Selecting Alfalfa Varieties for New Mexico

Circular 654

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Introduction

Alfalfa hay remains New Mexico's number one cash crop (USDA NASS, 2009). Whether used as pasture, hay, silage, or greenchop, the value of alfalfa to New Mexico is further enhanced by its contribution to livestock production as meat, milk, and other products.

Each year, new alfalfa varieties are released, and there are considerable annual yield differences between the highest- and lowest-yielding varieties in irrigated tests included in New Mexico State University's Alfalfa Variety Test Reports (http://aces.nmsu.edu/pubs/variety_trials/welcome.html#alfalfa). Economically, this would translate into a significant difference in returns per acre per year due to variety. In addition to yield increases, genetic improvement for pest resistance and environmental stress tolerance has increased stand persistence due to the ability of individual plants to survive field conditions over multiple years. This also leads to more stable yields over a longer period, during which establishment costs can be recovered before the stand must be replaced. Consequently, choosing a good variety is the first step (followed by proper irrigation, fertility, pest control, and harvest management) in maximizing profit from alfalfa production by establishing a highly productive, persistent stand of alfalfa for the intended purpose. While yield is often the first criterion used for variety selection, there are several other factors that should be considered because they can impact yield and stand persistence, and there are some factors that should not affect varietal choice.

Considerations in Selecting an Alfalfa Variety

Fall dormancy. New Mexico is a large and diverse state, encompassing many temperature zones that affect crop growth (Figure 1). Therefore, varieties that perform well in one location may not be as productive elsewhere. Performance compared to other varieties over a number of years and locations is the best indication of varietal adaptation and persistence. One way to select varieties is to use the unbiased information collected from New Mexico Alfalfa Variety Tests that are conducted by NMSU scientists in a particular region. This data is published annually in variety test reports and made available online (http://aces.nmsu.edu/pubs/variety_trials/welcome.html#alfalfa). Table 1 is an example of how the New Mexico Alfalfa Variety Test Reports summarize information about performance in New Mexico, pest resistance, and the other varietal characteristics.

Local adaptation and yield potential can be estimated to an extent by fall dormancy (FD) category, which indicates the variety's tendency to stop growing in the fall. Fall dormancy categories range from 1 (very dormant) to 11 (very nondormant). The more dormant (FD 1 to 3) varieties will be slower to "green up" in the spring and quicker to stop growing in the fall, regardless of local climate. Such varieties are adapted to areas with a shorter growing season that also may have very severe winter conditions. When grown in more temperate climates with longer growing seasons, these varieties generally do not yield as well as less dormant varieties because they do not take advantage of the longer growing season. Less dormant varieties (FD 7 to 11) tend to be green throughout winter (Figure 2) or at least will "green up" earlier in the spring and may have greater fall production. These varieties will more fully utilize the extended growing season, but because they may try to regrow throughout the winter, they are more susceptible to stand loss from winter injury that can result in reduced spring yields.

Generally, there is a range of two to three FD categories that are persistent and yield equally well on the average in any given region. See the examples in Table 1 where varieties are listed alphabetically by fall dormancy category. It is best to choose a variety that has performed well over several years and locations. Based on currently available data, varieties in FD 3 to 5 are best adapted to north-central New Mexico, as indicated by high yields (Figure 3), while those in FD 6 and 7 are most suitable for the lower elevations of the I-40 corridor (Figure 4). Data from Las Cruces indicate that varieties in FD 6 to

