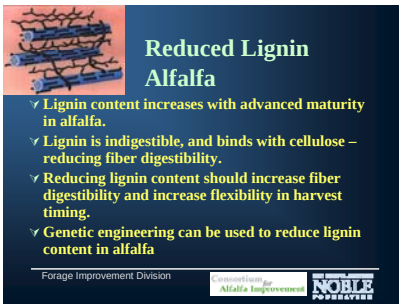
Biotech Traits to be Incorporated into Alfalfa

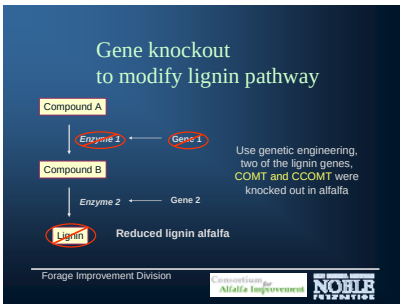
The Consortium for Alfalfa Improvement (CAI) is made up of researchers from The Samuel Roberts Noble Foundation, the U.S. Dairy Forage Research Center (USDFRC) in Madison, WI, Forage Genetics International (FGI), and Pioneer Hi-Bred International, Inc. The purpose of the consortium is to improve important characteristics in alfalfa such as nutritional content and digestibility. The first two initiatives by the consortium will focus on improving protein utilization and cell wall digestibility via lignin reduction and decreasing bloat and bypass protein problems via insertion of genes to express condensed tannins. Therefore, the consortium’s major goal is to re-design alfalfa as a major forage source. This would be of such impact as to justify use of any

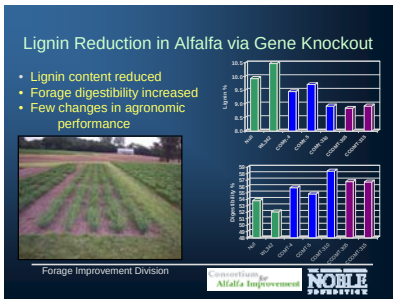
biotechnologies. Below are a few traits being investigated at the Noble Foundation or through its participation in the CAI.

Lignin Down-Regulation

Scientists at the Noble Foundation "knocked-out" the main genes that code enzymes required for lignin synthesis in alfalfa. CAI scientists are now in the process of evaluating transgenic plants with reduced expression of one or more lignin biosynthetic genes. Although these transgenic plants contain reduced lignin content, they vary widely in lignin composition. Increased fiber digestibility is also a common feature of these transgenic plants, but agronomic performance varies significantly by transgene. Basically, lignin is reduced by approximately 25% and NDF digestibility increased by 10-12% when compared to conventional alfalfa. Based on multiple lab and field studies initiated since 2000, transgenic plants with reduced expression of two key lignin enzymes, COMT and CCOMT, showed decreased lignin, increased fiber digestibility, and acceptable agronomic performance. Elite alfalfa populations containing the silenced transgenes have now been developed. Hay produced from these populations were used for both CAI sheep and dairy feeding studies designed to confirm improved animal performance of these reduced lignin alfalfa plants. Positive results from these feeding trials were found thereby moving this project into an accelerated development mode. Reduced lignin alfalfa will provide an important new biotech trait for hay producers, providing more flexibility in harvest management and increasing forage quality and/or forage yield. This type of high value hay should, in turn, be very desirable for dairies looking to increase milk production, yet decrease manure output.



