COOPERATIVE EXTENSION
COLORADO STATE UNIVERSITY
APRIL 1999
VOLUME 19
ISSUE 4

agronomy news

Where Does Birdsfoot Trefoil Fit In Colorado?

Salt-affected soils, high mountain meadows, and potential harvest delays could mean birdsfoot trefoil is the right forage.

FORAGES ISSUE INSIDE:


Birdsfoot Trefoil

Birdsfoot trefoil (Lotus corniculatus) is a forage legume that has not been widely planted in Colorado although it has characteristics which make it well suited for certain environments. Because of its greater tolerance to salinity compared to alfalfa, birdsfoot is being evaluated as a potential species for use on salt affected soils in the Arkansas Valley. Jim Valliant, Regional Irrigation Specialist at Rocky Ford, is conducting the evaluations of birdsfoot trefoil for that area. Please do not hesitate to call Jim (719-254-7609) for the latest information on how trefoil is doing on these soils.

The other environment where birdsfoot trefoil is potentially adapted in Colorado is found in the higher elevation mountain meadows of the western part of the state. Most forage producers at higher elevations cut their meadows once for hay and then graze any regrowth in the fall. Birdsfoot trefoil fits this production scheme well because first cutting yields are comparable to alfalfa and the regrowth can be safely grazed due to trefoil's non-bloating characteristic. Trefoil does not work as well at lower elevations where multiple cuttings are taken because it is slower to regrow, especially compared to alfalfa, which limits total seasonal yield.

A positive attribute of birdsfoot trefoil compared to alfalfa is that forage quality does not decline as

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Birdsfoot

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rapidly with maturity. This trait has positive implications for producers that cannot realistically harvest all their hay at peak quality due to constraints such as time, labor, or weather. Alfalfa that has been interseeded into mountain meadows is typically over mature by the time it is harvested and may only have a crude protein content of 14%. Overall, forage quality of trefoil is comparable to alfalfa and other legumes commonly grown in mountain meadows.

Birdsfoot trefoil is most productive when grown on fertile, well-drained soils with a pH above 6.5. However, it tolerates wetter soil conditions than alfalfa, but not as wet as for alsike and some of the other clovers. Trefoil can also survive short periods of flooding which is important in mountain meadows due to the less than ideal irrigation conditions. Birdsfoot also grows well on low fertility soils, especially those low in phosphorus. It is not as sensitive to soil phosphorus levels compared to alfalfa and some of the clovers. Once established, trefoil can survive periods of drought and appears to be a longer lived plant under most conditions when compared to alfalfa.

The biggest drawback to birdsfoot trefoil is that seedlings lack vigor which can reduce establishment success. Interseeding is the most common method used to introduce legumes into existing meadow vegetation. However, proper seeding techniques and careful management must be used when interseeding birdsfoot trefoil to overcome its lack of seedling vigor during the establishment year. The following recommendations should be followed to improve establishment success.

❖ Seed in the early spring (April-May) prior to the initiation of rapid growth. Seeding can also be done in mid-July (if irrigation water is available) following an early hay crop or in the late fall just prior to the ground freezing.

❖ Suppress the existing vegetation prior to seeding using methods such as herbicides (Roundup), intensive grazing, or light tillage.

❖ Drilling is generally more successful than broadcasting.

❖ Seed must be inoculated with the appropriate Rhizobium bacteria to insure nitrogen fixation. If you do not plant inoculated seed, you might as well leave the drill in the shed.

❖ Plant seed of known origin and variety, not VNS (Variety Not Stated). Certified seed is generally worth any extra cost. Keep in mind that the larger the seed, the more vigorous the seedlings will be as seed size and vigor are strongly correlated.

❖ 'Norcen' and 'Leo' are two varieties that appear to be adapted to and establish well in mountain meadows. However, most local seed dealers do not carry these varieties, but can order them if you ask far enough in advance. 'Leo' is the more difficult one to get since it is of Canadian origin.

