CONSIDERATIONS IN CHOOSING AN ALFALFA VARIETY

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ABSTRACT

Choosing an alfalfa variety is arguably one of the most important decisions to make in an alfalfa operation. Variety selection impacts yield, forage quality, pest resistance and the life of a stand. The consequences of a poor decision last for years after establishment. Poor stand persistence can increase stand establishment costs (stands must be replanted more often) and reduce overall production revenue. While very important to most growers, the cost of seed should actually play a minor role when weighed against other more important considerations including yield, disease and insect resistance and other performance characteristics. A 'savings' of $1 per pound of seed can lead to losses of hundreds of dollars from reduced yield over the life of the stand. When choosing alfalfa varieties, growers should carefully consider local variety trial results from multiple years of field trials, climatic conditions and fall dormancy requirements, disease and pest history, stand persistence, and lastly seed price and availability.

Key words: Alfalfa, *Medicago sativa*, variety selection, pest and disease resistance, stand persistence, fall dormancy, yield trials.

INTRODUCTION

One of the most important decisions made by an alfalfa producer is which variety to plant. Variety selection will directly affect yield, quality, pest tolerance, and stand life. Because alfalfa is a perennial crop where stands typically last a minimum of 3 or more years, the variety choice involves a large commitment affecting years of production.

Yield should generally be the greatest determining factor in variety selection. The effect of climate and pest pressures on yield and quality of a particular variety can be substantial. Therefore, it is important to know the climate in your area to select a variety with the correct fall dormancy score. It is also critical to know the pest problems that prevail in your area. Fall dormancy and pest resistance ratings have been developed for alfalfa varieties to better understand their potential suitability for specific locations.

Although seed cost can appear significant at the time of planting, using it as the primary basis for variety selection is irrational. In relation to the overall performance of a variety,

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seed cost is normally insignificant. Over the life of a stand Putnam (2003) estimated seed cost to be less than 3% of the overall costs to produce alfalfa.

Choosing a variety should involve all of the previously mentioned considerations. There are several sources of variety information that can be accessed through university and industry sources. The internet can serve as a very helpful tool for accessing this information. Years of historical alfalfa variety information, as well as useful links related to choosing a variety, can be accessed through the California Alfalfa and Forages Workgroup website located at http://alfalfa.ucdavis.edu.

YIELD PERFORMANCE

Variety trials are conducted throughout the state of California to represent the primary production regions of the state. There are currently seven different variety trials located in each of the four major production regions in the state. University of California variety trials are conducted on multi-year basis consisting of at least 3 or more years of data.

The potential increase in revenue from enhanced yield with proper variety selection can be substantial. An example of 3-year data from the Kearney Agriculture Center in Fresno County is given in Table 1. This table shows yield differences of nearly 3.0 tons/acre.

While yield is the single most important factor in determining potential returns, it can also be highly variable due to climatic variation. Thus, it is important to look at multi-year trial data from an area similar in climate to the area of interest. If available, it is best to look at several years of data from different locations. You will have considerably more confidence in a variety selection decision if a variety has performed well across several locations with similar environmental conditions.

Interpreting data from the variety trial results can be challenging due to the high number of entries. Results are presented in descending order with the highest yielding variety at the top and the lowest yielding variety at the bottom (Table 1). Yields are expressed as a mean of four or five replications or as a percentage of the check or standard variety (commonly CUF 101 or Vernal depending on the trial location). A series of letters indicating statistical differences often follow the average yield column. These letters indicate statistical differences between varieties—varieties that are not followed by the same letters are considered statistically different in yield (see Table 1).

There can be large differences in variety performance between cuttings, between years, and within a regional area. For example, in Table 1, the experimental variety UC 2212 yielded 28th in the first year of production, but was ranked number 1 by the third year (Table 1). Therefore, it is very important to use data from as many years and trials as possible from different sources in selecting a variety. These trials should have multiple years of data (3 years or more). It is helpful to focus on about the top third of the varieties in a particular trial for decision-making purposes.