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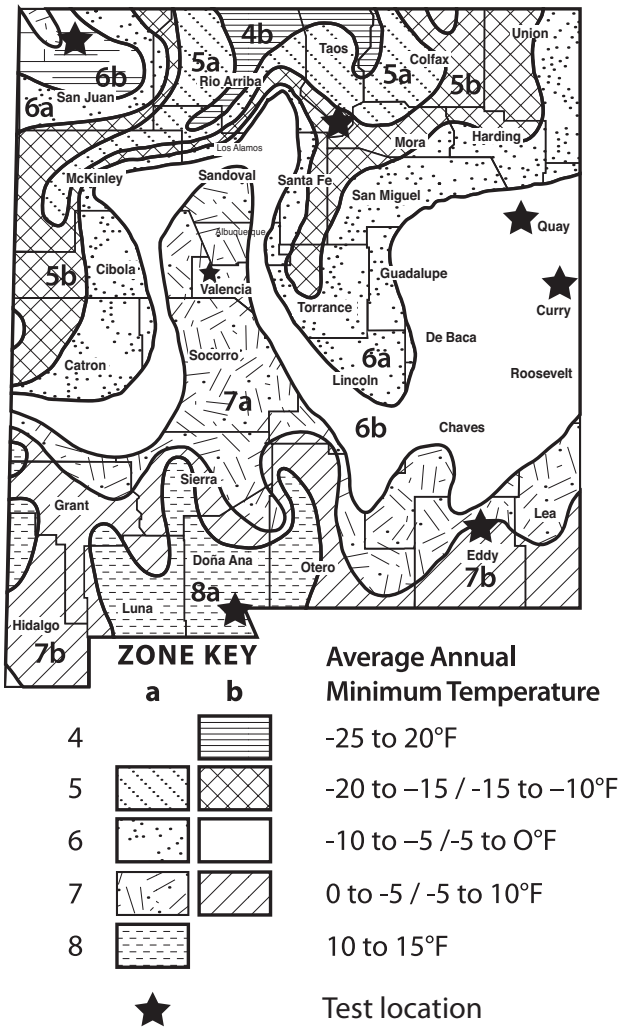

Figure 1. **New Mexico plant growth zones as determined by temperature and the locations of current and previous New Mexico Alfalfa Variety Tests.**

Figure 2. **The effects of alfalfa fall dormancy (FD) category six weeks after harvest in early November in Tucumcari, NM. The density of green leaves indicates the level of dormancy, with more dormant varieties having less green throughout the winter.**

Table 1. Example of Characteristics and Performance of Alfalfa Varieties Across Years and Tests in New Mexico Presented in the New Mexico Alfalfa Variety Test Reports. Shaded areas indicate that the variety was not in that particular test, while clear blocks mean that the variety was in the test. A double asterisk (**) indicates that the variety had the highest yield in the test for that year, and a single asterisk (*) means that the variety yielded equally to the highest-yielding variety. Note: This table is not intended as a list of recommended varieties.

		Varietal Characteristics[1]												Las Cruces		Artesia				Tucumcari				Los Lunas						Farmington					
					Pest resistance									2008[2]		2006			2008	2005			2007	2005				2007		2005				2007	
Variety	Proprietor	RR	WS	FD	BW	PRR	FW	AN	SAA	PA	BAA	SN	RKN	08[3]	09	07	08	09	09	06	07	08	08	06	07	08	09	08	09	06	07	08	09	08	09
FSG 351	Allied Seed		2.0	3	HR	HR	HR	R	R	HR	R	R	HR																	*	*	*	**		
WL319HQ	WL Research		1.0	3	HR	HR	HR	HR	R	HR	n/r	MR	n/r							*	*														
PGI459	Producer's Choice		n/r	4	HR	HR	HR	HR	R	R	n/r	n/r	n/r										*											*	
WL343HQ	WL Research		1.0	4	HR	HR	HR	HR	R	R	MR	R	n/r																					*	
FSG 528SF	Allied Seed		n/r	5	HR	R	HR	HR	n/r	R	n/r	n/r	n/r										*											*	**
56S82	Pioneer HiBred Int'l		5.0	6	HR	HR	HR	HR	HR	HR	HR	HR	HR				*			*	*	**	*								**	*	*		
Cimarron VL600	Great Plains Res.		n/r	6	R	HR	HR	HR	R	HR	HR	R	MR															*	*						
Wilson	NMSU		n/r	6	R	n/r	R	n/r	MR	R	n/r	MR	n/r				*		*	**	*	*	*	**	*	*	*							*	
AmeriLeaf 721	America's Alfalfa		n/r	7	R	HR	HR	HR	HR	R	MR	MR	R			*	*											*	*						
Doña Ana	NMSU		n/r	7	MR	R	MR	LR	MR	R	n/r	n/r	n/r			*	*				*	*	*						*					*	
58N57	Pioneer HiBred Int'l		6.0	8	LR	HR	R	HR	R	HR	HR	MR	HR	*		*	*																		
Dura 843	Croplan Genetics		n/r	8	n/r	HR	HR	n/r	HR	HR	HR	R	MR				*																		
HybriForce-800	Dairyland Seed Co.		n/r	8	MR	R	HR	HR	n/r	MR	n/r	HR	R						*																
WL550RR	WL Research	Y	6.0	8	R	HR	HR	HR	R	HR	HR	R	R				*																		
59N59	Pioneer HiBred Int'l		n/r	9	LR	HR	R	R	HR	HR	R	LR	HR	**	*				*																
	WL Research		n/r	10	n/r	R	HR	n/r	HR	HR	HR	R	HR				*																		

