Perennial Grass Trials for Forage Purposes In Three Areas Of Southcentral Alaska

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ABSTRACT

Forage trials of seeded perennial grasses were conducted at four sites in three areas of southcentral Alaska on soils with pH readings generally below 5.5 (down to 4.35). Three trials were at forested locations and one at a subalpine site. Each trial was sustained for three to five harvest years under a two-harvest system. 'Engmo' timothy (*Phleum pratense*), the standard forage grass on strongly acidic soils in the region, equaled or, more often, exceeded the other grasses in first-harvest yields, but often was surpassed in second-harvest yields. Grasses often substantially exceeding timothy in second-harvest yields included reed canarygrass (*Phalaris arundinacea*) and entries of tufted hairgrass (*Deschampsia caespitosa*) and Bering hairgrass (*D. beringensis*), sometimes providing more total yield than timothy. Some red fescues (*Festuca rubra*) and 'Nugget' Kentucky bluegrass (*Poa pratensis*) also tended to surpass timothy in second growth. Smooth bromegrass (*Bromus inermis*) failed at sites with soil pH below 5.3, but persisted at one site with pH varying from 5.3 to 5.7. 'Garrison' creeping foxtail (*Alopecurus arundinaceus*) also failed at these sites; its close relative meadow foxtail (*A. pratensis*), was better adapted to the strongly acidic sites. Indigenous polargrass (*Arctagrostis latifolia*) about equaled or surpassed timothy in yield at two of the sites, and bluejoint reedgrass (*Calamagrostis canadensis*) provided comparable but somewhat lower yields.

Timothy tended to be higher in digestible dry matter than most grasses, but near to below average in CP, P, K, and Ca concentrations. Some deficiencies occurred in energy values (DDM) and, except for red fescue, in Ca concentrations of first-harvest herbage relative to the requirements of a growing 500-lb steer. Crude protein of second-harvest herbage was deficient for many grasses at two sites, and DDM was marginal to low for some, but especially for bluejoint reedgrass.

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INTRODUCTION

Much of the land subject to agricultural development in southcentral Alaska contains soils which are more acidic than those in the Matanuska Valley, where most of the research on forages has been conducted. These soils also differ in other characteristics, such as volcanic ash content. Because of the soil differences coupled with regional climatic differences, current research information is inadequate for areas recently committed to agricultural development. Smooth bromegrass is the standard perennial forage grass in the Matanuska Valley. The cultivar 'Manchar' is most commonly used, although 'Polar' bromegrass has been determined to be superior in winterhardiness (Wilton et al. 1966). Polar bromegrass incorporates germplasm of the native pumpelly bromegrass (table 1) in its breeding stock and probably has wider adaptability in Alaska than other smooth bromegrasses. Unfortunately little seed of this Alaskan-developed variety has been produced for use by farmers. Small forage plantings have been made of Garrison creeping foxtail, a relatively recent introduction to Alaska. It sometimes is recommended for areas subject to ponding.

Timothy is the most relied-upon species for a seeded, perennial forage grass on acidic soils below pH 5.7 to 6.0. Meadow foxtail also has been used to some extent on strongly acidic soils. Bluejoint reedgrass is an important forage in some areas where extensive stands of this grass occur, generally on low pH soils. Native stands of bluejoint are grazed and harvested for stored forage, particularly on the lower Kenai Peninsula and on Kodiak Island. Stands of Bering hairgrass also provide a source of forage on Kodiak Island and in other coastal and island situations. Red fescue and Kentucky bluegrass are sometimes seeded in mixes where grasses are established for grazing purposes. Also see Klebesadel (1983) for a discussion of forages in Alaska.

Trials including these perennial grasses and others were established in the following three areas of southcentral Alaska, all of which are subject to current and future agricultural development: the upper Susitna

Valley near Talkeetna, the lower Susitna Valley at Pt. MacKenzie (fig. 1), and the lower Kenai Peninsula in the vicinity of Homer. All of the plantings included Engmo timothy against which other grasses were compared for yield and quality characteristics. A number of experimental grasses based on native plant collections at north latitudes were included in the trials. All trials were conducted for at least three, full harvest seasons with two harvests taken per season.

Figure 1.Forage trial at Pt. MacKenzie. Reed canarygrass is in the left foreground, red fescue 568 with its close-growing mat of leaves is on the right, and Engmo timothy is in the background behind red fescue.

METHODS

Grasses were established on plots measuring 4 or 5 ft wide × 14 or 15 ft long. Seedings were conducted by hand-broadcasting on the surface followed by raking and tamping. In each trial, entries were randomly assigned positions in each of four blocks (replications) of plots. Harvests were conducted with a sickle-bar mower, taking a swath measuring 2 × 12 ft from the center of each plot and leaving about 2.5 to 2.8 in of stubble. Samples were retained for drying at about 140 °F (60 °C) for dry-matter determinations and laboratory analysis. All yields are reported on the dry-matter basis. Hay yields may be calculated on a 12 percent moisture basis (= dry matter yield × 1.136).

Laboratory analyses were conducted for percentage nitrogen (%N × 6.25 = crude protein content [C.P.]), phosphorus (P), potassium (K), and calcium (Ca), and for digestibility according to the in vitro dry matter disappearance method (IVDMD), a test employing rumen fluid in a test tube. This quality measurement is reported as DDM (digestible dry matter) in this report.

Trial Locations

Talkeetna

The trial near Talkeetna was conducted on the Yoder farm on poorly developed Rabideux silt loam (Typic Cryorthod). Rabideux is the most prevalent soil series of agricultural value in the Talkeetna area. The plot area included some low-lying ground inclined to wetness and a drier, better-drained portion. Soil samples taken at different times ranged in pH from 4.74 to 5.30. Early-season samplings were lower in pH than late-season samplings. Vegetation in the area is mainly mixed white spruce *(Picea glauca)* and paper birch *(Betula papyrifera)*. The trial was seeded in 1980 and harvests were taken in the following 3 years.

Pt. MacKenzie

The trial at Pt. MacKenzie was on Homestead silt loam (Typic Cryorthod), which is one of the two dominant soil types in that area. It differs from Kashwitna silt loam (= Flathorn silt loam), the other major soil type, in having a shallower profile over a gravel outwash base. Soil samples taken in late June 1982 measured pH 5.32 and those taken in late June 1984 measured pH 5.67. Vegetation prior to clearing was mainly mixed birch and spruce. The trial was seeded in 1981; this report concerns harvests taken through 1984.

Homer

Trials were conducted at a subalpine site and at a lower-elevation, forested site in the Homer area. The subalpine site was on Lookout Mtn. at about 1,500-ft elevation. Vegetation in this subalpine zone consists of extensive stands of bluejoint reedgrass, stands of mixed forbs and grasses, thickets of Sitka alder *(Alnus sinuata)* and willow *(Salix sp.)*, and isolated trees and patches of Sitka spruce *(Picea sitchensis)*. The trial was established on ground that had been cultivated by a heavy-duty rototiller followed by discing to eliminate the growth of bluejoint reedgrass and to incorporate the heavy accumulation of surface organic material. Soil is Kachemak silt loam (Dystric Cryandept) with pH 4.95. The plots were established in 1975 and harvested for 5 years through 1980. In the first 3 years the plots were fertilized at a much lower rate than were the other trials.

