PROGRESS REPORT - 1979

Department of Land Resource Science & Ontario Institute of Pedology

Research - Teaching - Services

Ontario Agricultural College, University of Guelph

June 1980
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FOREWORD

We in the Department of Land Resource Science and in the Ontario Institute of Pedology are pleased to present our 1979 Progress Report. It provides a record of much of our work in teaching, research and service. I hope you find herein many things of interest and value and we would welcome your enquiries about our programs.

In last year's Foreword I referred to the increasing public awareness of the need for better care of our land resources and of the increasing interest in soil conservation and good soil management. Of particular interest to me this year is the recognition among farmers and soil scientists alike of the limitations to crop yields which are caused by suboptimal soil physical conditions (for example, poor tilth, structure and drainage). New varieties and hybrids with an increasing yield potential are being brought forward each year, but, on many fields, yields are not increasing. From the research standpoint there are some challenging problems ahead to sort out the actual mechanisms of soil limitations to crop yields and to devise solutions. On the other hand, we know a lot already from past research and experience, and extension people and farmers need to develop the ways and means of putting economical, practical solutions into place.

I wish to acknowledge the financial support provided over the past year for our various programs. A large part of the funding is supplied by the Ontario Ministry of Agriculture and Food and we are most grateful for this sustained support year after year. We are also appreciative of the funds received from the Ministry of Colleges and Universities, the Ministry of Natural Resources and the Ministry of the Environment. Various federal agencies including Agriculture Canada, the Natural Sciences and Engineering Research Council, and the Atmospheric Environment Service provided research support. Various industry groups contributed: the Wine Council of Ontario, the Fertilizer Institute of Ontario, Canadian Industries Limited, Imperial Oil Limited and the Canadian Turfgrass Research Foundation. Many people in other departments at this university and at other locations helped in various ways with our teaching and research programs. We also are particularly grateful for assistance provided by individual farmers for permitting us to carry out experiments on their land in various locations.

The publication of this Progress Report is the result of the efforts of many in the Department and Institute but I'm pleased to thank particularly Krysia Steinberg, Don Irvine and Andy McLennan for the typing and organization and Professor D.E. Elrick and Dr. C.J. Acton for the editing.

June 1980
K.M. King
Chairman, Department of Land Resource Science
Coordinating Director, Ontario Institute of Pedology
Department of Land Resource Science
PERSONNEL AND INTERESTS

K.M. KING, B.S.A. (Toronto), M.S., Ph.D. (Wisconsin), Professor and Chairman of the Department. Evapotranspiration and photosynthesis of field crops; environmental measurements. (Ext. 2447 and 2448) *. 

W.A. MITCHELL, Administrative Technical Officer. (Ext. 2484).

AGROMETEOROLOGY

Faculty/Professional

D.M. BROWN, B.S.A., M.S.A. (Toronto), Ph.D. (Iowa State), Professor. Climate related to land use planning, crop zonation, climatological reference stations, relationships of crop growth and development to climate and weather. (Ext. 2206).

T.J. GILLESPIE, B.Sc. (British Columbia), M.S.A. (Toronto), Ph.D. (Guelph), Associate Professor. Relationships of plant diseases and pests to weather; computer modelling of soil and air microclimates. (Ext. 2645).


Technical Staff

R.N. Hughes - Weather records. (Ext. 2458).
R.E. Sweetman - Electronic instrument operations and plot work. (Ext. 2208).

* Extension number at the University of Guelph. University of Guelph phone number is (519) 824-4120.
SOIL SCIENCE

Faculty/Professional

T.E. BATES, B.S.A. (Toronto), M.Sc. (North Carolina State), Ph.D. (Iowa State), Professor. Fertilizer use and prediction of fertilizer requirements for field crops; micronutrient and metal availability; in charge of provincial soil testing laboratory. (Ext. 2452).

E.G. BEAUCHAMP, B.Sc. (Agr.), M.Sc. (McGill), Ph.D. (Cornell), Associate Professor. Nitrogen in the soil/crop system; soil-plant relationships; fertilizers and plant nutrition. (Ext. 3239).

J. BELISLE, B.Sc. (McGill), M.Sc. in progress (Guelph), Instructor. Development of teaching aids for introductory soils. (Ext. 3393).

D.E. ELRICK, B.S.A. (Toronto), M.S., Ph.D. (Wisconsin), Professor. Transport mechanisms through soils and applications to soil pollution. (Ext. 3758).

L.J. EVANS, B.Sc. (Southampton), Ph.D. (Wales), Assistant Professor. Soil genesis and clay mineralogy. (Ext. 3017).


S.G. HILTS, B.A. (Western Ontario), M.A. (Toronto), Ph.D. in progress (Toronto), Assistant Professor. Natural resources management, environmental planning, land utilization. (Ext. 2702).

B.D. KAY, B.S.A., M.Sc. (Guelph), Ph.D. (Purdue), Associate Professor. Physico-chemical reactions in soils, including frost heaving and mobility of water and plant nutrients at mineral surface; soil physical chemistry. (Ext. 2487).

J.W. KETCHeson, B.S.A. (Toronto), M.S., Ph.D. (Illinois), Professor. Soil management for better tilth; tillage related to fertilizer use; runoff and erosion studies; manure and crop residues. (Ext. 2489).

T.H. LANE, B.S.A., M.S.A. (Toronto), Professor. Extension coordinator; soil management and land-use. (Ext. 2450).
E.E. MACKINTOSH, B.S.A. (Saskatchewan), M.Sc. (British Columbia), Ph.D. (Adelaide), Associate Professor. Study of soil properties and their relationship to land use; applied clay mineralogy. (Ext. 2492).

R.A. McBRIDE, B.Sc. (Guelph), Research Associate. Land productivity. (Ext. 3594).

M.H. MILLER, B.S.A. (Toronto), M.S., Ph.D. (Purdue), Professor. Soil fertility, plant nutrition and land productivity. (Ext. 2482).

R. PROTZ, B.S.A., M.S. (Saskatchewan), Ph.D. (Iowa State), Professor. Soil genesis and classification; soil variability; soil clay mineralogy; mapping techniques and soil landform relationships. (Ext. 2481).


N.R. RICHARDS, B.S.A. (Toronto), M.S. (Michigan State), D.Sc. (Laval), Professor. Soil classification and land use. (Ext. 3194).

R.W. SHEARD, B.S.A. (Saskatchewan), M.S.A. (Toronto), Ph.D. (Cornell), Professor. Harvest management and fertilizer use for production, longevity and quality of perennial forage species. (Ext. 2491).


R.L. THOMAS, B.Sc., M.Sc. (Alberta), Ph.D. (Ohio State), Professor. The chemical characterization and reactions of soil organic matter. (Ext. 2459).

T.J. VYN, B.Sc., M.Sc. (Guelph), Research Assistant. Soil tillage and crop rotations, jointly with Crop Science Department. (Ext. 3397).
## Technical Staff

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<tr>
<th>Name</th>
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<td>J.D. Aspinall</td>
<td>Soil survey. (Ext. 2476).</td>
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<td>N. Baumgartner</td>
<td>Soil physics and soil management. (Ext. 8556).</td>
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<td>I.A. Becker</td>
<td>Soil testing operations. (Ext. 2494).</td>
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<td>D.E. Ben-Oliel</td>
<td>Soil chemistry and clay mineralogy. (Ext. 8157).</td>
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<tr>
<td>J.F. Brown</td>
<td>Soil testing operations. (Ext. 2494).</td>
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<td>J.C. Bryant</td>
<td>Soil management and plant nutrition plot work. (Ext. 2494).</td>
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<td>E.L. Dickson</td>
<td>Runoff collection and analysis, research analytical laboratory. (Ext. 8157).</td>
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<tr>
<td>M.R. Evans</td>
<td>Computer data analysis. (Ext. 2458).</td>
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<td>J.A. Ferguson</td>
<td>Soil management and plant nutrition plot work. (Ext. 2494).</td>
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<tr>
<td>E.F. Gagnon</td>
<td>Supervisor, soil testing operations. (Ext. 2494).</td>
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<tr>
<td>J.M. Harrison</td>
<td>Study on graduate education in agriculture. Term appointment.</td>
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<td>D.E. Irvine</td>
<td>Cartographer. (Ext. 3364).</td>
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<tr>
<td>J. Lovcanin</td>
<td>Soil management and plant nutrition field plot. (Ext. 8157).</td>
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<tr>
<td>J.A. McLennan</td>
<td>Cartographer. (Ext. 3364).</td>
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<tr>
<td>E. Mozuraitis</td>
<td>Agricultural reclamation of aggregate lands. (Ext. 8170).</td>
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<tr>
<td>C.E. Miller</td>
<td>Soil classification. (Ext. 8175).</td>
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<tr>
<td>M.E. Ormond</td>
<td>Plant analysis. (Ext. 2494).</td>
<td></td>
</tr>
<tr>
<td>D. Tel</td>
<td>Pollution control and waste management; soil and water analysis and research analytical laboratory. (Ext. 3507).</td>
<td></td>
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<tr>
<td>B.E. Weirmeir</td>
<td>Laboratory Assistant. (October, 1979 to February, 1980).</td>
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<tr>
<td>J.C. Yeomans</td>
<td>Denitrification in soils. (Ext. 8157).</td>
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GEOLOGY

Faculty

H.S. ARMSTRONG, B.A., M.A. (Toronto), Ph.D. (Chicago), D.Sc. (McMaster), Professor. Dean of Graduate Studies. (Ext. 2441).