[1]RR=Roundup Ready if "Y"; WS=Winter Survival (1=No injury, 6=Dead plants), FD=Fall Dormancy (2=Vernal, 3=5246, 4=Legend, 5=Archer, 6=ABI 700, 7=Doña Ana, 8=Pierce, 9-CUF101), 10=UC1887, BW=Bacterial wilt, PRR=Phytophthora root rot, FW=Fusarium wilt, AN=Anthracnose, SAA=Spotted alfalfa aphid, PA=Pea aphid, BAA=Blue alfalfa aphid, SN=Stem nematode, RKN=Rootknot nematode (southern or northern); S=Susceptible, LR=Low resistance, MR=Moderate resistance, R=Resistant, HR=High resistance.

n/r indicates either that the variety was not rated for that characteristic or no rating was available.

[2]Establishment year

[3]Harvest year

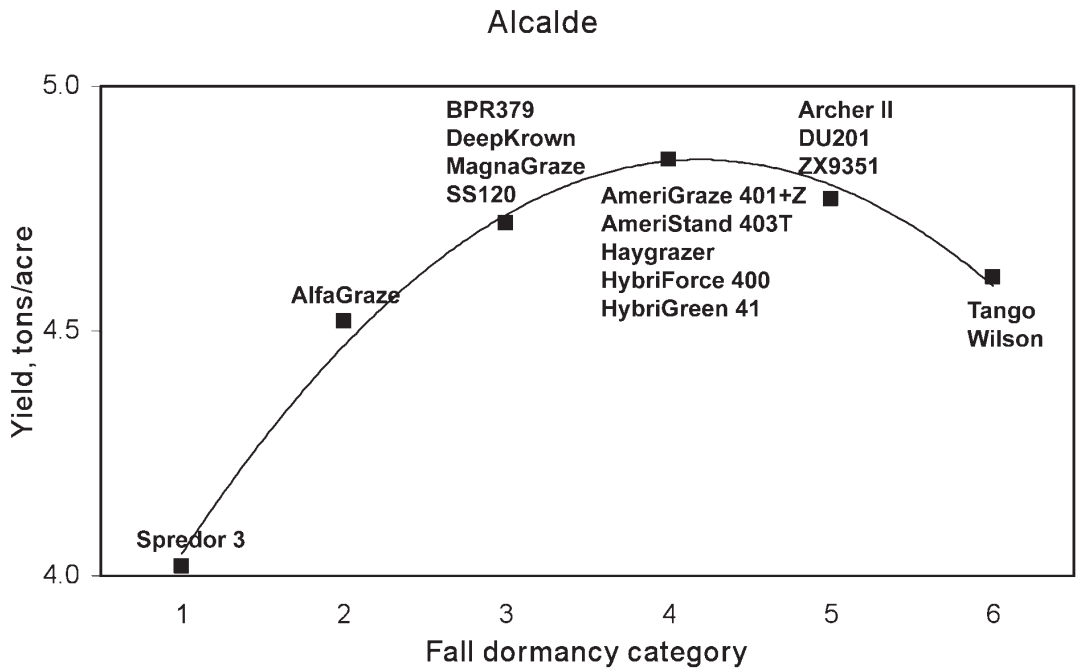