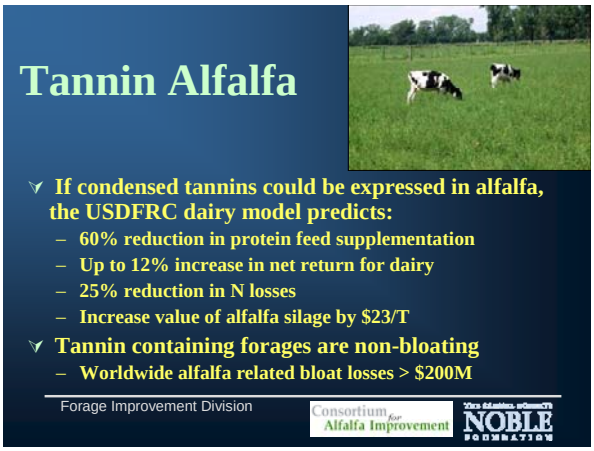


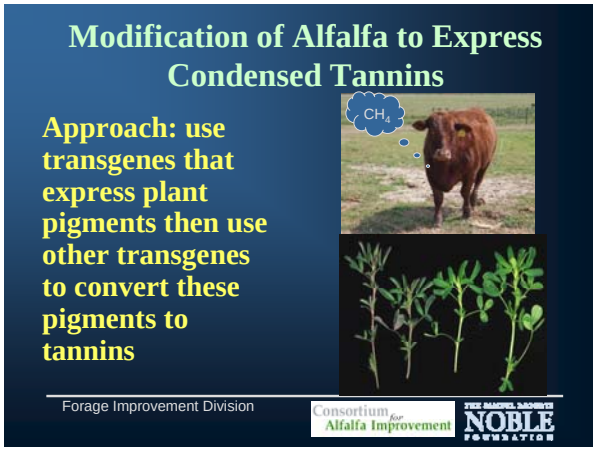


Increased Expression of Condensed Tannins

Proanthocyanidins (PAs, also known as condensed tannins), a class of flavonoid-derived polymers, reduce pasture boat and improve nitrogen nutrition for ruminant animals when present in forage, but are absent from the leaves and stems of alfalfa. It was found that when introducing PAs into tissues in which they do not naturally occur, it is first necessary to express the anthocyanin pathway responsible for plant pigments from which the precursors of PAs are derived. Additional genes then need to be introduced in order to provide the functions for PA monomer biosynthesis, transport and polymerization. This need to insert all the genes necessary to obtain functioning pathways demonstrates the complex nature of this work. It is also not known how introduction of the PA pathway to alfalfa foliage will affect agronomic performance. However, things are progressing well and some of the early stage experiments have

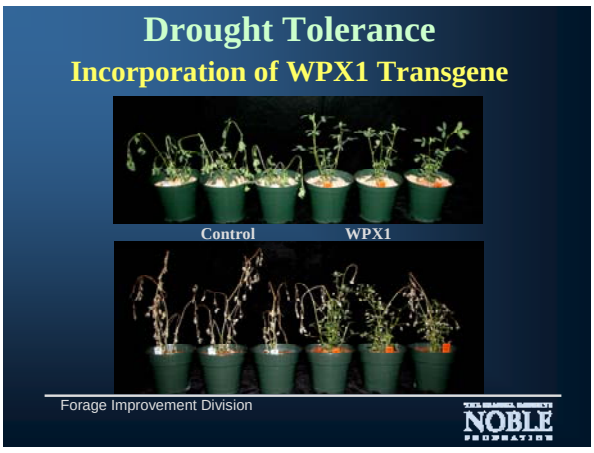
demonstrated successful deployment of the pathway and production of condensed tannins.