M.E. BROOKFIELD, B.Sc. (Edinburgh), Ph.D. (Reading), Assistant Professor. Palaeoecology, palaentology, stratigraphy and tectonics. (Ext. 2654).

W. CHESWORTH, B.Sc., M.Sc. (Manchester), Ph.D. (McMaster), Associate Professor. Geochemistry, petrology, mineralogy, geological mapping. (Ext. 2457).

W.A. GLOOSCHENKO, B.S. (California, Berkeley), M.S. (California, Davis), Ph.D. (Oregon). Adjunct Professor. Vegetation ecology and geochemistry of wetlands.

L.P. MARTINI, Doct. Geol. Sci. (Florence), Ph.D. (McMaster), Associate Professor. Sediments and sedimentary rocks, sedimentology, glacial and pleistocene geology. (Ext. 2488).

COOPERATING PERSONNEL LOCATED IN THE DEPARTMENT


Clerical Staff for the Department of Land Resource Science

P.E. Berines - Administrative Secretary. (Ext. 2448).
L. Bissell - Clerk. (Ext. 2661).
J.L. Cook - Clerk. (Ext. 2486).
J. Giles - Stenographer. (Ext. 2455).
K.M. Halliburton - Stenographer. (Ext. 2661).
L.E. Lepage - Stenographer. (Ext. 2455).
F.I. Peer - Stenographer. (Ext. 8747).
K. Steinberg - Secretary. (Ext. 2451).
R. Wright - Stenographer. (September, 1979 to April, 1980).
SERVICE TO AGRICULTURE AND THE PUBLIC

EXTENSION AND CONTINUING EDUCATION INVOLVEMENT

The Department of Land Resource Science continues to contribute significantly in the areas of continuing education, public relations and extension.

Many of the problems of the 1970's continue to be relevant and of concern to extension personnel, farmers, and individuals as well as governmental agencies.

Energy input costs for agricultural production and alternative resource utilization will continue to be significant areas for consideration into the 1980's.

A greater and more significant research contribution will be required in new tillage techniques and the associated soil erosion control problems.

The research emphasis in soil management must also continue as it relates to water quality, cropping systems, manure utilization, sewage sludge use for agricultural production, and soil test interpretation and calibration.

Table 1: Summary of extension and continuing education activities, Department of Land Resource Science for 1979-1980 (faculty days involved - 8 hours/day).

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<tr>
<th>Type of Extension Involvement</th>
<th>Total Days Involved in Extension</th>
<th>% of Effort in Extension</th>
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<tr>
<td>Extension</td>
<td>42.5</td>
<td>10.5</td>
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<td>Continuing Education</td>
<td>17.0</td>
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<td>Tours (groups)</td>
<td>21.0</td>
<td>5.0</td>
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<td>Extension Consultations</td>
<td>204.5</td>
<td>51.0</td>
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<tr>
<td>Extension Talks (speeches)</td>
<td>25.5</td>
<td>6.5</td>
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<tr>
<td>Publications</td>
<td>22.5</td>
<td>5.5</td>
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<tr>
<td>Radio, TV programs</td>
<td>5.0</td>
<td>1.0</td>
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<tr>
<td>Other Significant Ext. Act.</td>
<td>36.0</td>
<td>9.0</td>
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<tr>
<td>Public Relations</td>
<td>30.0</td>
<td>7.5</td>
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<td>404.0*</td>
<td>100.0</td>
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* Man years @ 220 days/year = 1.8
Extension Services

Activities associated with 42.5 days (10.5%) of various individual inputs were:

- O.M.A.F. In-service Update and Planning (Guelph, London and Kingston)
- Danish Researcher's Conference
- Poultry Industry Conference and Exhibition
- Junior Farmer Soil and Crop Management Tour
- Farm Managers and Rural Appraisers
- Bankers School
- Manure System Conference
- Erosion Demonstration
- Erosion Planning Session
- Northern Ontario O.M.A.F. Update
- O.M.A.F. Soil Test Interpretation Update
- O.A.C. January Conference
- O.M.A.F. 1980 In-service Planning
- Soils and Crops Branch Conference
- 1980 Soil Management Conference Planning
- Thunder Bay Spring Farm Conference
- Forage Days at Elora
- Agrometeorology Seminar and Workshop

Tours (groups)

Visiting groups toured research facilities and programs involving 21 days (5%) of faculty time and effort in extension.

- O.M.A.F. Extension Branch Tour
- O.M.A.F. Soil Conservation Tour
- Forage Demonstration Tours
- Soils and Crops Branch Tours
- O.S.M.R.C. Summer Tour
- Oxford County Soil and Crop Tour
- Orientation Tours (E.R.S.)
- Huron Co. Beef Tour
- Wentworth County Soil and Crop Tour
- Netherlands' Engineers Tour
- 4H Tours at Elora Research Station
- Kitchener-Waterloo Pollution Probe Tour
- Soil Testing Laboratory Tours
- Junior Farmers Tour
- Soils and Crops Club Tour at Elora Research Station

Continuing Education

Faculty contributed 17 days (4%) of their extension activities to areas such as:

- Ontario Hydro Property Agents and Land Appraisers
- Independent Study Course Evaluations
- The Church and Change (week-long course)
- Turf Manager's Short Course
- Novice Farmer program

Extension Consultations
The major faculty input (204.5 faculty days - 51%) continues to be required in consultation areas such as:

- Niagara Chemicals
- Dufferin Aggregates
- Ontario Corn Committee
- Ontario Agrometeorology Weather Services
- Bruce County
- Perth County
- Halton County Erosion Problem
- Oxford County
- Wellington County
- Dufferin County
- Organization of Ontario Municipalities
- Consultant and Witnesses for Federal Department of Consumer and Corporate Affairs
- Ontario Limestone Committee - O.M.A.F.
- Kitchener-Waterloo Record on Soil Testing
- Ontario Ministry of the Environment on Use of Composted Garbage on Agricultural Land
- Guelph Correctional Centre on Development of a Vegetable Production Program
- Plant Products Division of Agriculture Canada on Heavy Metal Standards in Dried Sludges and Composts
- Harrison Brothers Fisheries - Picton on Use of Fish Bi-products as Fertilizers and Feeds
- O.M.A.F. and O.M.E. Committee on Sewage Sludge Guidelines
- Ontario Soil Management Committee
- Sub-Committees of O.S.M.R.C.
- Ontario Fruit Research Committee and Sub-Committees
- Scheduled Office Consultations
- Unscheduled Office Visitors
- Telephone, Correspondence, Enquiries

Extension Talks (speeches)
Speaking at, contributing to, or participating in conferences and meetings took up 25.5 days (6.5%) of reported faculty time in contribution to extension. The following indicate the range of engagements covered:

- Halton Region Agriculture Committee and Federation of Agriculture - Milton
- Netherlands Engineers - Burlington - Sewage Sludge Use on Land
- Oxford County Soil and Crop Improvement - Soil Testing
- Royal Botanical Gardens - Soil Management for Home Gardens
- Oxford County Soil and Crop Improvement - Interpreting Soil Test Results
- Haldimand Soil and Crop Improvement Association
- Master Feeds Farm Customers - Soil Management
- Dufferin County - Soil and Crop Improvement - Saving Money on Fertilizers
- Norfolk County Corn Day - Soil Testing
- Soil Management Course for Fertilizer Dealers at Ridgetown
- North Simcoe County - Manure Management
- Lambton County - Land Use and Erosion
- Elgin County - Soil Testing
- Simcoe County Farmer's Week - Micronutrients
- Ontario Grain Corn Council (Huron County)
- Quinte Farm Show and Conference
- Brant County - Manure Management
- Halton County - Manure Management
- North Simcoe Soil and Crop Improvement Association - Climate and Crop Production
- Frontenac County Hay and Seed Fair - Manure Management
- Landscape Ontario Conference - Soil Testing
- O.G.S.A. Symposium - Turf Management

Publications

This area of extension activity required 22.5 days (5.5%) of personnel time and is reflected in the following contributions to extension:

- Soil Testing for Ontario - I.F.I.P.
- Use of Stabilized Sewage Sludge on Agricultural Land - Factsheet
- Soil Acidity and Liming - revised Factsheet
- Guidelines for Safe Rates of Nutrients Applied at Seeding - revised Factsheet
- Sulfur and Sulfate Fertilizers - Do We Need Them? - revised I.F.I.P.
- Factsheet - Review, Edit and Co-author Prior to Publication
- O.M.A.F. Publication Revisions
- O.M.A.F. Soils and Fertilizer Publication Committee
- Dollar and Cents of Field Work Timeliness - Factsheet
- The Advantages of Timely Haying - Information Leaflet
- Scheduled Planting of Sweet Corn - Factsheet
- O.M.A.F. Press Service - Soil Conservation
- Remote Sensing - O.M.A.F. Highlights
Radio, T.V. Programs