Figure 3. **Relative yields of irrigated alfalfa fall dormancy categories at Alcalde in north-central New Mexico (5,275 ft. elevation).**

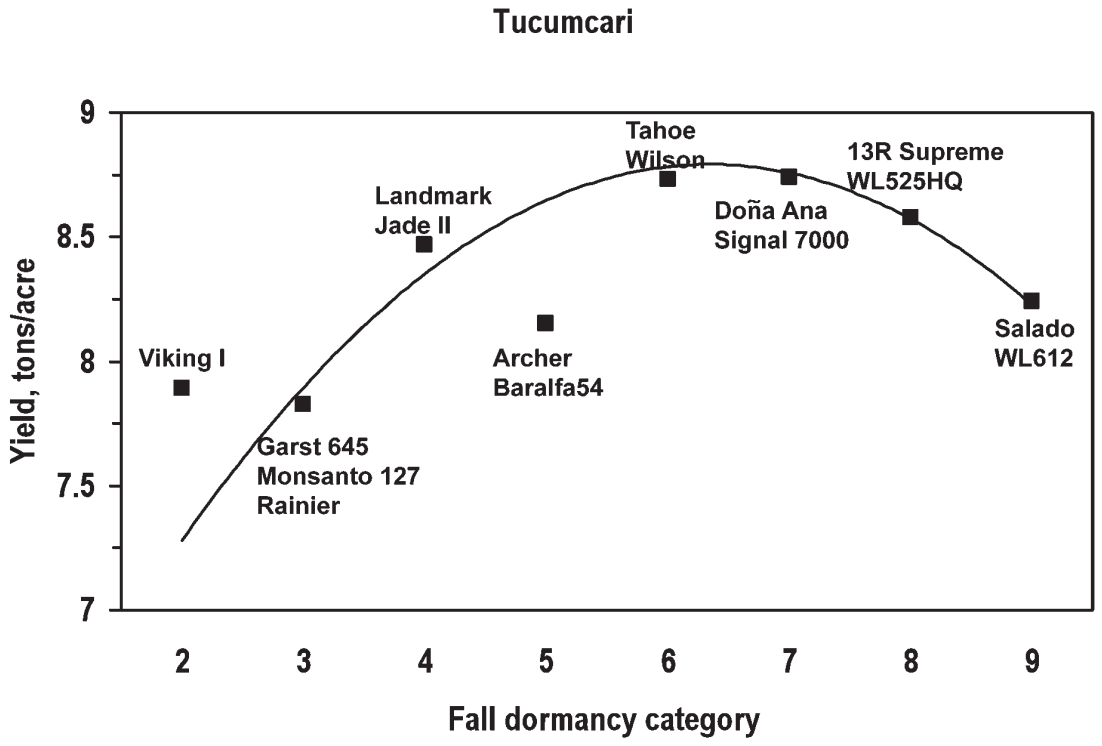

Figure 4. **Relative yields of irrigated alfalfa fall dormancy categories at Tucumcari at a lower elevation (4,091 ft.) along the I-40 corridor in eastern New Mexico.**

8 are most suitable for the southern regions of the state. The least dormant variety that will survive at a given location is not necessarily the highest yielding variety (Figures 3 & 4). Consequently, variety selection should be based on individual performance in addition to FD category, recognizing that there is a risk of stand loss with less dormant varieties if a severe winter occurs.

