EFFECT OF REED CANARYGRASS AND RED CLOVER MIXTURES ON FORAGE YIELD AND MINERAL CONTENT IN SOUTHCENTRAL ALASKA

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INTRODUCTION

Early perennial forage performance research was done in Alaska at a number of locations near the turn of the twentieth century, including Copper Center, Kenai, Sitka, and Rampart (Georgeson, 1899; Georgeson, 1901–1904). Resulting yields for native and introduced cool season perennial grasses were fairly positive, however, all sites were rain fed and some seedings were unsuccessful due to dry conditions. Timothy (*Phleum pratense* L.), smooth bromegrass (*Bromus inermis* L.), perennial ryegrass (*Lolium perenne* L.), and orchard grass (*Dactyls glomerata* L.) dominated the early test plantings.

Perennial clover plantings were also evaluated at similar locations with mixed results (Georgeson, 1899; Georgeson, 1901–1904). Seedings of medium and mammoth red (*Trifolium pratense* L.), white clover (*Trifolium repens* L.), and alsike clover (*Trifolium hybridum* L.) from both American and Norwegian seed sources produced very well at Sitka. However, the American seed tended to out perform the Norwegian seed (Georgeson, 1899). Red clover seeded at Kenai May 30, 1900 produced little growth the seeding year but survived the winter well and produced a fair hay crop in 1901 due primarily to dry conditions (Georgeson, 1901).

With the increase in dairy farming in Alaska, the need for a hardy legume became apparent as a reliable source of high quality feed was essential. In response to this need, USDA scientists introduced three Russian mammoth red clover strains to the Agriculture Experiment Station in Fairbanks in 1929. Seeded on a south slope in Fairbanks, the three strains survived the first winter and provided excellent growth the second year. Little attention was given these plantings until 1947 when red clover seed was harvested from a hay field at the Fairbanks Experiment Station, increased in 1948, and likely outcrossed with twelve other Russian mammoth red clover strains introduced in 1931 and 1942. The result was the release of Alaskland red clover in 1953 (Hodgeson et al., 1953).

Red clover is a high-yielding, high-quality legume adapted to a variety of environments and is the most widely grown of all clovers (Jensen et al., 2001). Red clover is known to establish excellent stands when seeded with a small-grain companion crop due to its high shade tolerance (Barnes et al., 1995). In hay stand renovation trials at Pt. MacKenzie, Altaswede red clover was successfully no-till seeded into existing timothy stands and has performed very well (Sparrow and Gavlak, 2000). Harvest management certainly has an effect on red clover yield, quality, and persistence. Wiersma et al. (1998) contrasted harvest management schemes on red clover and showed that yield and quality increased with increased harvest frequency, though persistence related to infrequent harvest frequency.

Numerous trials have been conducted assessing the nutritional requirements (Laughlin et al., 1971) and adaptability of red clovers in Alaska. Sparrow and Panciera (2000) assessed herbage and nitrogen yield of red clover at three locations. At Pt. MacKenzie, Altaswede red clover (mammoth type released by University of Alberta) produced greater overall herbage yield and significantly greater nitrogen yields than Kenstar red clover (medium type released by University of Kentucky; Taylor and Anderson, 1973) over a four-year period.

Reed canarygrass (*Phalaris arundinacea* L.) is a perennial grass adapted to a wide range of growing conditions. It is a vigorous, long-lived, sod-forming perennial much more capable of surviving a variety of harvest management schemes than many cool-season grasses. Reed canarygrass mixes well with legumes, as it is not excessively competitive when seeded with legumes and tends to fill in gaps in the stand due to its sod-forming habit. Early varieties were scrutinized due to a relatively high alkaloid content which can cause reduced gain in lambs (Marten et al., 1981). However, recently released varieties have considerably lower alkaloid levels and when mixed, will provide a high-yielding, high-quality feed (Coulman, 1996; Shaeffer et al., 1990).

A perennial, cool-season grass observation trial at Pt. Mackenzie showed that reed canarygrass maintained high yields and considerable persistence when compared to timothy and smooth bromegrass (M.T. Panciera, personal communication). Mitchell (1986) assessed the dry matter yields of cool season grasses in a two cutting system at three Alaska locations. At Pt. MacKenzie, total reed canarygrass yields were similar to the other cool-season grasses with much of the total yield contributed by the second cutting. Mitchell and Mitchell (1986) compared seeding-year yield and quality of bromegrass, timothy, and reed canarygrass under varying phosphorus fertility treatments. All responded positively to phosphorus levels up to 90 kg/ha, with reed canarygrass producing significantly greater yields than either bromegrass or timothy, while quality parameters including crude protein and energy were significantly less. The latter observation was attributed to a dilution effect of the higher yield.

In Alaska, much of the work with reed canarygrass indicates a susceptibility to winterkill in some areas of the state (Irwin, 1945; Klebesadel, 1994; Klebesadel and Dofing, 1991) particularly the windswept benches where much of the recent cited research was done.

In nearly all the studies conducted in Alaska contrasting reed canarygrass with other high-yielding perennial cool-season grasses, reed canarygrass quality is significantly inferior to the other species (Mitchell, 1986; Mitchell and Mitchell, 1986). Inferior quality with advancing maturity is a problem with reed canarygrass and may be one of the main reasons it is not more widely grown.

Considering the adaptability of red clover to companion plantings, its high yield of high-quality feed, and the adaptability of reed canarygrass in mixes with legumes, it is appropriate to assess the mixtures of the best-performing species and cultivars grown in Alaska in an attempt to increase both the yield and quality of feed for ruminant animals. This report presents information on studies conducted at three locations: Matanuska Experiment Farm, dryland (MEF); Pt. MacKenzie Research Farm, dryland (PMD); and Trytten Farm (at Pt. MacKenzie), irrigated (PMI); from 1999 to 2001.

