

PROCEEDINGS

2011 Idaho Alfalfa and Forage Conference

Best Western Burley Inn, Burley, Idaho
22-23 February, 2011



**IDAHO HAY AND FORAGE
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Kimberly Research & Extension Center

3806 N 3600 E

Kimberly, ID 83341

208.423-6678

gshew@uidaho.edu

**Welcome
to the
2011 Idaho Hay & Forage Conference
Burley, Idaho, 22-23 February 2011**

On behalf of the planning committee, we welcome you to this gathering of the state's leaders in alfalfa and forage production. This conference will start with an emphasis on alfalfa and forage crop management and conclude on the second day discussing corn and other forages. Our objectives are to: 1) extend research information; 2) provide continuing education on forage irrigation, export markets; forage pests, weeds, and diseases; new markets and genetics, organic forage production, and corn grasses, and silage issues; 3) learn from producers and consumers about effective ways of producing and using forages; 4) give an opportunity to the forage-related industries to provide information about equipment, products, and services they can provide; and 5) provide opportunity for the Idaho Hay & Forage Association to inform everyone about regulatory, political, and business issues affecting agriculture.

We express our appreciation to the speakers who provide this excellent program and proceedings. These people have generously taken the time to share their knowledge with you. We are also thankful to the many sponsors and exhibitors of the conference. Their contributions have made it possible to keep registration fees low and provide a quality program!

This is truly a cooperative effort between the Idaho Hay & Forage Association and the University of Idaho Extension System.

Welcome to the 2011 Idaho Alfalfa and Forage Conference!

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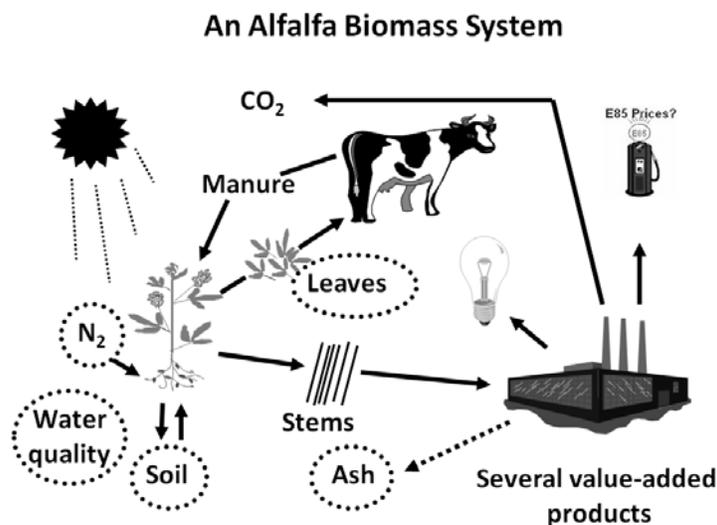
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ALFALFA – A SUSTAINABLE CROP FOR BIOMASS ENERGY PRODUCTION

JoAnn F. S. Lamb ¹

ABSTRACT

Alfalfa (*Medicago sativa*) has the potential to be a significant contributor to America's renewable energy future. In an alfalfa biomass energy production system, alfalfa forage would be separated into stem and leave fractions. The stems would be processed to produce energy, and the leaves would be sold to provide additional income as a livestock feed and/or a source of value-added products. Other value-added components unique to an alfalfa biomass energy production system include a fertilizer N replacement value (for subsequent crops in rotation), increased soil N and C concentrations, and improved ground water quality. Both biochemical [saccharification and fermentation to liquid fuel (ethanol)] and thermochemical (combustion or gasification) conversion technologies can be used to produce energy or electricity from alfalfa stem biomass. Alfalfa stem cell wall sugar yields and lignin concentration impact the efficiency of energy conversion depending on the technology used (Lamb et al., 2007; Boating et al., 2008). Cell wall lignin concentration impacted the efficiency of biochemical conversion but showed little to no impact on thermochemical conversion. Choice of energy product, dry matter yield, management practices and real world evaluation methods will impact selection methods and breeding goals when modifying alfalfa stems for biomass energy production. What's next?



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¹ J.F.S. Lamb, USDA-ARS Plant Science Research Unit, 411 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN. Published In: Proceedings, Idaho Hay and Forage Conference 22-23, February 2011, Burley ID, University of Idaho Extension.

Feed Cost Comparisons: Back of the Envelope Techniques

Gina Greenway¹ and C. Wilson Gray²

ABSTRACT

How do various feedstuffs compare on a dollar per nutrient basis, and which feeds are the best buys? A simple method is to divide the cost by the percent of nutrient. For example to compare products on a (per unit) of protein basis divide the cost (per unit) by the percent protein to derive the cost (per unit) of protein. For each hay grade we evaluate the cost per unit (ton) of protein and cost per unit (ton) of TDN using the lower bounds figure for each grade at 90% DM. For TDN, Supreme was estimated using a TDN percentage of 55.9% while, premium was estimated at 54.5%, Good at 52.5%, and Fair at 50.5%, prices of alfalfa hay were evaluated on a per ton basis for Idaho in years 1997 through 2008. An index was developed based on the relative feed value and Premium hay value. Using data from USDA (NASS) we then evaluate the cost per unit of both TDN and Crude Protein for other popular feedstuffs. The dairy industry as a major consumer of forages is changing from one where dairies grow their feed to an industry that purchases most of their feed requirements.

Keywords: Alfalfa, relative feed value, cost per unit, protein, total digestible nutrients, CP, TDN

INTRODUCTION

The question arises often as to which grade of hay is a “better buy” or how does the price for hay compare to other nutrient sources. This study looks at a relative cost comparison on two factors, total digestible nutrients (TDN) and crude protein (CP). To accomplish this, a comparison based on relative feed value (RFV) and relative to the price of Premium hay is developed (Table 1). Using the methodology developed, hay growers and buyers can assess relative values of feed and compare per unit cost for protein and nutrient value. As the study shows these values have fluctuated on a year-to-year basis, with the relative prices for CP or TDN changing over time.

METHODS

Evaluate whether hay consumers over- or under-paid for hay based on RFV and relative to the price of Premium hay.

Step 1. Develop an RFV index to express the amount of RFV of each hay grade relative to a base hay grade. We used premium quality hay as the base.

Divide RFV of each grade of hay by the RFV of the Base Hay (Premium) to develop the RFV Index to express the RFV relative to the base. (Table 5)

Examples

Supreme RFV is 185 and the Premium RFV is 170. Therefore, $((185/170) * 100)$ gives a “RFV Ratio” of Supreme-to-Premium of 108. The RFV Ratio of Premium-to-Premium is $((170/170) * 100)$ or 100.

¹ Gina Greenway is a Graduate Student in the Agricultural Economics and Rural Sociology Department, UI;

² C. Wilson Gray, District Extension Economist, Twin Falls R&E Center, University of Idaho. Published In: Proceedings, Idaho Hay and Forage Conference 22-23 February 2011, Burley, ID, University of Idaho Extension.

Likewise, Good-to-Premium would be $((150/170)*100)$ or 88 and Fair-to-Premium is $((130/170)*100)$ or 76.5.

Step 2. Once the index is developed for each quality we evaluate the price relative to the RFV index by dividing price by the RFV index value associated with that price. This places the price of all hay qualities on the same basis as Premium hay for an easy comparison of hay price on a relative basis.

Examples

A Supreme hay price of \$93.71 per ton in 1999, divided by an RFV Index of Supreme Quality Hay (108) gives $((93.71/108)*100) = \$86.77$ which can be compared directly to the 1999 Premium hay price of \$79.71. Given that Good quality hay averaged \$66.83 per ton in 1999, a Premium equivalent price would be $((66.83/88)*100)$ or \$75.94. Therefore, given the RFV of each quality and hay, producers underpaid for Supreme quality hay by \$7.06 per ton and overpaid for Good and Fair quality hay.

RESULTS

Both the price of hay and the number of acres harvested have remained fairly stable over the last 20 years in Idaho. Total acres harvested have fluctuated between 900 thousand and 1.2 million acres over the time period considered. Price had remained quite stable in the 80 to 100 dollar per ton range until 2007 when the price of alfalfa hay began to skyrocket (Table 2). By 2008 the price of hay in Idaho had peaked in excess of 200 dollars per ton and by 2009 hay prices had once again come into check at values of 115 dollars per ton. There is a significant price incentive for producers to achieve Premium Quality over Good Quality hay. From 1997 to 2008, the average Price differential between premium quality hay and good quality was \$17.88 per ton, with the minimum price differential consistently exceeding \$10 per ton (Figure 2). By meeting Premium Quality Standards producers can ensure a healthy return for management effort.

On average for years 1997 through 2008 (with available data) Premium Quality hay earned \$114 per ton, while Supreme earned \$111 per ton. This may suggest that producers consider focusing their efforts on achieving a crop that meets Premium Quality Standards. The years and data in this study illustrate that Supreme hay quality may not yield great enough returns to outweigh the managerial efforts and additional inputs required to produce it. Average price differential from 1997 to 2008 between Supreme quality hay and premium was just \$2.82 per ton.

To better understand the direction of future hay and milk prices and the relationship between the two, the Western States Mailbox Milk price is graphed (Figure 1) together with the average premium hay price of three western states (CA, OR, ID). The price of milk is then forecasted through 2012 using Holt-Winters triple exponential smoothing³. This method reveals that milk prices are predicted to hover in the 12 to 15 dollar per CWT. range. Using the past behavior of hay prices following milk price trends as an indicator, it can then be shown that as milk prices fall from record highs hay prices will decrease.

To compare regional differences among prices we charted each grade of hay and compared price differentials. We see that for Premium Quality Hay in the years 1997 through 2008 California Hay was earning on average 25 dollars more per ton than the same quality hay in Idaho. Prices in Washington were 13 dollars higher than in Idaho, on average. For supreme quality hay, again Washington and California prices on average exceed the price received in Idaho by nearly 40 dollars per ton. The average for good hay quality in California exceeded the price of good quality hay in Idaho by 26 dollars, while the price of hay in Washington exceeded the Idaho hay price by 13 dollars on average. Fair Quality hay prices remained quite close between Idaho and Washington with an average of just over 6 dollars in price differential. However, California prices exceeded Idaho prices by 20 dollars on average.

Feed barley, grain corn and soybean meal were also compared. In general barley and corn are less costly for TDN but more expensive for CP. Soybean meal is also less costly for TDN and less expensive

³ Holt-Winters is a technique used to obtain short run reliable forecasts in data that exhibits both trends and seasonality.

or comparatively priced for CP (Tables 3, 4). These relationships change year-to-year due to the relative prices for each commodity.

The number of hay producers in Idaho has increased as the dairy industry has grown over the years. In 1997, there were 3,669 hay producers farming 405,227 acres with 546 of those farmers classified as dairy farmers farming 69,472 acres of hay. In 2002 there were 4,087 hay producers having production on 485,111 acres, with 435 of them being dairy farmers raising hay on 78,579 acres. The acre trend continued in 2007, with 4,195 hay producers on 523,930 acres and 357 dairy farmers raising hay on 86,081 acres (NASS). These statistics are for all hay raised. The number of dairy farms that raise their own hay is decreasing, which follows the decrease in the number of dairy farms in the state. As the number of acres per dairy farmer increases along with the total number of acres of hay production, the total number of dairy farms decreases. The trend shows that that majority of hay consumed on dairies is purchased from outside suppliers.