The lower-elevation site was on a bottomland terrace above Fritz Creek east of Homer that was vegetated with Sitka spruce and willow thickets prior to clearing. Soil is Mutnala silt loam (Typic Cryorthod) with pH measurements of 4.35 to 5.05. The plots were established in 1977 and were harvested twice annually from 1979 through 1981.

Grasses in Trial

The grasses placed in trial included some standard varieties commonly used for forage in Alaska, other commercially available materials, and a number of experimental entries of Alaskan or other origins. Brief descriptions of the entries are given in Table 1, along with the origins, where known. Named varieties (cultivars) are denoted with single quotation marks. Commercial entries that do not trace to particular breeding stock have no varietal distinction. Experimental materials are given accession numbers in a system that combines IAS[1] with a number. To avoid unnecessary repetition here, the IAS is omitted and only the number listed.

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[1]IAS: From Institute of Agricultural Science, a former name for Alaska Agricultural and Forestry Experiment Station.

Table 1. Grasses placed in trial.

Name[1]	Growth form	Origin
Phleum pratense		
Timothy	Tall, leafy, leaves from	
'Engmo'	stem and base; wide leaves	Norway
Bromus inermis		
Smooth bromegrass	Tall, leafy from elongating	
'Manchar'	stem; wide leaves	Manchuria
'Polar' (hybrid involving		includes Alaska
B. inermis and *B. pumpellianus*		germplasm
Alopecurus pratensis		
Meadow foxtail	Medium tall, leafy from	
	elongating stem; wide leaves	North Dakota
Alopecurus arundinaceus		
Creeping foxtail	Medium tall, leafy from	
'Garrison'	elongating stem; wide leaves	North Dakota
Phalaris arundinacea		
Reed canarygrass	Tall, leafy from elongating	probably
	stem; wide leaves	Minnesota
Festuca rubra		
Red fescue	Medium; leaves mostly	
'Arctared', 534, 567, 568	basal; fine, narrow leaves	Alaska
188		Poland
Poa pratensis		
Kentucky bluegrass	Medium to short; leaves	
'Nugget'	mostly basal; medium leaves	Alaska
'Sydsport'		Sweden
Calamagrostis canadensis		
Bluejoint reedgrass	Tall; leafy from elongating	
274, 477	stem; medium wide leaves	Alaska
Arctagrostis latifolia		
Polargrass	Tall, leafy from elongating	
60, 63, 317, 333, 405, 571	stems; wide leaves	Alaska
Deschampsia beringensis		
Bering hairgrass	Medium tall; leaves mostly basal, narrow	
'Norcoast', 19, 73, 74, 346	leaves (wider than the following)	Alaska
Deschampsia caespitosa		
Tufted hairgrass	Medium tall; leaves	
239, 243, 455	mostly basal; narrow leaves	Alaska
229, 284, 393, 394, 560		Iceland
Agropyron desertorum		
'Nordan' crested wheatgrass	Medium tall; stemmy	North Dakota

[1]Names presented in following order:
Scientific name (italics)
Common name
Cultivar (variety) name in single quotes and/or accession no. of experimental entries.

RESULTS

Forage Yields

The details of forage yields with information on fertilizer applications are presented in the following tables contained in the appendix: Table A-1 for Talkeetna, Table A-2 for Pt. MacKenzie, Table A-3 for Lookout Mtn., and Table A-4 for Fritz Creek. Figure 2 summarizes the yields, employing overall averages, for selected entries from each trial.

Engmo timothy was the top producer or among the top producers in the first cutting of a two-harvest system at the four trial sites. Other grasses outproduced timothy to varying extents in the second harvest. Engmo generally produced at least 2 tons of dry matter per acre in the first harvest at the lower-elevation sites. However, second-harvest yields of timothy generally were less than 1 ton per acre, averaging much lower than that over the terms of the studies at the four sites (fig. 2).

Timothy achieved its highest yields in first harvests at Fritz Creek east of Homer, producing 3.66 tons/acre in 1979, and at Pt. MacKenzie, attaining 3.44 tons/acre in 1983. It averaged the most over a 3-year period at Fritz Creek. Predictably, the lowest yields were obtained at the subalpine site on Lookout Mountain north of Homer, the site with the coolest, shortest growing season. Yields at this site were also affected by the low fertilizer rates applied in the first 3 years of the study. The experiment was designed originally to determine production under a low-level management regime. But a two-harvest system at low fertilizer rates proved too punishing, and fertilizer rates were raised in the last 2 years.

Bromegrass, though producing fair to good yields in the initial harvest year at the Talkeetna and Lookout Mtn. sites, subsequently was replaced by native growth, thereby demonstrating its unsuitability for these sites. Garrison creeping foxtail also was unsuited for these sites, showing particular signs of stress at the Talkeetna site. Though not included in the

