SOIL TESTING IN SASKATCHEWAN - PRESENT AND FUTURE

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Rapid chemical tests for the determination of fertilizer needs of crops and to diagnose production problems indigenous in soils have received widespread attention, not only in Saskatchewan, but throughout North America during the past few years. The need for, and perhaps the popularity of, soil testing can be attested to by the data presented in Table I. Over 2,000,000 soil samples were analyzed by the various soil-testing laboratories in the United States alone in 1960. It has been conservatively estimated that the number of samples tested in the States in 1963 would exceed 3,000,000 (Richard Cory, University of Wisconsin). In contrast, the number of soil samples analyzed in Canada is much more modest. Approximately 61,000 samples were analyzed by the soil-testing laboratories located in Ontario and the Prairie Provinces during the 1963 period. Ontario far outshadowed the other provinces in that they are currently analyzing approximately 50,000 samples per year.

Table I Number of Soil Samples Tested by Selected Laboratories

Location	No. of Samples	Charge per Sample
(A) U.S.A., 1960		
(1) Northeast	152,000	Nil - 2.50
(2) North central	1,233,600	0.25 - 1.50
(3) Southern	614,100	Nil - 2.00
(4) Western	84,700	Nil - 2.50
(B) Canada, 1963		
Alberta	6,100	0.50
Saskatchewan	1,500	Free
Manitoba	5,000	3.00
Ontario	48,700	Free

The Scope of Soil Testing at the Present Time

For many years now, the Department of Soil Science has provided a soil-testing service for the farmers of the province. The Department has no special laboratory nor staff specifically designated to carry out this work. A portion of the graduate student laboratory is used for the analyses and all materials, equipment, chemicals and staff have been provided on an ad hoc basis by the Department.

During the early years, plant nutrient analysis (phosphate) was conducted on all samples, in addition to analyses designed to identify the specific soil type in the area from which the sample was taken and detect any serious structural or salinity problems in the area. In 1957 (See Table II) when the number of samples analyzed was approximately 600, it was found necessary, due to staff limitations primarily, to discontinue the available phosphate test. At that time, we advised professional agrologists both in government service and in industry that samples submitted for testing would not be analyzed unless some specific soil problem existed. In spite of the fact that only a limited soil-testing service was being offered, the number of samples has steadily increased. During the past year, several hundred samples submitted by farmers were not analyzed; in each instant a letter was sent to the farmer indicating the reason for not conducting the analyses.

Table II Total Samples Analyzed for the Years 1952-1964
Department of Soil Science

Year	1952	1953	1954	1955	1956	1957	1958
No. of Samples	444	400	363	512	371	622	637
Year	1959	1960	1961	1962	1963	1964	
No. of Samples	884	1094	950	1400	1495	1695	

With the ever increasing responsibilities of the staff in other areas, we have debated at some length as to whether or not the soil-testing services we are now offering should be discontinued until such time as an adequately staffed soil-testing laboratory was established. A positive decision was never reached because we realized that even the limited testing service we now offer is essential to the welfare of many farm units, and further that this type of service cannot be obtained elsewhere. I want to emphasize, however, that our current courtesy program of soil analyses for public assistance is superimposed on top of facilities already fully occupied and is creating a good deal of inconvenience. Farmers submitting samples for analyses are often required to wait for periods as long as two to three months before receiving any recommendations. In November, 1964, 847 soil samples were submitted for analyses. A backlog of over 200 samples was already awaiting analyses on November 1. Analyses on the November samples will not be completed until early in February.

Our courtesy testing services at the present time are not only incomplete (plant nutrient analyses are not being conducted), but also leave an unavoidable impression of laxity and inefficiency with farmers who have submitted samples and expect a reply within a reasonable period of time. In addition, the full time of our one and only technician is required to carry out these analyses, and his various duties and responsibilities have had to be assumed by other members of the staff.