CONCLUSIONS

1. When choosing among feed alternatives take a few minutes to do a rough calculation to determine costs on a dollar per nutrient basis. This can save a costly mistake especially with regard to increasingly popular alternative feeds that may seem like a good deal on the surface. A quick investigation can yield much better decision making criteria.
2. There is a significant price incentive for producers to achieve Premium Quality over Good Quality hay. By meeting Premium Quality Standards producers can ensure a healthy return for management effort.
3. The number of dairy farms that raise their own hay is decreasing. The trend shows that that majority of hay consumed on dairies is purchased from outside suppliers, indicating stable demand for high quality forage.

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http://oregonfeed.org/mehren_art_1206.htm

http://oregonfeed.org/mehren_art_0909.htm

USDA Quality Guidelines for Alfalfa Hay

<http://extension.oregonstate.edu/catalog/html/sr/sr1056-e/7table2.pdf>

USDA NASS

<http://www.nass.usda.gov/>

APPENDIX

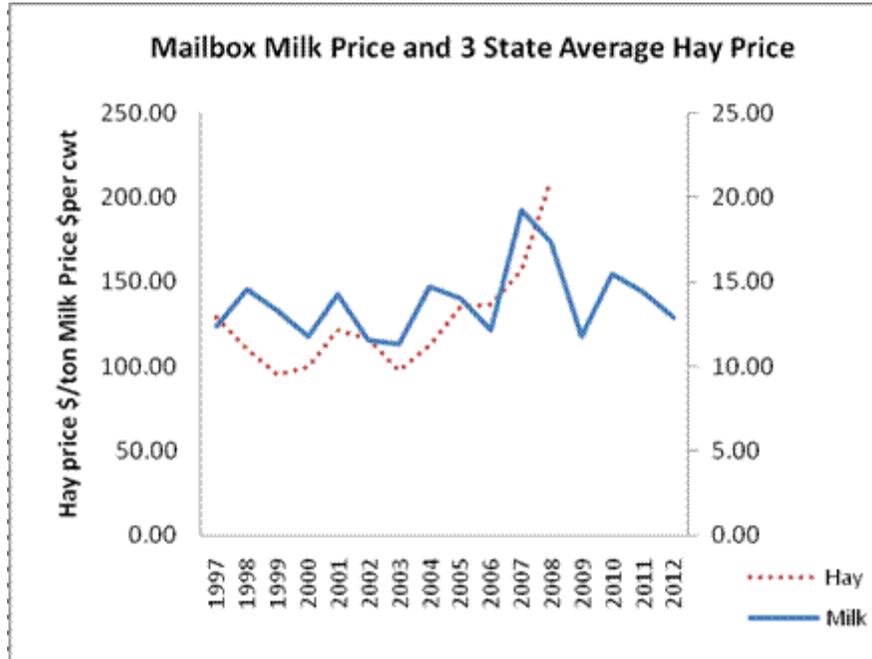


Figure 1

Table 1 Alfalfa guidelines (for domestic livestock use and not more than 10% grass)

Quality	ADF	NDF	*RFV	**TDN-100%	**TDN-90%	CP
Supreme	Under 27	Under 34	Over 185	Over 62	Over 55.9	Over 22
Premium	27-29	34-36	170-185	60.5-62	54.5-55.9	20-22
Good	29-32	36-40	150-170	58-60	52.5-54.5	18-20
Fair	32-35	40-44	130-150	56-58	50.5-52.5	16-18
Utility	Over 35	Over 44	Under 130	Under 56	Under 50.5	Under 16

Table 2 Idaho Alfalfa Hay Prices By Grade 1997-2008

Idaho	Supreme	Premium	Good	Fair
1997		\$111.83	\$98.21	\$83.16
1998		\$95.56	\$80.81	\$65.16
1999		\$93.71	\$79.41	\$59.68
2000		\$90.72	\$90.47	\$72.35
2001		\$127.96	\$114.37	\$96.65
2002		\$107.97	\$110.57	\$87.11
2003		\$89.40	\$82.92	\$72.11
2004		\$103.85		\$84.50
2005		\$116.75	\$116.11	\$103.38
2006		\$140.00		\$110.40
2007		\$130.00	\$142.88	\$125.00
2008			\$196.18	\$152.00
Average Price		\$111.15	\$114.03	\$96.47
High Price		\$140.00	\$196.18	\$152.00
Low Price		\$89.40	\$79.41	\$59.68

Table 3

Comparitive Feedstuffs on a Price Per CP Basis							
Year	Supreme (Hay)	Premium (Hay)	Good (Hay)	Fair (Hay)	Barley	Corn	SB Meal
1997		559.15	545.61	519.75		885.57	
1998		477.80	448.94	407.25	647.10	707.00	
1999	425.95	397.05	371.28	373.00	0.00	663.27	336.19
2000	412.36	452.35	447.83	452.19	536.62	674.20	347.19
2001	581.64	571.85	536.94	562.25	542.93	717.93	335.45
2002	490.77	552.85	483.94	465.81	681.82	845.48	363.16
2003	406.36	414.60	400.61	386.31	722.85	881.92	512.83
2004	472.05	0.00	469.44	407.06	546.09	750.73	371.23
2005	530.68	580.55	574.33	436.19	590.28	728.86	348.20
2006	636.36	0.00	613.33	562.50	817.55	1107.87	410.92
2007	590.91	714.40	694.44	781.25	1373.11	1530.61	668.58
2008		980.90	844.44	906.25	1205.81	1479.59	662.33

Table 4

Comparitive Feedstuffs on a Price Per Ton/TDN Basis							
Year	(Supreme Hay)	(Premium Hay)	(Good Hay)	(FAIR Hay)	Feed Barley	Corn	Price SB Meal
1997		205.19	187.07	164.67		96.43	
1998		175.34	153.92	129.03	97.06	76.98	
1999	167.64	145.71	127.30	118.18	0.00	72.22	87.48
2000	162.29	166.00	153.54	143.27	80.49	73.41	82.07
2001	228.91	209.85	184.10	178.14	81.44	78.17	83.42
2002	193.15	202.88	165.92	147.58	102.27	92.06	88.83
2003	159.93	152.15	137.35	122.40	108.43	96.03	104.62
2004	185.78	0.00	160.95	128.97	81.91	81.75	109.13
2005	208.86	213.05	196.91	138.20	88.54	79.37	92.89
2006	250.45	0.00	210.29	178.22	122.63	120.63	90.19
2007	232.56	262.17	238.10	247.52	205.97	166.67	137.09
2008		359.96	289.52	287.13	180.87	161.11	189.39

Table 5

Idaho RFV To Price Index 1999-2008 (Relative to Premium RFV 170)									
1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
86.77	83.36	117.58	99.22	82.15		107.28		130.00	n/a
79.71	90.47	114.37	110.57	82.92	n/a	116.11	n/a	142.88	196.18
75.94	91.36	109.54	98.72	81.72		117.16		125.00	152.00
78.01	94.61	117.64	97.46	80.83		91.26		125.00	145.00

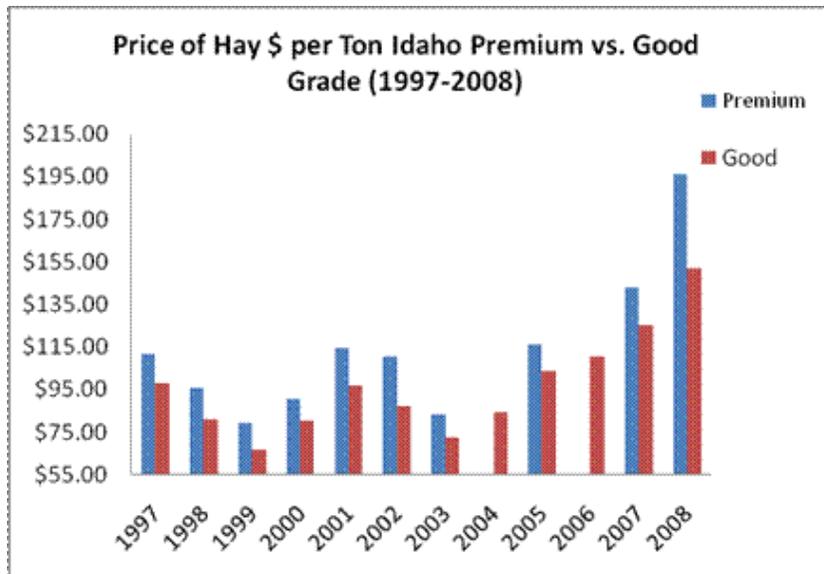


Figure 2

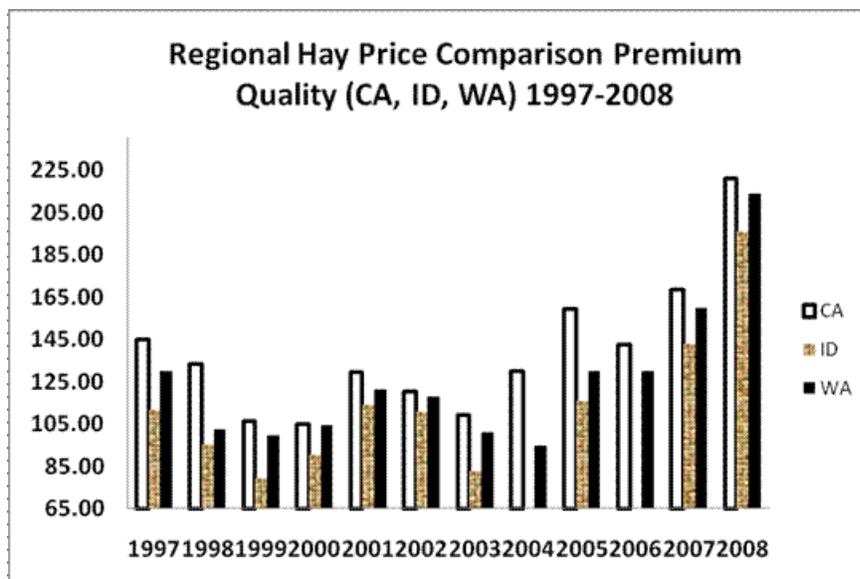


Figure 3

EXPORT DEMAND, NEW MARKETS, AND LONG TERM OUTLOOK

Gregory P. DeWitt, Nicholas J. Gombos, and Shaun S. Harris¹

Export Demand

Brief History of Hay Export

Exports of U.S. Alfalfa began in the 1970's with alfalfa hay cube shipments to Japan to meet growing milk consumption. As the Japanese dairy industry developed, so did the demand for long fiber forage products to increase health and production of Japanese herds. In the middle to late 1980's, there was a large increase in forage imports into Japan as well as developing markets in South Korea and Taiwan.