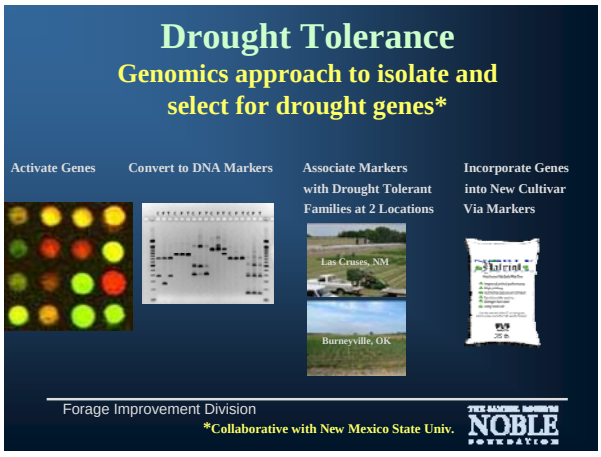




Water Use Efficiency and Drought Tolerance

A lot of alfalfa grown in the U.S. is produced under irrigation or under dryland conditions where water commonly limits productivity. Several research organizations are currently exploring and testing transgenes that increase drought tolerance and water use efficiency when expressed in crop plants. Gene candidates for drought tolerance are now being expressed in alfalfa. One of these is the WXP1 gene discovered by scientists at the Noble Foundation. This work is in its early stages, but has shown as a "proof of concept" that insertion of transgenes like WXP1 increases alfalfa's ability to be productive, or even recover more quickly, after periods of limited water.





In a related genomics project (e.g. genetic mapping with molecular markers), the Noble Foundation is collaborating with New Mexico State University to identify genetic mechanisms associated with drought tolerance within cultivated alfalfa itself. Markers

associated with drought tolerance genes would be identified and then used in selecting alfalfa genotypes for the production of new drought tolerant cultivars. This approach brings the power of genomics technologies to bear in the process without the regulatory and public perception problems associated with transgenics. Thus far, genes are being identified that control yield under conditions that are 50% of normal irrigation.

Biomass and Flowering

Although genes for increased biomass production or delayed flowering are of little interest for grain crops, they offer exciting potential for alfalfa. Several such genes have been identified in general phenotypic assays of new gene candidates and are now just beginning to be inserted into alfalfa. These new transgenes may offer the best opportunity to significantly increase overall forage yield in alfalfa.

Alfalfa's Role and the Biofuels Industry

The main criteria for any biofuels crop are high yields achieved with low input costs in an environmentally friendly manner. This is why switchgrass is targeted as one of the main dedicated energy crops for cellulosic ethanol production. The requirement of low cost of the delivered feedstock, possibly as low as $50-60 per ton, is the greatest hurdle for alfalfa growers to overcome. At this stage, therefore, it is simply better to sell alfalfa in the high value hay market.

However, alfalfa will have an important role for use in rotation or inter-cropping systems with corn or perennial grasses to off-set production and nitrogen costs of these mainly grass feedstock systems. For alfalfa to be used directly as a biofuel crop, it may also mean dividing the harvested product into components, such as leaves and stems, and using the leaves to produce high value meal and the stems for sale to a biorefinery. This use was very well described at the 2008 Kentucky Alfalfa Conference by Martin (2008). If co-products such as pharmaceuticals are simultaneously extracted from the leaf material, this allows the economics of using alfalfa as a biofuel crop to work even better.

From the CAI lignin project mentioned above, it was also demonstrated that lines containing the lignin down-regulated trait showed a two-fold improvement in enzymatic hydrolysis efficiency. This efficiency could therefore eliminate the requirement for costly chemical pretreatment for sugar production. More ethanol should then be able to be produced per ton of this low lignin alfalfa thereby making it a very efficient biofuel feedstock. This efficiency, in turn, would allow the biorefineries to pay substantially more for the delivered feedstock due to high the alcohol yield per ton along with the concurrent need to store lesser amounts of the feedstock at the biorefinery.

Summary

Biotechnology research in alfalfa, especially to study and/or incorporate complex traits, is in a time of increased emphasis and success throughout the world. The Roundup Ready® gene was the first biotech trait to be successfully commercialized in alfalfa, but new biotech traits continue to be investigated and incorporated. These traits are generally ones that breeders have made little progress for improvement through conventional means. Another aspect is the high impact potential of these new traits to alfalfa growers. Although there are many traits being investigated throughout the world, initial research is concentrating on the following: improving protein utilization and cell wall digestibility via lignin reduction, decreasing bloat and bypass protein problems via insertion of genes to express condensed tannins, and insertion of genes to control water use efficiency and flowering or those to increase biomass production. Consortia of various partners like those described for the Consortium to Improve Alfalfa are also important to bring new biotech traits into alfalfa. Finally, the impact of biotech traits such as reduced lignin, have the potential to increase alfalfa's value as a feedstock for ethanol production, which in turn should increase its value to the evolving biofuels industry.