MATERIALS AND METHODS

Researchers collected soil samples in May 26, 1999 to six-inch depth at both Pt. MacKenzie locations with analytical results shown in Table 1. Soil analytical techniques included pH by 1:1 soil:water suspension, electrical conductivity (EC) by saturated paste extract, organic matter (OM) by loss on ignition, nitrogen species by 2N KCl extraction and Cd reduction, cations and micronutrients by Mehlich-3 extraction, and boron by hot water extraction (Gavlak, 1994).

The Pt. MacKenzie trials were established on a Kashwitna silt loam (Typic Haplocryod) and

Table 1. Preplant soil analytical results by location from 0- to 6-inch samples collected June, 1999.

	pH	EC[1] mmho/cm	OM[2] %	NH_4-N ppm	NO_3-N ppm	P ppm	K ppm	Ca ppm	Mg ppm	Zn ppm	Cu ppm	Mn ppm	B ppm
PMD [3]													
	5.3	0.14	9.1	2	<1	4	152	447	45	0.8	0.7	13	0.11
PMI [4]													
R 1 & 2	5.1	0.28	8.7	18	6	3	110	334	49	0.5	0.7	9.1	0.07
R 3 & 4	5.2	0.28	9.6	30	8	3	134	361	58	0.7	0.6	8.9	0.13
MEF [3]													
	6.2	0.98	7.5	2	39	86	173	2726	140	1.2	3.9	8.5	0.42

1. EC = electrical conductivity.
2. OM = organic matter.
3. Random samples of all replications.
4. Sampled by paired replications.

the Matanuska Experiment Farm trial was established on a Knik silt loam (Typic Eutrocryept). Fertilizer was broadcast at rates of 100 lbs P_2O_5/ac (0-45-0) and 100 lbs K_2O/ac (0-0-50-18S) at the Pt. MacKenzie dryland and Matanuska locations only. Nitrogen was applied to half of each replication at 30 lbs N/ac (34-0-0) and rototilled to approximately six inches deep at the PMD and MEF sites only. At the Pt. MacKenzie irrigated site, 250 lbs/ac 22-11-11-6 plus 100 lbs/ac 46-0-0 were broadcast the last week of May and incorporated to approximately six inches deep prior to seeding.

Seventy-two plots each measuring 5 by 20 feet were arranged in a randomized complete block design with 18 seeding-rate treatments in four replications (Table 2). Altaswede red clover seeding rates were 3.0, 6.0, 12.0(x), and 24.0 lbs PLS/ac (Pure Live Seed) and Vantage reed canarygrass seeding rates were 2.5, 5.0, 10.0(x) and 20.0 lbs PLS/ac, where (x) was the standard rate. Researchers used a walk-behind plot planter[1] to seed the plots on June 3, June 4, and June 1, 1999 at the

1. Carter Mfg. Co., RR2 Box 250A, Brookston, IN 47923

Table 2. Reed canarygrass and red clover treatments seeded at three locations in southcentral Alaska.

Treatment Number	Seeding Rates
1	Check Alta 1.0x
2	Check Van 1.0x
3	Van 0.25x, Alta 0.25x
4	Van 0.25x, Alta 0.5x
5	Van 0.25x, Alta 1.0x
6	Van 0.25x, Alta 2.0x
7	Van 0.5x, Alta 0.25x
8	Van 0.5x, Alta 0.5x
9	Van 0.5x, Alta 1.0x
10	Van 0.5x, Alta 2.0x
11	Van 1.0x, Alta 0.25x
12	Van 1.0x, Alta 0.5x
13	Van 1.0x, Alta 1.0x
14	Van 1.0x, Alta 2.0x
15	Van 2.0x, Alta 0.25x
16	Van 2.0x, Alta 0.5x
17	Van 2.0x, Alta 1.0x
18	Van 2.0x, Alta 2.0x

PMD, PMI and MEF sites respectively. No irrigation water was applied at the PMI location in 1999.

Plots at MEF were harvested August 18–19, 1999 using a four-square-foot frame from which above-ground biomass was removed (minus weeds). Since, as described above, the plots were split by halves with regard to nitrogen, each half plot was sampled separately. Plots at PMI were harvested similarly (without the nitrogen split) on September 13, 1999. The PMD location was not harvested in 1999. Due to deficiency symptoms observed at the Pt. MacKenzie locations during the 1999 growing season, all plots were surface broadcast with 2 lb B/ac, 160 lb P_2O_5/ac (0-45-0) and 100 lb K_2O/ac (0-0-50-18S) October 5, 1999.

All locations received 100 lb P_2O_5/ac (0-45-0) and 100 lb K_2O/ac (0-0-50-18S) plus 30 lbs N/ac (34-0-0) surface broadcast in a split plot arrangement in spring 2000. Plots at Matanuska were harvested with four-square-foot frames by half plot July 10–12, 2000, with weeds separated from biomass samples on each half plot. The researchers harvested the same plots again on September 19, 2000 using a walk-behind flail-type plot harvester[2] without the nitrogen split. The Pt. MacKenzie locations were not harvested in 2000.

All locations received 100 lb P_2O_5/ac (0-45-0) and 100 lb K_2O/ac (0-0-50-18S) plus 50 lbs N/ac (34-0-0) surface broadcast May, 2001 without the nitrogen split. Plots at the MEF location were harvested June 28 and again August 27–29, 2001 using the forage plot harvester. Sixty lbs N/ac were surface broadcast June 29, 2001. Plots at the PMD location were cleared July 11–13, 2001 (the experimental area was clipped and forage was removed to simulate harvest) and 60 lbs N/ac were surface broadcast on July 13 without the nitrogen split, with the second harvest on September 11, 2001 by forage plot harvester. The PMI location was harvested only once in 2001 on August 6–7.