Forage exports to Asia have increased significantly over the past 30-plus years. Baled hay products including alfalfa, Timothy, Oat Hay, Sudangrass, and other grass hays and straw products have taken market share away from hay cubes. With the consumption of imported forage and roughage products continuing to grow in Japan, Korea, and Taiwan, the outlook for steady and increasing demand for U.S. grown products to these and other markets is positive.

Processing for Export

With most export processors, forage and roughage products are grown under contract and through partnerships with growers in the various hay-growing regions of the Western U.S. These hay and straw products are usually barn-stored, tarped, or delivered directly to export facilities for processing and packaging. Processing long fiber products usually involves “densifying” or double-compressing the product into full bales, half-cut bales, or big bales depending on customer preference. Products are then shipped in ocean-going containers to international markets.

Markets

- **Japan** is the largest market for U.S. forage and roughage products. According to Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics, Japan imported almost 6.3 million metric tons (MT) of alfalfa from January 2000 through November 2010 averaging nearly 570,000 MT per year over 10 years. Non-alfalfa forage and roughage products such as grass mix, Timothy Hay, Sudangrass, oat hay, and other grass hays and straws exceeded 11.8 million MT over the same period—well over 1 million MT per year—indicating Japan's sophisticated demands and mature feed market (Figure 1). Demand for hay in Japan has been steady over the 10 year period.

Partner	Product	UOM	2005	2006	2007	2008	2009	2010
Japan	OTHER HAY	MT	1,218,019	1,036,789	999,128	1,107,683	996,085	972,988
Japan	ALFALFA HAY	MT	614,367	559,523	490,106	558,538	686,148	540,444
Grand Total		MT	1,832,386	1,596,312	1,489,234	1,666,221	1,682,233	1,513,432
				-15%	-7%	11%	1%	-11%

Figure 1 Exports of alfalfa and other forage to Japan. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

¹ G. DeWitt, ACX Pacific Northwest, Inc., 4540 California Avenue, Suite 520, Bakersfield, CA 93309; N. Gombos, ACX Pacific Northwest, Inc., 920 E. Pacific Coast Highway, Wilmington, CA 90744; S. Harris, ACX Pacific Northwest, Inc. 5693 Vantage Highway, Ellensburg, WA 98926. Published In: Proceedings, Idaho Alfalfa and Forage Conference 22-23 February, Burley, ID, University of Idaho Extension.

- South Korea** is a large, mature market for U.S. hay products. Only in the last two years has another country exceeded South Korea's demand for hay which has grown by 5% over the last five years. Unlike other countries, South Korea imports hay on a quota system whereby products and quantities are regulated by the government to encourage domestic production. This market is slightly more volatile than other markets due to possible and severe currency fluctuations. Figure 2 shows volume of imports over 5 years. Figure 3 overlays the volume with the Korean currency.

Partner	Product	UOM	2005	2006	2007	2008	2009	2010
Korea, South	OTHER HAY	MT	315,092	328,589	398,779	376,421	352,233	406,058
Korea, South	ALFALFA HAY	MT	100,161	127,832	134,489	159,235	159,460	151,504
Grand Total		MT	415,253	456,421	533,268	535,656	511,693	557,562
				9%	14%	0%	-5%	8%

Figure 2 Exports of alfalfa and other forage to Korea. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

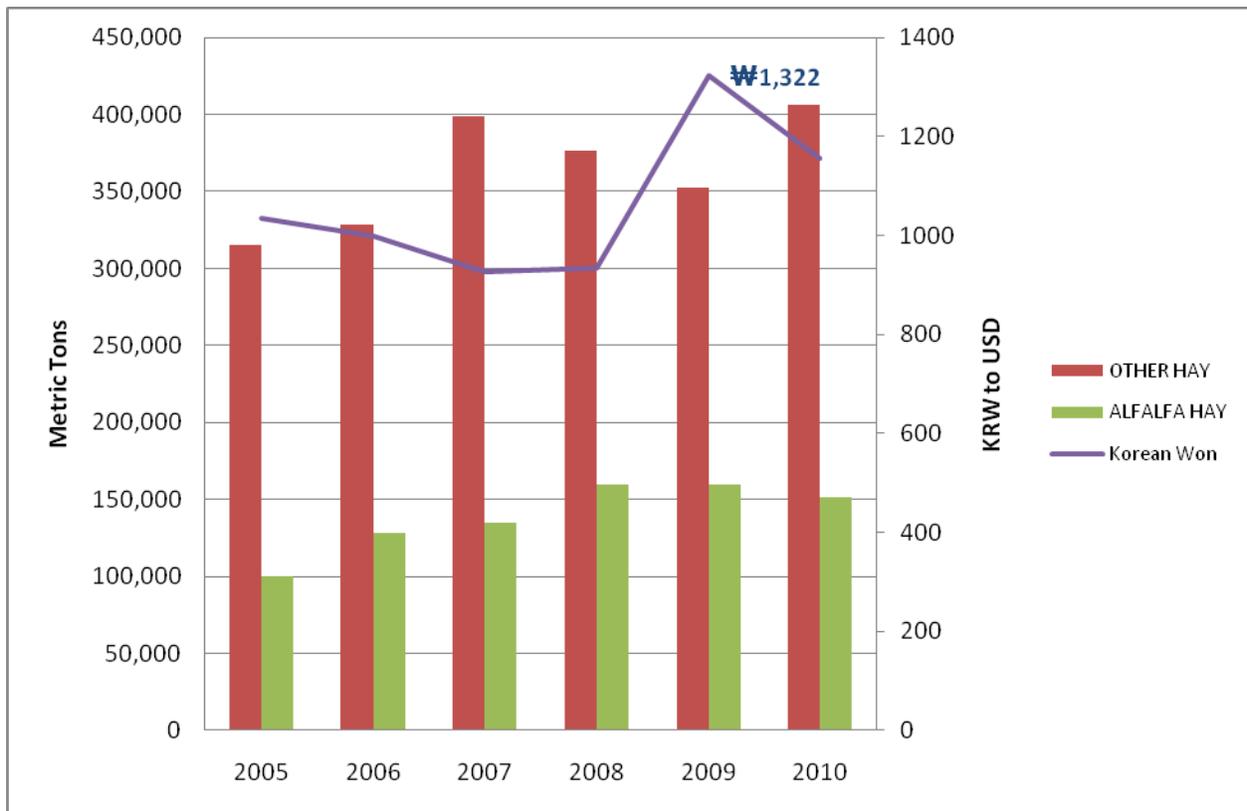


Figure 3 Exports of alfalfa and other forage compared to Korea Won value against U.S. Dollar. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

- **Taiwan** is the third most mature market which saw sudden gains in 2010 over previous years and an overall increase of 5% over the previous 5 years.

Partner	Product	UOM	2005	2006	2007	2008	2009	2010
Taiwan	ALFALFA HAY	MT	47,308	52,633	54,227	51,248	47,918	91,547
Taiwan	OTHER HAY	MT	57,883	59,169	62,750	58,371	68,052	47,804
Grand Total		MT	105,191	111,802	116,977	109,619	115,970	139,351
				6%	4%	-7%	5%	17%

Figure 4 Exports of alfalfa and other forage to Taiwan. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

- **The Combined Regions** totaled over 3 million metric tons of forage and roughage in 2010. The largest market is East Asia at over 2.4 million metric tons or more than 75% of the global demand. The Middle East is the second largest regional market at over 670,000 metric tons or 21% of the market. North American exports include shipments to Canada and Mexico at nearly 45,000 metric tons of product.

Partner	Product	2005	2006	2007	2008	2009	2010
East Asia	OTHER HAY	1,593,344	1,426,237	1,462,500	1,545,383	1,431,926	1,511,656
East Asia	ALFALFA HAY	763,157	741,495	681,847	788,661	970,389	925,001
Middle East	ALFALFA HAY	9,299	18,944	29,001	103,744	500,967	429,872
Middle East	OTHER HAY	27,221	22,031	13,635	29,089	186,130	242,820
North America	ALFALFA HAY	83,870	46,206	34,259	21,608	65,960	37,675
North America	OTHER HAY	10,671	5,631	5,221	5,862	12,488	7,493
Southeast Asia	OTHER HAY	690	946	1,213	1,923	2,590	11,938
Southeast Asia	ALFALFA HAY	1,138	1,061	1,990	2,545	3,136	7,202
European Union	OTHER HAY	5,016	2,885	1,630	2,947	3,118	3,562
European Union	ALFALFA HAY	864	495	440	537	319	264
Other Europe	ALFALFA HAY	0	0	0	0	3,785	2,196
Other Europe	OTHER HAY	0	0	0	0	665	170
Caribbean	ALFALFA HAY	634	312	588	1,101	1,208	1,052
Caribbean	OTHER HAY	567	1,122	646	713	1,391	1,051
South America	OTHER HAY	0	0	211	126	2,425	672
South America	ALFALFA HAY	0	0	0	0	698	0
South Asia	ALFALFA HAY	258	130	158	405	104	585
Oceania	ALFALFA HAY	0	0	71	176	170	163
Oceania	OTHER HAY	367	0	0	0	0	27
North Africa	OTHER HAY	0	0	64	183	140	100
Central America	ALFALFA HAY	0	124	151	106	151	19
Central America	OTHER HAY	88	0	15	0	0	0
Soviet Union	OTHER HAY	0	0	0	0	23	0
Grand Total		2,497,184	2,267,619	2,233,640	2,505,109	3,187,783	3,183,518
			-10%	-2%	11%	21%	0%

Figure 5 Exports of alfalfa and other forage to all regions. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

New Markets

- China** is a growing market which came on the scene within the last 5 years. Alfalfa hay is the primary export forage from the U.S. Unlike other hay products, alfalfa does not require a special import permit. The Chinese market has grown exponentially each year by as low as 40% to as high as 88% (Figure 6). According to this trend, China could easily require half a million tons of U.S. alfalfa in the next 1-2 years. Due to Chinese regulations, only exporters with a compliance agreement with the USDA are allowed to ship hay to China.

Partner	Product	UOM	2005	2006	2007	2008	2009	2010
China	ALFALFA HAY	MT	251	420	2,321	19,348	74,985	140,363
China	OTHER HAY	MT	0	0	79	0	12,482	81,227
Grand Total		MT	251	420	2,400	19,348	87,467	221,590
				40%	83%	88%	78%	61%

Figure 6 Exports of alfalfa and other forage to China. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

- The Middle East** is another emerging market region with interest in U.S. forage and roughage products. Most of the export demand stems from policy changes in the Middle East which affect water allocation for forage crops. The United Arab Emirates is the largest importer with approximately 95% share. However, in the last two years, interest has picked up in Jordan and Saudi Arabia.

