# Soil Productivity Studies Initiated Along with the Basic Soil Survey in the Southwest

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With the initiation of the basic soil survey in the Swift Current map area, the Saskatchewan Institute of Pedology, Saskatoon, with cooperation from the C.D.A. Research Station, Swift Current, began a program to obtain some new productivity data for selected soils within the map area for inclusion in the soils report. While there is considerable yield information which can be used to evaluate the productivity of different soil associations, there is little or no comparative yield information which can be used to evaluate the productivity of map units within an association.

Because of its wide occurrence throughout the area, soils formerly mapped in the Haverhill association, developed on medium to moderately fine textured glacial till and occurring on gently to moderately rolling topography, were selected for the initial study. The initial study was restricted to one map unit, described as: Dominantly Orthic Brown series with a significant combination of Calcareous Brown and Orthic Regosol series.

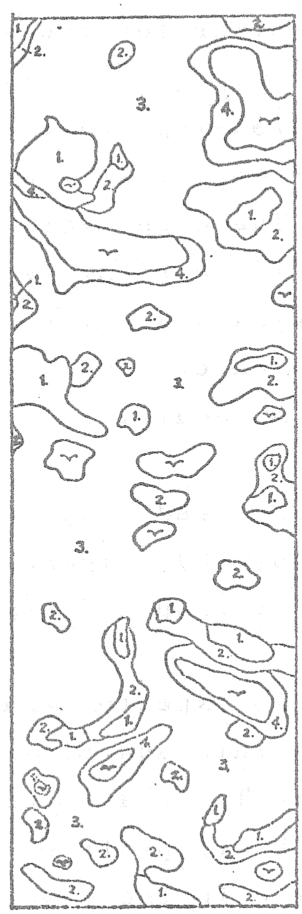
Early in the spring of 1971, four fields of established forage and five summerfallow fields being sown to wheat were selected to represent the same mapping unit. In April 1972, a fifth forage field was located to bring the forage study in line with the productivity study for wheat. Within each field, five catenary sequences were selected, each site consisting of a summit, mid-slope and lower-slope position. In 1972 a more intensive study was undertaken on the wheat fields, selecting four sites down each slope. The summit position sampled was either an Orthic Regosol or a Chernozemic Calcareous Brown. The mid-slope positions were either Orthic or Calcareous and the lower-slope profile was a more moist Orthic or a Cumulic Eluviated Brown. Each site was sampled for spring moisture and nutrient status. This was done immediately after seeding on the wheat fields. With the co-operation of each farmer, data such as seeding rate, chemical treatments, growing season rainfall, etc., were collected. Where the forage fields were being grazed, cages were used to cover each plot.

Detailed soil series maps were made for each field (e.g. Fig. 1) and it is hoped to be able to extrapolate a "field yield" from the yield data that is comparable to the estimated yield obtained from each farmer.

At each site, yields were obtained by square yard sampling. The forage plots were harvested in June. The wheat fields were harvested in August just prior to swathing. Personnel from the Swift Current Research Station harvested the forage plots and threshed and weighed both wheat and forage samples.

What we are really trying to get at is something raised by Mr. Ellis just a few moments ago. Up until now the productivity of the various field separations discussed in the soil report has been based mainly on field observations with very little data to rely on. This study just outlined is the first attempt to obtain some data to indicate to us and to others such as yourselves, the significance of some of the field separations we are making. After all, we hope we are not just spending a great deal of time and money making the more detailed separations just for our own benefit. When making these field separations in the new surveys, we have always thought that in a field of uniform parent material, the Orthic profile outyielded the Calcareous profile and in dry years, that an Eluviated profile will slightly outyield the Orthic, but we have no recent data to substantiate this.

Let us then have a look at some of the data I have been obtaining for wheat. Available soil phosphorus increased with increasing profile development down the slope (Table 1). It was expected that in the summit position, the Regosolic profile would have a lower available phosphorus than the Calcareous profile. It did not contain less, but was not significantly higher than that of the Calcareous profile. There was a two- to three-fold increase in available phosphorus in the lower-slope position. The dark colored Ah horizons of



LEGEND

1. Regosol (eroded knoll) - 7.3%
2. Calcareous Brown - 12.0%
3. Orthic (columnar Brown - 67.6%
4. Rego-Brown (high lime) - 5.3%
Gleysolic (slough bottom) - 7.8%

Figure 1. Detailed soil series map of a 70 acre field

these profiles were quite thick, partially due to the increased profile development, but in a large part due to translocation of surface material downslope by wind and water. It would be recommended that thirty pounds per acre $P_2O_5$ be applied to the shallow upper-slope profiles, twenty pounds to the mid-slope Orthic profile, with none being required for the lower-slope positions.

Available soil nitrogen was similar for the shallow profiles on the slope summit and the shallow Calcareous profiles in the mid-slope position (Table 2). With increasing profile development (thicker Ah horizon and development of a lime free Bm horizon), the available nitrogen increased. The high available nitrogen in the lower-slope position is attributed to nutrient leaching and translocation of surface materials downslope by wind and water. Nitrogen is measured to a depth of 24 inches and in some cases, the dark colored surface horizons were almost that thick. No additional nitrogen would be required in the form of fertilizer.

