Acid Soils in West-Central Saskatchewan

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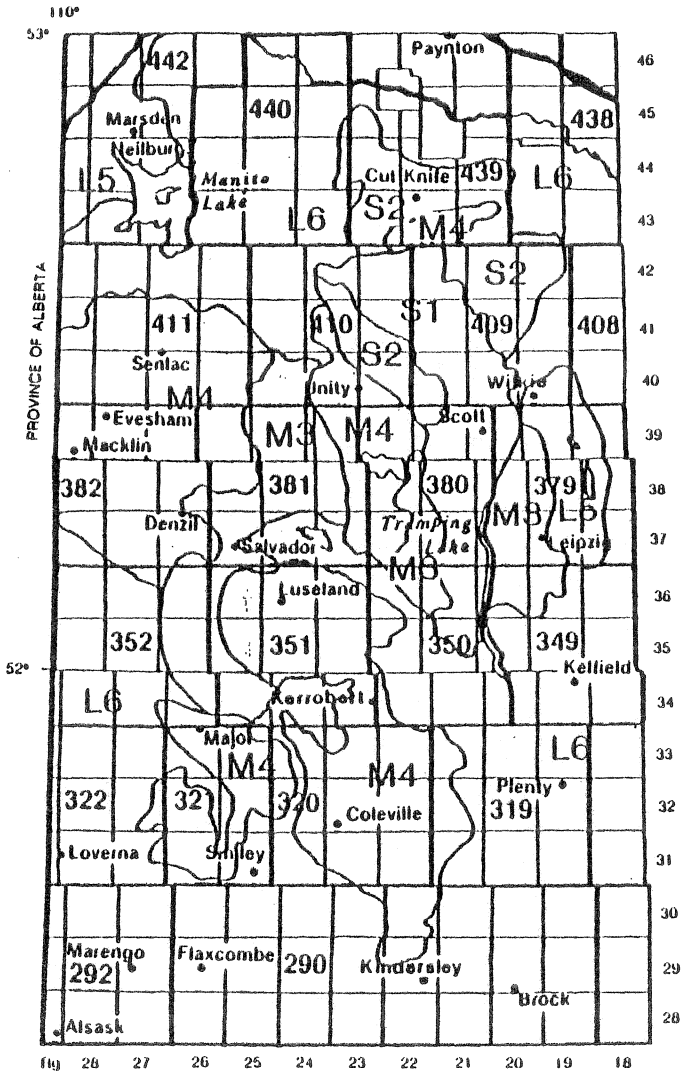
Soil acidity is an important factor in agricultural production (Pearson and Adams, 1967; McLean, 1976). As the acidity increases or pH becomes lower, the range of crops possible becomes less and the yield of many crops is reduced. Below pH 6.0 the yield of alfalfa is reduced and below pH 5.0 the yield of wheat, barley, and rape are substantially reduced and alfalfa barely grows (Hoyt et al, 1974).

Soil acidity has not been much of a concern for Saskatchewan agriculture. The first evidence that acid soils were more than a minor occurrence came from an early soil survey of the Scott Experimental Farm (Clayton and Schroer, 1948). They noted that in some plots of crested wheat-alfalfa mixtures, certain patches of alfalfa were considerably taller and more vigorous. More detailed observations established that these patches of vigorous growth were confined to the calcareous or neutral soil, while the poor growth was confined to the acid soils. Continuing fertility research at Scott by Ukrainetz (1973) has shown yield responses from liming acid soils of up to 7 bu/ac for wheat and 30 bu/ac for barley. The increase in yield depends on several factors such as; a) initial pH of the soil, b) amount of lime added, and c) the amount of phosphorus fertilizer added.

In preparation for a detailed soil survey of the west-central portion of the province, a broad survey of soil acidity was conducted in 1980. About 400 samples were collected and analyzed for acidity and it was determined that acid surface soils with pH ranging from less than 5.0 to 6.0 occur in an area bounded by Kindersley, Macklin, Cutknife and Wilkie (Figure 1). The area involved is about one million acres.

Areas of extensive acid soils (S1 and S2 areas) occur on level to undulating Dark Brown and Black Chernozemic soils. They are composed mainly of 30-80 cm of silt loam material over a loam to clay loam, slightly to moderately stony glacial till. Most of the soils in these areas are acid, although the shallow soils on the tops of ridges or knolls are usually neutral to alkaline. The data in Table 1 is from a series of soil samples along a transect near Scott, Saskatchewan.

Figure 1: Acid soils in West Central Saskatchewan.



EXTENSIVE ACID SOILS

S1 Most of the fields (75-100%) in the area contain acid (pH 5.0-5.8) soils and in a typical field with acid soils, more than 80% of the soils will be acid.

S2 Most of the fields (60-90%) in the area contain acid (pH 5.0-6.0) soils and in a typical field with acid soils, more than 70% of the soils will be acid.

COMMON ACID SOILS

M3 Most of the fields (60-80%) in the area contain acid (pH 5.0-6.0) soils and in a typical field with acid soils, approximately 25-70% of the soils will be acid.

M4 Some (40-70%) of the fields in the area will contain acid (pH 5.0-6.0) soils and in a typical field with acid soils, approximately 25-70% of the soils will be acid.

FEW TO NO ACID SOILS

L5 Few (20-40%) of the fields in the area will contain acid (pH 5.5-6.5) soils and in a typical field with acid soils, approximately 20-50% of the soils will be acid.