Partner	Product	UOM	2005	2006	2007	2008	2009	2010
Bahrain	ALFALFA HAY	MT	0	0	0	0	0	272
Bahrain	OTHER HAY	MT	1,786	903	585	1,786	2,197	1,319
Israel	OTHER HAY	MT	0	0	0	0	813	278
Jordan	ALFALFA HAY	MT	0	0	0	0	1,227	5,685
Jordan	OTHER HAY	MT	0	0	0	23	1,027	2,740
Kuwait	ALFALFA HAY	MT	0	0	0	181	1,908	4,152
Kuwait	OTHER HAY	MT	0	0	0	0	1,273	432
Oman	ALFALFA HAY	MT	0	0	1,028	0	0	220
Oman	OTHER HAY	MT	44	33	0	0	0	0
Qatar	ALFALFA HAY	MT	0	310	27	14	1,071	2,040
Qatar	OTHER HAY	MT	25	98	73	689	956	1,872
Saudi Arabia	ALFALFA HAY	MT	0	0	0	130	1,329	3,324
Saudi Arabia	OTHER HAY	MT	0	0	0	470	345	4,601
United Arab Emirates	ALFALFA HAY	MT	9,299	18,621	27,946	103,419	495,432	414,179
United Arab Emirates	OTHER HAY	MT	25,366	20,988	12,977	26,121	179,519	231,578
Yemen	ALFALFA HAY	MT	0	13	0	0	0	0
Yemen	OTHER HAY	MT	0	9	0	0	0	0
Grand Total		MT	36,520	40,975	42,636	132,833	687,097	672,692
				11%	4%	68%	81%	-2%

Figure 7 Exports of alfalfa and other forage to Middle East. Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

Long Term Outlook

Despite the global economic down-turn of the recent past, exports of U.S. forage and roughage products have increased approximately 4% over the last 5 years. During that time, more than 13 million metric tons of alfalfa and other hay were exported, representing an average of 2.6 million metric tons per year and growing. The Japanese market is likely to remain stable and could experience some slight decreases as the Japanese population decreases. The South Korean market should remain even as long as the Korean Won is stable against the U.S. dollar. The Chinese market will continue to mature as their dairy sector recovers and milk and other dairy products becomes a regular staple for the emerging middle class. What remains to be seen is the affect of a higher value Chinese Yuan against the U.S. dollar which should spur demand even further. The Middle East market appears to be growing, apparently driven by decreased water resources and limited supply from other countries. Despite a positive long-term outlook, U.S. suppliers must work together to ensure a stable U.S. hay market to keep competing countries at bay.

VOLE MANAGEMENT

Danielle Gunn¹, Ronda Hirnyck, Glenn Shewmaker, Sherman Takatori, Lance Ellis

ABSTRACT

Vole populations in Southeastern Idaho have increased exponentially. Increased populations have significantly reduced yields in rangeland, alfalfa, pastures, and other agricultural crops. In addition to losses incurred by producers, homeowners experience vole damage in lawns, trees, shrubs, and gardens. Hypotheses for increased populations include a series of mild winters and wet springs in 2009 and 2010 that produced an abundance of forage. High acreages of CRP lands and public grazing issues are also contributing factors. If these conditions do not change, populations will continue to increase. Therefore, knowledge of voles and implementation of prevention and control measures has become necessary to decrease damage to crops, lawns, and gardens.

Keywords: Voles, rodents, crop yield reduction, baiting, rodenticides, habitat modification

INTRODUCTION

Voles cause significant damage to rangeland, alfalfa, pastures, and other agricultural crops. They also cause significant damage in orchards, nurseries, turf farms, ornamental flower plantings, landscapes, lawns, and vegetable gardens. Voles have remarkable reproductive capacity, which further amplifies problems associated with these rodents. Population surges can occur frequently when adequate forage and habitat are readily available. Forage losses from voles have been estimated at 10 to 50 percent (Colorado State University, 2006) in pastures and alfalfa. Voles can also damage and kill trees and ornamental shrubs. Damage to plants is caused by eating roots, bark on tree trunks, stems, tubers, and leaves.

Voles are non-game mammals in Idaho and can be legally managed on private property and public lands. Management options depend on the pest, endangered species considerations, the situation, cost limitations, and equipment and labor availability. Since voles can cause extensive damage and substantial economic losses, it is important to understand their biology and habits before implementing management strategies.

Vole Biology

Several species of voles exist in Idaho, and it can be difficult to distinguish among them. The meadow vole or meadow mouse, (*Microtus pennsylvanicus*), is the most common species found in pastures, rangelands, crops, and lawns in Idaho. Meadow voles are heavy-bodied, small rodents with short legs and tails, small rounded ears, and coarse blackish to grayish brown fur with black-tipped hairs and bi-colored tails. Voles generally average 4 ½ to 5 ½ inches long, including the tail, when full grown. Under good weather and feeding conditions, voles can reach up to 7⁵/₈ inches in length.

¹ D. Gunn, Univ. of Idaho, Fort Hall Extension Office, P.O. Box 306, Fort Hall, ID 83203, 208-236-1046, dgunn@uidaho.edu. R. Hirnyck, Univ. of Idaho, G. Shewmaker, Univ. of Idaho, S. Takatori, Idaho State Department of Agriculture, L. Ellis, Univ. of Idaho. Presented at the Idaho Hay and Forage Conference 22-23 February 2011.

Voles can reproduce year-round with a peak breeding period in the spring followed by a second, smaller breeding period in the fall. Females can reach reproductive maturity in 35 to 40 days. They average one to five litters per year with three to six young per litter. Gestation length is approximately 21 days.

Vole populations are cyclic and can fluctuate dramatically from year to year. During most years, voles are not a significant problem and the populations are partially controlled by predators such as snakes, coyotes, foxes, hawks, owls, dogs, and domestic cats.

If habitat is abundant and provides adequate protection from predators, high protein food sources exist, and weather conditions are ideal, vole populations can quickly reach damaging levels. Minor peak populations occur approximately every four to six years, and epidemic populations occur about every 10 to 12 years. However, these cycles are not necessarily regular. Population explosions may last a year or more before the population crashes. These events can result in infestations of 400 voles or more to the acre, resulting in significant potential for economic and aesthetic losses.

Vole Behavior

Most damage caused by voles is the result of their feeding activity. Voles can weigh 3 to 4 ½ oz. and can eat nearly their own body weight daily. Voles damage crops by feeding on roots and stems, grass, seeds and underground reproductive structures such as bulbs and tubers. They damage and kill trees and shrubs by girdling and removing the bark from the trunk or stems near the base. Damage to trees and shrubs normally occurs in the winter when voles are foraging under snow cover. Voles have a home range of approximately ¼ acre or more.

Voles are active all year, especially in the spring and fall. They are most active at night, but can also be seen during the day.

Voles are normally found in areas of dense ground cover. Vegetation greater than six inches in height, snow cover, brush piles, leaves, and low-hanging tree limbs all provide excellent habitat protection from predators. Rangeland, alfalfa, grass hayfields, pasture, orchards, home lawns, and gardens provide ideal habitat and food sources for these pests.

Voles do not like crossing bare ground and prefer cover when feeding. Feeding activity can easily be recognized by the presence of shallow tunnels and runways in vegetation and by underground nests of grass, stems, and leaves. Runways are approximately one to two inches wide with an entrance hole leading underground. Frequently used runways may have grass and other nearby vegetation clipped very close to the ground. Feces and small pieces of clipped vegetation are usually found in runways. Voles seldom stray from their usual travel routes.

Very few references exist as to the extent of the cost of vole damage in field crops, lawns, and nursery stocks due to the cyclic nature of their populations and the potential for explosive population epidemics. Economic losses can be severe but are often not quantified.

METHODS

Several methods exist to control voles. Data regarding voles and control methods was collected from existing literature and field observations. Information was also collected on vole biology, management techniques including habitat modification, trapping, baits, baiting, and predators from other sources.

Vole Management

Areas subject to vole invasion should be routinely monitored for signs of feeding activity from early spring until late fall. If possible, monitor for signs in the winter. Vole signs can be identified year-round. Runways, feces, clipped forage, gnawed stems, bark, and roots, and tunnels are all signs of possible vole activity.

Table 1 provides a summary of various control measures to help manage damaging vole populations.

Habitat Modification

Habitat modification and/or population reduction strategies will prevent large population increases. Methods include the following:

- Mowing, burning ditch banks, barrow pits and fence lines.
- Clearing weeds and debris from windbreaks and other affected areas.
- *If practical*, developing weed-free cultivated buffer strips around cropland and/or large acreages. This strategy can substantially discourage vole activity in cropland.
- Alfalfa and pasture can be grazed or mowed in the late fall when active plant growth is not taking place to reduce habitat and food sources.
- Aluminum flashing or other materials can be constructed around areas of concern to serve as entry barriers.

Plant Protection

You can protect trees, shrubs, and flower beds by surrounding plants with netted wire. Install $\frac{3}{8}$ inch netted wire approximately six inches below soil level to approximately six inches above ground around trees, shrubs, and flower beds to protect plants from vole predation.

Trapping

This control method is best utilized in small areas, such as lawns, and is not effective or practical for large infestations. Individuals with small infestations can trap voles using wooden mousetraps. Trap placement is crucial for optimum success. Place traps at right angles to and flush with the ground in surface runways. Always attach a small chain to the trap or raptors or other predators will drag the vole and trap off.

Bait is generally not needed because voles will trip traps during normal activity. If desired, traps can be baited with peanut butter, oatmeal, or apple slices. Voles occasionally learn to take bait without tripping the trap. To avoid bait loss, mix peanut butter with cotton wool or cotton balls and clamp into the tripping mechanism of the trap.

Examine traps daily and remove and bury dead voles. Like all rodents, voles can carry diseases, bacteria, and other organisms that can be harmful to human health so do not handle voles without gloves.

Baiting

Toxic bait can successfully control voles in gardens, turf, rangeland, and cropland perimeters. Many of the baits must be placed in bait stations. Figure 1 illustrates a simple PVC pipe bait station. The plywood cover provides an area voles will go to that is protected from predators or raptors, keeps bait dry so it does

not lose effectiveness, and prevents access by children, birds, pets, and other animals. Although Figure 1 suggests a quarter sheet of plywood, any sturdy covering, such as tarps, canvases, disc harrow blades, or metal roofing material will suffice. When using this type of bait station in turf areas, it is important to regularly move the bait station so turf under the cover is not significantly damaged. Place bait station(s) on the edges of turf where the most significant activity is apparent.

For range and pastures, lengthen the feeding tube to at least 12 inches and stake the bait station to the ground. The longer tube holds more bait since these stations cannot be monitored as often as those in lawns and gardens. The longer feeding tube also reduces bait spillage. In these areas, bait stations do not need to be covered since pets and children are not likely to be present and good vegetative cover will encourage voles to visit the bait station. However, if safety is a concern, use a durable type of covering over the bait station. The cover will prevent non-target poisoning and deter other animals from damaging the bait station.

Normally, voles are not particularly bait shy. Always use fresh bait products. Old bait products may have an off odor or could be moldy or damaged. If voles are not consuming bait products, pre-baiting with non-toxic bait that is the same size, shape and formulation as the toxic bait may be used to increase bait consumption. Once voles are used to consuming the non-toxic bait on a regular basis, change to the toxic bait.