2. Swift Machine & Welding Ltd., 1881 Chaplin St. W, Box 1372, Swift Current, SK CANADA S9H 3X5

Figure 1. Seeding year forage DM yield by N application at Matanuska Experiment Farm, August 18–19, 1999.

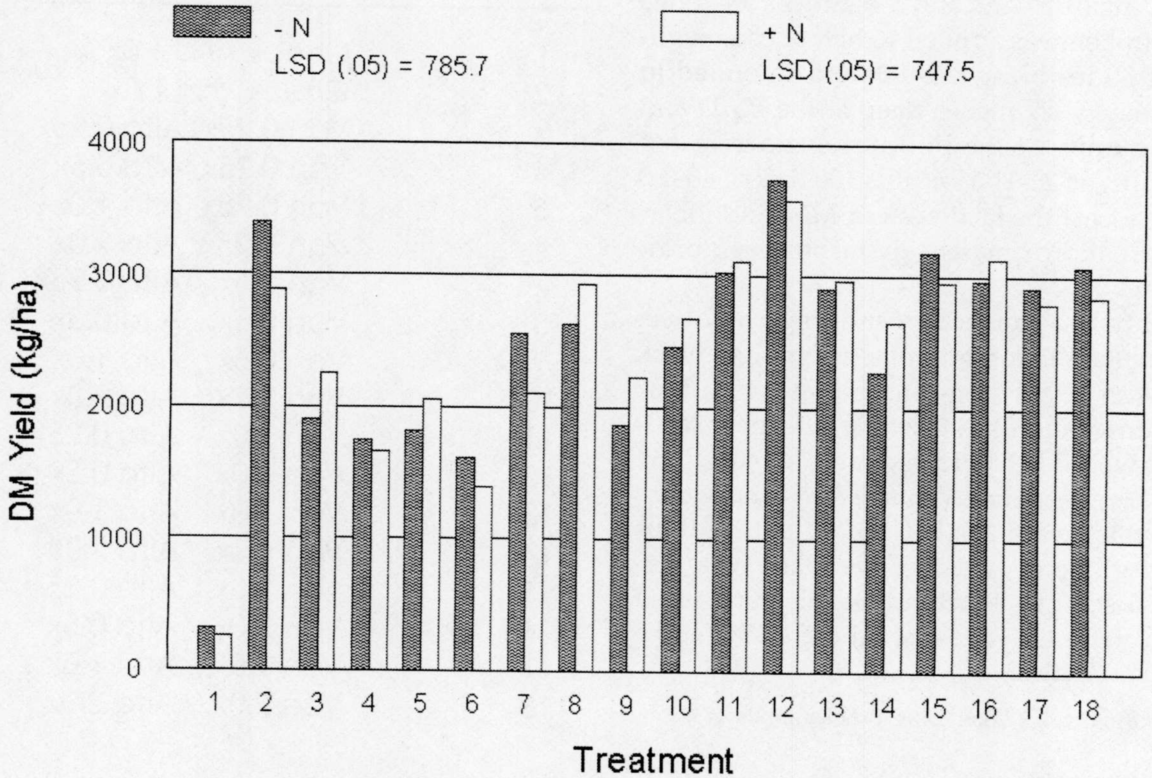


Figure 2. Seeding year forage DM yield and N uptake by seeding rates at Matanuska Experiment Farm, August 18–19, 1999.