Winter survival. Some varieties are more capable of withstanding low temperatures than their fall dormancy category indicates. Hence, the North American Alfalfa Improvement Conference has developed a classification specifically for winter hardiness, Winter Survival (WS), for which a rating of 1 indicates little or no winter injury and 6 indicates plant death. Ratings are made after the first winter for spring seedings. At least two years of ratings showing specific differences between check varieties are required for an acceptable standard test at a location. Because these tests are conducted in areas that have severe winters, few nondormant varieties currently have been rated for winter survival, but more and more are being tested. When using the winter survival data, keep in mind that these tests usually are conducted in the northern states, and varieties that will not survive their more severe winters might survive in New Mexico. The New Mexico Alfalfa Variety Test Reports also are valuable tools for determining the winter survivability of tested alfalfa varieties, particularly in the northern half of New Mexico and in the north-central mountains, where several nondormant varieties (FD 7–9) have performed well.

Disease resistance. Resistance to diseases is based on the percentage of plants surviving standardized tests. Varieties are rated as being susceptible (S; less than 5% of plants survive) or having low resistance (LR; 6–14% survival), moderate resistance (MR; 15–30% survival), resistance (R; 31–50% survival), or high resistance (HR; more than 50% survival) to specific diseases. For New Mexico, adapted alfalfa varieties should have a disease resistance rating of R or HR to bacterial wilt (Bw), Fusarium wilt (Fw), Phytophthora root rot (PRR), and anthracnose (An) (National Alfalfa Alliance, 2010). This information, when available, is provided for each variety evaluated in the New Mexico Alfalfa Variety Testing Program (Table 1).

Many other alfalfa diseases also occur in New Mexico; the best protection against these is proper management. Seedling diseases can occur anytime conditions are favorable and can effectively destroy a new stand. Disease resistance in seedlings is often very low or not developed. Seed treated with fungicides should be used each time alfalfa is planted. Ask your seed salesperson about fungicidal seed treatment and read the associated label for more information.

Insect resistance. Many insects feed on alfalfa in New Mexico, but varietal resistance is available only for spotted alfalfa aphid (SAA), pea aphid (PA) and blue alfalfa aphid (BAA). As with disease resistance, varieties should have at least an R rating for each of the insects and, when available, this information is provided for each variety evaluated in the New Mexico Alfalfa Variety Testing Program (Table 1).

Varietal resistance to other alfalfa insects in New Mexico, such as alfalfa weevil and cowpea aphid, might be available in the near future. White-fringed beetle, another emerging pest, is also being found in alfalfa fields in the southern two-thirds of the state. Currently, the best protection against these insect pests is proper management to maintain a healthy stand, which may occasionally necessitate pesticide use.

Nematodes. Southern, northern, Javanese, and Columbia root-knot nematodes infest approximately 25% of alfalfa fields in New Mexico and may have been an undetected cause of yield and stand reduction statewide in past years. Stem nematodes have been reported from northern New Mexico, but don't seem to cause the serious problems found elsewhere in the western U.S. Alfalfa varieties resistant to stem nematodes and either southern or northern root-knot are available, but no varieties are resistant to both species of root-knot nematode. Resistance to southern root-knot nematode is found mainly in nondormant varieties. Varieties should be selected that have at least an R rating with regard to every species of nematode likely to be on the farm.

Roundup Ready and other genetically modified alfalfa (GMO alfalfa). The ability to genetically modify alfalfa has led to the development of varieties that can withstand the application of Roundup herbicide and could lead to the future release of varieties with other desirable traits such as improved nutritive value and drought tolerance. Roundup Ready alfalfa varieties could become a valuable component of whole-farm weed management systems, although growers are reminded that no herbicide is without limitations and are cautioned to use appropriate herbicide management strategies to prevent the development of herbicide resistance by weeds. Very few Roundup Ready alfalfa varieties have been tested by the New Mexico Alfalfa Variety Testing Program, but it is likely that more will be. Those varieties are designated as Roundup Ready in the New Mexico Alfalfa Variety Test Reports (Table 1). The variety selection guidelines described in this publication should be applied equally regardless of GMO status: proper variety selection, site selection, stand establishment, irrigation management, fertility, pest control, and harvest frequency enhance alfalfa plant health and stand