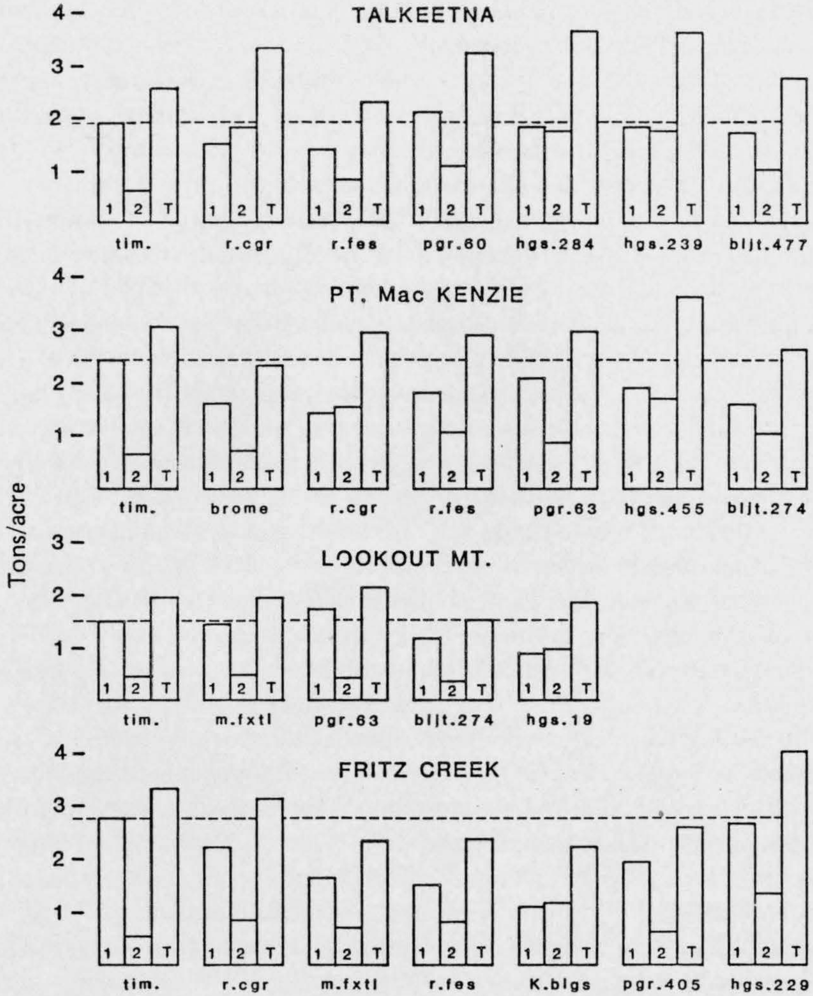

Figure 2. Averages of first-harvest (1), second-harvest (2), and total dry-matter yields (T) of selected entries for trials over 3-year terms at Talkeetna, Pt. MacKenzie, and Fritz Creek, and over 5-year term at Lookout Mtn. Entries are as follows: tim. = 'Engmo' timothy; r. cg=reed canarygrass; r. fes. = 'Arctared' red fescue; pgr. =polargrass; hg. =hairgrass; bljt. =bluejoint; brome= 'Polar' brome; m. fxtl. =meadow foxtail; K. blgs. = 'Nugget' Kentucky bluegrass. Dashed reference line is at level of first-harvest yield of timothy for each trial location.

Fritz Creek trial, the intolerance of bromegrass and creeping foxtail to strongly acidic soils probably would have dictated their failure. At Pt. MacKenzie, bromegrass generally produced considerably lower yields than timothy in the first harvest, but exceeded timothy by a small amount in second-growth production, most likely benefiting from the warming of the soil and increased pH in mid to late summer.

Reed canarygrass was included in three trials and generally produced less than timothy in the first harvest but often considerably more in the second harvest. It averaged more total yield than timothy over a 3-year period at the Talkeetna site. Second-growth yields of reed canarygrass exceeded 2 tons/acre at Talkeetna and Pt. MacKenzie in some harvests.

Meadow foxtail demonstrated much more adaptability to strongly acidic soils than the closely related creeping foxtail. It was similar to timothy in first- and second-harvest yields at the cool-season subalpine site on Lookout Mtn. north of Homer. At Fritz Creek and Pt. MacKenzie, it produced lower yields than did timothy in the first harvest and somewhat more in the second harvest over 3-year trial periods. Meadow foxtail has the undesirable trait, however, of lodging easily under heavy production and wet conditions. Under these circumstances it becomes gummy at the base and difficult to cut. Both meadow foxtail and creeping foxtail are among the first grasses to develop flowering heads.

In some instances the red fescues about equaled or exceeded timothy in first-harvest yields; most often, however, timothy substantially outproduced red fescue in the initial harvest. The red fescues that remained healthy exceeded timothy in second-harvest yields. However, red fescue entries showed signs of serious injury, judged to be disease related, at the Talkeetna and Fritz Creek sites. At Talkeetna, 'Arctared' persisted while three experimental entries were so severely depleted in the third year of the trial as to not warrant harvest. At Pt. MacKenzie, the experimental entries averaged higher overall yields than Arctared, mostly because of their higher second-harvest yields.

Kentucky bluegrass is similar to red fescue in growth form. At Fritz Creek, 'Nugget' bluegrass produced less than red fescue in the first harvest but more in the second harvest, averaging nearly the same overall. Nugget surpassed 'Sydsport', another bluegrass cultivar, in that trial. At Pt. MacKenzie, the red fescues produced substantially more than Nugget bluegrass in the first harvest, and all fescues except Arctared averaged more in the second harvest as well.

Some experimental entries of polargrass about equaled or exceeded timothy in first-harvest yields at Talkeetna and the Lookout Mtn. sites but most often were substantially exceeded by timothy in the first harvest at Fritz Creek and Pt. MacKenzie. Polargrass generally exceeded timothy in second-harvest yields at the lower-elevation sites.

First-cutting yields of some hairgrass entries were fair to good but most were below that of timothy. Their strong regrowth capabilities produced some of the highest second-harvest yields and resulted in some of the highest average total yields at the Talkeetna, Fritz Creek, and Pt. MacKenzie sites. Some Bering hairgrasses (similar to 'Norcoast') showed yield reductions as the result of injury at the Talkeetna and Lookout Mtn. sites. This was probably related to the effects of disease coupled with the stress of a two-harvest system.

Bluejoint reedgrass is utilized as a forage from native stands, particularly on the lower Kenai Peninsula and Kodiak Island, where it occurs in abundance. It is very similar to polargrass in growth habit. In the three trials in which it was included, bluejoint averaged less than polargrass and timothy in total yields, mainly owing to lower first-harvest yields.

Some serious reductions in stands were noted at some of the sites in the year following the terms of the studies. In the fourth year at the Fritz Creek site, severe stand reductions were sustained by reed canarygrass, Arctared fescue, Nugget bluegrass, and Sydsport bluegrass; those sustained by meadow foxtail were somewhat less severe. Engmo timothy, polargrass, and the hairgrasses maintained harvestable stands.

Stand reductions also occurred at Talkeetna in the fourth year; this followed an unusually dry growing season in 1983. All second harvests were greatly reduced in 1983 at both Talkeetna and Pt. MacKenzie because of droughty conditions during the summer season. First harvests were bountiful, nevertheless, owing to a high soil-moisture content at the start of the growing season.

Various amounts of stand reduction occurred in general at the Lookout Mtn. site after the fifth year of harvest. The initial, low rates of fertilizer applied there probably contributed to a weakening of the plants under the two-harvest regime.

Forage Quality

Details of forage quality are presented in the following tables contained in the appendix: Tables A-5 and A-6 for Talkeetna, A-7 and A-8 for Pt. MacKenzie, A-9 and A-10 for Lookout Mtn., and A-11 and A-12 for Fritz Creek.

Average first-harvest nitrogen contents for Engmo timothy at the four sites ranged from 1.64 percent to 2.40 percent (average for years analyzed at each site). Thus average crude protein (%N × 6.25) ranged from 10.3 percent to 15.0 percent for Engmo. The lowest crude protein content for timothy was obtained at Pt. MacKenzie and the highest at the Lookout Mtn. site. First-harvest N values in general were highest at the Lookout Mtn. site and lowest at the Pt. MacKenzie and Talkeetna sites.

Because of the various factors that affect nutrient contents of forages, it is difficult to make direct comparisons between entries for their forage quality. Among the factors affecting quality are nutrient conditions of the soil, stage of growth at harvest, growing conditions, kind of forage, and rate of growth. An increased growth rate can have the effect of diluting the concentration of a nutrient in a plant. Thus, in many cases where two grasses are compared for crude protein (N content), the grass with the highest yield will have the lower N concentration. Vogel (1983) and White and Wight (1984) found crude protein and DDM to be negatively correlated with forage yields in their respective studies with bromegrass and with a number of legumes and grasses. The first-harvest herbage of timothy at Pt. MacKenzie varied from 8.8 percent to 12.9 percent in crude protein over a three-year period. When cut in the emergence stage with 2.08 tons/acre production, timothy had 12.9 percent crude protein; cut in the headed stage with 3.44 tons/acre production, timothy had 8.8 percent crude protein.