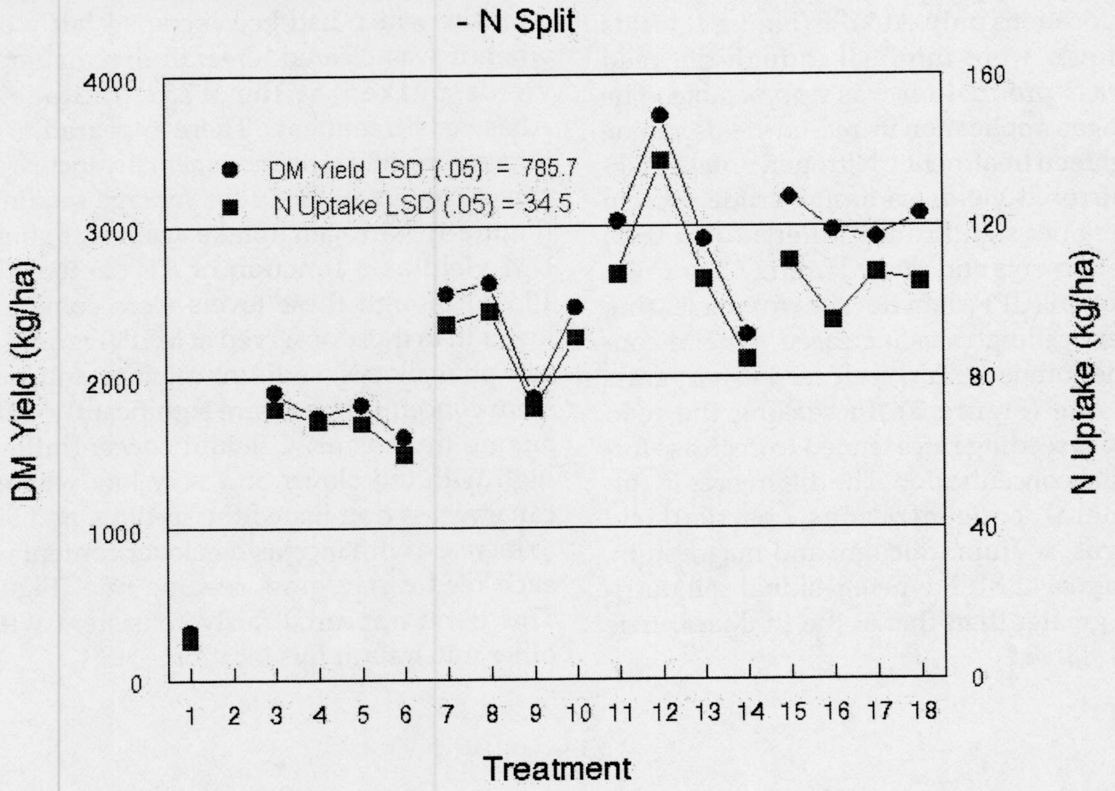
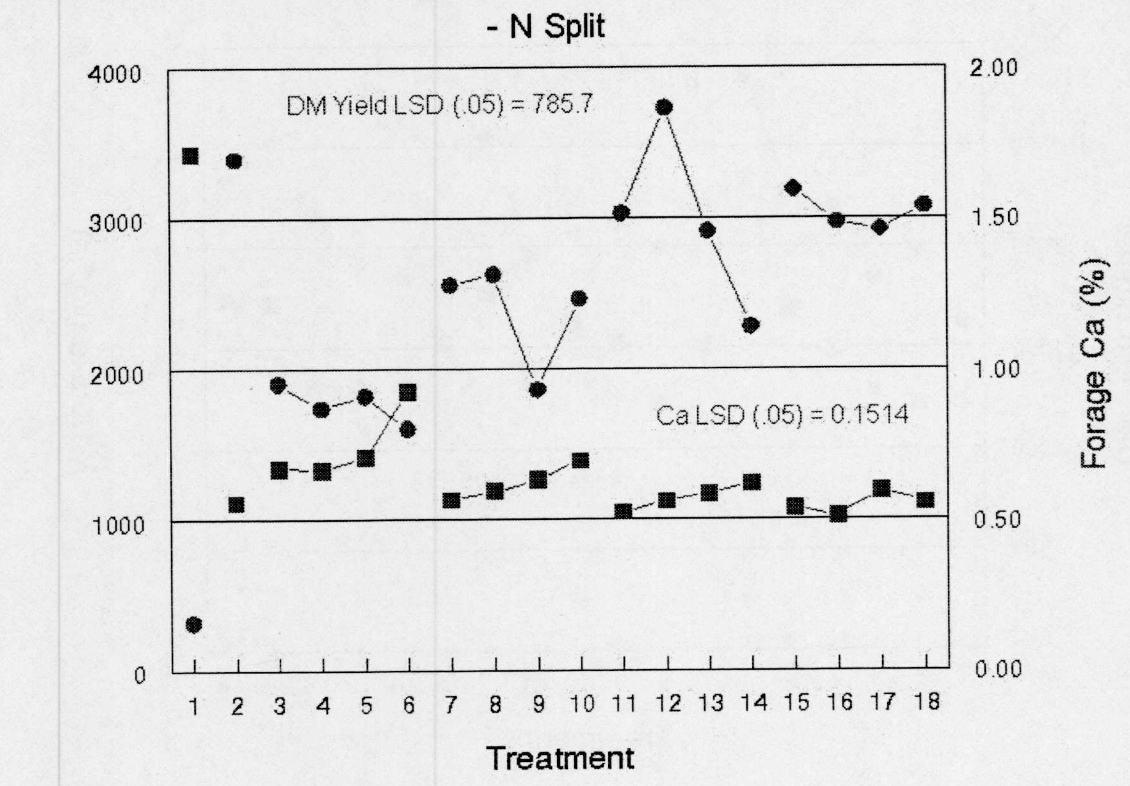


Figure 3. Seeding year forage DM yield and Ca concentration by seeding rates at Matanuska Experiment Farm, August 18–19, 1999.



RESULTS AND DISCUSSION

Seeding year yields were determined at MEF and PMI locations only. At MEF (Figure 1) yields of red clover were minimal though the reed canarygrass production was appreciable. The split nitrogen application increased yields in nine of the eighteen treatments. Nitrogen uptake (Figure 2) mirrored yields as forage crude protein levels were not significantly different ($P \leq 0.05$) among treatments and ranged from 17.7 to 24.4% crude protein (CP) (data not shown). Increasing red clover seeding rates increased mineral content of the forage within each reed canarygrass seeding rate (Figure 3). Increasing the reed canarygrass seeding rates tended to decrease forage calcium concentration. The differences in forage mineral concentrations, particularly phosphorus, sodium, calcium, and magnesium, were minimal at MEF where residual soil nutrition was greater than that at the Pt. MacKenzie locations (Table 1).

Red clover and reed canarygrass appeared to be nutrient deficient in the seeding year (1999) at the PMI location. The experiment was established on a site which had been scraped fairly deeply when it was cleared. Overall dry matter (DM) yields peaked at the 0.25x Vantage, 2.0x Altaswede treatment. There appeared to be an increase in yield with incrementally increased red clover content at the 0.25x Vantage seeding rate (Figure 4). Nitrogen uptake again was similar to DM yield as a function of CP content (7.4 to 10.2%) though these levels were considerably lower than those observed at MEF (Figure 4). Forage phosphorus, sodium, calcium and magnesium concentrations were significantly different among treatments. Calcium concentration was high with red clover and very low where reed canarygrass dominated the seeding, and tended to increase with increasing clover content within each reed canarygrass seeding rate (Figure 5). This trend appeared fairly consistent with the other minerals at this location.

Figure 4. Seeding year forage DM yield and N uptake by seeding rates at the Trytten Farm (PMI), September 13, 1999.