Table 1. UC KERNEY ALFALFA CULTIVAR TRIAL 2000-02 YIELDS. TRIAL PLANTED 9/16/99.
This table is provided as an example of alfalfa yield data collected each year from 7 locations throughout California. For a complete review of alfalfa yield trial data, see http://alfalfa.ucdavis.edu.

ENTRY	FD Score	2000	2001	2002	AVERAGE	% OF CUF 101
		Dry Ton/Acre				%
Released Varieties						
WL 625 HQ	9	11.12 (1)	14.06 (3)	12.37 (2)	12.51 (1) A	118.7
SW 8718	8	11.00 (2)	14.19 (1)	12.15 (3)	12.45 (2) A	118.1
UC-2212	9	10.11 (28)	14.07 (2)	12.40 (1)	12.20 (3) A B	115.7
Mecca II	9	10.58 (10)	13.26 (8)	11.53 (5)	11.79 (7) A B C D E	111.8
DynaGro AL999	9	10.58 (7)	12.95 (12)	11.36 (8)	11.63 (9) B C D E F G	110.3
Dura 843	8	9.83 (35)	13.59 (7)	11.27 (9)	11.56 (11) B C D E F G H	109.6
PGI 481	8	10.28 (22)	13.26 (9)	10.88 (15)	11.48 (13) B C D E F G H I	108.8
Pershing	8	10.58 (8)	12.52 (24)	10.98 (12)	11.36 (14) C D E F G H I J	107.8
Ameristand802 (ZX9	8	10.48 (13)	12.63 (20)	10.92 (14)	11.34 (15) C D E F G H I J	107.6
SW 9500	9	10.35 (19)	12.72 (17)	10.72 (19)	11.26 (16) C D E F G H I J K	106.8
Magna 901	9	10.32 (20)	12.54 (23)	10.74 (18)	11.20 (18) C D E F G H I J K L	106.2
57Q77	7	10.14 (27)	12.43 (27)	10.93 (13)	11.17 (21) D E F G H I J K L	105.9
ADF 99-801	9	10.53 (12)	12.73 (16)	9.89 (37)	11.05 (25) E F G H I J K L M N O	104.8
WestStar	9	10.16 (25)	12.47 (26)	10.41 (25)	11.02 (26) F G H I J K L M N O P	104.5
El Tigre Verde	8	9.40 (41)	12.63 (21)	10.69 (20)	10.90 (29) G H I J K L M N O P	103.4
Achiever	7	10.17 (24)	11.96 (38)	10.32 (27)	10.82 (31) H I J K L M N O P Q	102.6
58N57	8	9.92 (32)	12.10 (34)	10.09 (34)	10.71 (33) J K L M N O P Q	101.5
Yolo	8	9.42 (40)	12.50 (25)	10.18 (32)	10.70 (34) J K L M N O P Q	101.5
Falcon	8	9.61 (38)	12.09 (36)	10.00 (35)	10.57 (35) K L M N O P Q	100.2
CUF 101	9	9.64 (37)	12.10 (35)	9.89 (36)	10.54 (36) K L M N O P Q	100.0
Magna 8	8	9.60 (39)	12.29 (31)	9.66 (40)	10.52 (37) K L M N O P Q	99.7
Highline	9	10.21 (23)	12.36 (30)	8.85 (45)	10.47 (38) L M N O P Q	99.3
SW 9301	9	8.87 (45)	11.90 (40)	10.28 (28)	10.35 (41) N O P Q R	98.2
ADF 98-801	7	9.04 (44)	11.66 (42)	10.19 (31)	10.30 (42) O P Q R	97.7
Dura 765	7	10.04 (30)	11.14 (44)	9.66 (41)	10.28 (43) P Q R	97.5
Tulare	8	9.15 (42)	11.41 (43)	9.74 (39)	10.10 (44) Q R	95.8
Fiesta (8G519)	8	9.13 (43)	11.05 (45)	8.92 (44)	9.70 (45) R	92.0
MEAN		10.15	12.61	10.57	11.11	
CV		6.90	5.70	6.10	6.20	
LSD (.05)		0.98	1.01	0.90	0.76	

