SOIL QUALITY BENCHMARKS IN ALBERTA[1]

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ABSTRACT

Long-term benchmark soil sampling started in the fall of 1998 to monitor soil quality across Alberta landscapes and is part of the AESA (Alberta Environmentally Sustainable Agriculture) Soil Quality Monitoring Initiative. These sites were chosen to be representative of the soil-landscape patterns and agronomic practices within a given ecodistrict. This paper will introduce the soil quality benchmark project, its intent and data of the first year of benchmark establishment.

INTRODUCTION

Development of a province-wide network of benchmark sampling was initiated last spring and summer by the Conservation and Development Branch of Alberta Agriculture, Food and Rural Development (AAFRD). Monitoring of these benchmark sites is part of the AESA (Alberta Environmentally Sustainable Agriculture) Soil Quality Monitoring Initiative. There are two goals for this program. The first is to determine the state of soil quality across Alberta and the second is to determine the risk of change in soil quality with various management practices.

The main objectives of the fall benchmark sampling across Alberta are to:

- provide baseline soil information
- evaluate landscape effects on soil quality and soil quality risk assessment
- provide a data set to test and validate simulation models (crop growth, wind and water erosion)
- monitor changes in soil quality over time on a field landscape basis

SITE DESCRIPTIONS

Benchmark Sites were selected based on several criteria identified by the AESA Soil Quality Committee. Forty-one benchmark sites, representing 41 ecodistricts, were located within the agricultural area (white zone) of Alberta (Figure 1). The soil quality benchmark sites are representative of soil-landscape patterns and agronomic practices within each ecodistrict. At each benchmark site, sampling occurred at each of three landscape positions (upper, mid and lower slope positions). All sample sites were located with GPS (global positioning system) to permit future locating and sampling of the same sites.

The cooperators at each benchmark site have agreed to provide their past cropping histories and current annual agronomic practices including: crop rotations, tillage practices, crop seeded, fertilizers and herbicides applied, and harvest methods.

A detailed soil survey of 20 of the 41 sites was completed in the fall of 1998 by CAN-AG Enterprises Ltd. Soil profile descriptions to a depth of one meter and sampling of the major horizons for each of the three landscape positions were completed. Landscape descriptions were noted. How well the benchmark site fit the concept of its ecoodsitrict was also determined. These descriptions will provide baseline soil information.

MATERIALS AND METHODS

Sampling protocols were established for both plants and soils. Annual sampling of soils and vegetation will be carried out by Conservation and Development staff. Plant samples will be taken at harvest time to

