CEREALS FOR FORAGE PRODUCTION AT POINT MacKENZIE

George Mitchell
Jerry Purser
Cooperative Extension Service
University of Alaska

With Contibutions from:
W. W. Mitchell, R. L. Taylor, C. L. Ping,
G. J. Michaelson and M. W. Herlugson
Agricultural Experiment Station
University of Alaska

COOPERATIVE EXTENSION SERVICE
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INTRODUCTION

Research history on the soils in the Point MacKenzie project area is limited when compared to many other agricultural areas in Alaska. However, four years of soil fertility and forage production data has been compiled. The basis for information included here is research carried out on the research tract at Point MacKenzie by the staff at the Palmer Research Center. This information coupled with many years of breeding and crop selection data from the nearby Matanuska Valley, make preliminary recommendations possible.

An earlier publication entitled "Grain and Forage Crops for Southcentral Alaska" (A00149) offers general recommendations, some of which are pertinent to the Point MacKenzie Project. However, major soil differences and significant climatic variation from areas where prior research efforts were carried out, require some adjustments in production practices.

This publication, while including some general recommendations, will concentrate on fertilizer and crop requirements specific for Point MacKenzie. In addition, current information on forage quality and harvest dates are included.

SOIL CONSIDERATIONS

The soils within the project area consist of two major series; Kashwitna and Homestead silt loams. The Homestead series is generally found on the east and the Kashwitna on the west side of the project area. The Kashwitna series is the predominant soil in the area with the Homestead more often occuring on convex ridges. The major difference between the two series is the depth of silt loam over

gravelly sand. The Homestead is the shallower of the two series with a silt loam mantle of 6 to 10 inches compared with 10 to 18 inches for the Kashwitna. Other than depth of topsoil, the two series have essentially the same chemical and physical properties. Depending on native vegetation, method of clearing (amount of soil removed), time in production and possible other factors, the working pH of project soils may vary from approximately 5.3 to 6.3. Since lime is not an economic alternative at the present time, crop selection is the primary means available to the grower in dealing with this range in soil acidity. Comprehensive soil testing practices are mandatory in helping the grower select both annual and perennial forages that will perform well.

Without exception, soils of the region are deficient in nitrogen (N) and phosphorous (P_2O_5) and yield response to additions of these nutrients can be expected. Available potash (K_2O) is generally low; however, yield response to its application in cereal forages has been small. Regardless of response, application of potash for maintenance is required on low testing soils. It should be remembered that, in general, cereals grown for forage remove somewhat more N and P_2O_5 and considerably more K_2O, than when grown for grain and only the grain is harvested (Table 1). While this information is for barley, similar results can be expected for oats.

TABLE 1. Nutrient removal by a 60 Bu/A yield of barley grain versus a 3 Ton/A (D.M.) yield of barley forage harvested at the late milk stage.

Crop & Yield	Nutrients Removed		
	N	P_2O_5	K_2O
	- - - lbs/A - - -		
Barley Grain (60 Bu/A) 1/	66	24	21
Barley Forage (3 Ton/A)	78	30	80

1/ Straw Returned

The Kashwitna and Homestead soils are high phosphorous fixers and relatively high rates of P_2O_5 are recommended during initial years of production. In later years, some downward adjustment will be possible based on soil testing and cropping history. Lower initial rates of P_2O_5 are possible if applied in a band near the row. Relatively high rates of nitrogen are recommended for cereal forage; not only because of higher removal rates, but also because high vegetative yield and quality are as desirable as they are in perennial forages. In addition, lodging, while certainly not desirable, is less critical when the cereal is used for grazing, silage, or hay. If cereals are harvested at heading or early milk stage, they are less likely to lodge than later when the heads are heavy.

FERTILIZER RECOMMENDATIONS FOR OAT AND BARLEY FORAGES

The extremely low levels of available N and P_2O_5 on newly cleared soils in the project area requires careful attention to all aspects of fertilization. Any portion of the field that is missed or where poor distribution occurs will be clearly observable. Careful calibration of equipment and periodic checks on calibration cannot be overemphasized. Calibration charts which come with equipment are based on "average" fertilizer materials; field calibration with your fertilizer is essential for accurate application rates.