When using toxic baits, caution must be used around children, pets, and non-target animals. Pick up any spilled bait and dispose of according to the label. Carefully read and follow all label instructions before applying bait. Dispose of dead voles and bait that may escape the trap so there is no chance of poisoning pets, livestock or wildlife.

Rodenticide baits may pose a hazard to federally designated endangered and/or threatened species and may not be used in any manner that results in their death or harm. It is the responsibility of the pesticide applicator to perform any application correctly so that it will not harm and/or kill any threatened and/or endangered species. Extensive endangered species information may not always be listed on the label. Check the Environmental Protection Agency's Endangered Species Bulletins online for restrictions regarding the use of rodenticides in areas these species may or are known to inhabit. If you have questions or concerns regarding species that may be affected by your application, please contact your local Extension Office, the local or state fish and wildlife agency, or your state department of agriculture.

Bait: Zinc Phosphide

Zinc phosphide can be sold under trade names such as Prozap® and ZP AG®. Some zinc phosphide products are combined with grains, while others are in pellet form.

Some zinc phosphide products are restricted-use pesticides and require a pesticide applicator license to purchase and use. These products include those labeled for agricultural crops such as wheat, barley, alfalfa, potatoes, sugar beets, grape vineyards, orchards, and nursery stock. These products can be broadcast on the target site. Before purchasing, check the label carefully to be sure the product can be used on the target site and crop.

Other zinc phosphide products are general-use pesticides and do not require a pesticide applicator license. These products can be purchased by consumers in packages of one pound or less. When allowed by the label, these products can be used in turf, lawns, and other noncrop areas. They can be placed in runways, in or next to burrows, or mechanically broadcast in infested areas. In many areas, bait spreaders are available for rental. However, it is always a good practice to place zinc phosphide in a bait station to keep it out of reach of children and non-target animals.

Be sure to keep zinc phosphide from getting wet. Moisture activates the chemical, rendering it ineffective very quickly.

Zinc phosphide acts rapidly, and a single feeding is generally lethal to voles within 12 hours. In rare cases, voles may survive and become bait shy. For this reason, zinc phosphide should not be used in the same field more than once in a 6-month period.

Zinc phosphide converts to phosphine gas when it is ingested by a vole, causing death. It does not accumulate in the vole's body tissues. Therefore, predators or scavengers such as dogs or cats are not likely to be affected by eating poisoned rodents. However, children, pets, birds, and other animals can be affected by direct contact with the bait. Store bait out of reach and use it carefully to minimize unintended access.

Bait: Anticoagulants

Anticoagulants are classified as first and second generation products. First generation anticoagulants require multiple feedings by the rodent before a lethal dose is ingested. Examples of these products include Warfarin, Diphacinone, and Chlorphacinone. These products can be used for home and residential use but should be used with a tamper resistant bait station.

Second generation products are single feed products and are not allowed to be sold in grocery, drug, hardware or home improvement stores for home and residential use. Second generation products will have one of the following active ingredients; Brodifacoum, Bromadiolone, Difenacoum, and Difethialone. Products containing these active ingredients are restricted to professional, farm, ranch, and facility use.

Information provided regarding first and second generation products will be effective June 4, 2011 and after existing stocks are sold in accordance with EPA's Rodenticide Risk Management Decision, dated June 4, 2008.

Anticoagulant baits are formulated using grain or other food sources that will attract rodents. These baits are usually in the form of pellets and blocks, and some are coated in paraffin to provide moisture resistance. Paraffin-coated baits are useful around ditches and other areas where moisture may cause other types of baits to spoil and lose potency.

Anticoagulant baits cannot be applied directly to food or feed crops. To avoid contact with a growing crop, these baits are used in areas adjacent to crop fields, in orchards after fruits or nuts are harvested, or during crop dormancy. Before purchasing any product, check the label to be sure it can be used on the target site.

Diphacinone bait products (Ramik Brown® and Kaput-D®) are restricted-use pesticides available only to those who have a current pesticide applicator license. These products can be used in fruit and nut orchards, tree nurseries, and tree farms, but cannot be applied directly to food or feed crops.

Another restricted-use pesticide is Rozol® Vole Bait (chlorphacinone). It can be used in non-crop areas, lawns, turf, ornamental flower and shrub plantings, orchards, nurseries, and tree and forestry plantations.

General-use anticoagulant pesticides include another formulation of chlorphacinone (Rozol® pellets) and warfarin (Kaput®, Rodex®). These products can be used by the general public. They are intended for use around homes and buildings.

All anticoagulant baits are toxic to other animals; take precautions to prevent non-target animals from consuming the bait. Carefully read and follow the precautionary statements on the pesticide label. Bait must be used at the specific target site as indicated on the label.

Predators

Owls, hawks, snakes, cats and dogs, among others, utilize voles as a food source. However, relying on predator control will not keep vole populations at an acceptable level to minimize or eliminate damage to cropland, rangeland, trees and lawns.

RESULTS

Based on field observations, producer interviews, current weather, cropping, and grazing patterns, vole populations may continue to increase. However, all factors involved in epidemic vole populations and dramatic fluctuations are not fully understood. To provide a solution to cyclic increases, this paper has been developed for producers and homeowners to use as a guide to identify and control rodents. A more extensive rodent management guide will be available soon. It will also be used as a study guide for Idaho pesticide applicator exams.

CONCLUSIONS

Due to the remarkable reproductive capacity of voles and current forage and climatic conditions, more than one control method may need to be utilized to achieve acceptable population levels. Investigative results show baiting to be one of the most successful control options; particularly when combined with habitat modification practices. It is absolutely crucial that individuals monitor for vole signs. Remember voles are active during the winter and can cause substantial damage to crops, trees, and lawns that are under snow cover. Check for vole tunnels and feces frequently in fields, lawns, and around trees. When signs are found, implement control measures to reduce property damage.

Disclaimer

ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Pesticide laws and labels change frequently and may have changed since this publication was written. Some pesticides may have been withdrawn or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless the specific plant, animal, or other application site is specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Trade Names--To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Groundwater--To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

TABLES

Table 1. Vole management options.

Control Method	Rodenticide	Legal Constraints	Timing	Comments
Meadow Voles				
Vegetation Modification	n/a	n/a	Early spring through late fall	Mow, graze, or burn vegetation. Remove weeds and other debris.
3/8" Netted wire/exclusions 6" below and above desired vegetation.	n/a	n/a	Year round	Excellent for protecting trees, shrubs, and flowers.
Trapping	n/a	n/a	Anytime	Begin in early spring. Place traps at right angles in surface runways.
Hand and Mechanical Baiting	Zinc phosphide	Check individual product labels, some allow use on cropland. Some formulations are restricted use products.	Early spring through late fall.	Apply by hand or mechanically. Bait stations are useful for larger populations. Do not apply when moisture is anticipated.
Hand and Mechanical Baiting	Anticoagulants (chlorophacinone, warfarin)	For non-crop use only. Generally for use around homes and buildings.	Anytime	General use pesticides available without a license. Requires multiple applications.
Hand and Mechanical Baiting	Restricted use anticoagulants: Diphacinone (Ramik Brown®, Kaput-D®) and chlorophacinone (Rozol® Vole Bait)	Restricted use pesticide. For use in orchards, nurseries, turf, lawn, golf courses, tree and forestry plantations and other non-crop areas. May be applied to dormant alfalfa.	Early spring through late fall.	Requires multiple applications. Requires a pesticide applicator license to purchase and apply.

FIGURES

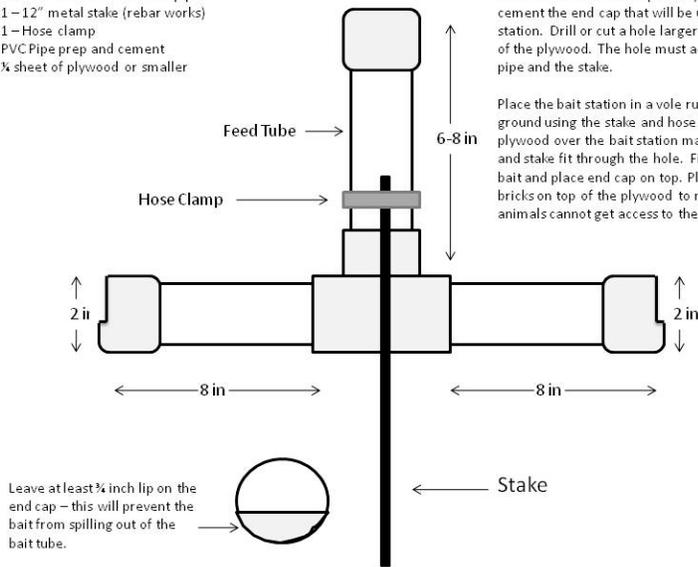
Materials Needed:

- 3 - 2" PVC pipe cut to 8" lengths
- 3 - 2" PVC pipe end caps (two partially cut, see diagram)
- 1 - 2" T-connection for PVC pipe
- 1 - 12" metal stake (rebar works)
- 1 - Hose clamp
- PVC Pipe prep and cement
- ¼ sheet of plywood or smaller

Instructions:

Assemble all of the pieces as seen in the diagram below, making sure that you cement all of the pipes to the T-connection and the two partially cut end caps. Do not cement the end cap that will be used to fill the bait station. Drill or cut a hole larger than 2" in the middle of the plywood. The hole must accommodate the PVC pipe and the stake.

Place the bait station in a vole runway and secure to the ground using the stake and hose clamp. Place the plywood over the bait station making sure that the tube and stake fit through the hole. Fill the feed tube with bait and place end cap on top. Place weight such as bricks on top of the plywood to make sure larger animals cannot get access to the bait.



Leave at least ¼ inch lip on the end cap - this will prevent the bait from spilling out of the bait tube.

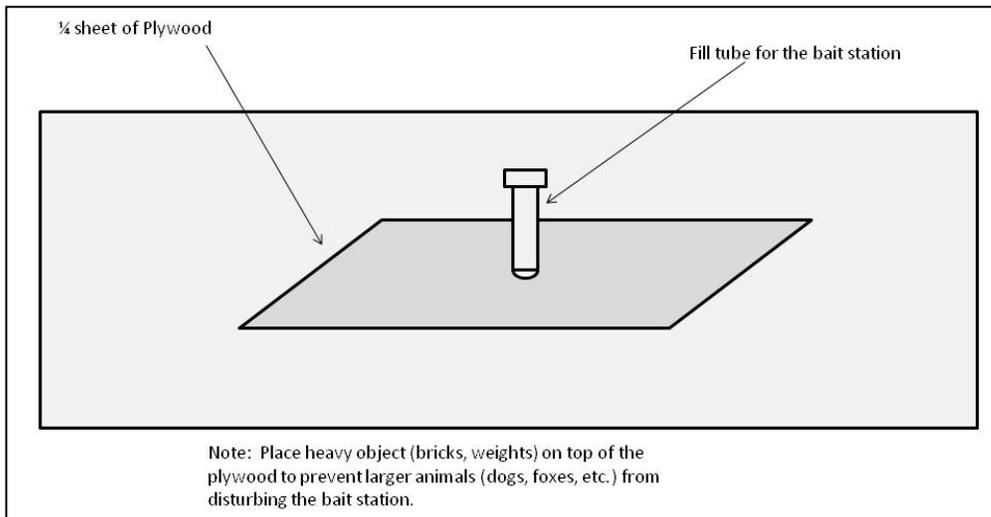


Figure 1. Bait station construction.
Diagrams by Sherman Takatori

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AUTOTOXICITY IN ALFALFA: CAUSES, EFFECTS, AND ROTATION

Greg E. Blaser, Kristi M. Larsen¹

Abstract

The average stand of alfalfa in Idaho is between 5-6 years. Once it has become evident through stand and stem evaluation or through increased pest population that the alfalfa stand needs to be replaced, the grower should consider some potential problems in an existing alfalfa stand or in replanting a new crop too quickly. University studies have shown that there should be a minimum of one year before reestablishing alfalfa because of autotoxicity in existing alfalfa.