What has been done to establish an adequate soil-testing service

A special committee was established by the Minister of Agriculture in 1961 to investigate the need for a soil-testing service. This committee consisted of representatives of the Saskatchewan Department of Agriculture and the University of Saskatchewan. In July, 1962, this committee recommended to the Minister that a feed and soil-testing laboratory be established at the University, that the laboratory operate under the direction of a committee compromised of Saskatchewan Department of Agriculture and University personnel, that the Department of Agriculture subsidize the cost of analyses at a level equal to approximately one-half the cost, and that adequate specialist and extension services be recognized as essential in order to ensure effective utilization of the services provided by the laboratory.

Since that time, very little headway has been made with the establishment of the laboratory, and the needs and pressures are becoming more acute each year.

At the last meeting of the Advisory Council to the College of Agriculture held in October, the following resolution was passed: 'that the Advisory Council recommend to the Board of Governors that the soil- and feed-testing be implemented at this University as soon as possible.' At the request of Dean Hutcheon, and after studying a brief submitted by the Dean in support of the establishment of a soils- and feed-testing service, the Agricultural Committee of the Board recommended to the Board, and the Board of Governors subsequently approved that the laboratory be

Soil testing is normally envisaged as involving only rapid chemical tests for the determination of the plant nutrient requirements of soils, and on which fertilizer recommendations are based. While the scope and extent of the services that would be offered by the soil-testing laboratory here in Saskatoon has not as yet been finalized, the service we plan to make available to the farmers of this province goes much beyond the determination of available plant nutrients.

Available phosphate: From the wealth of field fertility experiments that have been conducted on fallow land over a wide range of soil types during the past 7 or 8 years, approximately 14,000 soil test values have accumulated. Time does not permit a detailed discussion of the significance of the statistical computations carried out on these data using the I.B.M. computer. Multiple regression analyses clearly showed that of the various factors assumed to affect response to phosphate fertilization, only two appeared to have any significant effect, the level of sodium bicarbonate extractable phosphate and the check yield. The more significant conclusions that can be drawn from these data are as follows:

1. Approximately 60 percent of the variation in yield increases resulting from phosphate fertilization (11-48-0) can be explained on the basis of the sodium bicarbonate test values. The phosphorus fertility level of surface soil samples can be conveniently subdivided into very low, low, medium, high, and very high. The range in soidium bicarbonate extractable phosphate (p.p.m.) for

each category is less than 8, 8-14, 15-20, 21-26, and greater than 26.

2. Recommendations will not change basically as the level of extractable phosphate in the soil increases. Soils falling in the very low, and low ranges should receive at least 50 pounds per acre of 11-48-0. This rate of application should drop to 40 pounds per acre for the remaining categories. Recommendations for soils falling in the high and very high ranges will be modified, depending on date of seeding. Fertilizers will not generally be recommended on these soils unless the crop is seeded prior to the third week in May.

3. The negative and highly significant relationship between check yield and response to phosphate fertilization has been interpreted as indicating that the plant available phosphate during drier-than-normal growing seasons is much lower than that indicated by the soil tests. Consequently the absolute yield increase resulting from phosphate fertilization is, on the average, greater on dry than on wet years. Fertilizer recommendations for fallow-seeded crops will not be influenced by forecasts of drier-than-normal growing conditions.

4. The statistical analyses are currently being carried out on a soil association basis. There is a good possibility that certain modifications in the above-noted soil-test categories may have to be made for certain groups of soils.