NOTES: Variety X Year interaction is significant

Trial seeded at 25 lb/acre viable seed on Hanford fine sandy loam soil at the Univ of Calif. Kearney Agricultural Center, Parlier, CA. Entries followed by the same letter are not significatly different at the 5% probability level according to Fishers (protected) LSD.

Varieties can change from location to location. To illustrate changes in variety performance between locations, refer to Table 2, which depicts the difference in yield for Variety A from two different locations in the Intermountain region. Data from the Scott Valley trial showed Variety A to be the highest in yield, while the same variety ranked 28th in yield over the same 3-year period in Tulelake (Table 2). Most other varieties performed similarly at the two locations. Therefore, it can be important to identify how well varieties perform across different locations. Thus, it is important to find data from trials as similar in climate and soil type as possible to your farm.

Table 2. Differences in yield (tons per acre) of a variety from trials conducted in Scott Valley and Tulelake in the Intermountain Region of California.

Entry	Location	1999	2000	2001	2002	Ave.	(rank)
Variety A	Scott Valley	4.16	7.67	7.89	7.62	6.84	(1)
Variety A	Tulelake	3.94	8.46	7.35	9.08	7.21	(28)

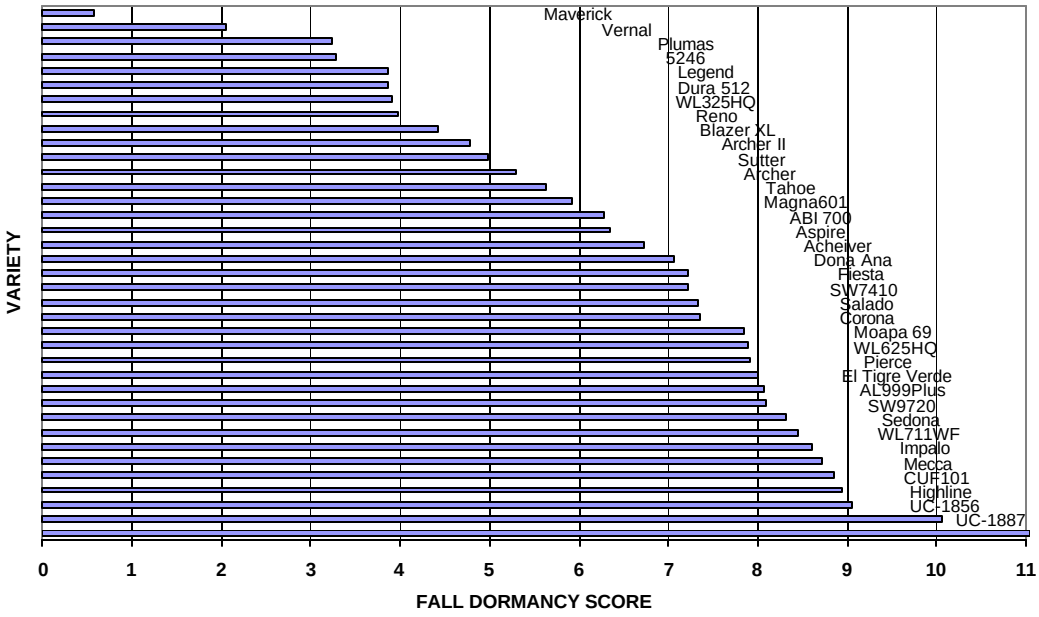
A variety trial best represents variety performance at the location where the trial is conducted under the specific environmental conditions present (climate and soil) and management (cutting schedule, irrigation, fertilization, etc.) used at that site. Actual field conditions and management at your farm may be different. Therefore, it can be helpful to use on-farm trials to monitor yields in large strip plots to better assess performance under your environment and management. Select from the top yielding varieties in the University trials. It is best to plant several strips within a field and replicate (plant each variety in more than one strip) if at all possible. This greatly improves the accuracy of the results. It is possible to compare varieties in different fields but use caution, as the results can often be misleading. Differences in soil and management between fields can overshadow the true differences between varieties.