Keywords: Alfalfa, Medicago, Autotoxicity, Crop Rotation, Allelopathic

Stand Evaluation

Some growers in the Pacific Northwest automatically replace the stand of alfalfa every 4 years, however if the grower wants to continue with the existing stand, they need to assess the condition of the existing stand. When the grower determines what is best for their operation, the decision to replace the stand of alfalfa, is based on stem and stand count. Initially, plants per square foot was the standard to determine when to replace the alfalfa; however, in the last several years alfalfa replacement has been assessed by stem count. Glazier (2007) suggests the number of plants per square foot is: greater than 25 in the establishing year, greater than 12 in the spring of the first production year, greater than 8 in the spring of the second production year, greater than 5 in the spring of the third production year. However, the preferred method of stand evaluation (Penn State Univ.) is a stem count per square foot. By exploring this method it has been shown to be a good indicator of potential yield. Stems to be included are any stem that is 4 inches taller or anything that could be harvested. Other basic guide lines (Montana State Univ.) in stem evaluation are: if stem count is 55 or more expect no change in yield, if between 40 and 50 expect some reduction as the stand declines, if less than 39 stems per square foot there will be a decline or reduction in yield. The best option might be deep tillage and incorporation of the existing crop or attempt interseeding. In a one year study done at BYU-Idaho in five year old alfalfa, the results though not statistically proven; were similar to the findings of Montana State. These results indicated that the poor stem count not only affected the yield but also increased weed and pest problems. With the increased weed problem not only would there be a reduction in yield but also in feed quality.

Autotoxicity

Once the grower has determined to replace the existing alfalfa, there are the concerns that need to be evaluated. 1) How long to go without replanting alfalfa? Guidelines from Purdue and other university studies show that at least one year would be the best option. However when talking to some growers in the Pacific Northwest they are doing a minimum two year rotation. 2) What rotation crops could be

¹ G. Blaser, Brigham Young University-Idaho, 525 South Center 1300, Rexburg, ID 83460; K. Larsen
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University of Idaho Extension

used to utilize the one or two year rotation? In California a typical rotation would be a cereal crop grown for either grain or hay. In the Pacific Northwest the rotation crops include corn, barley, and wheat. The primary purpose of utilizing cereal crops is to take advantage of the fixed nitrogen in alfalfa. Some growers have indicated reluctance to long term alfalfa. Because of their desire to utilize the fixed nitrogen of the alfalfa, growers of sugar beets and potatoes find this another way to use the one year rotation. Some growers, due to lack of equipment and other issues, find that the rotation from alfalfa cannot extend for one or two years. They have had some success in planting within two to three months. The first year's production is acceptable; however yield reduction is noticeable in the following years. These growers may be interested in finding other rotation crops that use the equipment they already have instead of investing in new equipment, an example is timothy grass, oats, and other grasses. By using a rotation crop it provides the time to reduce the water soluble chemicals found in alfalfa. These chemicals create what is called autotoxicity.

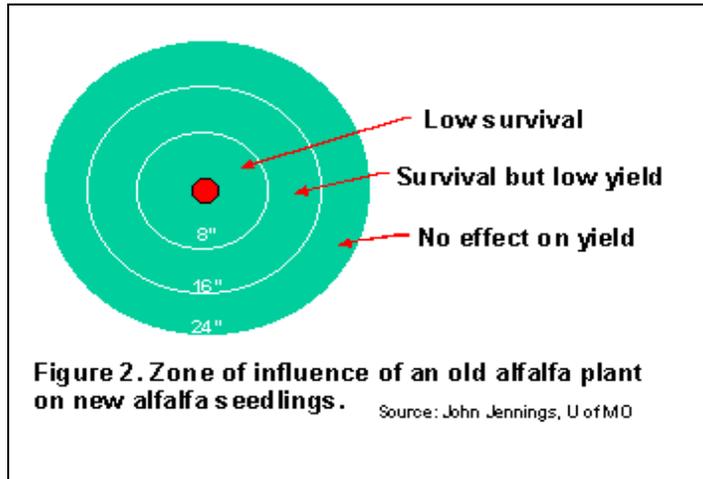
“Autotoxicity in alfalfa is described as a process in which established alfalfa plants produce a chemical or chemicals that escape into the soil and reduce establishment and growth of new alfalfa if seeded too soon following the old stand. The autotoxic nature of alfalfa has been hypothesized to be a result of environmental selection” (Jennings 2001). Much research has been done to find an explanation for failures in overseeding. ‘Some factors for failure in overseeding are 1) competition for light, water, and nutrients; 2) autotoxicity; 3) disease’ (Shewmaker, 2003). The new seeds are weak in comparison with the existing plants. As viewed in figure 1, the alfalfa stand on the left planted within weeks after tillage is thin and inconsistent, therefore yield



Figure 1. The effects of alfalfa autotoxicity on newly seeded alfalfa. The left strip plot was seeded 2 weeks after tillage of an existing stand, whereas the right strip plot was tilled 18 months prior to seeding. The thin, inconsistent alfalfa stand in the left strip is indicative of alfalfa autotoxicity. Photo credit: Dr. John Jennings, University of Arkansas .

will be poor. The stand of alfalfa on the right is lush and abundant with high yields. Autotoxicity also effects the germination of seedlings. The recommendation for waiting at least one year would be the least risk, although some growers have planted just weeks following the elimination of the previous stand, because of equipment or other issues. Klun, (1997) has developed his own technique for planting alfalfa back into alfalfa. He says “to experiment on 10-15 acres, get the fertility up the way it should be, scratch the ground up to get rid of the compaction”. The germination has not been as high as it could have been; he made a gamble and hoped that it was the correct one. Fortunately, it has worked for him but other growers have not been so successful. Some growers have seen a yield increase with this practice while others have not. A two year overseeding study planting alfalfa into alfalfa, demonstrated that alfalfa seedlings in an established stand did well initially, but in the second year many died out. Those remaining plants were weak and did not contribute to yield increase. (R. Long, D. Putman, M. Canevari 2003)

Autotoxicity is a form of allelopathy that affects alfalfa plants. Allelopathy is defined as the effect a plant has on another through the production of chemical compounds that are released to the environment. Medicarpins and phenolics are the possible compounds, though the true identity remains a mystery (Volenec, Johnson 2002). The water-soluble chemicals are most readily found in leaves and flowers though the compound can be found in the stem and roots. Plants younger than a year have fewer toxins than older plants. This means that with a less than acceptable stand of new seedlings the opportunity exists to reseed within one year's time and the new seedlings have a strong chance of survival. Some research in Michigan shows that a three week waiting period was all that was needed before replanting. In Missouri there was a yield loss of eight percent if alfalfa was planted within three weeks, and in Wisconsin yield reductions of seventy percent when seeded two weeks after plowing existing alfalfa and thirty percent after four weeks. Figure 2 shows an existing stand and the survival rate of new seeded alfalfa. This also shows the distance interval between the existing plant and the new seedling.



How to Deal with Autotoxicity

The majority of the studies show that the best way to deal with autotoxicity is to allow a minimum of one year between the existing stand and the new planting. In order to reduce the risk of toxicity the following guidelines may be of some help. Irrigation or rain fall will help dissolve or reduce the water-soluble chemicals causing them to leach out of the soil profile (Shewmaker 2003).

Evidence suggests that deep tillage of alfalfa fields (Shewmaker 2003) will mix with the soil and reduce the autotoxic chemicals. Soil texture will determine the amount of toxins in the soil. Sand for example is one type of soil that distributes the chemical and makes it easier to leach. If the soil is clay, delays in planting should be increased. Some growers suggest after harvesting the last cutting to remove the bales as soon as possible, then spray herbicide and till. The idea is to remove most of the allelopathic chemicals before they have time to settle into the soil.

Several studies have determined that a rotation out of alfalfa is best before reseeding back into alfalfa. Not only will a rotation interval between alfalfa crops reduce the toxicity, rotation will also reduce diseases, insects, weeds, and other pest pressures. As an added bonus rotation out of alfalfa will also provide utilization of fixed nitrogen to other crops.

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N FIXATION VERSUS N UPTAKE IN ALFALFA

JoAnn F. S. Lamb¹

ABSTRACT/ INTRODUCTION

Fertilizer N is the single most expensive input in nearly all crop production systems and has been implicated in declining groundwater quality due to nitrate contamination. Commercial alfalfas are highly productive in the absence of nitrogen inputs because of the symbiotic association with soil bacteria that fixes atmospheric N₂ into a form of N that the plant can utilize. The biologically fixed nitrogen produced can replace all or most of the N fertilizer needed by subsequent cereal crops following alfalfa in a rotation system. Indirect evidence such as reduced soil nitrate under alfalfa in dry and sub-humid environments and minimal nitrate leaching losses under tile-drained alfalfa has demonstrated that alfalfa is also efficient at removing sub-soil N and can be used to prevent groundwater contamination. Nitrogen fixation rates in alfalfa are influenced by the presence of N in the sub-soil. Alfalfa evaluated under high annual N application rates still obtained 20 to 25% of its N supply from biological N fixation. Plant breeding strategies for alfalfa should include methods to improve N fixation rates for a sustainable N supply for subsequent crops in rotation as well as alfalfas sensitive to the presence of nitrates to remediate high soil nitrate situations to protect groundwater quality. Alfalfas to improve N cycling and increase the efficient use of biologically fixed N could have a marked effect on the economic and environmental impacts of agricultural systems.

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IDAHO ALFALFA VARIETY TRIALS 2010

Glenn Shewmaker¹, Greg Blaser, and Ron Roemer

INTRODUCTION

Alfalfa is the most productive and widely adapted forage species. Idaho alfalfa acreage is about 1.25 million acres, and produced 5 million ton—third in the US—with an estimated gross value of \$1 billion in 2008. Forage yield and quality vary widely across Idaho environments and operations. The Idaho Agricultural Experiment Station (IAES) conducts alfalfa variety performance trials at several sites in southern Idaho including the Kimberly Research and Extension Center. Over 300 alfalfa varieties are available to US producers, and these performance trials are designed to assist producers in choosing their varieties.