5. The year of testing very sharply affects the yield increase from phosphate fertilization. It is very difficult at this time to see how the factors responsible - 'the weather factor' - can, in the future, be eliminated; in some cases the 'weather factor' will seriously interfere with the interpretation of soil tests for available phosphorus. Increased emphasis on research to ferret out the many unknowns that are responsible for the very marked interaction between years and 'effective' level of available soil phosphorus is essential. Research currently underway in this area does suggest that caution in interpreting soil test results, due to the uncertainty of weather, perhaps is unjustified. Fertilized plants have been shown to have the ability to utilize moisture much more efficiently than the unfertilized crop. Where moisture reserves are high, the plants develop a much better root system, and consequently should have a greater capacity to absorb moisture should a drought occur later on. Even where moisture is limiting growth throughout the entire growth period, fertilized plants have yielded better than their unfertilized counterparts. In the case of a completely disastrous drought, almost all of the farmer's production investment is lost. This is, after all, the chance he takes when he decides to plant a crop. It should be noted that almost the only production expense that can be eventually recovered under these conditions is the fertilizer.

Available nitrogen: Very little research has been carried out in Saskatchewan to establish suitable benchmarks for basing the nitrogen requirement of cereal grains seeded on stubble land or grasses. Dr. R.J. Soper's procedure for measuring available nitrogen in soils appears to be correlating exceptionally well with the response to nitrogen fertilization in Manitoba. Whether the same positive correlation will be attained here in Saskatchewan, remains to be seen. However, for the time being, the following benchmarks interpreted liberally from those currently being used by the Manitoba soil-testing laboratory will be used to predict the nitrogen requirements of cereal grains seeded on stubble land. These benchmarks will be modified as dictated

Table III Nitrogen Fertilizer Requirements of Cereal Grains Based on Soil Test Data*

Soil Nitrate-N Ratings lb. NO_3-N/2' depth of soil	Fertilizer Recommendations
0 - 15 (Very low)	40 lb. N/ac., broadcast in the late fall or prior to seeding in the spring.
15 - 20 (Low)	27-14-0 at 90 lb/ac. applied with the seed, or 30 lb. N/ac. broadcast in late fall, etc.
20 - 30 (Medium)	23-23-0 at 65 to 80 lb./ac., applied with the seed.
Over 30 (High)	Nitrogen fertilization not required.

*liberally interpreted from benchmarks set up by the Manitoba soil-testing laboratory.

by current research.

Salinity: The best land use that can be made of slightly, moderately or strongly saline soils can only be estimated following a soil test. The current criteria which we have used for some time is an arbitrary modification of the salinity benchmarks suggested by the U.S. salinity laboratory at Riverside. These are outlined in Table IV. While recommendations have varied slightly through the years as to the best land use that can be made of saline soils, to date no adverse criticism has been received either from the farmer or the agricultural representative (Ag. Reps. have received copies of all soil-test recommendations for the last seven years). Rightly or wrongly, we have accepted this lack of criticism as an indication that the current recommendations for optimum land use on saline soils is reasonably sound.

Table IV Relative Tolerance Limits of Agricultural Crops to Salt

(A) Field Crops

mmhos./cm. conductivity	
Less than 2.0	Little effect of salinity.
More than 4.0	Flax, oats and wheat yields reduced up to 50 percent.
More than 6.0	Barley and rape yields reduced up to 50 percent.

(B) Forage Crops

mmhos./cm. conductivity	
Less than 2.0	Little effect on salinity.
2.0 - 4.0	Red clover, Timothy Alsike and red clover not recommended. Crested wheat grass, red canary grass, intermediate wheat grass and Alfalfa should grow satisfactorily.
4.0 - 6.0	Sweet clover, Brome and Russian Wild Rye grass recommended.
6.0 -10.0	Tall and slender wheat grass recommended. Seeding mixtures should include some Brome or Russian Wild Rye grass.
Over 10.0	Grade VII land capability class (not suitable for agricultural purposes).

Soil type: In order to make maximum use of the soil survey reports and maps, and the more recently developed land capability maps and reports, it is essential that certain diagnostic tests be conducted on samples submitted by farmers; these tests are designed to identify the particular soil type present in the area from which the samples were taken. This enables the use of the vast amount of information that has been collected by the Saskatchewan Soil Survey and places any recommendations that are given on a relatively firm statistical basis.