persistence and, therefore, competition against the most difficult weeds. For less-than-optimum situations, herbicides are available to control most weeds in alfalfa. For more information about weed control options in alfalfa, see NMSU's Cooperative Extension Service Guide A-325, *Managing Weeds in Alfalfa* (http://aces.nmsu.edu/pubs/_a/A-325.pdf).

Grazing and traffic tolerance. Increasingly, more alfalfa varieties are being released that have naturally-selected tolerance to frequent defoliation and hoof or traffic damage. When these issues are a concern, adapted varieties should be selected that are advertised as having a broad crown set below the soil surface, which gives protection from hoof and equipment damage. Grazing-tolerant alfalfa varieties also have the ability to produce and retain leaves below the grazing horizon (4 to 6 inches), which allows photosynthesis to continue even under frequent defoliation of upper leaves. While information about grazing or traffic tolerance of specific varieties is not provided in the New Mexico Alfalfa Variety Test Reports (Table 1), performance of a limited number of varieties under winter grazing is included in the 2004 New Mexico Alfalfa Variety Test Report (http://aces.nmsu.edu/pubs/variety_trials/var04.pdf). Performance under summer grazing may be different than performance under winter grazing in New Mexico.

Seed cost and quality. Selecting an alfalfa variety based on seed cost is a gamble producers often lose. With few exceptions, seed labeled "common," "variety not stated," or "variety unknown" is of unknown genetic background and may or may not be locally adapted or have the necessary disease or insect resistance. Seed of improved varieties will be more expensive; however, a yield difference of 1/2 ton/acre in the first year will usually more than cover the difference in seed cost when the hay is sold for $160/ton. A review of New Mexico's Alfalfa Variety Test Reports demonstrates that annual yield differences are likely to be more than 1/2 ton/acre, even among improved varieties, and will continue throughout the life of the stand, which can be longer under proper management, thereby magnifying the return on the investment in seed of the improved variety. To be assured of achieving a long-lasting, highly productive stand, buy either certified or Plant Variety Protected (PVP) seed, which guarantees the genetics and performance of your seed. Look for a blue tag, which must be attached to all bags of certified seed, or PVP labeling, which indicates certification. Be sure to read the seed tag, which provides important information about the seed, including purity, amounts of other crop and weed seed (including any noxious weed seed), germination, and the test date (within the previous 9 months). For more information about seed labeling see NMSU's Cooperative Extension Service Guides A-131, *Certified Seed* (http://aces.nmsu.edu/pubs/_a/a_131.pdf) and A-216, *Know What Is in a Bag of Seed* (http://aces.nmsu.edu/pubs/_a/a_216.pdf). Order seed well in advance of planting time to ensure that it will be available when needed, but request delivery within one month of anticipated planting.

Inoculation. In addition to fungicide treatment, an essential seed treatment for alfalfa is inoculation with nitrogen-fixing bacteria. The best choice of seed is one that was inoculated with a seed treatment before it was bagged (as with the fungicide). Make sure the expiration date for the inoculant has not passed. Untreated seed should be inoculated by the producer prior to planting. Follow the inoculant manufacturer's recommendations and use a product labeled for alfalfa. Planter box inoculation is not nearly as effective for treating each seed as using a cement mixer or other similar equipment. Dry inoculants using static electricity to adhere to the seed are very effective and easy to use, but thorough mixing is still critical to make sure each seed is inoculated. If a peat-based inoculant product is used, the seed must be wet with a sticker solution for the inoculant to properly adhere to the seed. Again, use the manufacturer's recommended sticker agent. Carbonated beverages and syrup are often used as stickers, but the chemical qualities of these products will affect the viability of the nitrogen-fixing bacteria.