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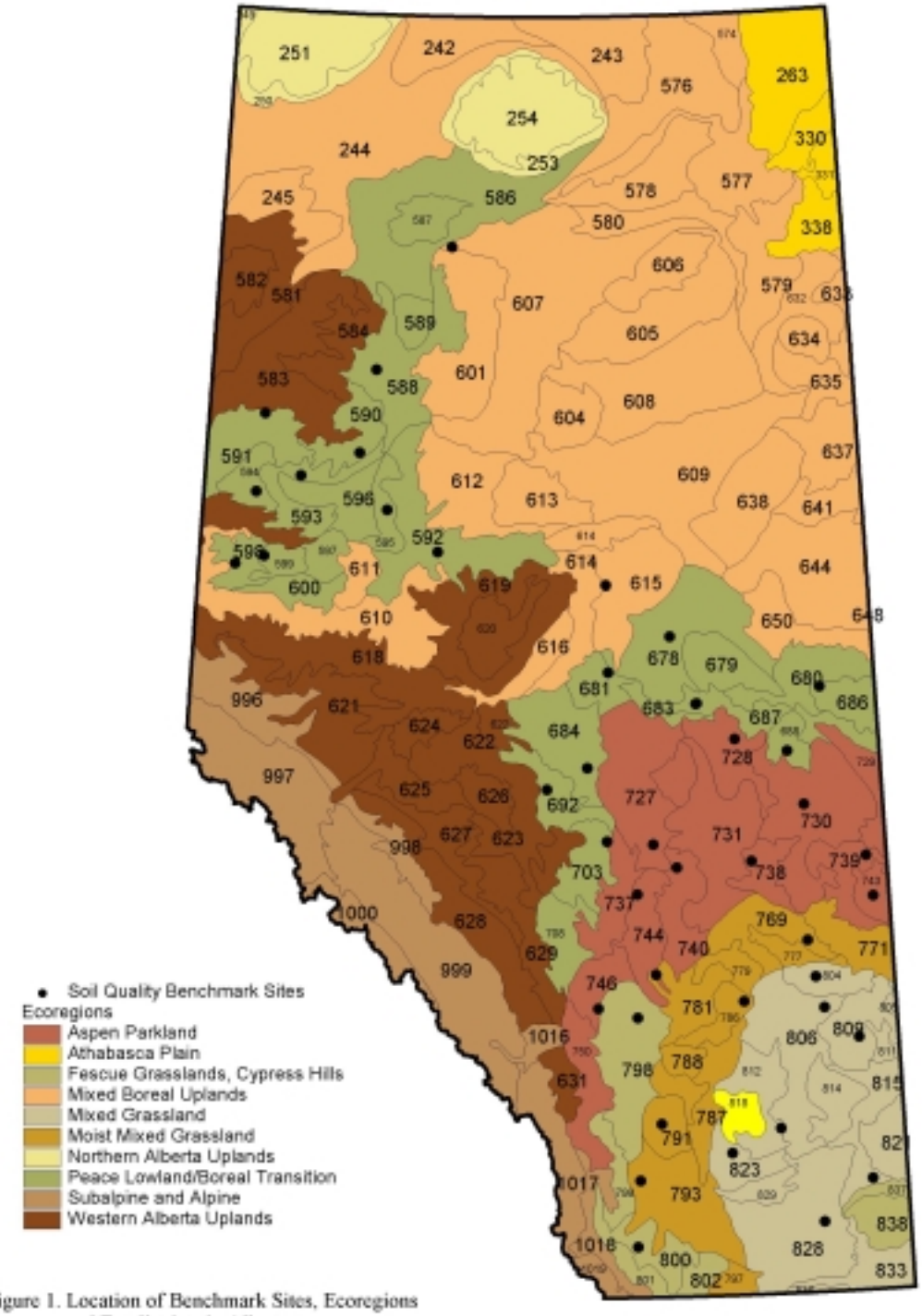

Figure 1. Location of Benchmark Sites, Ecoregions and Ecodistricts in Alberta.

determine total biomass and crop yields. Soil fertility sampling will occur each fall, after harvest of the crop, from two surface depths (0-15 and 15-30 cm). Samples are being archived.

A wide range of soil analyses are being carried out. The pedological samples are analyzed for soil texture, fertility, bulk density, salinity, acidicty, organic N and C, and inorganic C. Soil analyses for the fertility samples collected annually include fertility, mineralizable N, light fraction C and bulk density. Crop yields and plant analyses are also being done. Plant analyses include yield and protein content.

PRELIMINARY RESULTS

Twenty of the 41 benchmark sites were surveyed for classification and had major horizons sampled. Ap/Ah depths and corresponding organic carbon levels increased in the lower slope positions compared to upper slope positions for two of the five ecoregions represented by these pedological samples. There is a lot of variation within landscape positions (Table 1). However, further analyses, along with complete lab data for all benchmark sites, are required to determine if there are significant differences between slope positions and between ecoregions for these pedological samples.