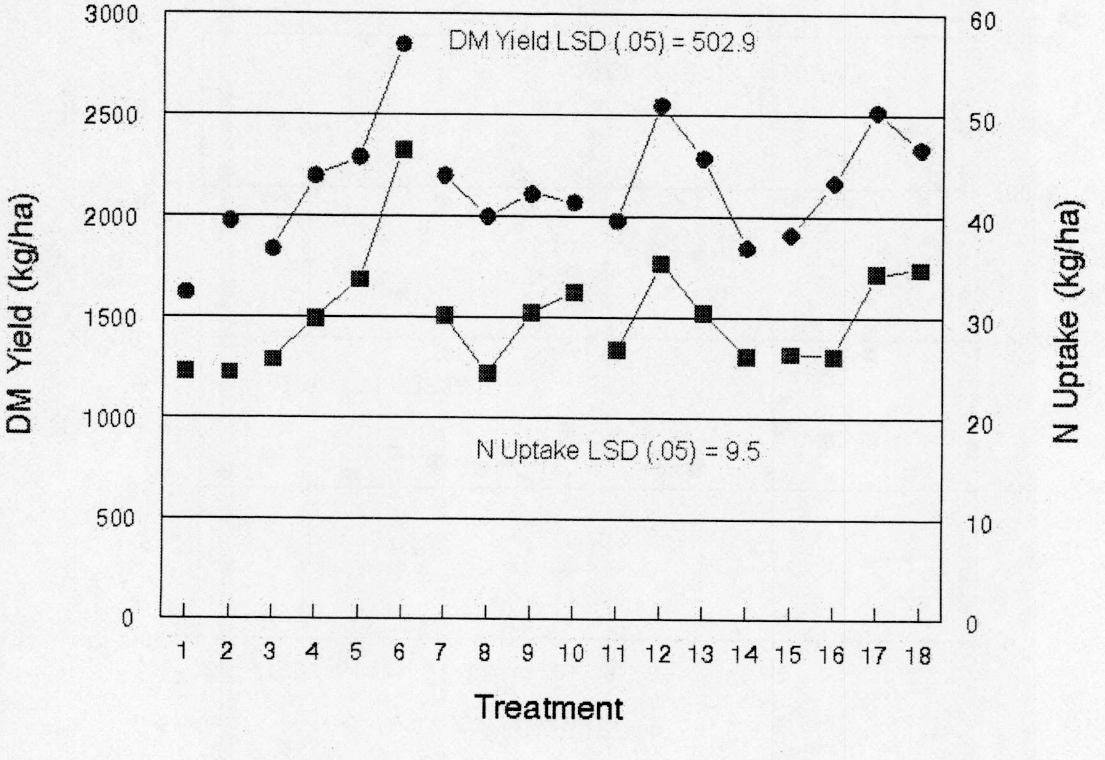


Figure 5. Seeding year forage DM yield and Ca concentration by seeding rates at the Trytten Farm (PMI) September 13, 1999.

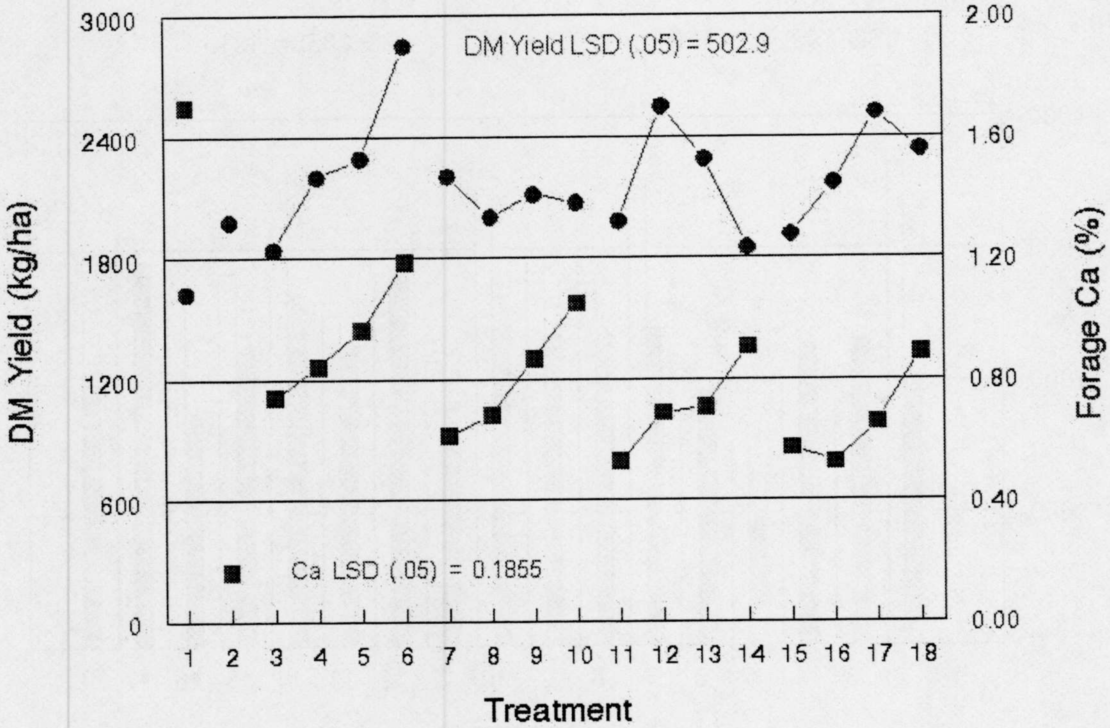


Figure 6. Total forage DM yield by seeding rates at Matanuska Experiment Farm by year; 1999 (1 cutting), 2000, and 2001 (2 cuttings in each year).