❖ Planting rates of 4 to 6 lbs/ac are adequate for interseeding. These rates account for some anticipated loss of seedlings due to competition from the existing vegetation.

❖ Hay earlier than normal (2-3 weeks) during the first year to remove the overstory of existing vegetation. Otherwise, the seedlings become spindly and weak due to shading and often do not survive through the winter.

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agronomy news
is a monthly publication of Cooperative Extension, Department of Soil & Crop Sciences, Colorado State University, Fort Collins, Colorado.
Web Site:
http//www.colostate.edu/Depts/SoilCrop/extens.html

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Birdsfoot

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❖ Do not graze seedlings during the year of establishment.

Many of the above recommendations were derived from a study that was initiated in 1994 near Gunnison. Five varieties of birdsfoot trefoil - 'Carroll', 'Empire', 'Leo', 'Norcen', and 'Tretana' - were interseeded into 3 types of seedbeds - no suppression (Control), Roundup sprayed (1 ½ qts/ac), and lightly rototilled (1 to 2 inches deep). In this study, interseeding birdsfoot trefoil into existing mountain meadow vegetation increased total hay yield an average of 1000 lbs/ac compared to the unseeded control (see Table 1). All 5 varieties established well and increased yield with the 'Leo' and 'Norcen' varieties having slightly higher yields than some of the others tested. Averaged across varieties, birdsfoot trefoil contributed 22% to total hay yield.

Crude protein content of the hay was also increased by interseeding birdsfoot trefoil. This increase averaged 2.4 percentage points compared to the unseeded control (see Table 1). As with yield, there was a trend of higher protein hay as the contribution from birdsfoot trefoil increased. For example, the 'Leo' and 'Norcen' varieties contributed about 25% to total yield and increased the protein content of the hay about 3 percentage points. Basically, protein content of the hay went from a level that was marginal for dry, mature cows (7.5%) to one that was adequate for most classes of livestock.

The only negative to interseeding birdsfoot trefoil was that digestibility of the hay was slightly lowered (see Table 1). This is in spite of the fact that trefoil alone is highly digestible (>67%). The reason for the lower hay digestibility was probably related to lower digestibility of the grass component. Birdsfoot trefoil contributes nitrogen to the system through fixation plus leads to shading in the canopy which causes other plants to grow towards the light. Both of these factors contribute to stemmier grass growth which lowers digestibility. Since grass made up about 60% of the hay in seeded plots (see Table 1), it had a dominating effect on overall hay digestibility.

Table 1. Effect of interseeding various varieties of birdsfoot trefoil (BFT) on yield, composition, crude protein content, and dry matter digestibility of mountain meadow hay, 3 year averages.

Variety	Yield	Hay Composition			Crude Protein	Dry Matter Digestibility
		Grass	BFT	Other		
	(lb/ac)	----------	----------	% ----------	----------	----------
Control	3300 a	83 b	0 a	17 a	7.5 a	65.6 c
Carroll	4240 bc	66 a	20 b	14 a	9.4 b	64.5 abc
Empire	4240 bc	65 a	19 b	16 a	9.8 b	65.0 abc
Leo	4470 c	56 a	24 b	20 a	10.5 b	63.2 ab
Norcen	4620 c	59 a	26 b	15 a	10.2 b	62.9 a
Tretana	3960 b	64 a	19 b	17 a	9.5 b	65.2 bc

Variety means were averaged over seeding methods and years.
Means within columns followed by the same letter are not significantly different (P>0.05).

Although this meadow was ideal for interseeding (i.e. low producing with patches of bareground), suppression of the existing vegetation was important for improving establishment success of the trefoil. Birdsfoot trefoil contributed only 12% to total hay yield in the direct seeded plots compared to 18 and 24%

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Will Ripping Or Aerating Improve Pasture Or Meadow Productivity?

Consider all conditions and test these tactics before using them on your entire grassland.