EFFECTS OF CLIMATE ON VARIETY PERFORMANCE-FALL DORMANCY

Variety selection can be challenging in California due to the diversity in the state's climate, which has a profound effect on variety performance and yield (Figure 1). Alfalfa varieties vary in their response to day length and temperature. Dormant varieties largely cease active growth in fall in response to shorter day length and cooler temperatures. This is a protection mechanism against low temperatures and freezing conditions. In contrast, nondormant varieties are less responsive to photoperiod (day length) and will continue to grow through the winter as long as temperatures are favorable. A fall dormancy scoring system has been developed to quantify the dormancy of a variety to assist growers with variety selection. Dormant cultivars (ratings of 1-3) are very sensitive to changes in day length and temperature, whereas non-dormant varieties (ratings of 7-9) are more insensitive to day length changes.

Figure 1 illustrates a range of varieties and their Fall Dormancy Scores. These are commonly reported by seed companies (Figure 1 contains actual measured FD scores, which may differ slightly from those reported by seed companies).

Figure 1. FALL DORMANCY SCORE OF SELECTED VARIETIES
(data from UC trials conducted by L. Teuber and K. Taggard, 2002)



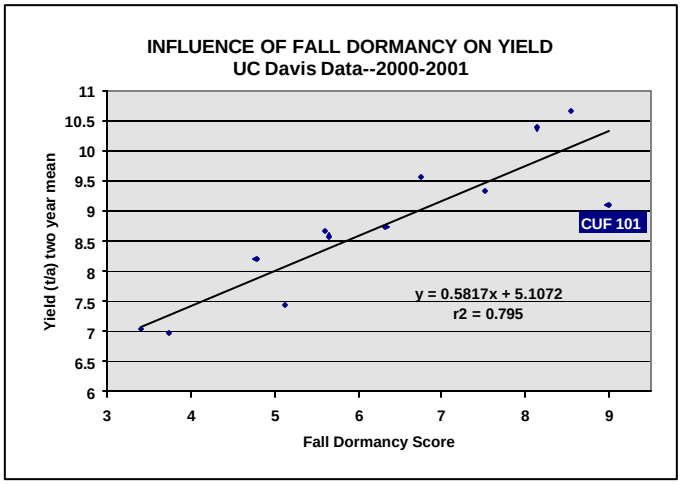


Figure 2. Influence of Fall Dormancy Score on Yield. Yield data is from 1999-planted trial ('01-02 data), and FD scores from UC Fall Dormancy Trial.

The effect of fall dormancy on yield is shown in Figure 2. Choosing the proper fall dormancy presents a dilemma. If too dormant a variety is selected yield is sacrificed (less fall and early spring growth), but if a too non-dormant variety is selected significant injury and even stand loss may result as the variety may be unable to withstand severe winter temperatures.

In the Intermountain region a fall dormancy rating of 2 to 4 would be desirable to minimize stand and yield loss from low winter temperatures and spring frost. However, in the Imperial Valley desert climate a non-dormant variety with a rating of 8 to 9 is advised. A non-dormant variety recovers more rapidly after cutting and continues growing throughout most of the year because of the mild winter temperatures in the Low Desert. Varieties should be selected with the appropriate fall dormancy rating that fits your local climatic conditions.