Capability rating: We are tentatively considering utilizing the soil tests as a means of providing the farmer with the beginning of what might be termed farm planning in Saskatchewan. The soils capability studies which were initiated two years ago under an A.R.D.A. research grant have yielded considerable practical information on land-use planning in the province. Certain of this information should prove of considerable value to the farmer-operators throughout the province. Perhaps this can be best illustrated by giving you a specific example.

A farmer in the Leroy area submitted samples from his farm for analyses. In addition to providing him with the limited soil-test information being inducted, detailed soil maps of his farm (See Figures 1 and 2) were also prepared. Besides providing him with standard fertilizer recommendations for the specific soil types found on his farm (these recommendations were not based on soil-test results), the farmer's attention was drawn to the approximately 35 acres on the SW-34, 25 on the NE-12, and 75 on the SE-12 that could be cleared and broken for cereal grain production. This additional acreage would certainly increase the overall production capacity of the farm. In addition, those areas on his farm that are considered not suitable for cereal grain production, but capable of being improved as pasture or for forage production, were noted. While only a limited number of farmers have been provided with information of this type to date, approximately half of these have taken the trouble to express their appreciation and thanks for the detailed soil and land-use data which we sent them.

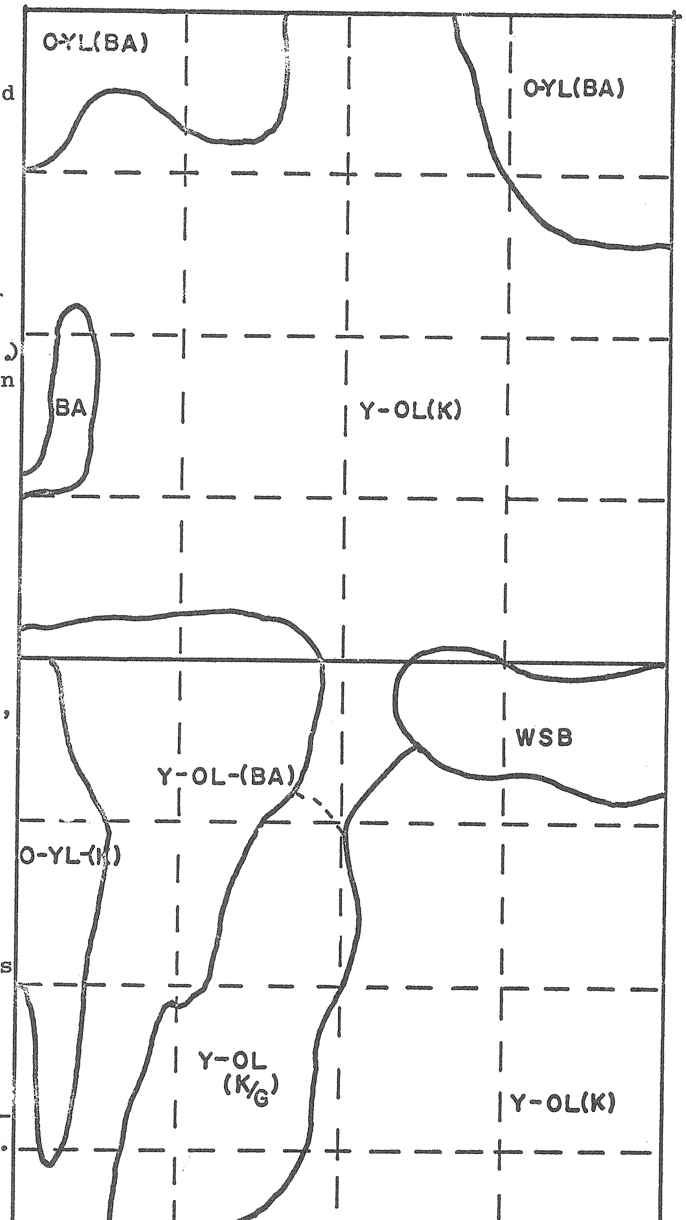
Summary

No attempt has been made in this discussion to elaborate on the need for, and the benefits that would be derived from, a soil-testing laboratory here in Saskatchewan. This aspect of soil testing has been emphasized on several occasions by myself in the form of briefs and communications to the Advisory Council to the College of Agriculture and to the Department of Agriculture officials. The request for the establishment of a soil-testing laboratory received the enthusiastic support of the University Board of Governors. All