Available soil potassium, as expected, was in excess for all profiles in all slope positions (Table 3). There was a marked increase in the lower-slope position, again attributed largely to translocation of surface materials downslope.

From these figures, it should be expected that the highest yields would result from the lower-slope Orthic and Eluviated profiles. The expected trend is illustrated in Table 4. There is an increase in wheat yield from the shallowest knoll profile (regosol) to the thickest, most well developed profile in the lower-slope position. There was a corresponding increase in straw length down the slope.

The percentage phosphorus in the grain increased slightly down-slope (Table 5), as did the protein content of the grain (Table 6). Perhaps in a year of higher rainfall than that of 1971, the protein content of the grain would follow the reverse trend.

Table 7 illustrates the type of yield variation being recorded between each site. In each instance, yield increased from upper- to lower-slope positions except in Moen's field where barnyard manure had been added to the eroded knolls. (Moen's yield figures were not used in the previous tables).

This has been a quick outline of some of the data being obtained from this new study. Presently, all of the data, including grain yield, straw yield, % protein, % grain phosphorus, available soil moisture, thickness of A horizon, depth to lime, growing season rainfall, and soil nutrient levels, are being subjected to statistical regression analyses.

Table 1. Available Phosphorus - all fields (lb/acre, 0-6 in)

| | | Mean | Range |
|---|---|---|---|
| Summit | Regosol | 11 | 7-18 |
| | Calcareous | 10 | 5-18 |
| Mid Slope | Calcareous | 10 | 7-12 |
| | Orthic | 17 | 9-25 |
| Lower Slope | Orthic | 33 | 8-69 |
| | Eluviated | 47 | 10-72 |

Table 2. Available Nitrogen - all fields (lb/acre, 0-24 in)

| | | Mean | Range |
|---|---|---|---|
| Summit | Regosol | 57 | 42-79 |
| | Calcareous | 48 | 27-95 |
| Mid Slope | Calcareous | 50 | 46-57 |
| | Orthic | 69 | 43-112 |
| Lower Slope | Orthic | 76 | 48-114 |
| | Eluviated | 102 | 56-155 |

Table 3. Available Potassium - all fields (lb/acre, 0-6 in)

| | | Mean | Range |
|---|---|---|---|
| Summit | Regosol | 450 | 320-600 |
| | Calcareous | 460 | 330-640 |
| Mid Slope | Calcareous | 410 | 300-550 |
| | Orthic | 530 | 280-900 |
| Lower Slope | Orthic | 690 | 360-900 |
| | Eluviated | 770 | 360-900 |

Table 4. Average Grain Yield (bu/acre), 1971 (all fields)

| | | Mean | Range |
|---|---|---|---|
| Summit | Regosol | 22.4 | 19.0-38.7 |
| | Calcareous | 23.4 | 10.0-44.5 |
| Mid Slope | Calcareous | 25.2 | 18.7-30.4 |
| | Orthic | 33.7 | 23.5-42.8 |
| Lower Slope | Orthic | 37.4 | 29.3-54.8 |
| | Eluviated | 39.7 | 14.5-50.9 |

Table 5. Grain Phosphorus (%), 1971 (all fields)

| | | Mean | Std. Error | Soil P |
|---|---|---|---|---|
| Summit | Regosol | 0.32 | 0.01 | 12 |
| | Calcareous | 0.34 | 0.01 | |
| Mid Slope | Calcareous | 0.35 | 0.03 | 16 |
| | Orthic | 0.34 | 0.01 | |
| Lower Slope | Orthic | 0.34 | 0.01 | 38 |
| | Eluviated | 0.37 | 0.01 | |

Table 6. Grain Protein (%), 1971 (all fields)

| | | Mean | Std. Error | Soil N |
|---|---|---|---|---|
| Summit | Regosol | 14.6 | 0.5 | 55 |
| | Calcareous | 14.3 | 0.3 | |
| Mid Slope | Calcareous | 14.3 | 0.7 | 65 |
| | Orthic | 15.0 | 0.3 | |
| Lower Slope | Orthic | 15.8 | 0.3 | 85 |
| | Eluviated | 16.0 | 0.4 | |

Table 7. Average Grain Yield (bu/acre), 1971

| | 1. Glascock (Shamrock) (3.9")* | 2. Gleim (Chaplin) (4.2") | 3. Fech (Morse) (3.7") | 4. Spady (Waldeck) (5.0") | 5. Moen (Leinan) (6.0") |
|---|---|---|---|---|---|
| Summit | 14.2 (2.1)** | 15.2 (2.2) | 30.7 (3.1) | 21.4 (2.7) | 37.7 (3.2) |
| Mid Slope | 28.8 (2.4) | 28.6 (2.1) | 35.9 (2.3) | 36.4 (2.6) | 31.0 (2.3) |
| Lower Slope | 32.6 (2.2) | 44.2 (2.9) | 38.6 (3.1) | 43.1 (3.6) | 33.1 (3.3) |

* Growing season rainfall

** Available soil moisture