Second-growth herbage, in general, attained higher N concentrations than first-growth herbage at the Pt. MacKenzie and Talkeetna sites. In some cases, however, considerably higher second-harvest than first-harvest yields contributed to lower second-growth N contents, as occurred with the hairgrasses at Pt. MacKenzie in 1984. At the Lookout Mtn. and Fritz Creek sites, however, second-growth herbage was lower in crude protein than first-growth herbage, although second-growth yields were less. Differences in fertilizer treatments between the Kenai Peninsula sites and the Susitna Valley sites may have contributed to the lower N contents of second-growth herbage of the Kenai sites. For the Talkeetna and Pt. MacKenzie sites, at least 180 lbs of N/acre was applied with a portion of it added after the first harvest each year. Trials at the Lookout Mtn. and Fritz Creek sites received various rates of N up to 180 lbs/acre, with all of it applied in the spring.

Phosphorus contents were highest in herbage grown on Kachemak silt loam at the Lookout Mtn. site. Timothy averaged 0.37 percent P concentration in first-harvest herbage and 0.33 percent in second-harvest herbage harvested from the Lookout Mtn. site and from 0.21 to 0.26 percent at the other sites. The bromegrasses and creeping foxtail, grasses that showed poor adaptation to Rabideux silt loam, had the lowest P concentrations in their first-harvest herbage at the Talkeetna site. These grasses were low in P content at Pt. MacKenzie as well. On the lower Kenai Peninsula, grasses grown on Mutnala silt loam (Fritz Creek) were poorer in phosphorus than those grown on Kachemak silt loam (Lookout Mtn.).

Potassium concentrations generally were well over 1 percent to over 2 percent for all grasses and were highest in first-harvest herbage from the Lookout Mtn. site. Second-harvest herbage generally contained lower K concentrations than first-harvest herbage at all sites. Other research has indicated that K concentrations near 1 percent or below may be indicative of a K deficiency. That level was obtained in the second harvest of some of the grasses on Mutnala silt loam (Fritz Creek). Laughlin (1965, Laughlin et al. 1984) demonstrated the need for K fertilization to maintain good second-harvest yields on the lower Kenai Peninsula.

Calcium contents most generally were higher in second-harvest herbage than in first-harvest herbage. Concentrations of calcium in first-harvest herbage were below that of phosphorus for some of the grasses at all sites, but particularly at the Lookout Mtn. sites, where it was true in all cases. This falls below the minimum 1:1 ratio set for calcium in relation to phosphorus for purposes of animal nutrition (National Research Council 1984). The red fescues, as a group, contained the highest calcium concentrations, indicating that they are high calcium feeders.

Digestible dry matter (DDM) of first-harvest herbage generally was above 55 percent and often above 60 percent. Second-growth herbage often was as high in DDM as first-growth herbage. Average digestibility of first-harvest herbage of Engmo timothy ranged from a low of 61.1 percent at Fritz Creek to 67.5 percent at Lookout Mtn. Timothy was medium to high in digestibility for the first harvest and often the highest for the second harvest. As a rule, polargrass was lower than timothy in DDM, and bluejoint generally was the lowest. The digestibility of second-growth bluejoint on Kachemak silt loam (Lookout Mtn.) was substantially below that of first-growth bluejoint.

Table A-13 presents information on the nutritional requirements of a 500-lb, growing steer of medium frame size. These requirements would be lower for larger and more mature animals. The first-harvest herbage of only a few grasses was below the requirements in crude protein and phosphorus (tables A-5—A-12). Potassium contents were more than adequate. Most first-harvest deficiencies occurred in the values for Ca and energy (DDM). Except for the red fescues, calcium contents were generally low. Those most tending to be deficient in energy were the polargrasses, bluejoint, and hairgrasses, though they varied.

Crude protein values of second-harvest herbage were adequate and above at the Talkeetna and Pt. MacKenzie sites, but generally deficient at the lower Kenai Peninsula sites. Phosphorus generally was adequate. The increase in calcium concentration in second-harvest herbage tended to satisfy that requirement except at the Talkeetna site. Most grasses were adequate or only marginally below the minimum in second-harvest energy values. Bluejoint was the most deficient in energy, particularly at the Lookout Mtn. site.

SUMMARY AND DISCUSSION

Engmo timothy about equaled or exceeded the other grasses in first-harvest yields at all sites (fig. 2); a number of grasses surpassed timothy in the second harvest.

Reed canarygrass produced more total yield than timothy at Talkeetna and about equaled it at Pt. MacKenzie, generally exceeding timothy substantially in second-harvest yields.

Meadow foxtail about equaled timothy at Lookout Mt, but was surpassed by timothy at two other sites.

Some experimental red fescues surpassed timothy in total yield at Pt. MacKenzie because of higher second harvests, but experienced stand depletion at Talkeetna, probably owing to stress from pathogens. Arctared was more persistent than the experimental entries.

Nugget Kentucky bluegrass exceeded timothy in second growth but was surpassed by timothy in total yield.

Some entries of polargrass averaged a little more than timothy in the first harvest at Talkeetna and Lookout Mtn. and produced more total yield at Talkeetna. Polargrass about equaled or slightly exceeded timothy in regrowth.

Bromegrass failed at Talkeetna and Lookout Mtn., while it persisted at Pt. MacKenzie although yielding much less than timothy.

Creeping foxtail also failed at Talkeetna and Lookout Mtn. and diminished drastically at Pt. MacKenzie.

Bluejoint reedgrass averaged more total yield than timothy at Talkeetna; it exceeded timothy in second-harvest yield at Talkeetna and Pt. MacKenzie.

The better-yielding grasses at the forested sites produced from 3 to 4 tons per acre in total yield, providing about 2 to 2.75 tons per acre in the first harvest. High first-harvest yields at the subalpine site equaled about 1.5 or more tons per acre, adding only another one-half ton in the second harvest.

First-harvest herbage of Engmo timothy tended to be near to below the average in quality measurements of crude protein, P, K, and Ca relative to all the grasses tested. It was near to above average in digestible dry matter. Some of the lower values were probably related to the dilution effect of higher first-harvest production relative to that of most other entries. Crude protein content, in general, was notably higher at the Lookout Mtn. site and at the Fritz Creek location. Phosphorus and, to a lesser extent, potassium contents also were high at the Lookout Mtn. site. This may be partially related to the relatively low yields obtained at that site. Second-harvest quality measurements for Engmo timothy were, in general, higher relative to the average than they were in the first-harvest material. This was probably related to the generally low yields obtained for timothy in the second cutting. Engmo was highest in second-harvest DDM percentages (overall averages) at all locations. Crude protein content of second-harvest herbage was in general higher than that of first-harvest herbage at Talkeetna and Pt. MacKenzie but notably lower at Lookout Mtn. and Fritz Creek; second-harvest phosphorus and potassium contents also were lower at these sites. Phosphorus contents were still relatively high at the Lookout site.