organizations connected in the fertilizer trade have strongly supported the establishment of a soil-testing laboratory. For example, the Saskatchewan Wheat Pool drew up a detailed brief emphasizing not only the need for such services, but also that it was imperative that services of this type be made available to the farmers of the province at the earliest possible opportunity. This brief was presented to the Saskatchewan Department of Agriculture officials.

The scope and extent of the soil-testing services envisaged at the present time are much broader than those currently offered by either the Alberta or Manitoba soil-testing laboratories. While this additional information will result in an increase in the overall costs of analyses, we are confident that the small additional cost per sample will be more than compensated for by the benefits that will be derived by farmers submitting samples for analyses.

E 12-35-20-2nd

<u>Legend</u>



NE 12-35-20-2nd. Soil Capability Classification, Arable Land - 2^8_s 20% B.A.

80% (135 ac.) of the land in this quarter is capability Class 2, reduced to this level because of the accumulative effect of minor adverse soil characteristics. 20% (25 ac.) of the land included in this class is covered with bush, but is considered potentially arable.

Y-OL(K) - Yorkton-Oxbow loam, cultivated land, Class 2, 110 ac.

O-YL(BA) - Oxbow-Yorkton loam, covered with bush but potentially arable, Class 2, 25 ac.

Soil Capability Classification, Pasture Land - 6^2_w. 20%(22ac.) of the land in the quarter is Class 6 because of prolonged wet or poorly drained conditions such that it is suitable only for unimproved permanent pasture.

WsB - waste sloughs fringed with bush, non-arable, Class 6, 22 ac.

SE 12-35-20-2nd. Soil Capability Classification, Arable Land - 2^9_s 90%(140 ac.) of the land in the quarter is capability Class 2, reduced to this level because of the accumulative effect of minor adverse soil characteristics. 50% (75 ac.) of the land included in this class is covered with bush, but is considered potentially arable.

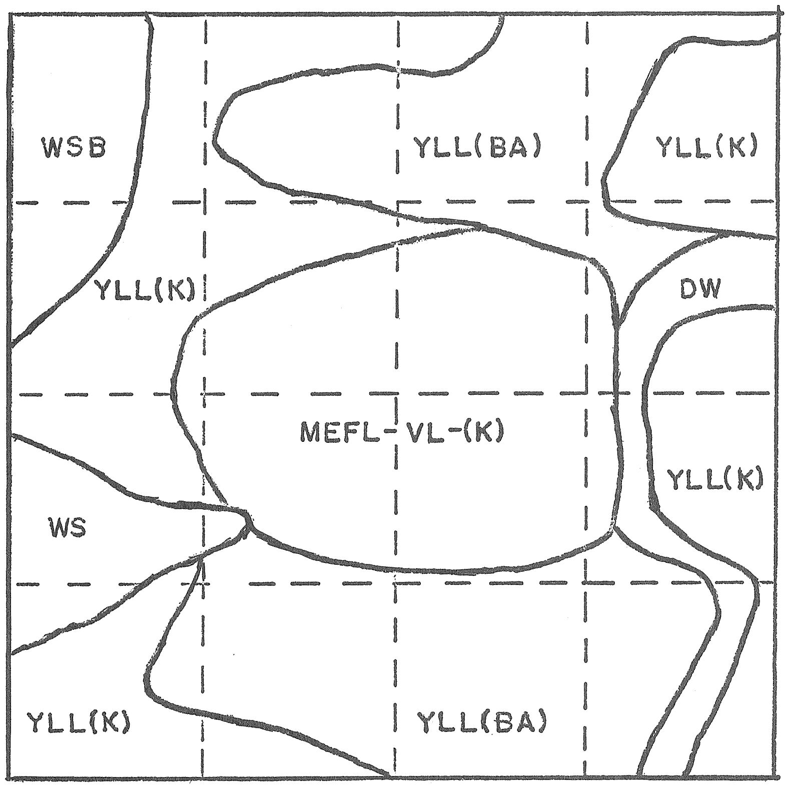
Y-OL (K and K/G) - Yorkton-Oxbow loam cultivated land, and arable land sown to tame grass, Class 2, 65 acres.