While the involvement is not large, it nevertheless represents 5 faculty days (1%) in extension commitment in the following ways:
- C.F.P.L. London T.V. - Interview on Liquid Fertilizers
- Wingham T.V. - Interview on Sewage Sludge
- Wingham T.V. - Interview on Soil Testing
- Wingham T.V. - Interview on Soil Testing
- Wingham T.V. - Interview on Value of Manure
- C.B.C. Radio Noon - Telephone Interview on Acid Rain
- C.B.C. Radio Noon - Cadmium in Ontario Tobacco
- Wingham T.V. (Three Additional Programs) on Climate, Manure and Sulfur
- C.H.C.H. T.V. - Video Tape

Other Significant Extension Activities

Areas of extension activity sometimes difficult to categorize under the previous extension sections involved 36 faculty days (9%) of effort such as:
- O.I.A. Public Relations Committee (Land Expropriation - Hanover)
- University of Guelph Manure Management Committee
- Agricultural Code of Practice
- Subpoenas - Consumer and Corporate Affairs - Kitchener and London
- Arkell Environmental Assessment
- O.S.M.R.C. Waste Utilization Committee
- O.S.M.R.C. Fertilizer Information Committee
- Ontario Sludge Implementation Committee
- Sewage Sludge Guidelines
- O.A.C. Extension Committee
- Climatic Data Assembly - Atmospheric Environment Service

Public Relations

Faculty devoted 30 faculty days (7.5%) of their extension effort that involved areas such as:
- O.A.C. Recognition Banquet
- Conference on Agricultural Meteorology - Minneapolis
- A.I.C. Convention - Fredericton
- Canada Climate Program in Agriculture Workshop
- O.A.C. Diploma Centennial Committee
- World Meteorological Organization - Sofia, Bulgaria
- Fertilizer Institute of Ontario Annual Meeting
- Sludge Disposal Conference - Madison, Wisconsin
- Swiss Consulate and Chinese Trade Tour Groups
- Department of Renewable Resources at MacDonald College
SOIL TESTING AND PLANT ANALYSIS SERVICE

The Department of Land Resource Science provides soil analysis to Ontario Farmers under contract to and in co-operation with the Ontario Ministry of Agriculture and Food. Plant and manure analyses are also provided but with the user paying full costs. The laboratory also analyses about 5,000 feed samples for the feed analysis program operated by the Department of Animal and Poultry Science. Greenhouse soil analysis is provided by the Department of Horticultural Science.

The number of soil samples received for analysis is at the lowest level for the entire year at the end of June and samples submitted after the end of June are usually intended for crops to be harvested the following year. The soil testing year for field samples therefore runs from July 1 to June 30.

Table 2: Soil samples tested in the Ministry of Agriculture and Food Laboratory, Department of Land Resource Science, University of Guelph.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td>36,195</td>
<td>25,862</td>
<td>39,709</td>
<td>40,944</td>
<td>48,520</td>
<td>36,719</td>
<td>37,604</td>
<td>48,943</td>
</tr>
<tr>
<td>Garden</td>
<td>4,013</td>
<td>4,531</td>
<td>3,854</td>
<td>4,831</td>
<td>5,127</td>
<td>1,946</td>
<td>3,326</td>
<td>4,024</td>
</tr>
<tr>
<td>Canadian Forces Base</td>
<td>864</td>
<td>853</td>
<td>941</td>
<td>852</td>
<td>923</td>
<td>860</td>
<td>942</td>
<td>828</td>
</tr>
<tr>
<td>Research - Federal, Provincial, University and unclassified</td>
<td>8,066</td>
<td>7,303</td>
<td>11,913</td>
<td>8,207</td>
<td>7,533</td>
<td>10,422</td>
<td>17,202</td>
<td>18,644</td>
</tr>
<tr>
<td>Industry\</td>
<td>79</td>
<td>100</td>
<td>15</td>
<td>36</td>
<td>22</td>
<td>25</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>50,117</td>
<td>38,659</td>
<td>56,832</td>
<td>54,870</td>
<td>62,125</td>
<td>49,972</td>
<td>59,121</td>
<td>72,480</td>
</tr>
<tr>
<td>No. of Users\</td>
<td>10,534</td>
<td>10,494</td>
<td>11,814</td>
<td>13,141</td>
<td>13,809</td>
<td>11,393</td>
<td>11,684</td>
<td>14,967</td>
</tr>
</tbody>
</table>

\ A fee is charged for industry samples for which the report does not go directly to local OMAF offices and to the farmer.
\ This statistic is slightly inflated as users who submit samples more than once per year are counted more than once.

A total of 48,943 farm samples were tested in 1978-1979, slightly more than the previous record set in 1975-1976 (Table 2). The number of samples analysed fluctuates quite widely from year to year. Fertilizer and crop prices and promotional programs by OMAF or Industry in some counties or regions affect the numbers of samples analysed but fall weather conditions are without doubt the most important factor in year to year fluctuations. The number of samples analysed per month shows this more clearly than the year figures (Table 3). The fall of 1978 was ideal for field work with the month of November showing by far the largest number of samples ever tested in one month. The fall of 1979 was quite wet resulting in a lower number of samples analysed in November than the year before. Mild weather in December 1979 and January 1980 resulted in some increase in samples tested in those months. By January 31, 1980 there were 50,072 samples tested, 4,043 less than at January 31 the year before.
Table 3: Number of samples received monthly from 1970-1980.

<table>
<thead>
<tr>
<th>Month</th>
<th>70-71</th>
<th>71-72</th>
<th>72-73</th>
<th>73-74</th>
<th>74-75</th>
<th>75-76</th>
<th>76-77</th>
<th>77-78</th>
<th>78-79</th>
<th>79-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>3,274</td>
<td>1,170</td>
<td>1,092</td>
<td>2,018</td>
<td>2,105</td>
<td>4,555</td>
<td>2,325</td>
<td>1,872</td>
<td>4,817</td>
<td>4,704</td>
</tr>
<tr>
<td>August</td>
<td>3,000</td>
<td>2,496</td>
<td>2,744</td>
<td>2,496</td>
<td>2,730</td>
<td>3,668</td>
<td>3,368</td>
<td>4,680</td>
<td>7,522</td>
<td>2,574</td>
</tr>
<tr>
<td>September</td>
<td>3,524</td>
<td>3,276</td>
<td>2,926</td>
<td>3,432</td>
<td>3,900</td>
<td>4,212</td>
<td>3,908</td>
<td>5,696</td>
<td>4,825</td>
<td>5,978</td>
</tr>
<tr>
<td>October</td>
<td>5,646</td>
<td>7,260</td>
<td>4,992</td>
<td>7,534</td>
<td>7,176</td>
<td>6,396</td>
<td>5,749</td>
<td>5,539</td>
<td>7,239</td>
<td>7,098</td>
</tr>
<tr>
<td>November</td>
<td>10,736</td>
<td>9,906</td>
<td>6,362</td>
<td>13,730</td>
<td>11,109</td>
<td>8,502</td>
<td>9,672</td>
<td>10,296</td>
<td>18,398</td>
<td>13,884</td>
</tr>
<tr>
<td>December</td>
<td>8,570</td>
<td>7,956</td>
<td>4,968</td>
<td>6,086</td>
<td>6,396</td>
<td>12,480</td>
<td>4,479</td>
<td>6,329</td>
<td>5,460</td>
<td>8,424</td>
</tr>
<tr>
<td>January</td>
<td>2,674</td>
<td>4,320</td>
<td>2,340</td>
<td>3,276</td>
<td>4,446</td>
<td>3,432</td>
<td>1,077</td>
<td>2,046</td>
<td>5,854</td>
<td>7,410</td>
</tr>
<tr>
<td>February</td>
<td>1,756</td>
<td>1,404</td>
<td>936</td>
<td>4,961</td>
<td>1,440</td>
<td>2,261</td>
<td>1,014</td>
<td>1,077</td>
<td>2,388</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>1,014</td>
<td>780</td>
<td>1,872</td>
<td>1,638</td>
<td>1,404</td>
<td>2,886</td>
<td>2,340</td>
<td>1,097</td>
<td>2,418</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>2,962</td>
<td>2,418</td>
<td>3,900</td>
<td>2,262</td>
<td>6,724</td>
<td>5,687</td>
<td>5,919</td>
<td>4,602</td>
<td>4,936</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>1,560</td>
<td>2,322</td>
<td>1,794</td>
<td>2,434</td>
<td>2,418</td>
<td>2,130</td>
<td>1,791</td>
<td>4,056</td>
<td>2,804</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>3,102</td>
<td>2,572</td>
<td>1,266</td>
<td>1,516</td>
<td>934</td>
<td>936</td>
<td>2,028</td>
<td>1,794</td>
<td>1,348</td>
<td></td>
</tr>
</tbody>
</table>

It is commonly agreed that more Ontario soil samples were tested in the U.S.A. in 1979/80 than in previous years. At the same time the fall of 1979 was less favourable for sampling than usual in a year when due to increased fertilizer prices farmers were quite interested in soil testing. With these factors believed to be effecting numbers of samples tested it is impossible to determine whether or not testing in the U.S.A. has reduced the number of samples tested in the OMAF laboratory. It is possible that the greater promotion of soil testing by the fertilizer industry, which has accompanied testing in the U.S.A., actually increased the number of samples tested in the OMAF laboratory.