Alfalfa varieties are tested for forage yield for at least three production years on irrigated sites. All trials are planted as randomized complete block experiments, with four or six replications. Trials receive adequate fertilization, irrigation, and weed control for optimum production. The 2008 Kimberly Alfalfa variety trial was planted on September 2, 2008 at the University of Idaho's Kimberly Research and Extension Center. A 2006 trial was planted May 17, 2006 at the Brigham Young University-Idaho farm in Rexburg, ID in cooperation with Greg Blaser, agronomist BYU-Idaho. Seedling-year production results are limited in value for predicting future performance.

The seed industry contributes significantly to the variety trials. Besides donating the seed, they pay a significant fee to offset our costs of doing the work. The Plant, Soil, and Entomological Science Department of the University of Idaho also contributes significantly in salary and equipment—the 5-ft forage harvester purchased for our use costs as much as a big machine.

OBSERVATIONS

1. Forage variety trials give **potential yields**. The yields are measured on fresh forage with a moisture percentage of about 75%. Yields are corrected to 100% dry matter but there is very little harvest loss in our trials. Harvest losses for raking, baling, and stacking dry hay can be as much as 20% of the total dry matter production. We also intensely manage the plots and we don't have traffic on the plots 5-9 days after cutting. Thus I would expect realistic hay yields about 80 to 90% of these, however, green chop or haylage yields would be closer.
2. Phosphate and potash fertilizer was applied pre-planting.
3. Varieties are listed in rank of highest average yearly yield. The "LSD" statistic given at the bottom of the table tells us that varieties with yield-differences less than that value in that column are not significantly different. For example, the Kimberly 2010 two-year average yield LSD value is 0.43 tons/acre. So yield from 'Rebound 5.0' (8.43 tons/acre) is not statistically different than 'WL343HQ' (8.00 tons/acre) or any yield between 8.43 and 8.00. There is a page full of good varieties!

¹ G. Shewmaker, Univ. of Idaho Twin Falls R&E Center, P.O. Box 1827, Twin Falls, ID 83303-1827. Published in: Proceedings, Idaho Hay and Forage Conference 22-23 February 2011, Burley, ID, University of Idaho Extension.

4. Don't put too much emphasis on 1-year's data from one location. I suggest looking at results from the Intermountain region of Northern California, Oregon's Malheur Station trials, and others similar in climate.
5. The forage quality data is preliminary and may change due to NIRS recalibration. However, relative differences will probably not change.
6. Kimberly Trial: This was the second production year. The spring and summer was unusually cool with average daily air temperatures 3 to 5 degrees below normal for June through August 2010. First cutting produced an average of 3.24 ton/acre hay compared to 2003-2008 average yield of 3.68 ton/acre. The 2nd and 3rd cuttings were near normal yields but 4th cutting averaged 1.21 ton/acre. The stands are good.
7. BYU-Idaho Trial: Good stand, cool spring weather and rain limited 1st cutting average yield to 2 ton/acre compared to the 2009 average of 2.87 ton/acre, but an excellent yield for the elevation.
8. Check Varieties: Vernal is a public check variety used in all trials. Vernal should yield near the bottom of the list, however this year at Kimberly it yielded among the top, probably a result of the lower fall dormancy and adaptation to cool weather. Check 1 and check 2 are several year old commercial varieties.

Yield is the most important economic factor for alfalfa profitability. Average yield over a period of years and at several locations is a good measure of disease resistance and plant persistence. Generally, the top yielding 1/3 of the varieties are not significantly different for yield. University trials offer neutral testing of varieties but will not test blends--if the source is different every year, there is no point to test it. Industry data can be valuable because it usually is for a longer period of time, but you should ask for the complete data from the trial, not just a section of it. Avoid data with only one year or a single harvest.

Forage Quality--Plant more than one variety, especially if you have large acreage and are seeking dairy-quality hay. Varieties with different maturities will reach the cutting time up to about a week apart, allowing you to cut more hay at the pre-bud or bud stage. Harvesting at the correct maturity and agronomic practices (proper irrigation and weed control) has a larger effect on quality than does variety.

Variety selection is important but not the only factor affecting yield and quality. Soil fertility management, irrigation management, weed control, and harvest management may affect your profit more than variety. However, almost all newer varieties will yield more and be more resistant to pests and diseases than the old public varieties!

Sources of Variety Information

University of Idaho Forage Extension: <http://www.extension.uidaho.edu/forage/>

Idaho Hay and Forage Association: <http://www.idahohay.com/>

National Alfalfa Alliance's: <http://www.alfalfa.org>

North American Alfalfa Improvement Conference: <http://www.naaic.org/>

Montana State University Extension: <http://www.animalrangeextension.montana.edu/Forage/forage.htm>

University of California, Davis: <http://alfalfa.ucdavis.edu/>

University of Idaho Alfalfa Variety Trials, 2010
In Cooperation with BYU- Idaho, Rexburg, Idaho
Harvesting Date: June 3, July 12, August 13, September 14, 2010
4th Year, Planted May 2006

Cultivar	2007-2010	2010 Forage dry matter yield				
	4-Year	Year	1st	2nd	3rd	4th
	Average	total				
	Tons/Acre	----- Tons/Acre -----				
4R200	8.54	7.32	1.88	2.20	1.94	1.31
WL343HQ	8.37	7.46	2.12	2.23	1.97	1.14
Marvel	8.34	7.45	2.03	2.20	2.02	1.21
MasterPiece	8.33	7.60	2.31	2.02	1.91	1.37
FSG408DP	8.29	7.41	2.00	2.15	1.93	1.33
Whitney	8.26	7.65	2.24	2.29	1.87	1.26
Lariat	8.23	7.25	2.01	2.14	1.96	1.14
DKA41-18RR	8.23	7.19	2.06	1.97	1.93	1.23
Magnum VI	8.22	6.93	1.84	1.94	1.86	1.30
FSG406	8.21	7.22	2.18	2.10	1.86	1.09
Legendairy 5.0	8.19	7.14	1.95	2.08	2.00	1.12
TS-5010	8.15	7.09	1.98	2.04	1.83	1.24
Mystery check1	8.14	7.05	1.59	2.23	2.05	1.18
Arapaho	8.12	7.35	1.96	2.12	1.92	1.36
54V09	8.11	7.00	1.89	2.03	1.93	1.14
Ameristand 403T	8.09	7.78	2.15	2.29	1.94	1.40
30-30Q	8.07	7.31	2.30	1.97	1.86	1.18
Oneida VR	8.04	7.24	2.09	2.06	1.88	1.22
54Q25	8.01	7.06	1.98	2.01	1.82	1.25
DKA34-17RR	8.01	6.96	1.76	2.07	2.02	1.13
Vernal	8.01	6.82	1.93	2.04	1.80	1.06
Shaw	8.00	7.58	2.28	2.23	1.96	1.12
9429	8.00	6.75	1.90	1.91	1.81	1.14
Melton	7.89	6.88	2.12	1.89	1.67	1.21
FSG351	7.89	7.20	2.04	2.04	1.95	1.18
Mariner III	7.83	7.07	1.98	1.91	1.86	1.33
Mean	8.14	7.22	2.02	2.08	1.90	1.21
LSD (.05)	0.80	NS	NS	NS	NS	0.18
CV %	6.8	7.8	14.3	12.5	8.8	10.3

University of Idaho: Alfalfa Variety Trials, 2010

Kimberly Research & Extension Center

Harvesting Date: May 25, June 30, July 28, September 28, 2010

Planted: September 2, 2008

2010 Forage Dry Matter Yield

Cultivar	2009-2010	2010 Forage dry matter yield				
	2-Year	Year				
	Average	total	1st	2nd	3rd	4th
	Tons/Acre	----- Tons/Acre -----				
Rebound 5.0	8.43	9.73	3.64	2.25	1.84	2.00
TS 4028	8.31	9.41	3.23	2.30	1.81	2.07
Vernal	8.20	9.48	3.32	2.36	1.80	2.01
eXalt	8.17	9.31	3.35	2.24	1.79	1.94
DKA43-13	8.17	9.50	3.29	2.28	1.82	2.11
FSG528SF	8.15	9.33	3.29	2.35	1.85	1.84
06KH17B	8.13	9.87	3.48	2.31	1.78	2.30
SunDance II	8.12	9.07	3.18	2.20	1.80	1.90
54V09	8.08	9.45	3.46	2.43	1.83	1.73
eXceed	8.07	9.01	3.21	2.20	1.78	1.83
Oneida	8.07	9.09	3.17	2.31	1.76	1.85
Phoenix	8.05	9.14	3.32	2.18	1.76	1.87
243	8.01	9.18	3.35	2.22	1.84	1.76
WL343HQ	8.00	9.23	3.17	2.23	1.80	2.04
FSG639ST	7.96	8.96	3.06	2.31	1.80	1.79
WL363HQ	7.93	9.19	3.25	2.23	1.75	1.97
Withstand	7.91	9.15	3.30	2.32	1.69	1.84
TS5026	7.88	9.21	3.34	2.24	1.72	1.92
LightningIV	7.86	8.71	2.87	2.07	1.76	2.01
DKA50-18	7.84	8.83	3.21	2.02	1.68	1.92
Check1	7.83	8.63	3.10	2.08	1.67	1.78
Mountaineer 2.0	7.82	9.09	3.25	2.25	1.74	1.86
FSG429SN	7.81	8.91	3.10	2.19	1.76	1.87
PGI459	7.77	8.71	2.94	2.21	1.74	1.82
Mean	8.02	9.17	3.24	2.24	1.77	1.92
LSD (.05)	0.43	NS	NS	NS	NS	NS
CV %	6.6	6.9	10.3	10.7	8.5	14.3

University of Idaho: Alfalfa Variety Trials, 2010
Kimberly Research & Extension Center
Forage Quality Harvested: May 25, 2010