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GROWING ALFALFA FOR WILDLIFE

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Alfalfa has long been recognized as a superb forage crop, which is why it is widely grown for dairy cattle, horses, sheep, and many other types of domesticated forage-consuming animals. Reasons for its popularity include wide adaptation, excellent nutritive value, good yield potential, perennial growth habit, a long growing season, and the fact that (in association with *Rhizobium* bacteria) it is a nitrogen-fixing legume that does not require periodic applications of nitrogen fertilizer.

Although alfalfa is widely grown for livestock, most people do not think of it as a wildlife-enhancing crop, and especially not as a crop to be planted specifically for wildlife. This is despite the fact that many of the same attributes that make it popular as a crop grown for domestic animals are also valuable in wildlife settings. However, there are reasons to believe that attitudes regarding alfalfa's potential as a wildlife crop are changing.

Wildlife Enhancement As A Fringe Benefit

Evidence of alfalfa's potential for wildlife purposes is that wild animals have always recognized it as a great crop; they feel free to visit alfalfa fields, consume alfalfa forage, or otherwise use it anytime it is planted within the geographical area in which they live. In fact, some animals even alter their range in order to access it more easily or more frequently! There is hardly any alfalfa producer who has not had the experience of seeing deer, birds, or other wild animals in their alfalfa field(s).

Yet, the extent to which alfalfa is used by wildlife is almost certainly underestimated by most producers. After all, wild animals are shy and secretive, and generally prefer to avoid being in close proximity to humans. Many are primarily or exclusively nocturnal, and thus are active only at times when humans are not usually present. In addition, there may be a considerable amount of unobserved underground biological activity in an alfalfa field including by mice, voles, ground squirrels, and other creatures.

In the Sacramento Valley in California, wildlife biologists did extensive studies of alfalfa fields to determine the extent of wildlife activity. They found that of 643 resident and migratory amphibians, birds, mammals, and reptiles known to occur in that area, 162 species (about 25%) were regularly using alfalfa fields to some extent, and about 10% percent were using alfalfa fields extensively.

In recent years agriculture has been criticized by some environmentalists who believe that virtually everything associated with food production has negative environmental consequences. In reality that is not the case. In many settings, especially in areas in which cities are encroaching on agricultural land, alfalfa makes an important contribution to wildlife and to the environment.

The point is that an alfalfa field is much more biologically diverse than it may appear, and actually offers a great deal to many wildlife species, including to game animals and game birds. Thus, anyone who grows alfalfa is, to some extent at least, enhancing wildlife, and thus might consider this to be a fringe benefit of growing the crop.

Growing Alfalfa Primarily For Wildlife

There are several reasons why alfalfa is not commonly considered a wildlife crop. First, while many farmers are wildlife enthusiasts, the majority of wildlife enthusiasts are not farmers. Thus, they often have limited experience with forage crops, and many don't fully understand the benefits the crop offers. In addition, some may be a bit intimidated by the relatively precise planting requirements and management concerns associated with alfalfa, or may simply be unwilling to learn about and exercise such management.

Wildlife management has evolved greatly in recent years. Twenty-five or thirty years ago it was not particularly common practice to make plantings of any type strictly for wildlife. When such plantings were made, in most cases they mostly consisted of cool season annuals (often small grain and/or other winter annuals) that, once established, required little management. In many cases the main, and often the only, objective for making such plantings was to attract game animals during hunting season in order to increase the likelihood of hunting success.

Things have changed. These days many wildlife managers are quite sophisticated in their management approaches. An increasing number are thinking about the long-term implications of management practices, including the importance of striving to provide optimum nutrition throughout the year. There is more awareness that nutrition can improve the health of wild animals, increase their size and weight, as well as increase wildlife populations by enhancing reproductive rates. Furthermore, while most plantings for wildlife are still made by hunters (or by people who are hired by hunters), there is also increasing interest in non-game wildlife by non-hunters as well as by hunters.