Numbers of plant, manure and field samples analysed all increased appreciably in 1978/1979 over the previous year (Table 4). In the case of plant samples there is no clear trend over a period of years. Charges for various analyses are presented in Table 5.

Table 4: Number of samples of plant, manure and other organic materials analyzed by the Soil and Plant Analyses Service Laboratory (with the exception of those for Land Resource Science research all samples were analyzed on a fee for service basis).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant samples (field)</td>
<td>150</td>
<td>82</td>
<td>49</td>
<td>156</td>
<td>317</td>
<td>175</td>
<td>263</td>
</tr>
<tr>
<td>Plant samples (greenhouse)</td>
<td>142</td>
<td>132</td>
<td>146</td>
<td>76</td>
<td>121</td>
<td>165</td>
<td>279</td>
</tr>
<tr>
<td>Manures, composts and sludge</td>
<td>66</td>
<td>39</td>
<td>71</td>
<td>82</td>
<td>57</td>
<td>80</td>
<td>115</td>
</tr>
<tr>
<td>Feeds***</td>
<td>95</td>
<td>870</td>
<td>1,861</td>
<td>3,306</td>
<td>3,878</td>
<td>4,373</td>
<td>5,293</td>
</tr>
<tr>
<td>Other****</td>
<td>58</td>
<td>308</td>
<td>260</td>
<td>179</td>
<td>303</td>
<td>501</td>
<td>437</td>
</tr>
</tbody>
</table>

Total Service Samples 241 1,131 2,387 3,805 4,676 5,299 6,387
Land Resource Science Research mainly plants 4,066 5,366 4,294 4,243 2,745 3,555 4,471

* The period reported is May 1 to April 30.
** Analyzed for the Department of Animal and Poultry Science as part of the feed analysis service.
*** Mainly plant tissue from other university departments.
Table 5: Analyses available through the Soil Testing and Plant Analysis Laboratory, Department of Land Resource Science, University of Guelph.

<table>
<thead>
<tr>
<th>Material</th>
<th>Analyses</th>
<th>Availability</th>
<th>Cost/sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Farm soils</td>
<td>plant available phosphorus, potassium and magnesium + pH (calcium and salt concentration if required)</td>
<td>all times</td>
<td>no charge - cost borne by Ontario Ministry of Agriculture and Food</td>
</tr>
<tr>
<td>2. Home garden and lawn soils</td>
<td>as in 1</td>
<td>all times</td>
<td>$1.00</td>
</tr>
<tr>
<td>3. Soil</td>
<td>organic matter</td>
<td>enquire at lab</td>
<td>$5.00</td>
</tr>
<tr>
<td>4. Soil</td>
<td>texture (% sand, silt and clay)</td>
<td>enquire at lab</td>
<td>quoted on request</td>
</tr>
<tr>
<td>5. Soil</td>
<td>other analyses may be available for groups of over 20 samples</td>
<td>enquire at lab</td>
<td></td>
</tr>
<tr>
<td>6. Liming materials</td>
<td>calcium and magnesium content, neutralizing value, particle size analysis</td>
<td>all times</td>
<td>$15.00</td>
</tr>
<tr>
<td>7. Dried plant and other organic materials</td>
<td>nitrogen, phosphorus, potassium, calcium, and magnesium</td>
<td>all times</td>
<td>$11.00</td>
</tr>
<tr>
<td>8.</td>
<td>boron, copper, manganese and zinc</td>
<td>all times</td>
<td>$11.00</td>
</tr>
<tr>
<td>9.</td>
<td>9 elements listed in 7 and 8</td>
<td>all times</td>
<td>$14.00</td>
</tr>
<tr>
<td>10. Manure and other moist organic matter</td>
<td>nitrogen, phosphorus, potassium, calcium, and magnesium and Z O.M.</td>
<td>all times</td>
<td>$13.00</td>
</tr>
<tr>
<td>11.</td>
<td>boron, copper, manganese and zinc</td>
<td>all times</td>
<td>$13.00</td>
</tr>
<tr>
<td>12.</td>
<td>9 elements listed in 10 and 11</td>
<td>all times</td>
<td>$16.00</td>
</tr>
<tr>
<td>13. Organic materials</td>
<td>sodium, iron, cadmium, chromium, lead, nickel, mercury and some other metals</td>
<td>enquire at lab</td>
<td>quoted on request</td>
</tr>
</tbody>
</table>

* electrical conductivity

** analysis of feed samples is arranged through the Department of Animal and Poultry Science

WEATHER AND CLIMATE INFORMATION

Observations were continued at the Elora Research Station and at the Arboretum Weather Station. Returns of data were sent to the Atmospheric Environment Service monthly for publication and a computer summary was also produced each month for distribution to over 100 customers on and off campus. In addition, there was a steady flow of requests for weather data and information for research from faculty and students. Queries received included the optimum soil temperature at which to apply dandelion weed killer, and ranged from whether variations in atmospheric pressure and humidity would affect the behaviour of cattle, to the likely soil temperatures at 1.5 m depth to calculate heat flow through basement walls.

Climatic normals were calculated using the 10 years of data collected at Elora 1970-1979; these normals replace those previously in use, which were calculated from a shorter period of record weighted with the normals for Guelph.
The Weather in 1979 at Elora Research Station and Surrounding Areas

The mean annual temperature was 0.4°C below normal, the fourth consecutive colder than normal year: cold weather in February and October was offset by mild conditions in March and December. Total precipitation for the year was near average although heavy falls in April, October and November were balanced by dry summer weather especially in July (Table 6). However, yields of forage and barley remained near average, without a repeat of the acute 1978 summer drought. Nevertheless, three irrigations applied to corn boosted yields by 15% (see page ). It was a dull year with only 90% of normal sunshine.

Table 6: Summary of 1979 weather at Elora.

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Temp. °C</th>
<th>Corn Heat Units</th>
<th>Degree Days &gt; 5°C</th>
<th>Degree Days &lt; 10°C</th>
<th>Rainfall mm</th>
<th>Snowfall cm</th>
<th>Total Precipitation mm</th>
<th>Total Sunshine hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>9.7</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>858</td>
<td>15.5</td>
<td>58.8</td>
<td>61.2</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.7</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>+ 20</td>
<td>- 6.2</td>
<td>+ 15.9</td>
<td>+ 0.1</td>
</tr>
<tr>
<td>February</td>
<td>-12.8</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>863</td>
<td>15.3</td>
<td>14.2</td>
<td>24.3</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 4.4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>+ 118</td>
<td>- 6.6</td>
<td>- 14.3</td>
<td>- 24.8</td>
</tr>
<tr>
<td>March</td>
<td>0.2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>- 85</td>
<td>+ 6.8</td>
<td>- 6.0</td>
<td>- 8.3</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>+ 2.8</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>April</td>
<td>3.9</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>423</td>
<td>73.5</td>
<td>34.8</td>
<td>109.3</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.6</td>
<td>--</td>
<td>+ 25</td>
<td>+ 20</td>
<td>+ 26.1</td>
<td>+ 23.9</td>
<td>+ 37.4</td>
<td>- 64.4</td>
</tr>
<tr>
<td>May</td>
<td>10.7</td>
<td>219</td>
<td>185</td>
<td>233</td>
<td>75.0</td>
<td>--</td>
<td>--</td>
<td>75.0</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 1.3</td>
<td>--</td>
<td>- 35</td>
<td>+ 37</td>
<td>+ 4.5</td>
<td>--</td>
<td>--</td>
<td>+ 4.5</td>
</tr>
<tr>
<td>June</td>
<td>16.6</td>
<td>570</td>
<td>346</td>
<td>72</td>
<td>62.6</td>
<td>--</td>
<td>--</td>
<td>62.6</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.4</td>
<td>--</td>
<td>- 24</td>
<td>- 15</td>
<td>+ 11</td>
<td>- 18.9</td>
<td>--</td>
<td>- 18.9</td>
</tr>
<tr>
<td>July</td>
<td>19.1</td>
<td>699</td>
<td>438</td>
<td>24</td>
<td>29.3</td>
<td>--</td>
<td>--</td>
<td>29.3</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.1</td>
<td>--</td>
<td>- 14</td>
<td>- 3</td>
<td>+ 2</td>
<td>- 37.6</td>
<td>--</td>
<td>- 37.6</td>
</tr>
<tr>
<td>August</td>
<td>17.5</td>
<td>646</td>
<td>386</td>
<td>44</td>
<td>64.4</td>
<td>--</td>
<td>--</td>
<td>64.4</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.8</td>
<td>--</td>
<td>- 30</td>
<td>- 26</td>
<td>+ 9</td>
<td>- 6.0</td>
<td>--</td>
<td>- 6.0</td>
</tr>
<tr>
<td>September</td>
<td>14.0</td>
<td>324</td>
<td>270</td>
<td>131</td>
<td>60.9</td>
<td>--</td>
<td>--</td>
<td>60.9</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.3</td>
<td>--</td>
<td>- 97</td>
<td>- 6</td>
<td>+ 2</td>
<td>- 25.9</td>
<td>--</td>
<td>- 25.9</td>
</tr>
<tr>
<td>October</td>
<td>7.4</td>
<td>65</td>
<td>104</td>
<td>333</td>
<td>100.7</td>
<td>1</td>
<td>--</td>
<td>101.0</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 1.0</td>
<td>--</td>
<td>- 27</td>
<td>- 16</td>
<td>+ 29</td>
<td>+ 33.1</td>
<td>+ 1.6</td>
<td>+ 31.3</td>
</tr>
<tr>
<td>November</td>
<td>2.5</td>
<td>--</td>
<td>- 27</td>
<td>466</td>
<td>113.2</td>
<td>17.5</td>
<td>--</td>
<td>130.2</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>+ 6.3</td>
<td>--</td>
<td>+ 26</td>
<td>- 14</td>
<td>+ 55.6</td>
<td>+ 3.4</td>
<td>+ 59.7</td>
<td>+ 2.8</td>
</tr>
<tr>
<td>December</td>
<td>- 2.6</td>
<td>--</td>
<td>--</td>
<td>638</td>
<td>53.5</td>
<td>25.3</td>
<td>--</td>
<td>76.2</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>+ 2.2</td>
<td>--</td>
<td>--</td>
<td>+ 71</td>
<td>+ 17.7</td>
<td>- 16.4</td>
<td>--</td>
<td>- 0.1</td>
</tr>
<tr>
<td>Year</td>
<td>5.6</td>
<td>2523</td>
<td>1807</td>
<td>4637</td>
<td>729.6</td>
<td>164.3</td>
<td>871.5</td>
<td>1799.6</td>
</tr>
<tr>
<td>DEPARTURE</td>
<td>- 0.8</td>
<td>--</td>
<td>- 214</td>
<td>- 120</td>
<td>+ 28</td>
<td>+ 32.6</td>
<td>+ 4.0</td>
<td>+ 13.3</td>
</tr>
</tbody>
</table>