The research results support the use of timothy in the areas studied when management objectives emphasize the first harvest or a single harvest. Among other commercially available entries tested, reed canarygrass showed potential on a total yield basis because of its high second-growth ability, which was superior to that of timothy. Reed canarygrass showed more potential in the Talkeetna trials than in the other trials. There has been little field experience with this grass in Alaska, however, which makes it an uncertain candidate.

The most frequently used timothy in Alaska has been the variety Engmo, which proved superior in winterhardiness to the Canadian variety 'Climax' in a Matanuska Valley trial (Klebesadel 1970). Seed supplies of named varieties of reed canarygrass have not been readily available. The unnamed material used in this study (supplied by an Idaho seed dealer) originated in Minnesota.

Among the experimental grasses, those showing the most potential for management as seeded forages under a mechanical harvest system included polargrass and some hairgrasses. Polargrass resembled timothy in its emphasis on first-harvest yield, but produced more second growth at two of the sites. It was most productive at Talkeetna. Work at the Palmer Research Center has identified some of the superior entries among a number under study (Mitchell 1982 and unpublished data, Klebesadel 1969).

Some hairgrasses showed both good first-harvest and second-harvest yielding ability. But in various trials with hairgrasses, entries have varied considerably in yielding ability and consistency of performance (Mitchell 1982 and unpublished data). An Alaskan entry of Bering hairgrass has performed well in a feeding trial in Iceland (Tomasson 1984). Tufted hairgrass is grazed extensively and cut for forage in Iceland (Mitchell 1979a); it also is an important species on some high- altitude sheep ranges in the Rocky Mountains (Bonham 1972). More needs to be done, however, on the application of these grasses for forage purposes.

Because of their ability to tolerate frequent defoliation, red fescue and Kentucky bluegrass lend themselves to grazing systems. They provided good second growth but their growth habit renders them difficult to cut with a flail chopper. Sickle bars and rotating knives are more efficient with these grasses.

Although the entries of bluejoint reedgrass seeded in these trials, in general, did not do as well as some of the other grasses, bluejoint merits consideration as a forage. Stands of bluejoint that occur naturally can be managed to produce 1.5 to over 2.0 tons of good-quality forage per acre in the first harvest (Klebesadel and Laughlin 1964, Mitchell 1979, Laughlin et al. 1984). High fertilizer applications were necessary, however, to promote good second growth on Kachemak silt loam (Laughlin et al. 1984)

Thus, forage systems with perennial grasses on soils that are strongly acidic, i.e. below pH 5.7, have few options currently available. If the emphasis is on hay or silage production from the first harvest, then timothy is the best choice. Under some circumstances, development of native stands of bluejoint for harvest is worthy of consideration, particularly in situations with strongly acidic soils and short growing seasons. Providing for a good first harvest and good regrowth for use in late summer presents some difficulties. It may be necessary to accept lower first-harvest yields by taking an earlier harvest than normal, thus permitting a longer period for regrowth, and applying high fertilizer treatments. Also, other forages could be established in a multiple management system to provide for late grazing or a late cut. Some experimental grasses demonstrated sufficient potential to warrant further study and possible application in small field trials.

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Table A-1. Dry Matter Yields—Talkeetna.[1]

	1981		1982		1983		3-yr average		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	Total
Forage Entry	tons/acre								
Engmo timothy	2.47a	0.96ij	1.14e-g	0.63e	2.12a-c	0.34f	1.91	0.64	2.55
Reed cgs.	1.95bc	1.81a	1.19d-g	2.26a	1.41d-f	1.41a	1.52	1.83	3.35
Arctared fescue	1.75cd	1.07g-j	1.19d-g	0.95de	1.35ef	0.64d-f	1.43	0.89	2.32
Polargrass 63	1.74cd	1.37d-f	1.77ab	1.30cd	2.19ab	0.85b-f	1.90	1.17	3.07
Polargrass 60	2.06a-c	1.36d-g	1.92a	1.23cd	2.50a	0.74c-f	2.16	1.11	3.27
Polargrass 333	1.69cd	1.29e-h	1.71a-c	0.80de	2.03bc	0.44ef	1.81	0.84	2.65
Polargrass 317	1.75cd	1.43c-e	1.55a-c	1.49bc	2.23ab	0.96a-c	1.84	1.29	3.13
Polargrass 624	1.74cd	1.24e-i	1.76ab	0.87de	2.49a	0.70c-f	2.00	0.94	2.94
Bering hgs. 346	2.00a-c	1.74ab	0.90gh	1.59bc	1.04f	0.84b-f	1.31	1.39	2.70
Bering hgs. 73	2.06a-c	1.72a-c	1.07fg	1.60bc	1.05f	0.68d-f	1.39	1.33	2.72
Tufted hgs. 243	2.42ab	1.87a	1.37c-f	1.97ab	1.67c-e	0.83b-f	1.82	1.56	3.38
Tufted hgs. 239	1.94bc	1.79a	1.70a-c	2.27a	1.95bc	1.24a-c	1.86	1.77	3.63
Tufted hgs. 284	1.94bc	1.70a-c	1.52b-d	2.29a	2.15ab	1.34ab	1.87	1.78	3.65
Tufted hgs. 393	1.81cd	1.59a-d	1.45b-e	1.97ab	1.93bc	1.10a-d	1.73	1.55	3.28
Tufted hgs. 394	1.85cd	1.61a-d	1.60a-c	2.10a	2.05a-c	1.09a-d	1.83	1.60	3.43
Bluejoint 477	1.82cd	1.46b-e	1.63a-c	1.10c-e	1.83b-d	0.56d-f	1.76	1.04	2.80
Manchar brome	1.78cd	1.11f-i	replaced by native growth						
Polar brome	1.41de	1.01h-j	replaced by native growth						
Garrison c. fxtl.	1.15e	0.80j	replaced by native growth						
Red fescue 83	1.95bc	1.38d-f	0.68h	1.15cd	replaced by native growth				
Red fescue 188	1.94bc	1.48b-e	0.88gh	1.20cd	replaced by native growth				
Red fescue 568	2.08a-c	1.38d-f	0.85gh	1.17cd	replaced by native growth				
Fertilizer Appl.	lbs/acre $N\text{-}P_2O_5\text{-}K_2O$								
spring appl.	100-100-75		90-90-90		90-90-90				
July appl.	115-0-0		115-0-0		90-0-0				

[1]Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-2. Dry Matter Yields—Pt. MacKenzie.[1]