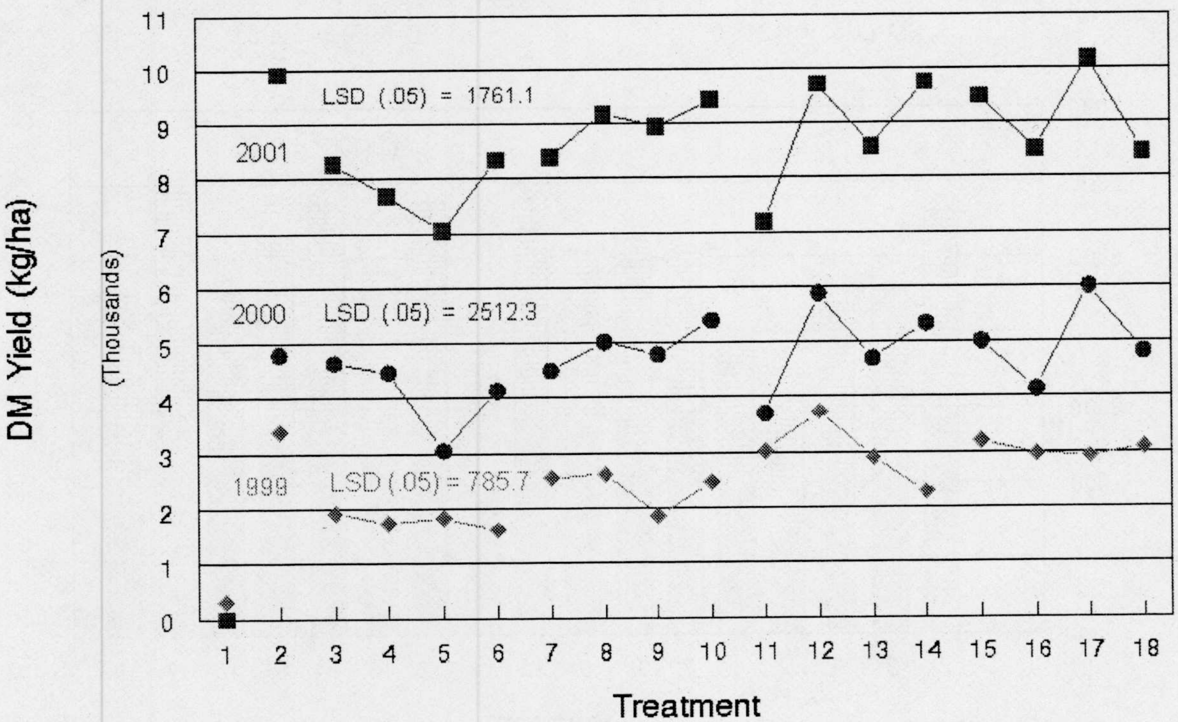


Figure 7. Forage DM yield by seeding rates and N application at Matanuska Experiment Farm, 1st cutting, July 10-12, 2000.

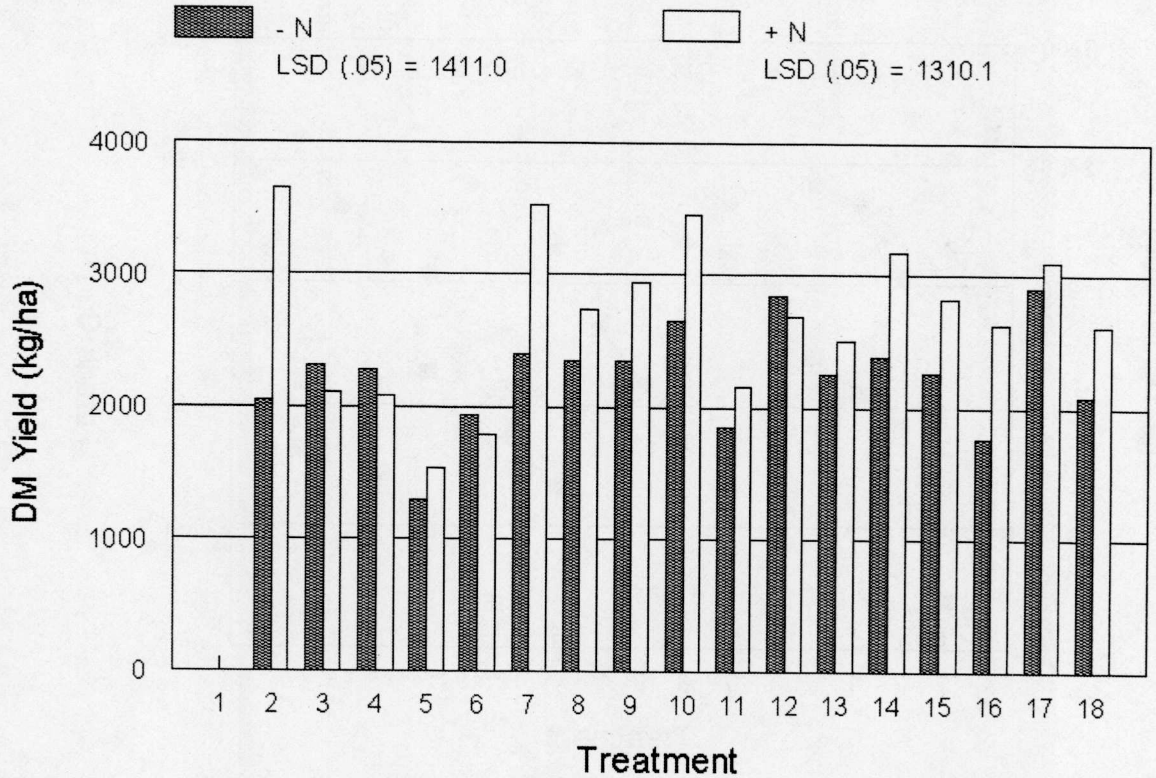


Figure 8. Forage DM yield by seeding rates at Matanuska Experiment Farm, 1st cutting, July 10-12, 2nd cutting September 19, 2000.