Renovating pastures and meadows using ripping or aerating is a somewhat common practice. In theory, these practices should be beneficial at improving productivity of pastures and meadows but there is little research based information from Colorado or other areas that supports this idea. Differences in soil type, plant species present, topography, irrigation practices, and soil water availability can all interact to determine whether the response to ripping or aeration will be positive, negative, or null. Therefore, producers should try these practices on a small part of their total acreage before fully implementing them. The costs of applying these practices are quite high when equipment (implement plus tractor with enough horsepower), fuel, and labor are considered to not get a positive yield response. Potentially, there are benefits that do not translate directly to increased production during the year that ripping or aerating is applied. Promoting improved plant vigor by increasing water infiltration and deeper root systems may only be beneficial during a year when irrigation water is short or plants are under drought stress. These scenarios are often hard to quantify under research conditions. Because of the uncertainties associated with these practices, the following discussion of potential benefits should be interpreted with cautious optimism.

Eliminating sod bound conditions and promoting water infiltration can potentially improve meadows and pastures with marginal hay yields. Grasses such as smooth brome and meadow foxtail often develop dense root masses at the soil surface which creates sod bound conditions. When sod bound, plant growth is stunted due to poor water infiltration and crowding within the root zone. Meadow and pasture plants need to constantly develop new roots to stay healthy and productive. Mechanically disturbing the root system can help alleviate sod bound conditions and promote healthier, more productive plants. On pastures and meadows that have heavy clay or compacted soils, aerating and ripping can improve water infiltration by fracturing the soil allowing better downward movement of water and roots. On side sloping meadows that are difficult to irrigate, ripping grooves along the contour of the slope can help distribute water more evenly. Retaining water longer on the side slopes allows more time for infiltration and helps reduce ponding in the low areas.

The two basic types of implements used to renovate pastures and meadows are rotating spike aerators and shank type rippers. Rotating spike aerators such as the Aerway Aerator are commonly used because this type of implement works well in the shallow, rocky soils often found in meadows. The rotating spikes create holes 4 to 8 inches in depth while minimally disturbing the soil surface. Shank type rippers create continuous grooves up to 8 inches

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in the rototilled and sprayed plots.

In conclusion, birdsfoot trefoil can be successfully interseeded into mountain meadows and should be considered as a potential legume for this environment. The greatest success can be achieved by using the right variety, 'Leo' or 'Norcen', and suppressing the existing vegetation prior to seeding. Once established, trefoil is long-lived and can contribute significantly to both yield and quality, especially crude protein content.

Aerating

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deep depending on soil and moisture conditions. Shank type rippers are similar to chisel plows except the shanks generally are not as aggressive and soil penetration is not as deep. Ripper shanks generally range from ¾ to 2 inches in width and are set on 12 to 18 inch centers depending on the manufacturer. Shank rippers do not work well in rocky soils as the shanks are often damaged or tend to pull rocks to the surface. They also require more horsepower and slower ground speeds than rotating spike aerators. The ripping action does disturb the soil more than rotating spike aerators, which may make it the better implement for severely sod bound conditions and compacted soils.

Generally, ripping and aerating are done in early spring as soon as meadows and pastures became accessible and before irrigation water is applied. Ripping and aerating are not frequently done in the fall since many meadows become very dry after the hay is removed. Such dry conditions make it difficult for the implements to penetrate the soil. If adequate soil moisture is present, fall ripping or aerating may be an option.

Aerating and ripping are not always beneficial towards improving the productivity of pastures and meadows. A multiple year study done on two mountain meadows near Gunnison, CO found that aerating and ripping did not improve productivity and, if anything, caused a significant decline (Table 1). Both sites had a well defined layer of organic matter several inches thick on the soil surface. These meadows were also inundated with water throughout much of the growing season due to the flood irrigation practices. The decline in production may be partially due to disturbance of vegetation caused by the equipment and partially due to making an already wet area even wetter by opening up the sod mat so it could trap and retain even more water than normal.