PEST AND DISEASE RESISTANCE

Alfalfa varieties vary in their resistance to insect, nematode, and disease pests. Yield performance and stand persistency of a variety is assumed to be directly related to pest resistance (Orloff and Carlson, 1997). Pest pressure can be highly variable throughout the state, even from year to year in any one location. Pests such as weevils, aphids, nematodes, and various diseases can significantly affect stand life and yield. While an insect pest rating of moderate resistance (MR) to resistance (R) is generally all that is needed for varieties to be planted in the cool climate of the Intermountain region, high resistance to most of the pests outlined in Table 3 is required for varieties produced in the Imperial Valley.

The minimum resistance recommendations required in the six alfalfa-production regions of California are outlined in Table 3. Vern Marble, UC Cooperative Extension Specialist emeritus, developed these recommendations through years of experience. A number of insects are important pests in alfalfa. Frequencies of occurrence and infestation levels vary considerably throughout the state. Root and crown diseases are more common, but not limited to, poorly drained soils with high clay content (Putnam et al., 1993). Plant parasitic nematode pressure is often localized and site specific (Carlson, 1991).

There is a much stronger need for high resistance to certain pests in some areas rather than others. For example, aphid resistance is much more important in desert and hotter Central Valley locations than in the cooler mountain regions (Table 3). However, while resistance to Verticillium wilt is not as important in low desert climates, it is essential in mountainous areas and the high desert.

It should be clear to growers that often times pest resistance is the ONLY economical method to combat certain diseases and pests. Diseases and insects may not occur every year. However, the use of pest resistance ratings to choose varieties is much like the use of insurance—its very valuable in those years that pest becomes important.

Table 3. Suggested minimum alfalfa cultivar pest resistance and fall dormancy ratings [1] for alfalfa pests found in six California climate zones [2].

Zone[2]	FD	SAA	PA	BAA	PRR	BW	FW	San	Stn	RKN	VW
Intermountain	2--4	SAA	R	MR	R	R	HR	R	R	R	R
Sacramento Valley	4--8	MR	HR	HR	HR	MR	HR	R	R	R	R
San Joaquin Valley	7--9	R	HR	HR	HR	MR	HR	R	HR	HR	R
Coastal	5--7	MR	HR	HR	HR	MR	HR	R	HR	HR	R
High Desert	4--7	R	R	R	R	MR	HR	MR	HR	HR	R
Low Desert	8--9	HR	HR	HR	HR	S	HR	HR	R	HR	S

[1] Pest Resistance abbreviations described below.

NOTE: These pest Resistance Ratings were originally developed by Dr. Vern Marble, Extension Agronomist, UC Davis, based upon decades of experience with alfalfa variety response in various locations in California.

[2] Zones correspond to the principle regions of alfalfa Production in California.

Resistance Abbreviations		**Percent resistance [1]**
HR	Highly Resistant	>51%
R	Resistant	31-50%
MR	Moderately Resistant	15-30%
LR	Low Resistant	6-14%
S	Susceptible	<5%

STAND PERSISTENCE

Stand persistence is an important consideration when selecting a variety, especially when a stand life of greater than 3 years is desired. Unlike annual crops, the producer will be committed to an alfalfa variety for several years. Improved stand persistence increases the productive life of an alfalfa stand and the establishment costs become less significant while overall revenue increases. Therefore, varieties should be selected for increased persistence.

Alfalfa varieties differ in their ability to compensate for stand losses due to self-thinning, weeds, and other environmental effects (Putnam et al., 1993). Stand persistence is commonly rated in University variety trials on the basis of either stand counts or stand ratings. Variety trials are rated for percent cover as a proportion of soil surface covered by the canopy. As stands decline, yield and quality of the hay can decrease substantially. Weeds invade the open spaces between alfalfa plants and weed control becomes increasingly difficult as alfalfa plant density declines. Eventually, growers are faced with the decision of whether or not to keep a stand for another year or replant. Information on stand persistence should be available through variety trial information accessed by informational resources.

SEED COST: IS IT SIGNIFICANT IN VARIETY SELECTION?