	1982		1983		1984		3-yr average		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	Total
Forage Entry	tons/acre								
Engmo tim.	1.74e	0.83f	3.44a	0.09g	2.08a	1.01e	2.42	0.64	3.06
Manchar brome	0.73hi	0.98f	1.89d-g	0.18g	1.11e-g	1.09e	1.24	0.75	1.99
Polar brome	0.91gh	0.91f	2.20c-f	0.16g	1.73a-c	1.08e	1.61	0.72	2.33
Garrison c. fxtl.	0.59i	0.90f	1.85e-g	0.19g	stand depleted below harvest level				
Meadow fxtl.	1.40f	1.14ef	2.31b-d	0.34fg	1.83ab	1.14e	1.85	0.87	2.72
Reed cgs.	0.95g	1.95bc	1.82fg	0.52ef	1.54b-d	2.17a	1.44	1.55	2.98
Polargrass 571	2.34a	1.45d	2.17c-f	0.15g	1.61b-d	1.15e	2.04	0.92	2.96
Polargrass 63	2.28ab	1.39de	2.27b-e	0.15g	1.72a-c	1.14e	2.09	0.89	2.98
Norcoast hgs.	2.24a-c	2.24a	1.84fg	1.21a	0.54hi	1.93a-c	1.54	1.79	3.33
Bering hgs. 73	2.09b-d	2.17ab	2.07c-f	0.82b-e	0.84gh	2.01a-c	1.67	1.67	3.33
Tufted hgs. 455	1.70e	1.95bc	2.66b	1.08ab	1.39c-f	2.14ab	1.92	1.72	3.64
Tufted hgs. 560	1.37f	1.46d	2.22c-f	0.89b-d	1.01fg	2.06a-c	1.53	1.47	3.00
Tufted hgs. 239	1.29f	1.36de	2.45bc	0.76c-e	1.11e-g	1.75a-c	1.62	1.29	2.91
Arctared fes.	2.04cd	1.35de	1.93d-g	0.64d-f	1.48b-e	1.27de	1.82	1.09	2.90
Red fes. 568	1.72e	1.95bc	2.09c-f	1.23a	1.28d-f	1.79a-c	1.70	1.66	3.35
Red fes. 567	1.78e	1.79c	1.92d-g	1.06a-c	1.25d-f	1.64b-e	1.65	1.50	3.15
Red fes. 534	1.89de	1.88c	2.13c-f	0.86b-d	1.59b-d	1.66b-d	1.87	1.47	3.34
Nugget blgs.	1.38f	1.32de	1.60g	0.97a-c	0.40i	1.86a-c	1.13	1.38	2.51
Bluejoint 274	1.75e	1.39de	1.84fg	0.54ef	1.22d-g	1.29de	1.60	1.07	2.68
Nordan crested wheatgrass		winterkilled							
Fertilizer Appl.	lbs/acre $N-P_2O_5-K_2O$								
spring appl.	90-90-90		90-90-90		90-90-90				
July appl.	115-0-0		90-0-0		90-0-0				

[1]Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-3. Dry Matter Yields—Lookout Mtn.[1]

	1976		1977		1978		1979		1980		5-yr Average		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	Total
Forage Entry	----------	----------	----------	----------	----------	----------	tons/acre	----------	----------	----------	----------	----------	----------
Engmo tim.	1.96c-e	1.03b	1.48b	0.05d	1.18a	0.07cd	1.45a-d	0.76bc	1.43a	0.28f	1.50	0.44	1.94
Meadow fxtl.	2.05b-d	0.77c	1.52b	0.18b	1.20a	0.24b	1.31b-e	0.79b	1.32ab	0.47bc	1.48	0.49	1.97
Polargrass 63	2.49a	0.64c-e	2.03a	0.16bc	1.42a	0.15b-d	1.60a-c	0.81b	1.15a-d	0.42b-e	1.74	0.44	2.18
Polargrass 60	2.25b	0.58c-f	2.07a	0.12b-d	1.33a	0.16b-d	1.76a	0.61d-f	1.29ab	0.31f	1.74	0.36	2.10
Polargrass 61	2.09bc	0.56c-f	1.91a	0.13b-d	1.15a	0.14b-d	1.65ab	0.52ef	1.17a-d	0.35d-f	1.59	0.34	1.93
Polargrass 48	2.07b-d	0.49d-g	1.85a	0.09cd	1.21a	0.14b-d	1.68a	0.56ef	1.29ab	0.31f	1.62	0.32	1.94
Polargrass 318	1.53f	0.28g	1.24bc	0.05d	0.79b	0.07d	1.29c-e	0.47f	1.13a-d	0.29f	1.20	0.23	1.43
Bluejoint 274	1.73ef	0.40e-g	1.05cd	0.09cd	0.77b	0.17b-d	1.19d-f	0.74b-d	1.21a-c	0.42b-e	1.19	0.36	1.55
Bluejoint 411	1.89c-e	0.67cd	1.14cd	0.11b-d	0.63bc	0.17b-d	0.98ef	0.65c-e	0.91c-e	0.48b	1.11	0.42	1.53
Bluejoint 519	1.82de	0.37e-g	1.09cd	0.07d	0.60bc	0.11cd	1.00ef	0.63c-e	1.08b-d	0.33ef	1.12	0.30	1.42
Bluejoint 259	1.88c-e	0.42fg	0.91c-e	0.07d	0.53cd	0.12cd	0.98ef	0.63c-e	0.89de	0.44b-d	1.04	0.34	1.38
Bluejoint 413	1.75ef	0.37fg	0.90de	0.05d	0.50cd	0.10cd	0.94f	0.61de	0.71e	0.49b	0.96	0.32	1.28
Bering hgs. 19	1.27g	1.46a	0.69e	0.63a	0.34d	0.49a	1.09ef	1.40a	1.22ab	0.82a	0.92	0.96	1.88
Polar brome	2.03b-d	0.61c-f	replaced by native growth										
Garrison c. fxtl.	0.70h	0.53d-g	replaced by native growth										
Fertilizer Appl.	----------	----------	----------	lbs/acre N-P_20_5-K_20	----------	----------	----------	----------	----------				
spring appl.	50-50-38		50-50-38		50-50-38		180-45-21		145-50-60				

[1]Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-4. Dry Matter Yields—Fritz Creek.[1]

	1979		1980		1981		3-yr average		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	Total
Forage Entry	tons/acre								
Engmo tim.	3.66a	0.57d	2.14bc	0.42g	2.56a	0.61bc	2.79	0.53	3.32
Reed cgs.	3.43ab	1.09b	1.87cd	0.67ef	1.50c	0.81bc	2.27	0.86	3.13
Meadow fxtl.	1.85e	0.80c	1.60de	0.64f	1.59c	0.66bc	1.68	0.70	2.38
Arctared fes.	2.30d	0.86c	1.81cd	0.81c-e	0.58d	0.82b	1.56	0.83	2.39
Nugget blgs.	1.91e	1.12b	1.35ef	1.02b	0.11e	1.27a	1.12	1.14	2.26
Sydsport blgs.	1.31f	0.85c	1.08f	0.89bc	0.32de	1.21a	0.90	0.98	1.88
Polargrass 405	2.71c	0.56d	1.05f	0.71d-f	2.18b	0.58c	1.98	0.62	2.60
Tufted hgs. 229	3.21b	1.50a	2.64a	1.28a	2.18b	1.31a	2.68	1.36	4.04
Bering hgs. 74	2.69c	1.14b	2.32ab	0.84cd	2.05b	1.34a	2.35	1.11	3.46
Fertilizer Appl.	lbs/acre $N\text{-}P_2O_5\text{-}K_2O$								
spring appl.	149-30-14		145-50-60		150-75-90				