L6 Very few (less than 20%) of the soils are acid; the usual pH will range from 5.8-7.0.

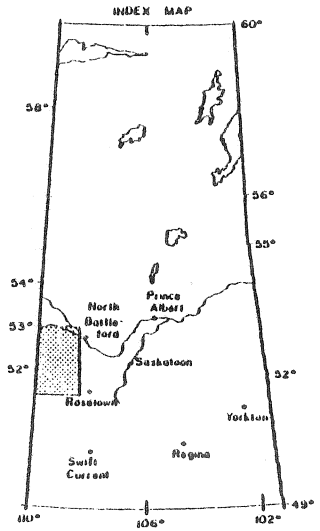


Table 1. Soil data along transect on a Scott silt loam (7-10-1).

Site + Number	Profile	Depth to Ck Horizon (cm)	Depth to till (cm)	pHΔ
1	Orthic	46	90	5.0
2	Orthic	70	105	4.9
3	Orthic	85	70	4.6
4	Orthic	55	70	4.6
5	Eluviated	ND*	ND	4.5
6	Eluviated	ND	ND	5.8
7	Orthic	ND	70	4.9
8	Orthic	60	60	4.5
9	Orthic	ND	ND	4.5
10	Orthic	45	45	4.4
11	Orthic	ND	26	4.4
12	Eluviated	ND	45	4.8
13	Orthic	ND	55	4.5
14	Orthic	ND	40	4.6
15	Calcareous	ND	20	6.8
16	Orthic	43	50	6.7
17	Orthic	60	ND	4.8
18	Orthic	53	60	4.6

*ND - not determined
ΔpH was measured in a 1:1 W/v ratio of soil and 0.01 M $CaCl_2$.
+Sites were selected along a straight line approximately 15 metres apart.

The pH of most of the soils ranges from 4.5 - 5.0 (Table 1). If the pH were measured in water instead of 0.1 M $CaCl_2$ the pH range would be about 4.9 - 5.4. The two soils sampled near the top of a knoll (site 15 and 16) were neutral in pH. On all other sites, the depth to the Ck horizon or depth to the till layer did not appear to have any effect on the pH of the surface horizon.

The areas where acid soils are common but not extensive (M3 and M4 areas) contain mixtures of Chernozemic soils and Solonetzic soils on undulating to rolling topography. The soil material ranges from silt loam to silty clay of varying thickness over till. The amount of acid soils in these areas depends on the topography and on the type of soil profiles present. On rolling landscapes, the soils on the long sideslopes and lower areas are usually acid while soils on the upper slopes are mainly neutral. On the silty clay materials on level to undulating landscapes the Orthic Chernozems are usually neutral, while the Eluviated Chernozems and Solonetzic soils are acid. The data from Table 2 is from such an area.

Table 2. Soil data for sites on silty clay soil.

Site+ Number	Profile	Depth to Ck Horizon (cm)	Thickness of Ae Horizon	pHΔ
1	Orthic Chernozem	20	NP	6.8
2	Calcareous Chernozem	18	NP	6.8
3	Orthic Chernozem	21	NP	6.5
4	Orthic Chernozem	22	NP	5.9
5	Solonetzic Chernozem	ND*	15	4.9
6	Solonetzic Chernozem	ND	33	4.8
7	Solonetzic Chernozem	ND	12	4.8
8	Orthic Chernozem	30	NP	6.2
9	Eluviated Chernozem	38	6	5.9
10	Orthic Chernozem	ND	NP	6.1
11	Calcareous Chernozem	ND	NP	7.0

*ND - not determined
NP - not present
ΔpH was measured in a 1:1 W/v ratio of soil and 0.01 M $CaCl_2$.
+Sites were selected along a straight line approximately 25 metres apart.

On the silty clay soils the pH of the surface horizon is usually related to degree of leaching or profile development (Table 2). In all cases, the leached Solonetzic soils have acid surface horizons.

All of the soils in the map area are developed on calcareous parent material. The average depth to calcareous material for 70 profiles sampled was 53 cm. In all profiles there is a gradual increase in pH with depth (Table 3).

The exact reason for the widespread occurrence of acid soils in this region is not known. Acid soils have been identified in other areas of the province on highly leached Solonetzic soils and on some forested soils. Research is continuing to determine the relative importance of factors such as parent materials, landforms, climate, or agricultural practices in determining the acidity of soils in west-central Saskatchewan.

Table 3. The pH values for various horizons of two acid soils.

Horizon	Depth (cm)	pH+	Soil Material
	Eluviated Black (2-10-1)		
Ap	0 -15	4.9	Silt Loam Lacustrine
Ae	15-23	5.6	Silt Loam Lacustrine
Btj	23-35	6.1	Silt Loam Lacustrine
2Btj	35-60	6.1	Loam till
2Ck	60-75	7.8	Loam till

Table 3. (continued)

Horizon	Depth (cm)	pH+	Soil Material
	Solonetzic Dark Brown (8-10-9		
Ap	0 -15	4.5	Silty Clay Loam Lacustrine
Ae	15-25	4.7	Silty Clay Loam Lacustrine
Bt1	25-35	6.0	Silty Clay Loam Lacustrine
Bt2	35-50	6.4	Silty Clay Loam Lacustrine
Ck	50-70	7.3	Silty Clay Loam Lacustrine
2Ck	70+	ND*	Loam till

+pH measured in 1:1 W/v ratio soil to 0.01 M $CaCl_2$.
*ND - not determined

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