Y-OL (BA) - Yorkton-Oxbow loam covered with bush but potentially arable, Class 2, 75 acres.

Soil Capability Classification, Pasture Land - 6^1_w. 10% (18 ac) of the land in the quarter is Class 6 because of prolonged wet or poorly drained conditions such that it is suitable only for unimproved permanent pasture.

WsB - waste sloughs fringed with bush, non-arable, Class 6, 18 acres.

S.W. 34-34-19-2nd



Legend

SW 34-34-19-2nd.
Soil Capability Classification, Arable Land - 3^6_n 20% B.A.
60% (100 acres) of the land in the quarter is capability class 3, reduced to this class because of transitory moderate limitation of salinity. 20% or 35 acres of the land included in this class is covered with bush, but is considered potentially arable.

YLL (K) - Yorkton light loam, cultivated land, Class 3, 30 acres.
YLL (BA) - Yorkton light loam, covered with bush, but potentially arable, Class 3, 35 acres.
MeFL-VL (K) - Meota fine sandy loam to very fine sandy loam, cultivated land, Class 3, 35 acres.

Soil Capability Classification, Pasture Land - 5^4_w 40% (59 acres) of the land in the quarter is Class 5 because of wet or poorly drained conditions limiting its use to pasture or hay land. Presumably this land would be responsive to improvement practices such as breaking, re-seeding, fertilization, water control, etc. which are feasible for the farmer to apply andwould result in increased forage productivity over the native condition.

Ws - waste sloughs, non-arable, Class 5
WsB - waste sloughs, fringed with bush, non-arable, Class 5
Dw - draw or shallow ravine, non-arable, Class 5

Note: Classification based on 1958 Assessment.

Explanation of Soil Capability Classes -

Class 1 - Soils in this class have no significant limitations restricting their use for crops. Average wheat yields 20-25 bu./ac. Estimated potential yields 30-35 bu./ac.

Class 2 - Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. These limitations may include the effects of: (1) topography (slope or pattern), (2) damage from erosion, (3) less than ideal soil depth, (4) difficulty in tillage owing to soil structure, or (5) stoniness, (6) wetness correctable by drainage but existing as a permanent limitation, (7) damaging overflow from lakes or streams, (8) slow permeability of the subsoil, (9) a deficiency in water-holding capacity, (10) salinity, (11) a deficiency in fertility, (12) climatic limitation on soil management and use including both precipitation and frost hazard. Average wheat yields 15.5-20 bu./ac. Estimated potential yields 24-30 bu./ac.

Class 3 - Soils in this class have moderately severe limitations, c.f. above, that reduce the choice of crops or require special conservation practices. Average wheat yield 11-15.5 bu./ac. Estimated potential yield 19-24 bu./ac.

Class 4 - Soils in this class have severe limitations, c.f. Class 2, that restrict the choice of crops, require special conservation practices and very careful management or both. Average wheat yields 9-11 bu./ac. Potential wheat yields 13-15 bu./ac.

Class 5 - Soils in this class are unsuited for cultivated field crops except perennial forage crops and are responsive to improvement practices. These may include cultivation, seeding, liming, fertilizing, and water control which are feasible for the farmer to apply.

Class 6 - Soils in this class are unsuited to cultivation but are capable of use for unimproved permanent pasture.

Class 7 - Lands unsuited for agriculture.