There have also been developments within the alfalfa industry that have facilitated the use of alfalfa in wildlife management. For example, advances in disease resistance, seed coating technology, and weed control have value in plantings of alfalfa made for wildlife enhancement just as they do in fields planted to produce forage for

livestock. In particular, the introduction of grazing-tolerant varieties has greatly increased the feasibility of planting alfalfa in areas in which wildlife populations (mainly deer or other large mammals) are so high that excessive defoliation is a threat to long-term stand persistence.

Why Consider Planting Alfalfa For Wildlife?

The answer to this question was touched upon in the introductory paragraphs of this paper, but a more detailed explanation should be helpful. There are numerous wildlife species, of course, and alfalfa offers different benefits to different wild animals. Because alfalfa as a wildlife crop is planted mainly by hunting enthusiasts, the emphasis in this discussion will be on benefits to game animals or to hunting enthusiasts. As viewed from the perspective of a wildlife manager, the benefits alfalfa offers can be put into a few main categories.

* Perenniation- As is the case with most farmers, wildlife enthusiasts like to use perennials whenever possible. The expense, the establishment risk, and especially the time and effort, involved in regularly planting annuals is something they would like to avoid.

* Nitrogen Fixation- Wildlife managers also like the fact that legumes such as alfalfa can symbiotically fix nitrogen when in association with *Rhizobium* bacteria. However, in the case of wildlife enthusiasts, appreciation of this unique trait of legumes is not so much due to avoidance of the expense of applying nitrogen, which is often an important incentive for of many livestock or hay producers. Rather, wildlife managers are especially likely to appreciate the fact that use of legumes means that application of nitrogen is one less management practice to be remembered and accomplished.

* Forage Quality- The nutritional benefits alfalfa provides to livestock are likewise of benefit to wild animals that consume the forage. In the case of deer, which is the wildlife species for which alfalfa is most commonly planted in the eastern United States, the nutritional attributes of alfalfa are of special interest. Not only is alfalfa forage highly digestible with a high protein content, it also contains high levels of calcium and phosphorus, which are important in antler development (this is a major selling point to deer hunters). In addition, having alfalfa available during summer helps ensure adequate milk production by does, increases the likelihood of rebreeding, and helps increase deer body weights prior to the onset of winter.

* Insect Attractant- Alfalfa is an excellent insectory. In a study done near Ithaca, New York, entomologists identified 591 insect species in a single field. For many species of birds, including game birds such as quail and wild turkey, availability of a good supply of insects is quite important, especially

when the birds are young. Alfalfa provides birds with high quality green leaf material as well as insects.

* Long Period Of Forage Availability – Bridging nutritional gaps is of critical importance in wildlife management, and it is difficult to find a crop that rivals alfalfa with regard to the ability to provide high quality forage over a long period of time. For example, in the Upper South alfalfa can provide forage for wildlife for 6 or 7 months in most years, and in the Deep South, alfalfa varieties that are in fall dormancy categories 7 or higher come close to being a year-around source of forage. In view of the fact that most wildlife species prefer a varied diet, having alfalfa available for wildlife over a long period of time is a major advantage. It is also important that alfalfa is a source of high quality forage during drought periods when other forage crops are unproductive.

* Potential To Attract Or Hold Wildlife- Some species of animals range over large areas. Because of its attractiveness to wildlife, alfalfa can be used as a tool to help keep wild animals in an area where they are desired. To a degree, it can even be used as a tool to encourage them to stay away from areas where they are **not** wanted. For example, a planting of alfalfa on a side of a large farm or ranch that is a long way from a paved road can decrease the likelihood of collisions of deer with motor vehicles.