*Departure* refers to the anomaly relative to the 1970-1979 normal.

January was colder than normal for the fourth year in a row and featured abundant snowfall. Temperatures were almost continuously below -10°C, 3rd to 11th, but most snow came in the latter half of the month, 16.8 cm falling during a storm on the 24th.
February was very cold, the mean minimum a frigid -17.3°C (0.8°F) with the mercury falling below -20°C on 11 nights; the severest spell was the 8th to 18th with a mean temperature of -20°C for the 11 days (Figure 1). The coldest day and night came on the 17th, with max. -19.8°C and min. -30.3°C. On the same day, the intense anticyclone responsible for the Arctic weather raised the barometer to an all-time station high of 1050.1 mb at Toronto International Airport. The Niagara River froze over for the first time since 1962. Snowfalls were light at Elora but January's snowpack was maintained with over a foot of snow lying throughout the month.

![ELORA TEMPERATURE °C 1979](image)

Figure 1: Daily maximum and minimum temperatures at Elora for 1979.

March saw an end to severe conditions and was a milder than usual month; a notable cold snap occurred from the 11th to 16th but the 20th to 24th saw quite balmy weather as the thermometer exceeded 12°C, touching 17.2°C on the 23rd. This mild weather melted the lying snow completely, with none lying the rest of the month.

April made up for this reprieve by producing the worst storm of the winter on the 5th and 6th; 22 cm of snow fell, accompanied by winds which reached 110 km/h in parts of Southern Ontario. It was Toronto's snowiest April since 1840. Despite this wintry beginning, a fine warm spell came in on the 20th to 26th with temperatures up to 22.5°C. The last snow on the ground was washed away by a deluge of 35.0 mm rain on the 13th, and the month's total precipitation was finally over 150% of normal (Table 7).
Table 7: Additional temperature and precipitation data for 1979 at Elora.

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Max. °C</th>
<th>Mean Min. °C</th>
<th>Extreme Max. °C</th>
<th>Extreme Min. °C</th>
<th>Total Precipitation (mm)</th>
<th>% of Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>-6.7</td>
<td>-12.7</td>
<td>0.7</td>
<td>-26.0</td>
<td>61.2</td>
<td>100.1</td>
</tr>
<tr>
<td>February</td>
<td>-8.3</td>
<td>-17.3</td>
<td>4.5</td>
<td>-30.3</td>
<td>24.3</td>
<td>49.5</td>
</tr>
<tr>
<td>March</td>
<td>4.5</td>
<td>-4.1</td>
<td>17.2</td>
<td>-16.5</td>
<td>73.2</td>
<td>89.8</td>
</tr>
<tr>
<td>April</td>
<td>8.4</td>
<td>-0.6</td>
<td>22.5</td>
<td>-11.6</td>
<td>109.2</td>
<td>152.1</td>
</tr>
<tr>
<td>May</td>
<td>16.2</td>
<td>5.2</td>
<td>28.4</td>
<td>-2.5</td>
<td>79.0</td>
<td>105.9</td>
</tr>
<tr>
<td>June</td>
<td>22.9</td>
<td>10.2</td>
<td>29.2</td>
<td>-1.4</td>
<td>62.6</td>
<td>76.8</td>
</tr>
<tr>
<td>July</td>
<td>25.6</td>
<td>12.7</td>
<td>30.3</td>
<td>6.1</td>
<td>29.3</td>
<td>43.8</td>
</tr>
<tr>
<td>August</td>
<td>23.2</td>
<td>11.7</td>
<td>28.2</td>
<td>3.0</td>
<td>64.4</td>
<td>91.5</td>
</tr>
<tr>
<td>September</td>
<td>20.7</td>
<td>7.3</td>
<td>28.1</td>
<td>-2.0</td>
<td>60.9</td>
<td>70.2</td>
</tr>
<tr>
<td>October</td>
<td>11.0</td>
<td>3.7</td>
<td>23.5</td>
<td>-4.3</td>
<td>101.0</td>
<td>145.5</td>
</tr>
<tr>
<td>November</td>
<td>6.1</td>
<td>-1.0</td>
<td>13.5</td>
<td>-10.0</td>
<td>130.2</td>
<td>184.7</td>
</tr>
<tr>
<td>December</td>
<td>0.4</td>
<td>-5.5</td>
<td>10.8</td>
<td>-15.6</td>
<td>76.2</td>
<td>75.4</td>
</tr>
<tr>
<td>Year</td>
<td>10.3</td>
<td>0.8</td>
<td>30.3</td>
<td>-30.3</td>
<td>871.5</td>
<td>101.3</td>
</tr>
</tbody>
</table>

May was rather cool overall, though the spell from the 8th to 11th was warm. Rainfall was near average and sunshine a little below normal. Corn Heat Units accumulated were 76 below the normal expectation, a position from which they never really recovered all summer.

Temperatures in June were near normal, warm spells were short. There were good sunny spells, especially from the 12th to 20th and the month had a dry character, 44 mm (70%) of the 63 mm total fall occurring on three days.

July was again near average temperature-wise, after a cool start it became hot from the 11th to 15th and 22nd to 24th: the 14th was the year's hottest day at 30.3°C (86.5°F). This was a notably dry month, with only 44% of normal rainfall. Moreover, 71% of this total came as a 21 mm fall on the 30th. There were some sultry nights, including that of the 24th/25th when the mercury fell no lower than 19.2°C.

In contrast to July's droughty conditions, August saw regular, although mostly light rainfalls. It was hot at first but at the end of the first week cooler weather arrived, persisting until after the mid-month. The change of type on the 7th saw severe thunderstorms in parts of Southern Ontario and tornado warnings in Toronto and district: a twister touched down between Woodstock and Waterford and caused 20 million dollars worth of damage. Overall, August was a little cooler and duller than normal.
Rainfall was well spaced in September, only 5 days having measurable rain, the smallest number of any month. However, the passing remains of hurricane 'Fredrick' on the 13th was unlucky for some areas, for example Kingston which was deluged with 128 mm rain. 29.5 mm fell at Elora, but the monthly total ended up in deficit of normal by over 25 mm (Figure 2). Due to the generally clear, settled conditions, sunshine reached 114% of average, the daytime temperatures were 1.0°C above normal and the mean min. was 1.3°C below. The C.H.U. accumulation ended with a -2.0°C frost on the 20th and was 214 units below normal.

![Graph showing accumulated precipitation vs normal at Elora for 1979.](image)

Figure 2: Accumulated precipitation vs normal at Elora for 1979.