Table 1. Ap/Ah soil depths and organic carbon contents (ranges in brackets) for pedological samples.[1]

Ecoregion	Position	Ap/Ah Depth (cm)		Organic Carbon (T/ha)		No. of Sites
		mean	range	mean	range	
Aspen Parkland	U	16	(7-28)	61	(13-153)	8
	M	20	(13-33)	93	(11-197)	
	L	26	(15-43)	101	(5-236)	
Boreal Transition	U	15	(8-22)	26	(6-57)	7
	M	19	(15-23)	58	(29-130)	
	L	20	(17-25)	103	(66-174)	

[1] analysis by Norwest Labs

Levels of available N, P, K, and S for the 0-15 cm sampling depth from the fertility samples varied among landscape positions for each ecoregion (Table 2). Similar to the pedologcical samples there was also a lot of variation within landscape positions. Again, further analyses are required to determine if there are significant differences between slope positions and between ecoregions for the fertility samples.

SUMMARY

The information collected from the benchmark sites will provide the following:

- detailed soil quality status on a range of soils across Alberta
- landscape effects on soil quality and soil quality risk assessment
- a cross validation data set across Alberta for soil quality modeling efforts
- temporal changes in soil properties at constant sites across Alberta
- soil, yield and management relationships
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Table 2. Soil fertility properties of 0-15 cm topsoils averaged for each ecoregions in Alberta

Eco-region	Slope position	Average available N (mg/kg)		Average available P (mg/kg)		Average available K (mg/kg)		Average available S (mg/kg)		Number of sites
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	
Aspen Parkland	U	1.0-22.6	10.3	8.0-34.0	19.9	142-804	311	3.7-32.7	9.0	9
Aspen Parkland	M	4.0-22.0	10.1	7.0-41.0	19.0	151-407	258	3.5-14.1	7.8	9
Aspen Parkland	L	4.7-20.4	10.8	5.0-54.0	23.3	133-645	339	5.3-68	16.3	9
Boreal Transition	U	1.8-19.8	6.5	4.0-23.0	8.6	76-461	173	3.1-12.2	8.0	8
Boreal Transition	M	4.0-13.0	7.5	3.0-26.0	11.9	53-342	174	2.6-18.6	9.1	8
Boreal Transition	L	4.0-22.4	7.9	3.0-84.0	23.6	50-446	236	4-37.2	11.7	8
Fescue Grassland	U	5.9-9.8	7.9	13.0-17.0	15.0	206-610	408	1.9-2.9	2.4	2
Fescue Grassland	M	7.4-9.3	8.4	15.0-19.0	17.0	275-672	474	2.5-3.5	3.0	2
Fescue Grassland	L	10.5-12.0	11.3	14.0-35.0	24.5	597-614	606	2.8-4.9	3.9	2
Mixed Boreal Upland	U	32.8	32.8	182.0	182.0	1110	1110	15.8	15.8	1
Mixed Boreal Upland	M	20.7	20.7	16.0	16.0	191	191	9.6	9.6	1
Mixed Boreal Upland	L	41.4	41.4	10.0	10.0	73	73	15.5	15.5	1
Mixed Grassland	U	2.8-50.5	13.1	4.0-20.0	11.0	174-349	262	1.4-109	28.6	7
Mixed Grassland	M	4.0-26.1	10.6	3.0-16.0	12.7	193-495	338	1.9-20.9	7.6	7
Mixed Grassland	L	3.3-20.1	10.5	7.0-33.0	17.9	277-697	456	2.2-69	15.6	7
Moist Mixed Parkland	U	6.2-42.4	22.4	14.0-54.0	33.0	273-559	401	3.3-111	29.5	5
Moist Mixed Parkland	M	7.0-30.3	14.7	8.0-39.0	21.0	262-566	396	2.5-10.5	5.2	5
Moist Mixed Parkland	L	5.3-36.5	17.1	13.0-32.0	21.6	276-690	441	3.2-326	69.8	5
Peace Lowland	U	5.9-39.6	19.7	4.0-45.0	19.6	111-391	219	4.1-38.2	14.9	9
Peace Lowland	M	7.7-59.8	17.2	5.0-51.0	20.6	120-430	225	7.5-26.1	16.5	9
Peace Lowland	L	7.1-61.2	31.9	13.0-39.0	25.0	155-387	263	6.1-46.9	22.6	9