When deciding to aerate or rip a pasture or meadow, it is important to consider soil characteristics and irrigation practices. On low lying wet meadows with peaty soils, aerating and ripping most likely will not be beneficial and may actually cause a significant decline in production. On dryer meadows, especially with compacted or heavy clay soils, aerating and ripping may improve productivity by alleviating sod bound conditions and improving water infiltration. Ripping can also be used to improve water distribution, especially on side sloping areas. However, as advised earlier, it would be wise to conduct small, site specific tests before fully implementing these practices with the expectation of increased productivity.

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Table 1. Changes in hay yields at two sites near Gunnison, CO from aerating and ripping, three year averages from 1995 to 1997

Treatment	----------Meadow A----------		----------Meadow B----------	
	lbs/acre	% change	lbs/acre	% change
Control	5130		3880	
Aerway Aerator	4090	-20.3	3090	-20.4
Ripped on 12 inch Centers	3770	-26.5	3540	- 8.8
Ripped on 6 inch Centers	3490	-32.0	3370	-13.4

Dry Bean Management Clinic Field School

August 10, 1999 or August 12, 1999
7 a.m. to 5:30 p.m.
at ARDEC
4616 NE Frontage Road, Fort Collins, CO (I-25 at exit 271)

Registration $150. Registration deadline June 15. $50 late registration fee. $25 discount for participants in Winter Dry Bean Clinic.

Call Conference Services at (970) 491-7501 for registration. Call Dusty Lewis at (970) 491-1917 for program details.

Does Colorado Alfalfa Need Boron ?

Boron rate studies in Colorado show fertilization is beneficial only under certain conditions.

Alfalfa is known to have a high boron (B) requirement and boron fertilization is commonly recommended back East. Boron fertilizer is sometimes recommended for alfalfa in Colorado although, in general, our soils have plenty of boron to supply the requirements of a vigorous alfalfa crop. Soils most likely to be low in boron are those with a pH near 8.5, low organic matter levels, and a sandy texture. Alfalfa rarely displays boron deficiency symptoms prior to the first cutting. Later in the season, one may observe bunchy, rosette growth due to shortened stems, yellowish red coloration of younger leaves, and eventually death of the terminal bud. These symptoms are signs of possible boron deficiency.

In 1997 and 1998, we studied alfalfa yield response to boron at two different test sites. In each test, soil samples were taken prior to test initiation to confirm that soil boron levels were low (<0.1 ppm). Alfalfa tests were located near Yellow Jacket in southwestern Colorado and in the sandhills near Wray in northeastern Colorado. We evaluated five boron application rates: 0, 0.5, 1.0, 2.0, and 4.0 lbs B/A. Solubor (from U.S. Borax) was used as the boron source and was applied prior to the first irrigation; the 4 lb/A rate was split into two applications before and after the first irrigation in order to avoid burning.

There was no effect of B application rate on alfalfa yield at either location, either by individual cutting or total yield (Tables 1, 2, and 3). We intentionally placed each of these tests under conditions where we thought a B response was probable. Locations had low soil B and low soil organic matter levels. The Wray site was also sandy. However, we still did not get measurable yield responses.

Table 1. Impact of boron application rate on alfalfa yield results (tons/A) in 1997 near Yellow Jacket, CO.

B Rate (lb/acre)	*First Cutting*	*Second Cutting*	*Third Cutting*	*Total*
0	3.00	2.31	1.44	6.75
0.5	2.73	2.37	1.44	6.54
1.0	2.85	2.33	1.40	6.58
2.0	2.74	2.37	1.44	6.55
4.0	2.92	2.32	1.49	6.73

These results could be due to high B levels in the irrigation water. Irrigation water samples (92) from the South Platte Basin had an average B concentration of 0.52 ppm with a range from 0.03 ppm up to 2.30 ppm. If a crop consumes 30-36 inches of water/year, it would take up 3.5-4.2 lb B/year using "average" irrigation water. This is probably the main reason we have not measured yield responses to B in this area of the state.