Based on Experiment Station research conducted at Point MacKenzie, the following recommended rates, when combined with other recommended practices and favorable moisture, have been shown to give good yields and quality.

NEW GROUND (2 TO 3 TONS/ACRE DRY MATTER YIELD GOAL)	
1) Broadcast Application (Lb/A of actual nutrients):	
90 N - 90 P_2O_5 - 60 K_2O	(450 Lb/A 20-20-15)
2) Banded Application:	
90 N - 60 P_2O_5 - 30 K_2O	(300 Lb/A 10-20-10 banded plus 130 Lb/A urea broadcast and incorporated)

Higher nitrogen rates at this level of production generally increase yields of oats to a greater extent than for barley. The same is true for total protein production per acre. However, the magnitude of the increase of both is very much influenced by other production practices and management of new ground. Obtaining full benefit from N rates greater than those recommended over the first two to three years of production following clearing is questionable.

Banding fertilizer is most effective when offset at least two inches from the seed furrow. When banding in the seed furrow, application should not exceed a total nutrient ($N + P_2O_5 + K_2O$) rate greater than 140 lb/A and no more than 30 lb/A of N as urea. Research on this subject is limited for Alaskan conditions. Applications beyond the recommended rate may be feasible under certain conditions of high soil moisture and use of low salt fertilizers.

SECOND AND SUBSEQUENT YEARS

The following table of broadcast fertilizer rates is based on soil test results and assumes the soil samples taken are reasonably representative of the field sampled. Information on proper soil sampling technique is provided on the reverse side of Extension Service Soil Sample Information Sheet (A-0044A) which is included in each soil test kit.

BROADCAST APPLICATION RATES

SOIL TEST	PPM P 0-5	6-10	11-20	21-35	36+
PPM K	lb/A of N - P_2O_5 - K_2O				
0-50	90-90-60	90-60-60	90-45-60	90-30-60	90-0-60
51-80	90-90-45	90-60-45	90-45-45	90-30-45	90-0-45
81-120	90-90-30	90-60-30	90-45-30	90-30-30	90-0-30
121-200	90-90-30	90-60-30	90-45-0	90-30-0	90-0-0
201 +	90-90-0	90-60-0	90-45-0	90-30-0	90-0-0

The nitrogen recommendation remains at 90 lb/A for a 2 to 3 ton/A yield goal (7 to 10 ton/A at 70% moisture) when harvested at fully headed for oats and early dough stage for barley. Buildup of soil test phosphorus (P) and potassium (K) is generally slow on newly cleared lands, with K proceeding much more rapidly than P. However, a combined change in soil test K level from very low (0-50 ppm) to medium (81-120 ppm) and P level from very low (0-5 ppm) to low (6-10ppm) can reduce fertilizer costs by as much as $10 per acre (1984 fertilizer prices).

For producers that may want to deviate from the rates recommended, the following table gives relative fertilizer costs versus expected yields at both higher and lower rates. It's worth noting that oats produce higher yields and require somewhat lower P_2O_5 rates than barley on newly cleared and unlimed soils at Point MacKenzie.

RELATIVE FERTILIZER COSTS VERSUS EXPECTED OAT AND BARLEY YIELDS AT POINT MACKENZIE

Rate N-P_2O_5-K_2O	Cost 1/	Yield (Ton/A)			
		Oats 2/		Barley 3/	
LB/A	$/A	D.M.4/	70% Moist.	D.M.	70%Moist.
120-90-90	76	3.2	10.6	2.7	9.0
120-60-60	70	3.1	10.3	2.0	6.7
90-90-90	69	2.8	9.3	2.6	8.7
90-90-60	62	2.8	9.3	2.6	8.7
90-60-60	55	2.7	9.0	2.0	6.7
90-60-30	53	2.6	8.7	2.0	6.7
60-60-60	46	2.2	7.3	1.8	6.0
60-60-30	41	2.1	7.0	1.8	6.0
30-30-30	23	1.5	5.0	1.3	4.3

1/ Based on in-state fertilizer prices in 1984; costs will vary depending on source and bulk rate
2/ Based on harvest at the fully headed growth stage
3/ Based on harvest at the soft dough growth stage
4/ Dry Matter (60°C)

Growers are cautioned that, in addition to lower yields, low fertilizer application rates will also reduce overall quality of the forage.