* Cover- Although many other plants provide cover for wildlife as well or better than alfalfa, this is another benefit to wildlife that can be mentioned. Alfalfa can be especially attractive to small animals such as rabbits, and for young game birds including quail or wild turkeys that simultaneously need cover as well as a high level of nutrition.

Unique Aspects Of Growing Alfalfa For Wildlife

Site selection is always important in alfalfa production, but location of a suitable site for a wildlife planting deserves special mention. Plantings made specifically for wildlife are often located in remote areas, so ease of access with planting and fertilizer application equipment is a consideration. Though locating plantings close to trees or other heavy cover may provide advantages to wildlife, alfalfa will not be productive in shady areas or in close proximity to tree roots.

Also, wildlife plantings are often made in areas that have not been in regular agricultural production, and thus may need more attention than is the case with most sites where alfalfa is planted on farms. Thus, the desirability of planning ahead and starting early to get a field in proper condition (taking soil tests, applying lime, eliminating roots or undesirable species, etc.) is especially important.

Most of the agronomic considerations associated with establishing alfalfa for wildlife are the same as for growing the crop for livestock. For example, it must be planted on a suitable soil type and a well-drained site. In addition, lime will usually need to be applied several months before planting to raise the soil pH to a suitable level, any needed fertilizer nutrients should be applied in accordance with a soil test, the seed should be inoculated, planting needs to be done with precision, etc.

Although a wildlife enthusiast generally will be pleased with a beautiful, thick stand, alfalfa stand density is actually not as important in wildlife plantings (especially in older stands) as is the case when plantings are made for livestock or for hay production. Although mowing to reduce shading or making a herbicide application may sometimes be desirable, as long as grasses or volunteer forbs are not offering excessive competition, in many cases it is not particularly harmful to have some volunteer plants growing along with alfalfa in a wildlife situation.

Assuming that alfalfa has been planted on a suitable site, a good stand obtained, and that pH and nutrient needs of the crop are met, the life of a stand planted for wildlife can be as long, and may actually exceed, that of a planting made for livestock. In many wildlife plantings there is less defoliation stress than occurs when alfalfa is used for hay or pasture. Also, with a planting made for wildlife there is usually less need to immediately replant another forage when alfalfa stands thin. A low percentage of alfalfa in a mixture with volunteer species may make a perfectly acceptable wildlife food plot.

Final Thoughts

While alfalfa clearly has many attributes as a wildlife plant, it is not right for every wildlife situation, just as it is not right for every livestock farm. Many soils and sites are not suitable for growing alfalfa, and various people have different goals, attitudes, and resources. Alfalfa should be viewed as a tool that is available to a wildlife manager that can be used when an appropriate situation arises. Furthermore, most wildlife species prefer a diversity of foods in their diet. Thus, even in situations in which it is clear that alfalfa can be used to advantage for wildlife purposes, it usually should be only one of a number of species planted for wild animals on a given piece of property.

However, interest in alfalfa as a wildlife crop has increased greatly in recent years. Foremost among the reasons why this has happened are: (1) greater interest among wildlife managers in providing year-around nutrition for wild animals; and (2) the availability of grazing tolerant varieties. Many wildlife managers have already proven that alfalfa can play an important role in wildlife enhancement, and it appears likely that the trend toward greater use of alfalfa for wildlife purposes will continue for the foreseeable future.

How we Produce & Market Alfalfa Hay

Clayton Geralds
Geralds Farms
Hart County, KY

In association with my son Christopher, we run a commercial hay farm in Hart County near Munfordville, Kentucky. Our total farm size is 560 acres, 300 of which are leased. The focus of our operation is producing small square bales for the horse market. We currently grow a range of forage species including 400 acres of alfalfa and alfalfa/orchardgrass and 150 acres of timothy, orchardgrass, and teff. On average we put up 70,000 small square bales a year. In this presentation I will discuss equipment requirements for establishing, maintaining, and harvesting top quality horse hay. In addition, I will provide an overview of our expectations for yield and quality of the product as well as proper input and storage requirements.