[1]Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-5. First-harvest forage quality—Talkeetna.[1]

Forage Entry	C.P.[2]	P	K	Ca	DDM
			%		
Engmo tim.	12.0	.24de	2.09a-d	.19c	61.7b
Reed cgs.	11.8	.25c-e	1.99b-e	.23a-c	57.9b-g
Arctared fes.	10.8	.24de	1.82c-e	.26a-c	59.5b-f
Red fes. 83	11.1	.23e	1.91b-e	.28ab	68.5a
Red fes. 188	11.5	.27a-e	1.75de	.23a-c	61.5b
Red fes. 568	11.9	.27a-d	1.90b-e	.26a-c	61.7b
Polargrass 63	11.4	.28a-d	2.09a-d	.21a-c	55.7e-h
Polargrass 60	10.7	.26b-e	2.17a-d	.22a-c	57.1b-h
Polargrass 333	11.1	.27a-e	2.26a-c	.29a	55.6e-h
Polargrass 317	11.7	.25c-e	2.32ab	.19c	54.2f-h
Polargrass 624	11.8	.27a-e	2.47a	.28ab	52.7h
Bering hgs. 346	12.4	.29a-c	1.60e	.20bc	61.2bc
Bering hgs. 73	11.1	.29a-d	1.83c-e	.19c	60.7b-d
Tufted hgs. 243	12.3	.29ab	1.76de	.18c	59.9b-e
Tufted hgs. 239	11.4	.27a-e	1.78de	.20bc	56.7c-h
Tufted hgs. 284	11.5	.29a-c	1.74de	.20bc	56.4d-h
Tufted hgs. 393	11.8	.31a	1.77de	.19c	55.9e-h
Tufted hgs. 394	12.4	.30ab	1.95b-e	.25a-c	55.4e-h
Bluejoint 477	12.0	.26b-e	1.78de	.18c	53.4gh
Manchar brome	11.3	.18	2.02	.25	56.9
Polar brome	11.9	.16	2.03	.27	59.3
Garrison c. fxtl.	12.9	.22	1.98	.31	59.4

[1]Average of 1981 and 1982 measurements, except for Manchar bromegrass, Polar bromegrass, and Garrison creeping foxtail whose values are for 1981 only and were excluded from the statistical analysis. Figures within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

[2]Differences were not significant for crude protein.

Table A-6. Second-harvest forage quality—Talkeetna.[1]

Forage Entry	C.P.	P	K[2]	Ca	DDM
			%		
Engmo tim.	16.2a-e	.26ef	2.19	.27b-f	70.0a
Reed cgs.	14.8c-i	.21fg	2.29	.26c-g	58.8b-d
Manchar brome	14.2e-j	.21fg	1.87	.26c-g	62.0b
Polar brome	14.3d-i	.18g	1.97	.28a-e	60.7b
Garrison c. fxtl.	15.5b-h	.26ef	1.82	.30a-c	54.3c-e
Arctared fes.	15.9a-e	.30b-e	2.46	.33ab	62.2b
Red fes. 83	13.8f-g	.24e-g	1.80	.28a-e	62.1b
Red fes. 188	13.5h-j	.26ef	1.84	.23c-h	60.1bc
Red fes. 568	14.3d-i	.26ef	1.88	.34a	59.1b-d
Polargrass 63	16.8a-c	.33a-d	1.93	.25c-h	60.9b
Polargrass 60	16.3a-d	.35a-c	2.05	.21e-h	59.0b-d
Polargrass 333	17.3ab	.36ab	2.37	.24c-h	51.5e
Polargrass 317	15.8a-f	.31a-e	2.61	.23c-h	58.8b-d
Polargrass 624	17.9a	.37a	2.42	.23c-h	57.4b-d
Bering hgs. 346	12.8ij	.25ef	1.74	.18h	59.1b-d
Bering hgs. 73	13.1ij	.28de	1.94	.19gh	58.4b-d
Tufted hgs. 243	13.1ij	.26ef	1.70	.20f-h	57.6b-d
Tufted hgs. 239	13.3ij	.25ef	1.69	.27b-f	63.0b
Tufted hgs. 284	12.1j	.24e-g	1.74	.22d-h	58.7b-d
Tufted hgs. 393	13.4h-j	.27d-f	1.84	.22d-h	59.3b-d
Tufted hgs. 394	13.7g-j	.28de	1.85	.29a-d	62.8b
Bluejoint 477	15.7b-g	.29c-e	1.87	.22d-h	53.5de

[1] 1981 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.
[2] Differences were not significant for K.

Table A-7. First-harvest forage quality—Pt. MacKenzie.[1]

Forage Entry	C.P.	P	K	Ca	DDM
	----------	----------	%	----------	----------
Engmo tim.	10.3f-g	.25c-e	2.08a-e	.21de	63.4de
Manchar brome	12.3b-d	.18h	2.42a-c	.21de	65.5b-d
Polar brome	12.7b	.20gh	2.20a-e	.20e	63.7de
Garrison c. fxtl.	10.6b-d	.20gh	1.81e	.23b-e	69.0a
Meadow fxtl.	10.1gh	.24de	1.99b-e	.22c-e	63.8de
Reed cgs.	12.7b	.29a	2.43ab	.27b	63.0e
Polargrass 571	11.3c-f	.28ab	2.27a-d	.27b	57.8g
Polargrass 63	10.9c-g	.28ab	2.45a	.26bc	57.4g
Norcoast Bering hgs.	11.3c-f	.25c-e	1.99b-e	.23b-e	63.4de
Bering hgs. 73	11.0c-g	.23ef	1.93c-e	.25b-d	64.8c-e
Tufted hgs. 455	10.0gh	.24de	1.85de	.23b-e	58.0g
Tufted hgs. 560	12.4bc	.28ab	2.06a-e	.25b-d	60.7f
Tufted hgs. 239	11.4c-f	.26b-d	1.85de	.23b-e	60.8f
Arctared fes.	10.9c-g	.25c-e	2.03a-e	.33a	58.8fg
Red. fes. 568	9.9gh	.23ef	2.07a-e	.36a	65.5b-d
Red. fes. 567	10.4e-h	.24de	2.09a-e	.37a	66.7bc
Red. fes. 534	9.6h	.21fg	2.02a-e	.34a	67.5b
Nugget blgs.	14.4a	.27a-c	2.09a-e	.27b	63.9de
Bluejoint 274	13.3b	.29a	2.30a-c	.23b-e	56.4h

[1]Average of 1982, 1983, and 1984 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-8. Second-harvest forage quality—Pt. MacKenzie.[1]