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Boron

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However, the Wray site uses water from the Ogallalla Aquifer which we would expect to have a lower B concentration and the Yellow Jacket irrigation water tested at 0.02 ppm B. A boron concentration of 0.3 ppm in irrigation water would supply 2 lbs B/A (based on 30 inches of consumptive water use). Therefore, yield increases in alfalfa are most likely when soil B is less than 0.1 ppm and water B is less than 0.3 ppm. When soil and water B levels are above these critical levels, B fertilizer application will probably not increase alfalfa yields.

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Table 2. Impact of boron application rate on alfalfa yield results (tons/A) in 1998 near Yellow Jacket, CO.

B Rate (lb/acre)	First Cutting	Second Cutting	Third Cutting	Total
0	2.50	1.95	1.28	5.73
0.5	2.58	1.94	1.31	5.83
1.0	2.54	1.94	1.25	5.73
2.0	2.53	1.94	1.30	5.77
4.0	2.55	1.93	1.34	5.82

Table 3. Impact of boron application rate on alfalfa yield results (tons/A) in 1998 near Wray, CO.

B Rate (lb/acre)	First Cutting	Second Cutting	Third Cutting	Fourth Cutting
0	1.74	1.59	1.30	1.63
0.5	1.91	1.52	1.32	1.62
1.0	1.85	1.54	1.26	1.45
2.0	1.77	1.50	1.24	1.60
4.0	1.84	1.60	1.19	1.58

Forage Network: Connecting Colorado producers to forage related expertise

Do you have a question related to growing forages in Colorado? If you have email, then just drop a note to the following address:

forage@coop.ext.colostate.edu

It will be delivered to Colorado State University Research and Extension personnel throughout the state who have expertise in forages. Those that can answer your particular question will respond.

Evaluating Pasture Grasses

Warm-season grasses may be a good production choice in western Colorado.

Grasses are used extensively in Colorado to produce feed for livestock. In 1997, hay, other than alfalfa, was produced on 610,000 acres in Colorado and was valued at more than $127 million. Much of this production was, no doubt, grass hay.

New grass species and cultivars periodically become available for farmers and ranchers to plant. Comparative yield data are needed to assist producers in selecting grass species and cultivars that are well adapted to their production systems.

A pasture grass evaluation was planted at the Colorado State University Fruita Research Center during the spring of 1994. Sixteen grass entries are being grown on a loam soil under furrow irrigation and yield data have been collected over a four-year period from 1995 through 1998. The experiment has been fertilized regularly, often after each cutting. Of the sixteen entries being evaluated; 13 are single specie, cool-season grasses; two are grass mixtures; and one is a warm-season grass. The elevation at Fruita is 4510 feet with an average annual precipitation of 8.4 inches. The growing season is 175 days.

Switchgrass

'Blackwell' switchgrass (warm-season grass) and 'Fawn' tall fescue had the highest cumulative hay yields over this four-year testing period (Fig.1A). Eight of the sixteen entries were not significantly different for low cumulative hay yields. These were 'RS-H' experimental, 'Lincoln' smooth brome, 'Manchar' smooth brome, 'Latar' orchardgrass, 'Climax' timothy, 'Bozoisky-Select' Russian wildrye, 'Palaton' reed canarygrass, and 'Oahe' intermediate wheatgrass.

The data from this study indicate the possibility of using switchgrass as a pasture grass in the warm valley areas of western Colorado. However, the management and use of a warm-season grass will be different from the cool-season grasses. Switchgrass is slower to begin spring growth and is therefore not as competitive against winter annuals and other early-season weeds. Additionally, growers who require early season pasture production should rely on cool-season and not warm-season grasses. Those who desire to maintain hay production during the heat of the summer may find switchgrass to be suited to their production system. Over the years, the second and third cuttings of 'Blackwell' switchgrass have generally been much larger than the first cutting, typical of that shown in Fig. 1B for 1998 and in contrast to the cuttings for 'Fawn' tall fescue and many of the other cool-season grasses. Establishing separate fields of cool and warm-season grasses should give producers the ability to maximize seasonal pasture or hay production.