October turned the tables with unusually frequent rain (145% of normal) and very meagre sunshine (56% of normal): relief came in a short but hot Indian Summer (19th to 22nd), but then there was a severe drop in temperature, from a max. of 23.5°C on the 22nd to just +0.9°C on the 26th, light snow also falling. Accumulated Growing degree days for the season were considerably below normal (Figure 3).

November was mixed, basically cold at first, then a mild third week with strong S.W. airstreams bringing large falls of rain. 64.2 mm fell on the 21st to 25th and the month ended with 185% of normal precipitation. There were a few light snowfalls early in the month but real wintry weather held off until the 29th, when sub-freezing conditions set in. Sunshine was surprisingly slightly above normal.
Figure 3: Accumulated growing degree-days vs normal at Elora for 1979.

Figure 4: Monthly mean temperatures vs normal at Elora for 1979.
December featured a marked lack of snow, and although snow fell on 12 days all but a couple of falls were slight and the greatest depth on the ground was a scanty 8.7 cm (on the 19th). As advection of milder air then began there followed two days of freezing fog (which gave a heavy deposit of rime) and then a mild and 'green' Christmas period characterized bleakly by fog and heavy rains. Consequently, no snow remained lying at the end of the year, and overall, the monthly mean temperature was 2.2°C above normal (Figure 4).

R. Hughes, R. Kelly and J. Walton

**Miscellaneous**

<table>
<thead>
<tr>
<th>Last frost in spring</th>
<th>-1.4</th>
<th>June 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>First frost in autumn</td>
<td>-2.0</td>
<td>Sept. 20</td>
</tr>
<tr>
<td>Greatest daily rainfall (mm)</td>
<td>35.0</td>
<td>Apr. 13</td>
</tr>
<tr>
<td>Greatest daily snowfall (cm)</td>
<td>16.8</td>
<td>Jan. 24</td>
</tr>
<tr>
<td>Longest spell without measurable precipitation</td>
<td>14 days</td>
<td>July 11-24 &amp; Sept. 15-28</td>
</tr>
<tr>
<td>Longest spell with precipitation each day</td>
<td>11 days</td>
<td>October 10-20</td>
</tr>
</tbody>
</table>
SOIL SCIENCE RESEARCH

LAND USE

Land Evaluation

The concept of Land Evaluation derives from the premise that the "value" or "importance" of various aspects of the land resource can be determined from a comprehensive assessment of all factors involved. Whether it is especially important that certain land areas be retained for, or allocated to particular land uses depends not only upon the physical, biological, technological, and geographical conditions that exist, but also on society's objectives or requirements for the products and services obtained from the land resource.

The term Land Evaluation, as used at the University of Guelph, describes a procedure for indicating the strategic importance of land areas to specific land uses if societal objectives for the products from the land resources are to be achieved. The procedure is a synthesizing technique that incorporates information about the biophysical capability of many different land areas for many different land uses, about the availability and utilization of land and non-land resources, and about goals or needs to be met from the use of land.

The overall objective for Land Evaluation research is to develop a methodology for such a procedure and to implement this methodology as an analytical system to provide a sound basis for land use planning at both the provincial and local levels. Such a system would permit government Ministries to examine the implications of land related objectives and provide a basis for formulating and evaluating comprehensive guidelines for land use in Ontario. Specific areas of land which are strategically important for agriculture could be identified and the implications of urban expansion on productive capacity of Ontario's farmland could be forecast.

Since 1976, a research program aimed at the development and demonstration of a methodology for Land Evaluation has been supported by the Land Resource Research Institute of Agriculture Canada, the Ontario Ministry of Agriculture and Food and the University of Guelph. An initial study on alternative evaluation methods (Girt et al., 1977) led to the development of a simple prototype model for Land Evaluation (LEM 1) in Ontario (Smit et al., 1979). Currently, the procedure is being refined for a subsequent model (LEM 2), which focuses on agricultural uses of land. This research involves personnel from the School of Agricultural Economics and Extension Education and the Departments of Geography and Land Resource Science. The program has been coordinated through the Centre for Resources Development.

Research concerned with the development of an operational land evaluation system involves several components, including:

(a) the establishment of an appropriate conceptual framework and the development of a suitable research methodology.
(b) the development of mathematical models and appropriate computer software to translate the concepts and system logic into an operational form.

(c) the empirical implementation of the system, which entails defining appropriate units of analysis and compiling the necessary data for the land resource base, for productivities and resource utilization levels for agricultural and nonagricultural commodities and activities, and for socio-economic conditions, including population, product demand, consumption patterns, trade, and urban growth.

The major emphasis within the Department of Land Resource Science has been to define the appropriate classes for the soils and climate of Ontario and to estimate the productivities and resource utilization for agricultural and forestry commodities.

The province has been divided into seven climatic zones based on corn heat units. The soils have been placed into one of 13 classes based primarily on CLI subclass limitations.

Estimations have been made of the productivity of each soil-climatic combination for 18 crops based on a simple moisture deficit/surplus model. More detailed plant growth models are being developed (see 1978 Progress Report, pp. 25-30) for corn and alfalfa. Although these models will be used in the land evaluation program at a later stage, the simpler models appear to be providing very reasonable estimates for use in LEM 2, the demonstration model now in final stages of development.

In addition, work has begun on estimating the productivity of each of these soil-climatic combinations (or 'land types' as they are termed in the model), for forestry. Some difficulty is expected in accurately comparing forest productivity to agricultural productivity, but preliminary research indicates that at least a rough approximation may be derived.

Further work partially in this department has involved specification of how urban land use is to be considered in the model. This has involved specifying the exact nature of the conflict between urban and agricultural land use, in order that some simple form of urban use can be built in, simply for demonstration purposes, as is the case with the forestry land use described above.

In total therefore, 20 land uses, 18 of which are crops, are being considered; this department has focussed its efforts on specifying the relationships between these uses and the land types of the model.

Co-ordination of Program 39

The Program Outline for Program 39 was rewritten in consultation with the participants from the Department of Land Resource Science and Geography and the Schools of Agricultural Economics and Extension Education and Engineering. The objective for the Program for the period 1980-1981 through 1984-1985 are:

(a) Land Evaluation and Land Use
(b) Soil Quality and Degradation
(c) Climate, Soil and Water Regimes
(d) Rural Land Use and Price Monitoring
(e) Soil Inventory and Correlation

It is envisaged that the research will recognize the increasing importance of rural planning and development and will attempt to produce information to assure an integrated use of resources in the rural countryside.

Project reports for Program 39, Agricultural Land Use, were reviewed and summarized for consideration, in the annual report of the Agricultural Research Institute of Ontario.

N.R. Richards

Liaison from OAC to the RDOP (Rural Development Outreach Project)

Effort has been directed towards formulating objectives and programs for the R.D.O.P. at the University. Of particular concern has been the possibility of integration of the R.D.O.P. program with that of existing O.M.A.F. commitments.

Rural Development is envisaged as involving the whole community with a view to assisting in its economic and social evolution through the use and management of natural, human and community resources for purposes such as forestry, mining, agriculture, commercial fishing and recreation as the focal part of rural endeavours guided by conservation and environmental considerations.

The activities of the R.D.O.P. revolve around objectives to:

- disseminate the concepts of outreach and integrated rural development by means of conferences, seminars and workshops.
- identify major issues for selected areas in Northern Ontario by providing forums for the exchange of ideas, identification of problems and the development of goals.
- further identify the educational resources of Northern Ontario so that any outreach program could incorporate, primarily, the resources of the Northern institutions.

- identify the research and development priorities of the major agencies serving Northern Ontario.

- develop an understanding of the trends and priorities for Northern development as seen by the major agencies and organizations, and assess the potential of the University of Guelph resources in relationship to these.

N.R. Richards

Canadian Agricultural Research Council (CARC)

Through an understanding between Agriculture Canada and the University of Guelph Dr. N.R. Richards may spend up to one-half his time as Chairman of the Canadian Agricultural Research Council. Funds are provided to the Department of Land Resource Science to employ resource personnel for services rendered to CARC by Dr. Richards.

CARC activities in 1979-1980 significant to land use are:

(a) Report On The Evaluation and Development in Agriculture and Food in Canada.

Sponsored by the Canadian Agricultural Research Council, the study sought information about the contribution of the agriculture and food sector to provincial and national gross products (G.N.P.); the national, provincial and other policies affecting the research and development program; recommended guidelines for prioritizing requirements for research and development; the methods used by the federal and provincial governments and the private sector to fund research and development; the relationship between funding sources and the recipients of the funds; and the requirements of an adequate national research and development program in terms of both human and financial resources as well as facilities.

The report received by CARC in January 1980 was circulated for examination and consideration of the conclusions contained therein.

(b) CARC received and adopted a report prepared by the Canada Committee on Land Resource Services on a "Strategy for Agricultural Land Resource Research for Canada".

The strategy (proposal) was prepared by the Canada Committee in response to a request from the Canadian Agricultural Services
Committee (CASCC) as recommended by the Canadian Agricultural Research Council (CARC).