Forage Entry	C.P.	P	K	Ca	DDM
	-------------	-------------	%	-------------	-------------
Engmo tim.	16.4a-c	.22b-e	1.70e-g	.40b-d	74.4a
Manchar brome	17.0ab	.22b-e	2.43a	.32d-g	66.8cd
Polar brome	18.0a	.22b-e	2.10bc	.35c-f	68.0c
Garrison c. fxtl.	17.9a	.20de	2.16ab	.36c-f	71.8b
Meadow fxtl.	17.0ab	.23a-d	2.07b-d	.26g	67.2cd
Reed cgs.	14.8cd	.23a-d	1.60fg	.33d-g	61.4g-i
Polargrass 571	16.4a-c	.25ab	1.71e-g	.39b-e	63.1e-h
Polargrass 63	16.0bc	.26a	1.68e-g	.38b-f	63.6e-g
Norcoast Bering hgs.	12.3e-g	.23a-d	1.99b-e	.31e-g	58.5jk
Bering hgs. 73	12.1e-g	.21c-e	1.62fg	.30fg	61.1hi
Tufted hgs. 455	11.7fg	.21c-e	1.53fg	.31e-g	57.5k
Tufted hgs. 560	13.3d-f	.23a-d	1.68e-g	.39b-e	60.6ij
Tufted hgs. 239	13.4d-f	.24a-c	1.63fg	.40b-d	60.4g-i
Arctared fes.	15.1cd	.22b-e	1.77d-f	.58a	66.1cd
Red fes. 568	11.4g	.19e	1.38g	.45b	63.7e-g
Red fes. 567	11.3g	.19e	1.41g	.40b-d	65.3d-f
Red fes. 534	11.6fg	.19e	1.53fg	.43bc	65.4de
Nugget blgs.	13.7de	.24a-c	2.09bc	.36c-f	62.0f-i
Bluejoint 274	16.3a-c	.25ab	1.81c-f	.35c-f	56.8k

[1]Average of 1982, 1983, and 1984 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-9. First-harvest forage quality—Lookout Mtn.[1]

Forage Entry	C.P.	P	K	Ca	DDM
	%				
Engmo tim.	15.0f	.37d	2.27fg	.24cd	67.5a
Meadow fxtl.	15.6ef	.36d	2.11g	.20d	63.7c-d
Polargrass 63	15.1f	.37d	2.41ef	.29a-c	59.0e
Polargrass 60	16.2e	.42bc	2.59c-e	.27a-c	59.1e
Polargrass 61	17.6cd	.45a	2.76a-c	.31a	61.9cd
Polargrass 48	16.3e	.42bc	2.53de	.32a	61.8d
Polargrass 318	17.3d	.41c	2.91a	.30ab	58.8e
Bluejoint 274	19.0ab	.44ab	2.78a-c	.29a-c	63.2b-d
Bluejoint 411	19.6a	.42bc	2.85ab	.20d	64.0b-d
Bluejoint 519	18.6b	.40c	2.69a-d	.21d	63.1b-d
Bluejoint 259	19.1ab	.44ab	2.65b-d	.25b-d	64.9ab
Bluejoint 413	19.0ab	.40c	2.78a-c	.29a-c	64.8a-c
Bering hgs. 19	18.3bc	.40c	2.31fg	.30ab	65.8ab

[1]Average of 1976, 1977, 1979, and 1980 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-10. Second-harvest forage quality—Lookout Mtn.[1]

Forage Entry	C.P.	P	K	Ca	DDM
	%				
Engmo tim.	11.0de	.33a-c	1.72a	.34e	67.1a
Meadow fxtl.	10.7e	.30d	1.72a	.34e	58.5b
Polargrass 63	12.5a-c	.31cd	1.70a	.47bc	60.0b
Polargrass 60	12.9ab	.34ab	1.61ab	.51ab	59.5b
Polargrass 61	12.1b-d	.33a-c	1.56a-c	.55a	57.2b
Polargrass 48	11.6c-e	.31cd	1.63ab	.55a	58.9b
Polargrass 318	12.9ab	.31cd	1.51a-d	.53ab	53.8c
Bluejoint 274	12.5a-c	.35a	1.45b-d	.48bc	53.5c
Bluejoint 411	13.6a	.34ab	1.52a-d	.42cd	51.6cd
Bluejoint 519	12.9ab	.32b-d	1.45b-d	.39de	51.4cd
Bluejoint 259	11.6c-e	.34ab	1.32d	.43cd	50.2d
Bluejoint 413	13.1ab	.33a-c	1.37cd	.50ab	53.9c
Bering hgs. 19	8.6f	.30d	1.36cd	.25f	59.0b

[1]Average of 1976, 1977, 1979, and 1980 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.

Table A-11. First-harvest forage quality—Fritz Creek.[1]

Forage Entry	C.P.	P	K^2	Ca	DDM
			%		
Engmo tim.	13.1cd	.22b	1.41	.21e	61.1bc
Reed cgs.	14.9bc	.22b	1.88	.22de	61.2bc
Meadow fxtl.	15.0bc	.24b	1.42	.24b-e	61.4bc
Arctared fes.	13.7cd	.22b	1.68	.36a	60.1c
Nugget blgs.	17.4a	.30a	1.85	.27b-d	64.5ab
Sydsport blgs.	18.2a	.29a	1.66	.29b	66.5a
Polargrass 405	16.5ab	.29a	1.87	.28bc	59.0c
Tufted hgs. 229	12.8d	.22b	1.80	.23c-e	61.7bc
Bering hgs. 74	13.8cd	.23b	1.62	.22de	67.1a

[1]Average of 1979 and 1980 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.
[2]Differences were not significant for K.

Table A-12. Second-harvest forage quality—Fritz Creek.[1]

Forage Entry	C.P.	P^2	K^2	Ca	DDM
			%		
Engmo tim.	10.5a	.21	.98	.41b	67.5a
Reed cgs.	7.4c	.21	1.28	.28d	62.6bc
Meadow fxtl.	10.2ab	.21	1.17	.23d	61.0c
Arctared fes.	9.1b	.20	1.19	.52a	65.3ab
Nugget blgs.	10.8a	.20	1.29	.30cd	60.5c
Sydsport blgs.	11.1a	.21	1.39	.36bc	60.4c
Polargrass 405	9.2b	.21	.99	.42b	61.7c
Tufted hgs. 229	9.2b	.22	1.20	.29cd	62.1c
Bering hgs. 74	6.3c	.17	1.26	.22d	62.1c

[1]Average of 1979 and 1980 measurements. Values within a column followed by the same letter do not differ significantly (5% level) as determined by Duncan's Multiple Range test.
[2]Differences were not significant for P and K.

Table A-13. Nutritional requirements to produce a moderate gain on a 500-lb steer of medium frame size.[1]

C.P.	P	K	Ca	DDM
		%		
10-12	0.20-0.24	0.6-0.8	0.3-0.5	60-63
Ca:P ratio: 1:1 minimum, 7:1 maximum				

[1]National Research Council 1984.

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