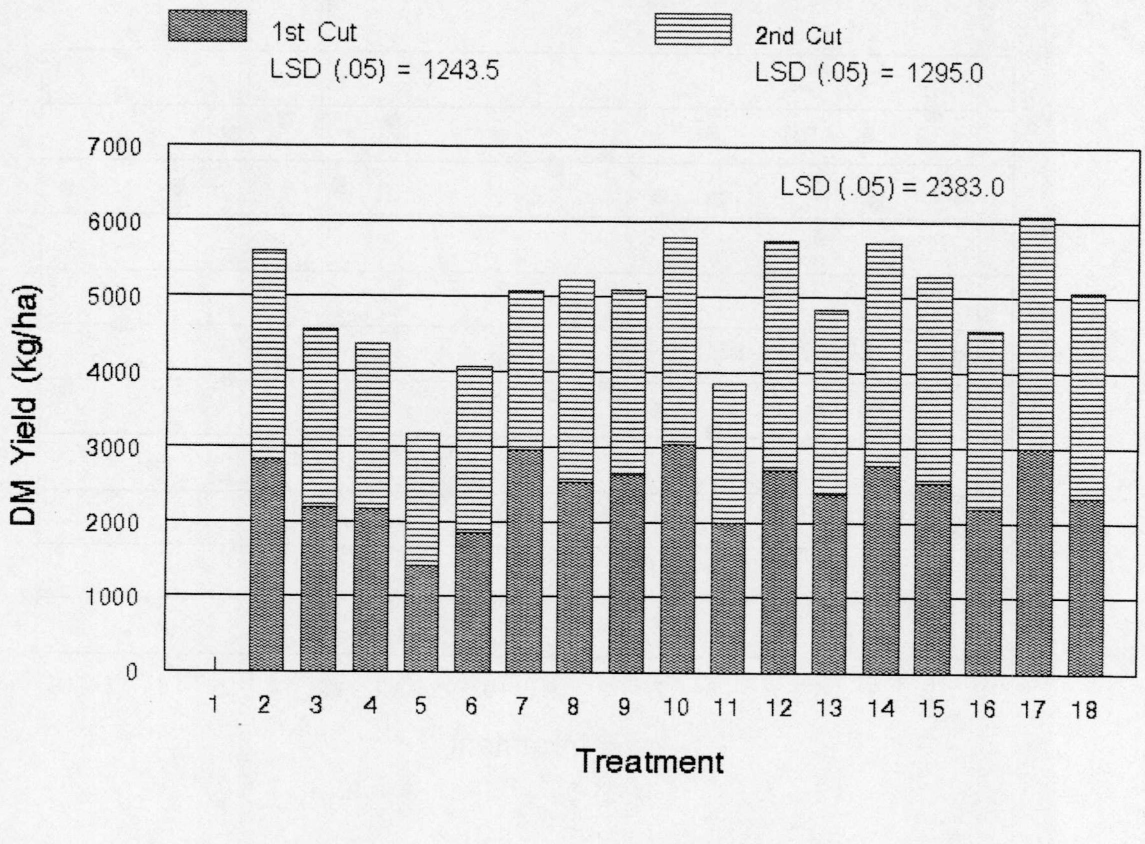
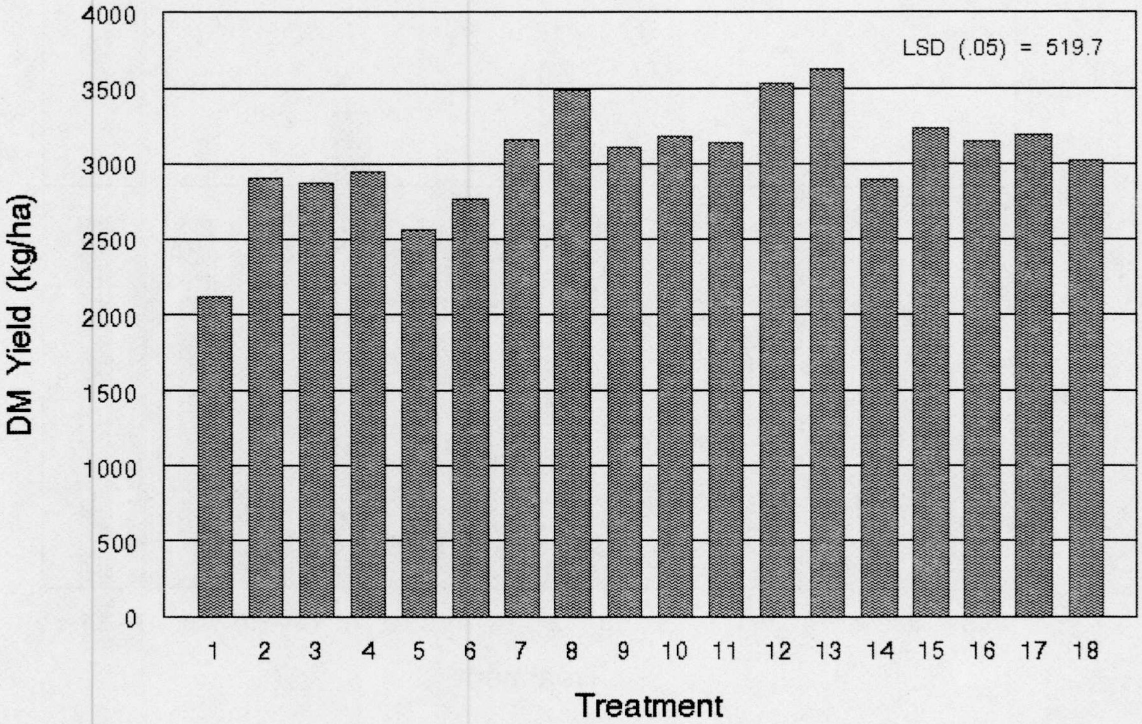


Figure 9. Forage DM yield by seeding rates at the Trytten Farm (PMI), August 6–7, 2001.