Organic certification. Alfalfa varieties are generally not certified as being organic, but individual seed lots can be. The only varieties excluded from organic production are genetically modified varieties such as Roundup Ready alfalfa; otherwise, the only varietal recommendation is to select well-adapted varieties. While some companies are selling lines of organic seed, organic production is related to the crop that is being grown, particularly for perennials, like alfalfa. If organically produced seed or other planting material can be acquired and the field meets organic production standards, the new seeding can be certified as organic from the beginning. If the planting material is not certified as being organically produced, the new stand cannot be certified as organic for the first year of its life. Organic producers should verify that the seed actually purchased meets the standards for organic production because that is specific to the management practices of the seed grower. Alternatively, alfalfa hay growers often can work with seed suppliers to special order untreated seed that meets organic standards. In any case, organic alfalfa growers should consult with their organic certifying agent to ensure that guidelines are met to attain and maintain certification.

Forage quality. Historically, high-quality alfalfa hay possessed the following characteristics: greater than 19%

Table 2. Forage Quality† of Irrigated Alfalfa Varieties Sown August 2001, at the NMSU Agricultural Science Center at Farmington

	Fall	CP, %		ADF, %		NDF, %		RFV		Fall dormancy means			
Variety	dormancy	Mean	SD	Mean	SD	Mean	SD	Mean	SD	CP, %	ADF, %	NDF, %	RFV
Champ	3	22.03*	±0.52	29.30*	±0.99	34.45*	±1.02	179.08*	±6.43	22.03**	29.30*	34.45	179.08*
DKA42-15	4	21.57*	±0.72	27.83*	±0.98	33.32*	±1.52	188.73**	±10.27				
WL327	4	22.17**	±1.13	28.36*	±0.80	33.61*	±2.32	187.11*	±15.76				
Megaton 3.5	4	22.06*	±1.68	28.05*	±0.94	33.85*	±1.25	184.82*	±8.88				
Geneva	4	21.50*	±1.09	28.41*	±0.92	33.77*	±1.17	184.68*	±7.91				
Legend	4	21.38*	±0.97	28.31*	±1.46	34.09*	±1.30	183.27*	±9.70				
Delta526	4	21.58*	±1.12	29.10*	±1.85	33.86*	±1.36	182.80*	±10.00				
Focus HSN	4	21.31*	±0.61	29.20*	±1.16	34.23*	±1.88	181.04*	±12.30				
Magnum V	4	21.36*	±0.76	28.52*	±0.56	34.44*	±0.95	180.28*	±4.93				
Forcast 1001	4	21.16*	±0.85	29.48*	±1.31	34.51*	±0.95	177.95*	±7.51				
HybriGreen 41	4	21.12*	±1.53	29.21*	±0.62	34.88*	±0.85	176.63*	±4.09				
WL342	4	20.98*	±1.00	28.78*	±0.63	35.24*	±1.49	176.20*	±5.51				
54V54	4	20.89*	±0.46	29.41*	±0.91	35.66*	±0.81	172.27*	±5.25				
HybriForce-400	4	20.54*	±0.43	30.12*	±1.53	35.74**	±1.31	170.61*	±9.07	21.36*	28.83*	34.40	180.49**
5-Star	5	21.36*	±0.40	28.81*	±0.59	33.92*	±1.15	182.88*	±7.35				
Archer II	5	20.92*	±0.33	29.72*	±1.18	35.50*	±0.68	172.46*	±5.29	21.14*	29.26*	34.71	177.67*
Doña Ana	8	19.95*	±0.61	30.55**	±0.91	37.33*	±0.72	162.48*	±4.55	19.95	30.55**	37.33*	162.48
Mean		21.26		29.04		34.78		178.14					
LSD, 0.05		Ns		Ns		Ns		Ns		1.28	Ns	1.79	11.85
CV, %		4.21		3.55		3.60		4.65					

†Appreciation is expressed to the Navajo Agricultural Products Industry Research and Testing Laboratory for conducting the analysis.

