EVALUATION OF FORAGE LEGUME POTENTIAL AT FAIRBANKS, POINT MACKENZIE, AND SOLDOTNA

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INTRODUCTION

Forage legumes have a high crude protein content and some residual nitrogen from these crops can be utilized by other species that follow legumes in crop rotations. Irwin (1945) compiled the results of early research covering a wide range of legumes, both annual and perennial, at several locations within Alaska, but neither the yields nor the persistence of these crops were comparable to native and introduced grasses. Recommended legumes included field peas and vetches in combination with cereal grains and either alsike or sweetclover in combination with bromegrass for silage (Sweetman et al., 1950).

Perennial legume yields (0.5 to 1.9 tons per acre) were low when compared to perennial grasses at the Matanuska Research Farm in southcentral Alaska (Klebesadel, 1980, 1983). These low yields were attributed to poor winterhardiness and consequent winterkill of most of the legumes. Formation of ice sheets, direct exposure to lethal temperatures (due to lack of snow cover), and desiccation reduce the ability of perennial legumes to survive winters in southcentral Alaska (Klebesadel, 1974).

Yield potentials for perennial grasses may exceed 4.5 tons per acre (Mitchell, 1982), while forage legumes may produce from 0.5 to 2.4 tons per acre in research studies and demonstrations (Klebesadel, 1980; Mitchell, 1986). Husby and Krieg (1987) reported average crude protein contents for Alaska hays to be in the range of 8.3 to 11.8%. Changes in the production potential of Alaskan dairy cattle have effectively redefined the quality of forage that must be produced for the dairy industry. Current milk production potential for Alaska dairy cattle (14,800 lb/yr) requires high concentrations (>16%) of crude protein in the ration (Brown et al., 1989; NRC, 1988). On a dry matter yield basis legumes do not compare well with grasses, but high crude protein content and the cost of protein supplements in Alaska justify further research with both annual and perennial leguminous forage crops.

Experiments were conducted to evaluate forage legumes for yield, quality, and persistence potential at three locations in Alaska. Preliminary results from these experiments are presented.

MATERIALS AND METHODS

Three replicates of 2.5 x 15 ft plots (69 varieties) were planted at Fairbanks and at Point MacKenzie, while a smaller set (16 varieties) was planted at Soldotna in late May and early June 1989. Fertilizer applications consisted of 50 lb P_2O_5 per acre as triple super phosphate and 60 lb K_2O per acre as K_2SO_4 at Fairbanks, 200 lb P_2O_5 per acre as triple super phosphate and 200 lb K_2O per acre as K_2SO_4 at Point MacKenzie, and 32 lb N per acre, 128 lb P_2O_5 per acre and 64 lb K_2O per acre as 8-32-16 at Soldotna. The following data were collected: emergence, flowering dates, yield, growth habit, and extent of nodulation. Persistence of perennial species will be evaluated in 1990. Forage samples were collected and analyzed for *in vitro* dry matter digestibility (IVDMD), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber

(ADF). Rainfall and soil test data for Fairbanks and Point MacKenzie are presented in Figure 1 and Table 1, respectively.

RESULTS

Fairbanks

Several species performed extremely well at this location, despite the lack of rainfall early in the growing season (Fig. 1). Six species produced more than 2.5 tons dry matter per acre and most IVDMD values were greater than 65%. Only one species contained over 20% crude protein, while five values of less than 15% were recorded. Neutral detergent fiber and acid detergent fiber contents were relatively low (26 to 45% and 19 to 33% respectively). Based on yield and quality performance vetch, annual medics, alfalfa, and red clover were the most promising species at Fairbanks.

Point MacKenzie

Forage yields at Point MacKenzie were lower than those observed at Fairbanks (Table 3). Most legumes perform better in neutral soils than under acid conditions and the soil pH differences at the two locations may explain this response. Nevertheless, dry matter yields in excess of two tons per acre were recorded at Point MacKenzie. Most species were greater than 65% IVDMD with 10 species over 70%. Three species surpassed 20% crude protein and three species contained less than 15%. NDF and ADF data indicated that fiber contents were similar at Point MacKenzie and Fairbanks. Faba beans, peas, red clover, and white clover appeared to have good potential at Point MacKenzie.

Soldotna

Due to space limitations, the data from Soldotna were not presented in this report. Fewer species and varieties were studied at this location, but the results were similar to Fairbanks and Point MacKenzie. Five species yielded more than 2.5 tons per acre, IVDMD values were greater than 65%, and crude protein ranged from 9.4 to 19.3%. Fiber concentrations (NDF and ADF) were similar to those observed at the other two locations. Berseem clover, peas, vetch, crimson clover, and red clover all appeared to merit further study at this location.

SUMMARY

The yield and quality of red clover were noteworthy at all three locations. Other promising species include vetches, medics, field pea, white clover, berseem clover, and crimson clover. Basic agronomic information (seeding rates, fertility requirements, harvest management, etc.) is needed for most legumes in Alaska. Long-term performance, winter survival (perennials), and specific management practices must be defined before these crops can be recommended.