Observations of the plots during the fall of 1998 identified several entries that were very competitive

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Grass

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against other plant invaders, particularly weeds. Plots that were highly weed-free were 'Fawn' tall fescue, 'Regar' meadowbrome, Economy pasture mix, and Premium pasture mix. Mixtures of grasses are often more competitive against plant invaders as evidenced in this study. Grasses that are not highly competitive against plant invaders are more likely to become weedy and contaminated with other more aggressive grass species. Grass entries that have become quite weedy (dandelions, foxtail, buckhorn plantain) and contaminated with other grasses were 'Newhy' hybrid wheatgrass, 'Luna' pubescent wheatgrass, 'Oahe' intermediate wheatgrass, and 'RS-H' experimental.

This article does not contain information about forage quality for these entries. Forage quality of grasses should be considered when making selections for planting. We are in the process of collecting multi-cutting, multi-year data related to aspects of forage quality for these sixteen grass entries. We plan to collect additional yield and quality data in this study for several more years. If you have any questions related to this study, please communicate with me at the Fruita Research Center, 1910 L Road, Fruita, Colorado 81521, phone: 970-858-3629, fax: 970-858-0461, or E-mail: cpearson@coop.ext.colostate.edu.

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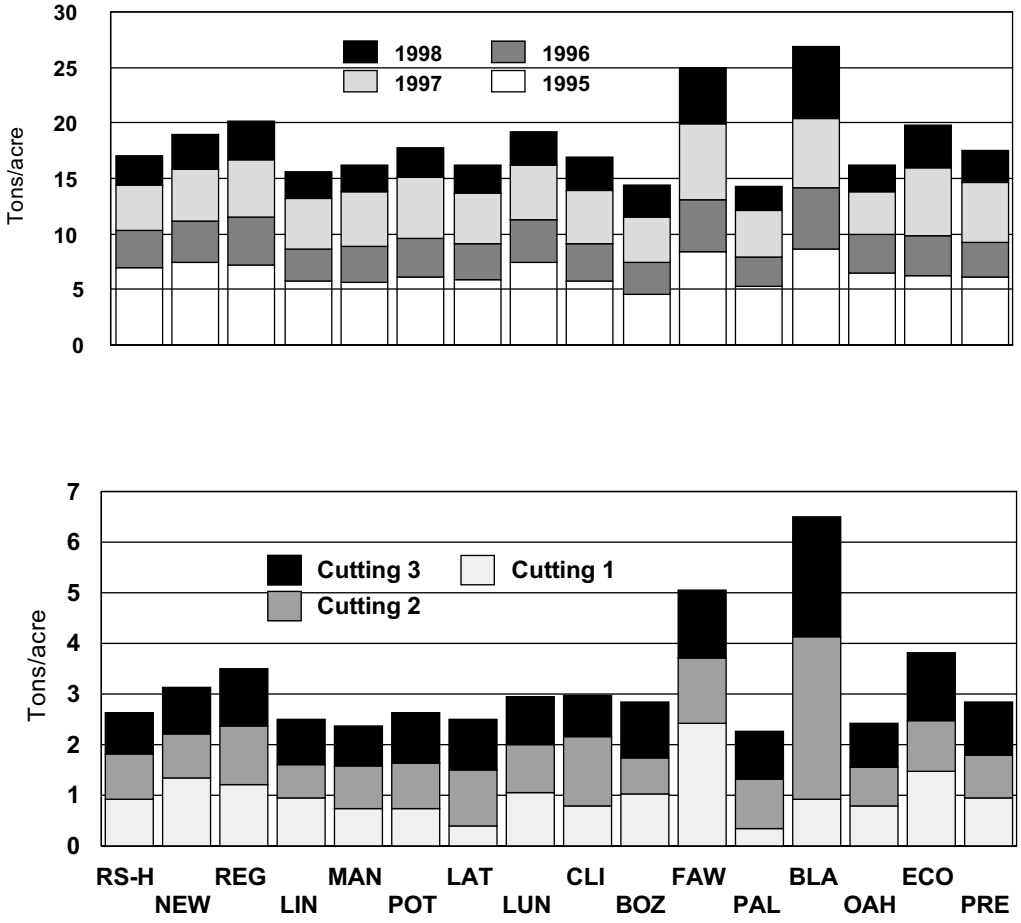