Winter 1999–2000 saw considerable damage to perennial forages in southcentral Alaska. Warm winter trends brought the air temperature from below zero to nearly 50 degrees Fahrenheit in less than 24 hours. The warm temperatures melted the snow, and rain contributed to the mass of water standing on still-frozen soil.

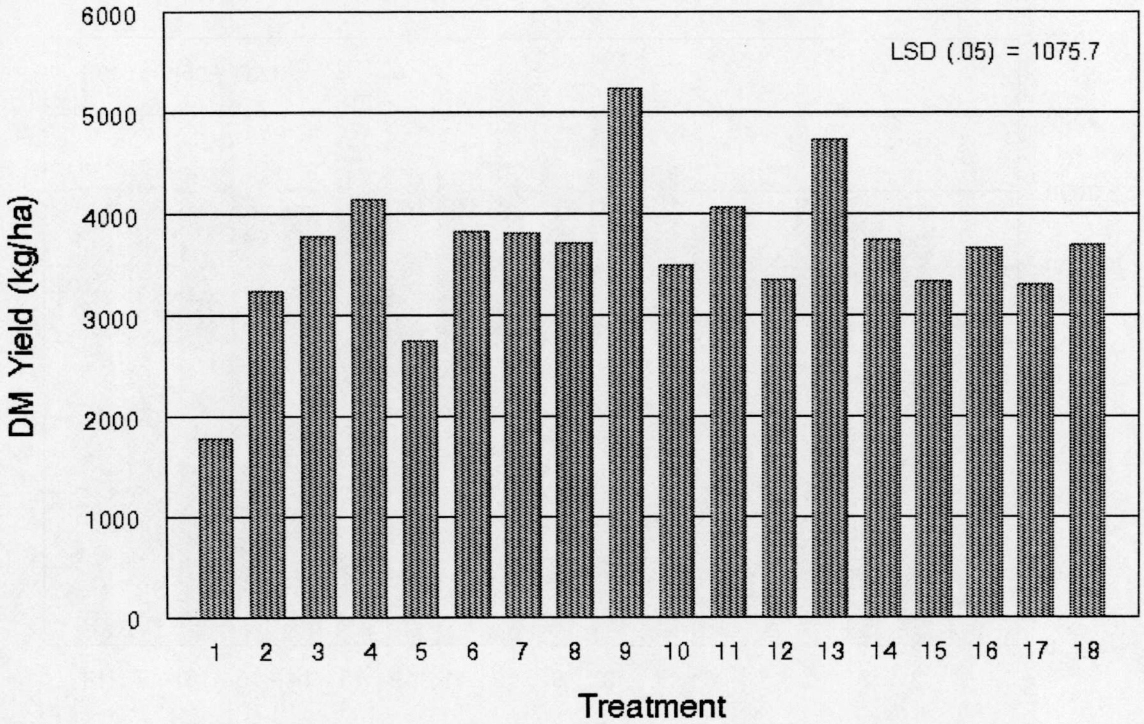
Red clover at the MEF location was almost eliminated by the winter weather although the reed canarygrass stands remained very uniform. Growing season conditions were cooler and more moist than normal so forage yields, even with two cuttings, were not as high as expected (Figure 6). Fertilizer nitrogen was split again in 2000 and yield responses in the absence of red clover in the stand were greater than observed in 1999 at MEF (Figure 7). The greatest response to nitrogen was in the Vantage Check. Figure 8 shows total forage yield by individual cutting. Second year yields were not taken at the Pt. MacKenzie locations. Forage quality data are unavailable for the 2000 and 2001 seasons at this time.

Considerable red clover emerged in Fall 2000 at the MEF location and survived the winter. Growing season 2001 was more normal, with a dry April and May and accumulating precipitation in June through harvest. Forage yields were excellent with some individual plots exceeding 12,000 kg DM/ha (Figure 5).

The PMI location was harvested August 6–7, 2001 (Figure 9). Forage yields averaged almost 3000 kg DM/ha with the red clover check producing just over 2000 kg DM/ha of likely very high quality feed (data not available).

The PMD location was cut July 11–13, 2001 with no DM yields taken. The red clover stand was very uniform and apparently did not suffer from the poor winter conditions. Second cutting yields averaged nearly 4000 kg DM/ha (Figure 10).

Figure 10. Forage DM yield by seeding rates at the Pt. MacKenzie Research Farm (PMD), September 11, 2001.



SUMMARY

The objective of this research was to assess the compatibility of reed canarygrass and red clover to determine optimum seeding rates of this mixture for forage yield and quality. Forage yields tended to be greater at MEF with the higher reed canarygrass treatments though the two high red clover rates seemed to restrict overall yield potential. Nitrogen uptake mirrored yield curves at all locations as protein content was very consistent in the forage across treatments. Mineral concentration tended to increase in the forage with increasing clover content and decreased slightly with increasing reed canarygrass seeding rates.

Yield potential for this mixture may be limited due to lack of residual calcium and phosphorus under certain soil pH conditions at Pt. MacKenzie.

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