CP, ADF, NDF, RFV, SD, LSD, Ns, and CV signify crude protein, acid detergent fiber, neutral detergent fiber, relative feed value, standard deviation, protected least significant difference, no significant difference among varieties based on a protected statistical analysis, and coefficient of variation, respectively. The SD gives an indication of the variability within a variety. Generally, eight individual observations for each variety (four replicates and two harvests for the data presented in this table) can be expected to vary from the mean by as much as the SD. For example, the crude protein (CP) of any of the eight samples for any variety can vary from the average for that variety by as much as the associated SD. The lack of difference between varieties is demonstrated, in that the largest SD given for any variable is nearly equal to the difference between the means of the highest and lowest varieties for each variable. If the difference between means within a column is equal to or greater than the LSD given at the bottom of that column, we are 95% certain that they are truly different. The CV gives an indication of the amount of variation accounted for in the statistical analysis of a variable. Lower CVs are better, with 10 being a generally accept maximum.

**Highest numerical value in the column.

*Not significantly different from the highest numerical value in the column based on the 5% LSD.

crude protein (CP), less than 31% acid detergent fiber (ADF), less than 40% neutral detergent fiber (NDF), retained leafiness, and freedom from foreign material, including weeds, sticks, soil, rocks, etc. Now, higher quality forage is needed to allow animals to maximize their genetically increased performance potential and, more and more, hay prices are being set based on quality, such that supreme and premium quality alfalfa hay will have >22% CP, <29% ADF, and <36% NDF. Fiber components have been associated with forage intake by animals (NDF) and digestibility (ADF and NDF digestibility [NDFD]) and are used to calculate relative feed value (RFV) or relative forage quality (RFQ) to simplify comparisons across forages. Lower RFV and RFQ values indicate lower quality and reflect either higher fiber or lower fiber digestibility values.

Varietal differences in quality are relatively small compared to other factors. Cultural and management practices, such as soil fertility, irrigation, weed and insect control, maturity at cutting, baling, and storage conditions, affect alfalfa hay quality to a much greater degree than variety selection. Harvest maturity, particularly, impacts forage quality because plant fiber increases with maturity. As an example, Table 2 gives quality data for alfalfa varieties in a test sown in 2001 at Farmington. No differences existed among varieties across FD categories, but there were differences among FD categories, likely due to stage of maturity at harvest. Regrowth after harvest is faster as fall dormancy category increases from 1 to 11 (from dormant to nondormant) and forage quality will decline with increased maturity. Therefore, if varieties in different fall dormancy categories are al-

ways harvested on the same day, as was the case in Table 2, those in lower FD categories usually will be at an earlier stage of maturity at the same harvest interval than varieties in higher FD categories. However, continued harvest at earlier maturities without regard to FD also depletes root carbohydrate reserves and can lead to stand loss after winter. Harvesting any variety at the late bud to early bloom stage will usually optimize the compromise between yield, quality, and stand persistence. It is possible that true quality improvements will be available in the future through traditional breeding or genetic modification; however, for the present it is best to select well-adapted, high-yielding, pest-resistant varieties without regard to reports of increased forage quality.

Summary

A successful alfalfa hay production system begins with selecting good varieties based on local adaptation; winter hardiness; resistance to diseases, insects, and nematodes; grazing or traffic tolerance; and seed quality, rather than seed cost or forage quality. Sustained benefit from the variety selection process in the form of higher yields—and therefore higher returns per acre over a longer life of the stand—is dependent on proper establishment, fertility, irrigation, harvest management, and pest control. For more information about alfalfa management, including when and how to renovate old alfalfa fields when productivity declines, contact your local county Cooperative Extension Service office or visit the NMSU Cooperative Extension Service agronomy publications website at http://aces.nmsu.edu/pubs/_a/.

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