Many people approach the variety selection decision with the mindset of trying to save a 'buck' and end up purchasing cheap seed. However, cheap seed may not end up being the bargain in the long run. If you consider the economics of variety selection in a perennial crop like alfalfa, you can stand to lose hundreds of 'bucks' with this approach. In terms of the relative importance of the different criteria used to select a variety, seed price ranks at the bottom. Although the seed costs can be significant at the time of planting, the yield difference that results from higher seed cost for better performing varieties offsets the lower establishment costs from cheaper low quality seed.

Figure 3. NET RETURNS for Improved Varieties compared with CUF 101
(Added Yield Compared with Added Seed Cost--Kearney Trial, 2000-2002)

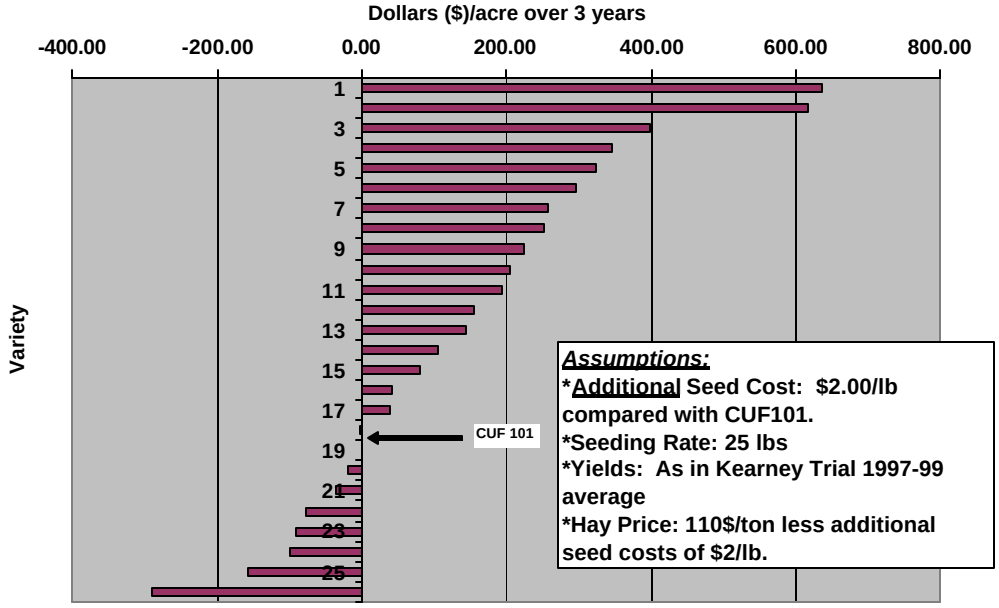


Figure 3 shows the NET return from variety choice. Seed costs typically range from about $1.00 to over $3.00 per pound between alfalfa varieties. In this analysis, we assume that any variety except CUF101 costs $2.00 more per lb., and yields and returns measured over 3 years. Yield of varieties can vary by 2.5-3 tons per acre per year. However, the amount of yield necessary to justify even a $2.00 increase in the price of seed is only 0.1 or 0.2 of a ton! In various cost analyses such as these conducted by Putnam (2003) using variety trial information throughout the state, increased revenue from planting higher performing varieties could be as high as $600 per acre over the life of the stand when compared with check varieties (see Figure 3). These figures were based on assumptions of $2 additional cost in seed, a seed rate of 25 lbs per acre, 3-year average yields, and a $100 per ton hay price. Differences realized in this analysis were only due to differences in variety performance (assuming that the variety would perform in a grower's field similar to the variety trial). Therefore, the primary decision in alfalfa variety selection should be based on performance rather than seed cost.

INFORMATION RESOURCES TO ASSIST WITH VARIETY SELECTION

There is an abundance of alfalfa variety information based on years of variety trial research conducted by public agencies and private industry. The volume of available information can make the variety selection process confusing, but the Internet can serve as an organized database for accessing and interpreting the information. Search engines available on the web allow you to make comparisons with variety data that would otherwise be cumbersome with hard paper documents.