SULFUR - Yield increases from sulfur application have been obtained in grass and small grain production in some areas of Alaska. At Point MacKenzie, application of sulfur to ryegrass, barley, oats, alfalfa, and red clover has not shown increases in yield. Research is continuing in this area.

MICRONUTRIENTS - Applications of boron, zinc, copper, manganese, iron and molybdenum have not increased yields of oats or barley in Experiment Station tests. However, the application of 1 lb/A of boron for two years, significantly reduced yields of barley but not oats.

Research to date has shown no evidence that nutrients other than N, P_2O_5 and K_2O are required for small grain forage production at Point MacKenzie.

CEREAL VARIETIES

While a number of adapted varieties of barley, oats, and wheat are recommended for grain production in Alaska, the availability of tested forage varieties is limited. Supplies of certified seed of some varieties may be an additional limitation.

Recommended Varieties:

Barley - (Not recommended for soils having pH less than 5.6)

Weal - An awnless, early maturing variety developed at the Palmer Research Center.

CAUTION: Smooth-awned or awnless varieties of barley are preferred. Rough awns can irritate livestock mouths particularly when harvested at later stages of maturity.

Oats

Toral - Full season variety developed at the Palmer Research Center.

Nip - Early maturing Swedish variety

Golden Rain - Full season Swedish variety

Ceal - Very early maturing variety developed at the Palmer Research Center

Other Oats

The following varieties have not been tested extensively for forage production in Alaska; however, they have shown promise in two years of tests by Dr. Bill Mitchell and in producer's fields: Foothill, Park, Victory and Athabasca.

In oat forage variety trials conducted by Roscoe Taylor at the Experiment Station's Matanuska Farm, varieties adapted to Northern Alberta, Canada, produced higher yields than those from Northwestern United States.

In Experiment Station tests at Point MacKenzie, Weal barley grown at pH 5.3 yielded over 1000 lb/A less dry matter than the same variety grown at pH 5.8. Toral oats produced the same yields regardless of pH. In view of these factors, an early soil test is strongly recommended before selecting and buying seed. In the absence of a soil test, oats are recommended.

Contact the Cooperative Extension Service or the Agricultural Experiment Station before using nonrecommended varieties.

SEEDING RATES AND CULTURAL PRACTICES

Recommended seeding rates for both barley and oat forage are as follows:

Drilled - 100 lb/A of pure, live seed

Broadcast - 125-150 lb/A of pure, live seed

The use of certified seed is strongly recommended. Certified seed has passed the field and bin inspection procedure of the Alaskan Crop Improvement Association or area of origin for imported seed and offers the best assurance of varietal purity, quality

and freedom from weed seed. When calculating seeding rates, do so in terms of pure, live seed. (PLS=% purity x % germination).

Although there is considerably more leeway on planting date for cereals grown for forage as opposed to grain, early planting is recommended. May and June are traditionally dry months in this area; early planting takes advantage of stored soil moisture for germination and early growth during this dry period. Spring tillage should be minimized but sufficient to properly incorporate preplant fertilizer and prepare a firm, moist seedbed. Loose seedbeds promote drying and reduce soil to seed contact. An optimum seedbed should be firm enough that a 180 lb person would leave footprints no deeper than the thickness of the sole on a workboot and have moisture within ½ inch of the surface. Something short of optimum will probably result on first and perhaps even second year crops following clearing operations; however, efforts toward that end will be rewarded with better stands and eventual yields.

Weeds are not yet a major production problem at Point MacKenzie. For this to remain so, standard weed prevention methods recommended for weed control in small grains and forages (Extension Publication A-00049) should be adhered to. These include planting only clean seed, eradicate weed species before they spread, and use mechanical or chemical means of destroying weeds before they produce seed. Prevention is easier and less expensive than control. If assistance is needed in identifying specific weeds, contact your local Extension Agent.

Companion crops such as peas and vetch have been successfully grown with oats in the Matanuska Valley. However, legumes require relatively high pH (greater than 6.0) for good growth. Until normal tillage practices, leaching precipitation and decomposition processes result in more uniform and less acidic soil at Point MacKenzie, companion legumes cannot be recommended. For those who are intent on trying a legume, do so on a small acreage the first year. It should also be remembered that the soils at Point MacKenzie do not contain nitrogen-fixing bacteria and legume seed should be inoculated with the proper strain of rhizobium. The

practice of planting oat and barley in alternate strips offers the possibility of maximizing yield and quality of both species. As mentioned earlier, however, soil pH values less than 5.6 will limit barley yields.