Some species, such as lupine and arrowleaf clover, had poor stands, but individual plants were large and vigorous. The poor stands may have been related to soil pH or agronomic variables such as seeding rate. The reasons for poor stands must be explained before these species are eliminated as possible crops for Alaska. Future plans include continued screening of forage legume species and management trials with species and varieties that have potential for Alaska livestock production systems.

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Figure 1. *Cumulative rainfall by location in 1989.*

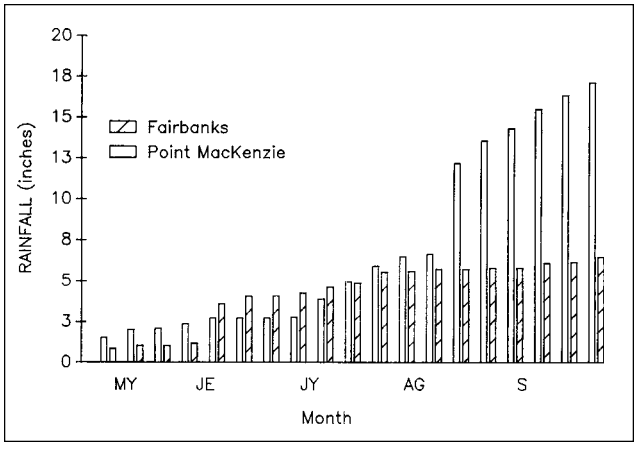

Table 1. *Soil chemical characteristics by location in 1989.*

	Organic Matter	pH	EC	NO_3+NH_4 N	P	K
	%		mmho/cm	———	ppm	———
Fairbanks	4.0	7.1			33†	
Point MacKenzie	9.5	5.3	0.21	14††	8†††	101†††
Soldotna		5.6		10††	10†††	69†††

† Bray extraction
†† 2 N KCl extraction
††† Mehlich 3 extraction

Table 2. *Yield and quality of legume species grown at Fairbanks in 1989.*

Common name	Species	Number of varieties	Yield Range	IVDMD	CP	NDF	ADF
			T/A	%	%	%	%
ANNUAL CLOVERS							
Subterranean	*Trifolium subterraneum*	2	0.8-2.5	69	10.2	35	24
Crimson	*T. incarnatum*	4	1.7-2.6	63	11.3	45	33
Arrowleaf	*T. vesiculosum*	1	1.4-1.8	75	12.8	32	25
Berseem	*T. alexandrinum*	1	1.6-1.8	75	13.7	38	27
Ball	*T. nigrescens*	2	0.7-1.8	76	13.8	33	25
OTHER ANNUALS							
Vetch	*Vicia spp. and hybrids*	7	0.6-3.3	71	20.2	38	29
Lupine	*Lupinus alba*	1	1.6-1.7	71	18.5	39	30
Flat Pea	*Lathyrus tingitanus*	1	1.9-2.4	68	15.9	40	32
Medics	*Medicago spp.*	2	1.8-3.3	68	15.6	42	31
PERENNIAL CLOVERS*							
Red	*Trifolium pratense*	5	0.7-3.1	74	16 .1	30	23
White	*T. repens*	2	0.9-2.2	79	17. 0	28	21
Alsike	*T. hybridum*	2	0.7-1.9	81	18.6	26	19
OTHER PERENNIALS*							
Alfalfa	*Medicago sativa*	3	1.5-3.0	67	16.8	35	29
Birdsfoot Trefoil	*Lotus corniculatus*	2	1.3-2.2	66	15.6	37	29

* Seeding year data only. Winter survival and subsequent yields will be determined in 1990.

Table 3. *Yield and quality of legume species grown at Point MacKenzie in 1989.*

Common name	Species	Number of varieties	Yield Range	IVDMD	CP	NDF	ADF
			T/A	%	%	%	%
ANNUAL CLOVERS							
Subterranean	*Trifolium subterraneum*	1	1.6-1.9	80	14.6	29	21
Crimson	*T. incarnatum*	5	0.8-2.2	61	12.6	48	35
Arrowleaf	*T. vesiculosum*	1	0.7-1.2	77	14.8	36	28
Berseem	*T. alexandrinum*	1	0.4-1.0	73	15.3	37	28
OTHER ANNUALS							
Fababean	*Vicia faba*	1	1.9-2.1	72	17.0	39	29
Vetch	*Vicia spp. and hybrids*	7	0.6-1.6	71	23.2	40	28
Lupine	*Lupinus alba*	1	0.5-1.5	68	18.5	45	34
Pea	*Pisum sativum arvense*	1	1.5-2.8	73	20.8	36	26
PERENNIAL CLOVERS*							
Red	*Trifolium pratense*	2	0.7-2.3	79	17.8	30	23
White	*T. repens*	1	0.7-2.7	85	22. 2	27	21
Alsike	*T. hybridum*	1	0.9-1.7	79	19.7	29	24
OTHER PERENNIALS*							
Alfalfa	*Medicago sativa*	1	0.4-1.7	72	17.0	39	29
Birdsfoot Trefoil	*Lotus corniculatus*	1	0.8-1.3	67	16.9	40	31

*Seeding year data only. Winter survival and subsequent yields will be determined in 1990.

NOTE: Research Progress Reports are published by the Alaska Agricultural and Forestry Experiment Station to provide information prior to the final interpretations of data obtained over several years. They are published to report research in progress but may not represent final conclusions.

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