Fig. 1. Cumulative annual hay yields over a 4-year period from 1995-98 (A), and hay yields of pasture grasses of the three cuttings at Fruita, Colorado during 1998 (B). 'RS-H' = experimental; NEW = 'Newhy' hybrid wheatgrass; REG = 'Regar' meadow brome; LIN = 'Lincoln' smooth brome; MAN = 'Manchar' smooth brome; POT = 'Potomac' orchardgrass; LAT = 'Latar' orchardgrass; LUN = 'Luna' pubescent wheatgrass; CLI = 'Climax' timothy; BOZ = 'Bozoisky-Select' Russian wildrye; FAW = 'Fawn' tall fescue; PAL = 'Palaton' reed canarygrass; BLA = 'Blackwell' switchgrass; OAH = 'Oahe' intermediate wheatgrass; ECO = grass mix of orchardgrass, tall fescue,smooth brome, and perennial ryegrass; PRE = grass mix of meadowbrome, orchardgrass, and perennial ryegrass.

Alfalfa Winterhardiness Ratings For High Altitudes Available

These ratings are an important selection tool.

Alfalfa is grown at high elevations throughout intermountain Colorado. In the San Luis Valley alone, about 130,000 acres are grown at an average elevation of 7600 feet. Colorado's total acreage grown at elevations above 7000 feet is approximately 200,000 acres. Variety trials are conducted annually at San Luis Valley Research Center at 7660 feet elevation. Winter survivability is an important varietal characteristic for this and similar high elevation areas.

Brand	Variety	Dormancy Rating	Winterhardiness Rating
DeKalb	DK 127	3.2	1.9
DeKalb	DK 140	3.7	1.5
Northrup King	Rainier	3.0	2.0
Northrup King	Rushmore	3.9	3.1
America's Alfalfa	Innovator +Z	2.8	2.3
A. V. Seeds	LegenDairy 2.0	3.0	2.0

Note: Varieties with more dormancy and greater winterhardiness have lower ratings.

Fall dormancy ratings used to be the best available indicator for winterhardiness. Plants with low ratings went dormant earlier and tended to survive winters better than plants that went dormant later. However, alfalfa breeders in the 1980's intentionally selected plants with an atypical relationship between dormancy and winterhardiness. They were looking for varieties that continued fall growth but could still survive harsh winters. Varieties are now available with these characteristics.

Winterhardiness tests have been developed which have little relationship to the old dormancy rating. This new test was designed to intentionally winter stress varieties and then rate them for damage and survival. The test involves establishment of a nursery in which plants are clipped at the early bud stage with a final clipping in mid-September. This clipping regime stresses plants and allows for consistent winter injury even during moderate winters. Snow removal is sometimes used to add further stress. Most tests are conducted in Wisconsin or Minnesota. Surviving plants are counted and scored for injury with relative winterhardiness ratings ranging from 1 to 6 (dormancy ratings range from 1 to 9). These standard varieties were assessed a rating: Maverick (1.0), Vernal (2.0), Ranger (3.0), and Fortress (4.0). For these standard varieties, the fall dormancy and winterhardiness ratings are the same. The table below shows some varieties that have different ratings for fall dormancy and winterhardiness. Winterhardiness ratings for many new varieties are available from alfalfa seed companies.

Growers in the high altitude (>7000 ft elevation) intermountain area should select varieties with greater winterhardiness and relatively little dormancy. For those growers trying for three cuttings per year, fall dormancy should be 3 or higher. Varieties with early fall dormancy simply stop growing in late summer which results in reduced third cutting yields. On the other hand, select as much winterhardiness as you can get. Growers in high altitude areas should select varieties that have a dormancy of 3 or higher and a winterhardiness rating of 2 or lower. Other varietal characteristics such as yield and disease and insect resistance are still important. The winterhardiness rating is simply an added characteristic to consider when selecting an alfalfa variety.