Entry	1st Cut	CP	ADF	NDF	dNDF ₄₈	Lignin	Ash	Fat	NE _L	NE _m	NE _g	RFV	NDFD	NFC	TDN1	RFQ	Milk/ Ton	Milk/ Acre
	Tons/A	(%)	(%)	(%)	(%)	(%)	(%)	(%)	Mcal/lb	Mcal/lb	Mcal/lb	Index	(%)	(%)	(%)	Index	lb/T	lb/A
06KH17B	3.5	22.5	25.0	27.5	15.8	6.8	10.8	2.13	0.75	0.77	0.49	236	57.7	39.1	69.4	267	2799	10274
243	3.4	22.3	25.7	28.4	16.0	7.0	10.7	1.94	0.74	0.76	0.49	226	56.3	38.6	68.5	253	2741	10115
Rebound 5.0	3.6	22.2	26.7	29.9	16.6	7.1	10.8	1.93	0.73	0.74	0.47	212	55.4	37.2	67.8	237	2663	9931
eXalt	3.3	22.5	25.7	28.3	16.1	6.8	10.9	2.06	0.74	0.76	0.48	228	57.0	38.4	68.7	256	2746	9781
54V09	3.5	22.3	26.8	29.8	16.5	7.2	10.8	1.91	0.73	0.74	0.47	213	55.5	37.2	67.6	238	2664	9453
Vernal	3.3	22.5	26.0	28.5	16.0	7.0	10.9	1.93	0.74	0.76	0.48	226	56.3	38.3	68.3	253	2721	9410
eXceed	3.2	22.6	25.4	28.2	16.0	6.8	10.5	2.01	0.74	0.76	0.49	229	56.7	38.7	68.9	258	2772	9187
DKA43-13	3.3	22.8	26.8	29.6	16.2	7.2	11.0	1.91	0.73	0.75	0.47	215	54.8	36.8	67.3	238	2653	9182
WL343HQ	3.2	22.3	26.7	28.5	15.9	6.9	10.6	2.02	0.74	0.76	0.49	225	56.0	38.6	68.6	252	2754	9098
DKA50-18	3.2	22.6	26.0	28.5	16.4	6.9	11.1	1.97	0.74	0.76	0.48	224	57.3	37.8	68.4	253	2710	9089
Mountaineer 2.0	3.3	22.7	26.3	29.2	16.3	7.0	10.8	1.93	0.73	0.75	0.48	219	55.7	37.4	67.9	244	2691	9078
FSG528SF	3.3	22.3	26.5	29.3	16.0	7.3	11.4	1.91	0.73	0.75	0.47	218	54.6	37.2	67.0	238	2630	8983
Phoenix	3.3	22.4	26.6	29.4	16.4	7.2	11.2	1.99	0.73	0.75	0.47	217	55.8	37.1	67.5	242	2660	8982
TS5026	3.3	21.8	26.0	29.3	15.9	7.2	10.8	2.02	0.74	0.76	0.48	219	54.4	38.0	67.6	241	2689	8955
FSG639ST	3.1	22.6	26.1	28.7	16.4	6.9	11.0	1.94	0.73	0.75	0.48	224	57.2	37.8	68.3	252	2709	8954
WL363HQ	3.2	22.5	26.0	28.9	15.8	7.1	10.8	1.96	0.74	0.76	0.48	222	54.6	37.9	67.8	245	2701	8917
TS 4028	3.2	22.5	26.2	28.9	16.1	7.1	11.2	2.02	0.73	0.75	0.48	221	55.5	37.4	67.7	245	2677	8875
SunDance II	3.2	22.1	25.7	28.6	16.4	6.8	10.2	2.03	0.74	0.76	0.48	225	57.5	39.2	69.4	258	2794	8848
Withstand	3.3	21.9	27.1	30.1	16.9	7.2	10.7	1.98	0.72	0.74	0.46	210	56.4	37.3	67.8	238	2670	8810
FSG429SN	3.1	22.9	25.1	27.8	16.0	6.7	11.0	2.01	0.75	0.77	0.49	233	57.6	38.3	68.9	262	2753	8637
Oneida	3.2	22.5	24.7	27.4	15.2	6.8	11.2	2.06	0.75	0.78	0.50	236	55.6	38.9	68.4	260	2751	8633
Check1	3.1	22.2	26.3	29.3	16.2	7.1	11.1	1.92	0.74	0.75	0.48	218	55.2	37.5	67.5	241	2663	8248
PGI459	2.9	22.6	25.7	28.3	16.0	7.0	11.2	1.97	0.74	0.76	0.48	226	56.5	37.9	68.1	253	2702	8177
LightningIV	2.9	22.2	26.4	29.5	16.3	7.2	11.0	1.94	0.73	0.75	0.47	216	55.2	37.4	67.5	238	2665	7929
Mean	3.24	22.4	26.0	28.8	16.1	7.0	10.9	1.98	0.73	0.75	0.48	222	56.0	37.9	68.1	248	2707	9064
LSD (.05)	NS	NS	NS	NS	NS	NS	NS	0.12	NS	NS	NS	NS	NS	1.5	NS	NS	NS	1236
CV %	10.3	3.6	4.6	5.1	3.8	4.6	3.7	4.4	2.0	2.4	3.4	6.5	3.5	2.7	1.6	7.2	2.8	9.7
Pr>F		0.98	0.46	0.52	0.34	0.50	0.06	0.05	0.51	0.50	0.50	0.53	0.43	0.03	0.11	0.45	0.08	0.05

Entry information for BYU-Idaho Trials

Marketer	Variety	FD	WS	Bw	Vw	Fw	An	PRR	APH	SAA	PA	BAA	SN	NRKN
Northwest Seed	9429	4	3	HR	R	HR	HR	HR	-	R	HR	HR	R	R
Tri-West Seed	30-30Q	3	2	HR	HR	HR	HR	HR	HR	R	R	-	-	-
Northwest Seed	4R200	4	2	HR	HR	HR	HR	HR	-	R	R	-	HR	R
Pioneer	54Q25	4	-	HR	HR	HR	HR	HR	-	R	R	-	HR	HR
Pioneer	54V09	4	-	HR	HR	R	HR	HR	-	R	HR	-	HR	HR
Tri-West Seed	Arapaho	3	2	HR	R	HR	R	HR	-	-	MR	-	R	HR
Mystery check	Check1	3	2	-	-	-	-	-	-	-	-	-	-	-
Mystery check	Check2	4	2	-	-	-	-	-	-	-	-	-	-	-
Dekalb	DKA34-17RR	3	2	HR	HR	HR	HR	HR	HR	-	HR	-	R	-
Dekalb	DKA41-18RR	4	2	HR	HR	HR	HR	HR	HR	R	HR	-	R	-
Dairyland/Tri-West Seed	Magnum VI	4	2	HR	HR	HR	HR	HR	HR	-	MR	-	R	HR
Farm Science Genetics	FSG351	3	2	HR	R	HR	R	HR	-	R	HR	R	R	HR
Farm Science Genetics	FSG406	4	1	HR	HR	HR	HR	HR	-	-	R	-	R	R
Farm Science Genetics	FSG408DP	4	2	HR	R	HR	HR	HR	-	-	R	-	R	HR
Simplot Grower Solutions	Lariat	3	1	HR	HR	HR	HR	HR	HR	-	HR	-	R	R
Cropland Genetics	Legendairy 5.0	3	2	HR	HR	HR	HR	HR	R	R	R	-	MR	LR
Allied Seed, LLC	Mariner III	4	2	HR	HR	HR	HR	HR	-	-	R	-	R	-
Allied Seed, LLC	Marvel	4	2	HR	HR	HR	HR	HR	-	R	R	-	-	-
Simplot Grower Solutions	MasterPiece	4	-	HR	R	HR	HR	HR	R	R	-	R	HR	R
Montana State Univ.	Melton	3	-	R	R	R	-	HR	-	MR	R	-	R	HR
Public--std check	Oneida VR	3	-	R	HR	HR	MR	MR	-	-	-	-	-	-
Montana State Univ.	Shaw	3	-	HR	MR	-	MR	R	-	R	R	-	MR	HR
Target Seed	TS-5010	4+	-	R	R	R	R	HR	-	R	R	R	HR	R
Public--std check	Vernal	2	-	R	-	MR	-	-	-	-	-	-	-	-
Northwest Seed	Whitney	4	3	HR	HR	HR	HR	HR	-	R	HR	-	HR	R
W-L Research	WL343HQ	4	2	HR	HR	HR	HR	HR	-	MR	R	MR	MR	-

Entry information for Kimberly Trials

Marketer	Variety	FD	WS	Bw	Vw	Fw	An	PRR	SAA	PA	BAA	SN	NRKN
Allied Seed, LLC	Withstand	4	2	HR	HR	HR	HR	HR		HR			
Allied Seed, LLC	Phoenix	5	4	HR	HR	HR	HR	HR		HR		HR	MR
AgSeeds	eXalt	4	2	HR	HR	HR	HR	HR	R	R		R	HR
Tri-West Seed	SunDance II	4		HR	HR	HR	HR	HR		R	MR	R	HR
Calwest Seeds	CW044031	5		HR	R	HR	HR	HR		R	MR		
AgSeeds	eXceed	4	2	HR	HR	HR	HR	HR		R		HR	HR
Producer's Choice Seed	PGI459	4	2	HR	HR	HR	HR	HR		R		HR	HR
Monsanto	DKA43-13	4	2	HR	HR	HR	HR	HR		R		R	R
Cropland Genetics	Rebound 5.0	4	2	HR	HR	HR	HR	HR		R			
Cropland Genetics	Mountaineer 2.0	5		HR	R	HR	HR	HR	R			HR	
Monsanto	DKA50-18	5	2	HR	HR	HR	HR	HR					
W-L Research	WL343HQ	4	1	HR	HR	HR	HR	HR	R	HR	MR	R	MR
W-L Research	WL363HQ	5	2	HR	HR	HR	HR	HR	R	R	MR	HR	R
Farm Science Genetics	FSG528SF	5	2	HR	HR	R	HR	R		R			
Farm Science Genetics	FSG639ST	6	3	HR	R	HR	R	HR		R		HR	HR
Farm Science Genetics	FSG429SN	4	2	HR	HR	R	HR	HR	R	HR		HR	R
FFRL, Logan UT	06KH17B												
Target	TS 4028	4	2	HR	HR	HR	HR	HR					
Target	TS-5026	5	3	HR	HR	HR	HR	HR					
Eureka Seed	LightningIV	4.3	1.5	HR	HR	HR	HR	HR		R			HR
Public--std check	Vernal	2											
Public--std check	Oneida												
Pioneer	54V09	4		HR	HR	R	HR	HR		HR		HR	HR
Mystery check	Check1	4	2	HR	R	HR	R	HR	R	R		HR	MR

Ratings for Alfalfa Varieties	
Code	Description
FD	Fall dormancy
WS	Winter survival
Bw	Bacterial wilt
Vw	Verticillium wilt
Fw	Fusarium wilt
An	Anthraxnose race 1
PRR	Pytophthora root rot
SAA	Spotted alfalfa aphid
PA	Pea aphid
BAA	Blue alfalfa aphid
SN	Stem nematode
NRKN	Northern root knot nematode
MLE	Multi-foliolate expression
GT	Continuous grazing tolerance

Resistance Ratings		
% Resistant plants	Resistance class	Class abbreviation
0-5%	Susceptible	S
6-14%	Low resistance	LR
15-30%	Moderate resistance	MR
31-50%	Resistance	R
>50%	High resistance	HR

Winter Survival Ratings		
Category	Check variety	Score
Superior	ZG 9830	1
Very good	5262	2
Good	WL325HQ	3
Moderate	G-2852	4
Low	Archer	5
Non winter-hardy	Cuf 101	6

Fall Dormancy Ratings	
Check variety	Rating
Maverick	1
Vernal	2
5246	3
Legend	4
Archer	5
ABI 700	6
Dona Ana	7
Pierce	8
CUF 101	9
UC-1887	10
UC-1465	11