(c) Research on Absentee Land Ownership in Huron County.

Data sources for the study were the computerized assessment rolls located in each Municipal Office. The following emerged concerning land ownership by type of non-resident category for Huron County: foreign 0.95%; non-Ontario Canadian 0.10%; non-local 3.7%; local urban 3.8%. The preliminary study has provided the necessary inventory required for further research into some of the effects and implications of the absentee land ownership phenomenon.

The study is continuing with particular reference to the extent and location of absentee land ownership and relationship to soil capability.

N.R. Richards

Survey of Natural Areas in Middlesex County

Seven students worked for fifteen weeks during the summer of 1979 to compile data on 'natural' or 'environmentally significant' areas in Middlesex County. Existing published information was used as a basis for further field work so that data was gathered on over seventy sites in total. As well specific field work was devoted to the preparation of a list of mammals and a list of herptiles, and further research on a list of flora of the county.

The research was supported by a Young Canada Works grant from Manpower and Immigration Canada, awarded to the McIlwraith Field Naturalists Inc., of London, and was co-organized with Prof. Frank Cook. The report remains to be edited and published.

S.G. Hilts

Agricultural Reclamation of Aggregate Lands

To assess the significance of competing demands for land between the aggregate and agricultural industries, an overview of the coincidence of these lands is required. In addition, one needs to know the extent to which mined aggregate lands can be reclaimed to an agriculture after use. Agricultural lands have been previously rated for all of Southern Ontario by the Canada Land Inventory (C.L.I.) and in some areas, the surficial geology is currently being rated by the Ministry of Natural Resources for potential sources of aggregate reserves. Where this information does not exist, criteria are required to rate the aggregate potential of the surficial geologic deposits.

The development of these criteria for rating surficial geologic deposits is completed. In rating the deposits, several assumptions were made: firstly, the presence of buildings, urbanization
or zoning bylaws that may virtually remove the possibility of sand and gravel extraction were not considered; secondly, the distance of the aggregate source from market was not considered; thirdly, the location of deposits with respect to availability or quality of surrounding supplies was not accounted for (i.e. local significance); and finally, depth and quality factors were not included where information was not available. Where possible, areas that were previously rated by the Ministry of Natural Resources for aggregate potential (i.e. PIB35: Sand and Gravel Resource of the Durham Area, Grey County and ARIP 1: Aggregate Resources Inventory of Mono Township, Dufferin County) are used as control sites against which to compare the data.

Where no reports or maps of deposits rated by the ministry are available, the deposits are rated as primary (1st), secondary (2nd) and tertiary (3rd) significant deposits. Deposits of primary significance are deposits with high or medium to high probability of locating economic reserves. Deposits of secondary significance are deposits with medium or medium to low probability of locating economic reserves, and tertiary deposits are those with a low probability of locating economic reserves.

The mapped ratings of the surficial deposits (using Quaternary Geology maps and Sand & Gravel Resource maps) are overlayed onto C.L.I. soil capability maps for agriculture maps. The coincidence of granular deposits of 1rd to 3rd significance compared with the capability classes 1 to 7 is being recorded. In this manner, an estimate of the area of overlap between different agriculture capability classes and potential aggregate reserve classes is obtained. As well, the feasibility of rehabilitating these sites to an agriculture after use is being assessed.

This work has been completed for a pilot study area and a methodology is now in place to complete the project for the Central Ontario Planning area. In addition, criteria have been developed for assessing reclaimed aggregate lands to determine the current 'state of the art' in reclamation within the aggregate industry. Approximately one hundred sites located throughout southern Ontario and part of northern Ontario are being evaluated. These data are being used to develop a set of guidelines for the aggregate industry to use in rehabilitation of mined aggregate lands to an agriculture after use.

E.J. Mozuraitis, W.E.J. Worthy, E.E. Mackintosh

Environmentally Significant Areas in Southern Bruce County

During the summer of 1979 field work was completed for a survey of 'Environmentally Significant Areas' in southern Bruce County, Ontario. This research involved a team of 9 students working over 12 weeks, supported by a Young Canada Works grant from Manpower and Immigration Canada, and an Experience 79 grant from the Ontario
Ministry of the Environment. The project was organized in cooperation with, and financially supported by the Saugeen Field Naturalists.

During the summer the field data, and all available published information, was analyzed and a draft report was prepared. Over the following months the report was extensively edited, with local members of the Saugeen Field Naturalists providing assistance at many points; Martin Parker served as co-editor of the volume. Since March, 1980, this report has been published as Report # 101 of the Centre for Resources Development, University of Guelph; it was jointly published with the Saugeen Field Naturalists.

Thirty-five major sites were included in this survey, and a number of other sets of data prepared. These included particularly lists of the flora and fauna of the region; the flora list is the first such list ever published for this region in Ontario. The report has been distributed to relevant government agencies; it is hoped that it will be of particular use to those involved in land use planning within the region. Furthermore, it contributes to the ongoing research on this topic in Ontario; such studies have now been published for at least fourteen counties or regions in the province.

S.G. Hillts

SOIL PHYSICS

The Coefficient of Dispersion of NaCl in a Clay Paste

For the montmorillonite paste, which was investigated in previous years and for which extensive knowledge about the intrinsic properties was obtained by experiment and by analysis, it appeared possible to link the thermodynamic and the hydrodynamic approach to the transport of salt under non-stationary conditions.

The thermodynamic equations for salt and water transport are reformulated for the condition of zero electric current, which is the common situation in soils. Subsequently, the equation for the salt transport is transformed in order to conform with the dispersion equation, which is commonly used in dispersion studies and is founded in hydrodynamics. Following this route, it appears that the dispersion coefficient contains an element due to salt sieving. Simultaneously, the convection term appears as a fraction of the Darcy flux times the equilibrium salt concentration, the fraction being determined by the value of the reflection coefficient.

As a by-product of the analysis it is recognized that the local liquid velocity profile, which deviates from the Poiseuille profile due to the obstruction to the flow by the counterions of the clay can be erroneously interpreted as caused by the viscosity of the liquid being higher the closer the liquid is to the solid surface of the clay particles.

The results of the above investigations have been accepted for publication in the Soil Sci. Soc. Amer. J.

P.H. Groenevelt, D.E. Elrick and K.B. Laryea
Sorption of Water in Soils: A Comparison of Techniques for Solving the Diffusion Equation

The one-dimensional horizontal movement of water in unsaturated soils can be described by the nonlinear diffusion equation

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x} \left[ D(\theta) \frac{\partial \theta}{\partial x} \right]$$  \hspace{1cm} (1)

where $\theta$ is the volumetric water content, $D(\theta)$ is the soil-water diffusivity and $x$ and $t$ are the space and time coordinates.

Four different methods for solving Eq. (1) are compared. All four methods gave values that generally were within one percent of one another. An improved simulation procedure was described in detail. The results are published in the December 1979 issue of Soil Science.

D.E. Elrick and K.B. Laryea

The Movement of Calcium and Potassium During Infiltration

The objective of this project is to develop an accurate yet simple model to describe the movement of water, $\text{Cl}^-$, $\text{K}^+$ and $\text{Ca}^{++}$ during the horizontal infiltration of $\text{KCl}$ into an initially $\text{Ca}^{++}$ saturated soil. Dr. K.B. Laryea, in his Ph.D. dissertation used an adsorption isotherm to predict the transport of $\text{K}^+$. In this present study, which is part of Michel Robin's M.Sc. program, cation exchange theory is used. The GASP IV simulation language is being used by Michel Robin to develop the cation exchange model.

M.J. Robin, K.B. Laryea and D.E. Elrick

Freezing of Field Soil in Ontario

During the winter of 1979-1980, the freezing of soil at Elora (21% clay, 48% silt, 31% sand) and at Milton (36% clay, 45% silt, 19% sand) was investigated for two different tillage treatments: conventional tillage (fall ploughing) and zero tillage.

At different times during the winter vertical cuts were made through the frozen zone using a concrete-cutter and the frozen blocks were lifted from the underlying unfrozen soil. The depth of the frost front was then measured in the field.
The blocks were brought to the laboratory and cut horizontally into slices of 4 to 5 cm thick. Dry bulk densities and total water contents were determined for the different layers. The volumes of the samples were determined by dipping the frozen cuts in liquid paraffin.

The results (Figures 5 and 6) show that the frost penetrates deeper into the ploughed soil than into the zero-tilled soil. This is more pronounced in the Elora plots where the zero-tillage treatment was practised for the last seven years than for the Milton plots where the zero-tillage treatment was only one year old.

Fig. 5: Depth of the frost front and the water table for Elora during the winter of 1979-80.

Fig. 6: Depth of the frost front and the water table for Milton during the winter of 1979-80.
The water tables were high during the early stages of the winter when there was considerable rainfall and little frost. They drop dramatically during the colder part of the winter and they come back up during the early stages of thaw. The water tables were higher in the Milton plots which are not artifically drained than in the Elora plots which are tile drained.