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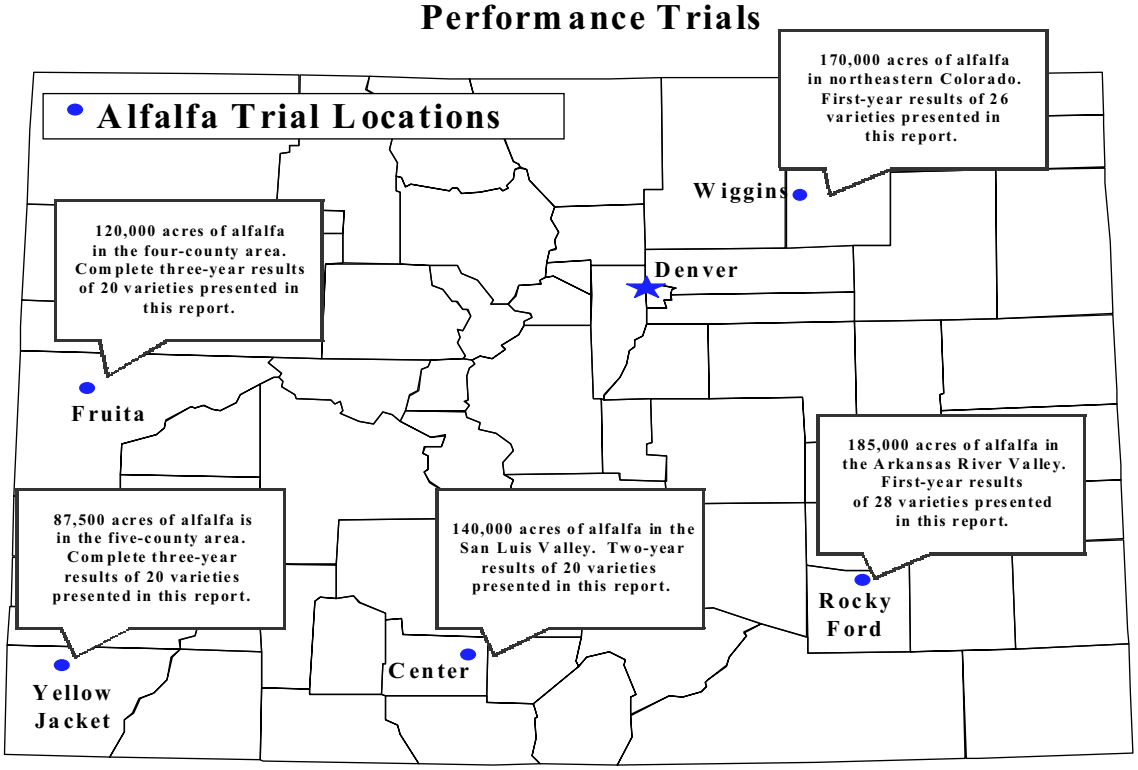
1998 Colorado Alfalfa Variety Performance Trials



To see alfalfa trial results from these locations, visit the web site at:
http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/alfalfa/alfalfa1.html

web sites

Looking for information about forages on the web? Try these sites:

http://www.cas.psu.edu/docs/casdept/agronomy/forage/forages.html
Penn State's Forage web page.

http://www.forages.orst.edu/
Forage information System liks to worldwide frage-related inforamtion, maintained by Oregon State University.

http://www.forages.css.orst.edu/Topics/Pastures/PGIS/index.html
Pasture and Grazinglands Information System, part of the Forage Infomation System.

http://wwwscas.cit.cornell.edu/forage.html
Forage - Livestock Systems at Cornell University.

http//www.psu.missouri.edu/lnl/
Lotus Newsletter, information specific to Birdsfoot Trefoil.

http://www.agric.gov.ab.ca/index.html
Forages and Range, part of the Alberta, Canada Agriculture, Food and Rural Development System.

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