As length of time in production increases, we expect a "mellowing" of the soil. Some increase in pH and more uniformity will likely occur as the soil is mixed and cropped. This may be offset somewhat by continuous application of nitrogen fertilizer, but experience in the Matanuska Valley has shown the long term pH and general growing conditions improve with time.

CEREAL FORAGE QUALITY

Results of preliminary testing of cereal forages at Point MacKenzie by Dr. W. W. Mitchell have shown that acceptable to excellent yields of barley and oats are possible on Point MacKenzie soils. On soils of pH 5.7 or less, Toral oats yielded 2.8 Ton/A dry matter compared to 2.1 Ton/A for Weal barley when harvested at the fully headed stage of growth. Toral oat yields of 3.8 Ton/A were obtained when harvested at the soft dough stage, at some cost to forage quality.

Cereals grown at Point MacKenzie performed rather poorly in terms of crude protein (CP) content and calcium (Ca) levels when compared with barley grown at Palmer (Table 2).

TABLE 2. Comparison of forage quality of Toral oats and Weal barley grown at Point MacKenzie, to Weal barley grown in the Matanuska Valley. Crops were harvested at the fully headed stage.

Crop & Location	D.M. Yield 1/	Crude Protein	P	Ca	IVDMD
	T/A	%	%	%	%
Toral oats, Pt. Mack.	2.8	7.50	0.18	0.16	56.0
Weal barley, Pt. Mack.	2.1	7.13	0.19	0.18	51.4
Weal barley, Palmer	2.8	11.50	0.19	0.96	58.7

1/ All tests were fertilized at the rate of 90-90-90 lb/A of $N\text{-}P_2O_5\text{-}K_2O$. (From: Forage Yield and Quality of Cereals at Pt. MacKenzie. By W. W. Mitchell

Crude protein, calcium, phosphorous, and digestible dry matter in Point MacKenzie forages were all below levels considered necessary for producing dairy cows. Energy and nutrient supplementation will be necessary for the cereals thus far tested.

Time of harvest should be given careful consideration by growers in this area. Forage quality decreases rapidly with increasing yield after head emergence (Table 3). Crude protein and digestibility registered their greatest decline between head emergence and the milk stage. Relatively high forage quality can be obtained by cutting at the fully headed stage; however, the producer must settle for significantly lower yield. For a given stage of growth, fertilizer rates are the primary factor in determining yield and quality. However, fertilizing with a definite goal, in terms of crude protein and total digestible nutrients, will be to little avail if time of harvest is not also carefully considered.

TABLE 3. Forage yield and quality for Toral oats when harvested at different stages of growth. Point MacKenzie, 1982.

Harvest Stage and date 1/	D.M. Yield	Crude Protein	P	Ca	IVDMD 2/
	Ton/A		%		
1 - AUG 2	1.5	11.8	0.26	0.18	68
2 - AUG 10	2.1	8.9	0.22	0.19	60
3 - AUG 26	3.2	5.8	0.17	0.16	57
4 - SEPT 9	3.7	5.0	0.16	0.16	56
5 - Sept 23	4.3	4.7	0.17	0.16	54

1/ 1- head emergence; 2 - fully headed; 3 - milk; 4 - soft dough; 5 - hard dough
2/ Digestible dry-matter

(From: Forage Yield and Quality of Cereals at Pt. MacKenzie. By W. W. Mitchell)

In 1984, the first full year of production, growers at Point MacKenzie produced forage with good feed value. Of silage samples submitted to the Experiment Station/Cooperative Extension Service Forage Testing Program, average forage quality was as follows:

Crude Protein	P	Ca	IVDMD
- - - - - - - - - -	%	- - - - - - - - - -	
10.1	.21	.31	57.1

Source: MaryLou Herlugson, Agricultural Experiment Station

These values fall well within the range expected for well-fertilized oats harvested between head emergence and the fully headed growth stage (Table 3). This serves to verify research results and points to the real benefits that can be gained from following research based recommendations.