Much of the variety trial information pertinent to growers in California can be accessed through the California Alfalfa and Forage Workgroup website located at http://alfalfa.ucdavis.edu. You can search the UCALF database for over thirty years of UC variety trial information. There is also access from this website to a number of links and variety information from other states by going to "Variety Trial Information", or the California Variety homepage. The link to the North American Alfalfa Improvement Conference (NAAIC) provides specific alfalfa variety descriptions and information from trials in other states. The Alfalfa Council Variety leaflet gives up-to-date information regarding fall dormancy, pest, and disease ratings outlined in Table 3 for the most current varieties. For UC variety trial information prior to 1994 you may contact Dan Putnam, UCCE Forage Specialist, UC Davis.

We suggest a sequence for choosing an alfalfa variety that includes all of the factors discussed above (Figure 4). The most important of these in most cases is likely to be yield. Secondly, fall dormancy should be determined, then pest resistance. Forage quality may be important for some growers, but caution should be used, since yields are often reduced with higher quality varieties. Lastly, after the performance potential of the variety is estimated, the price becomes important as illustrated in Figure 3.

CONCLUSIONS

The combination of a tremendous amount of alfalfa variety information generated from years of variety trials, coupled with a high degree of variation in climate throughout California makes variety selection in the state very challenging. We suggest a 5-step process to determine the best variety for your ranch. While yield is the most important criteria in selecting a variety, interpretation of trial results should include multiple years of data and be supplemented by field strip trials or grower experience when possible and credible. Climate and pest ratings of varieties should be compared to historical pest occurrences and weather data of local conditions to increase stand persistence and productivity. Use fall dormancy ratings to select the proper dormancy for your local climatic conditions to maximize fall growth and minimize spring frost damage or winter kill in cooler areas. Although the seed cost can seem significant at planting time, the potential increase in revenue from improved variety performance far outweighs any savings from cheaper seed. Informational resources available through the internet and your local University of California Cooperative Extension office can serve as a readily available source of up-to-date information for selecting the proper alfalfa variety that fits your local conditions.

Figure 4. Steps for choosing an Alfalfa Variety for your Ranch:

1. Choose a high-yielding variety. The first step is to determine whether a variety has high yield potential—usually the most important economic determinant in alfalfa production. The yield measurement integrates many other variety characteristics, including Fall Dormancy, Pest Resistance and Persistence. Check the most relevant multi-year yield for your region. Choose a group of high-yielding varieties (typically the top 1/3 of the trial, not just the top variety) as a group of acceptable lines to consider.

2. Determine your Fall Dormancy Requirements. Fall Dormancy affects yields and quality, but also the ability of the variety to survive. Discuss the FD adaptation for your climate and soil type with your UC Farm Advisor and seed company rep.

3. Determine Pest Resistance Characteristics. Resistance of your variety is often the ONLY way to economically combat certain pests and diseases. Even if a disease hits only 1 year out of ten, it may be severe enough to cause economic damage, and worthwhile to choose a resistant variety. Judge your need for a pest resistance package for your area considering all of your common pests, and those that may be severe if infrequent. Pest resistance should be considered an 'insurance policy' for down-side risk management, and contribute to higher yields and persistence.

4. Look for Evidence of Better Persistence, Forage Quality. Forage quality and persistence do differ between varieties, but be careful! If a seed company claims higher quality, carefully check the yield level. Often better quality is accompanied by lower yields. A more persistent line may not be worthwhile, if its yearly yields are significantly lower. Look for data which are evidence for both high yields and high quality.

5. Price/Availability/hats. Once you've estimated the potential PERFORMANCE of the variety, it's time to look for the best PRICE and other factors, such as whether the seed company rep is your favorite in-law. However, it's seldom economically rational to choose only the cheapest variety. And of course- there are the all-important seed company hats !

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