During the early stages of thaw, the top layer of the soil melts and becomes very wet (over-saturated). The bearing strength of this layer is then virtually zero. Further thaw causes desintegration of the ice lenses in the remaining frozen part of the profile. The ice lenses become brittle and structured with the columnar ice crystals directed vertically. Drainage of surface water through the still partially frozen soil appears to occur with increasing easiness. The soil becomes ice-free in a relatively short period. This occurs slightly earlier (a few days) in the zero-tilled soil than in the ploughed soil.

During the soil freezing period, ice lenses form and grow at certain depths. Dry bulk density and total water content profiles were determined at different times during the winter. As an example, we present the picture of the ploughed soil at Milton on Feb. 28, 1980 (Fig. 7). The lines indicate the fractions of the bulk space occupied by solid soil particles (on the left), ice (on the right) and air (in the middle). All water is considered to be in the form of ice.

Fig. 7: Fractions of soil solids, air and ice as a function of depth for a ploughed soil at Milton on Feb. 28, 1980.
which is a simplification made for the purpose of illustration. A large ice lense was present at a depth of about 26 cm. The ice lense which was present earlier at a depth of 15 cm seems to have desintegrated (lost water) without having caused the structure to collapse (the DBD is still very low, viz 0.4 g/cm^3). Shortly after all ice had disappeared from the soil, the dry bulk density profiles were determined again in order to detect the "footprints" of the winter. For the plot pictured in Fig. 7 (Milton ploughed) the DBD profile found on April 23 is presented in Fig. 8. The ice lenses have disappeared and the structure has collapsed resulting in a profile where the DBD increases more or less regularly from about 1.0 at the soil surface via a value of 1.3 at 25 cm to a value of 1.6 at 55 cm. A slight deviation from the regular increase is found at 18 cm depth which might be the result of the earlier ice lense at 26 cm. All depths were measured from the soil surface as present which causes a certain soil particle to sit at a greater depth during the winter due to frost heave.

![DBD profile](image)

Fig. 8: Fractions of soil solids, air and water as a function of depth for a ploughed soil at Milton on April 23, 1980.

The four DBD profiles as they occurred after the disappearance of ice and before any secondary tillage operations are presented in Figs. 9 (EP = Elora ploughed), 10 (EO = Elora zero-tillage), 11 (MP = Milton ploughed, same as Fig. 8) and 12 (MO = Milton zero-tillage). In Fig. 9 through 12 the volume fractions are now plotted in the sequence solid soil, water and air from left to right.
It appears that on a macroscopic scale (the soil samples were taken with rings 5 cm in diameter and 5 cm high) these profiles are "quite normal". The DBD is increasing with depth and in the top 20 cm the DBD's are slightly higher in the zero-tilled soil than in the ploughed soil. Effects of freezing on separate aggregates remains to be investigated.

P.H. Groenevelt and B.D. Kay

**Fig. 9:** Fractions of soil solids, water and air as a function of depth for a ploughed soil at Elora on April 22, 1980.

**Fig. 10:** Fractions of soil solids, water and air as a function of depth for zero-tillage soil at Elora on April 22, 1980.

**Fig. 11:** Fractions of soil solids, water and air as a function of depth for a ploughed soil at Milton on April 23, 1980.

**Fig. 12:** Fractions of soil solids, water and air as a function of depth for a zero-tillage soil at Milton on April 23, 1980.
WASTE DISPOSAL ON AGRICULTURAL LAND

Infiltration of Beef Manure Slurry into Soil

Unlined earthen storage ponds represent low cost alternatives for liquid manure storage facilities. If sufficient seepage from an unlined earthen pond occurs, groundwater may become contaminated and these structures would be deemed unacceptable.

Reductions in infiltration rates of liquid manure into soil have been reported in the literature, but considerable discrepancies exist. The reduction is attributed to the formation of a complete or partial seal on or near the soil surface, but the degree, the rate and the mechanism of sealing as well as the influence of texture and hydraulic head remain controversial issues.

The objectives of this study were to determine the rate and degree to which a clay (B.D. = 1.8 g/cm³), a loam (B.D. = 1.3 g/cm³) and a sandy loam soil (B.D. = 1.4 g/cm³) became sealed under conditions simulating manure storage ponds 1 m and 5 m deep, and to determine the mechanism of sealing of the loam soil.

Very rapid, non-linear, 5 to 10 fold reductions in infiltration rates occurred between 0.5 hr and 2 days in clay, loam and sandy loam soil columns receiving manure delivered at 1 m and 5 m constant hydraulic heads. These reductions were followed by slower non-linear reductions until approximately 14 days when the infiltration rates began to fall in essentially a linear fashion until the termination of the experiment at 31 days. The mean infiltration rates over the period from 24 to 31 days was dependant upon both soil type and hydraulic head and no significant interaction between these two parameters was found. Over this period, mean infiltration rates ranged from 0.042 cm/day for the clay soil, 1 m hydraulic head to 0.157 cm/day for the loam soil, 5 m hydraulic head.

An experiment involving the infiltration of manure and sterilized manure at 1 m hydraulic head, sterilized, clarified manure at 0.25 m hydraulic head, all into loam soil and the infiltration of sterilized manure at 1 m hydraulic head into glass beads was undertaken to determine the mechanism of formation of the partial seal. Trends indicate that the seal is primarily a surface phenomenon with minor contributions from soil pore clogging by particulates, microorganisms and microbial by-products. The interaction between colloidal and dissolved components of the manure and the soil also appears to play a minor role.

J.G. Rowsell, M.H. Miller and J.B. Robinson (Environmental Biology)
Waste Disposal of Sewage Sludge

This report is a summary of results obtained during the seventh year of an eight-year research program to determine the maximum rates of sewage sludge application which can be safely used on agricultural soil. Two sets of experiments are described. One is a field study of the effects of rate and source of sludge application on corn and bromegrass. Three sludges resulting from treatment of sewage for phosphorus removal with calcium hydroxide, ferric chloride and aluminum sulphate are compared to ammonium nitrate fertilizer as sources of nitrogen and their effects on crop yield and nutrient and metal content of crops and soil are measured. The second study is a greenhouse experiment with ryegrass as the crop and six sewage sludges selected for their high metal content. Crop growth and nutrient and metal uptake were measured.

Yields of bromegrass and corn resulting from sludge application were at least as high as yields with ammonium nitrate. Sodium bicarbonate-extractable (plant available) soil phosphorus was increased by sludge application in the order calcium sludge > iron sludge > aluminum sludge. As in previous years, soil pH and extractable soil calcium were highest with the calcium sludge and soil pH was lowest with the iron sludge. Cadmium, copper, nickel and zinc concentrations in plant tissue were high with high sludge application rates, particularly with sludges high in these metals.

In the greenhouse experiment, after the fourteenth crop of ryegrass was harvested, the root and shoot and the soil on which the ryegrass was grown were analysed for metal content. With the exception of zinc, metal concentrations were generally much higher in the root than in the shoot. The low mobility of lead and chromium in the soil-plant system is reflected in the high soil/shoot ratios of these metals. Cadmium and copper are readily absorbed by the root as indicated by the low soil/root concentration ratios, but are not so readily transported to the shoot as evidenced by relatively high root/shoot concentration ratios.

SOIL PLANT RELATIONS

Response of Corn Hybrids to Nitrogen Fertilization

From 1976 to 1979, five corn hybrids (PAG SxIII, Pioneer 3990, Warwick SL 207, Stewarts 2501, and United H 106) were compared at different nitrogen (urea) levels in field experiments to determine if differences in grain yield responses occurred. The hybrids were chosen on the basis of yield and standability. An analysis of variance was done on the combined data for the four years to provide estimates of interaction effects between hybrids, nitrogen levels and years.

A highly significant interaction effect between hybrids and years occurred indicating that the relative yields of the hybrids was not the same each year. There was no interaction effect between hybrids and nitrogen levels. The main effects of nitrogen levels and hybrids were highly significant. However, the year effect was nonsignificant.

The data confirm earlier observations with yields for individual years that hybrids respond in a similar manner to increasing nitrogen levels. This is an important observation since we now have some assurance that the choice of hybrid in nitrogen response experiments in the field is not likely to have a significant bearing on the results. It was observed that as the maximum yield of the hybrids increased, the optimum N level for profitable yield also increased.

E.G. Beauchamp
R.B. Hunter (Crop Science)
L. Kannenberg (Crop Science)

Time and Method of Liquid Cattle Manure Application for Corn

Treatments were continued for a third year (1979) and grain and silage yields obtained in field experimentation designed to determine the time (preplant vs side-dress) and method (injection vs surface) on nitrogen (N) availability in liquid cattle manure (LCM). LCM was compared with urea (preplant) and anhydrous ammonia (side-dress) on the basis of the total quantity of N applied. LCM applied to the surface before planting was incorporated by discing four days following application. The LCM applied as a side-dressing was not incorporated.

As for the previous two years, there was a substantial response to N in both grain and silage yields (Table 9). In general, injected LCM resulted in a larger response than when applied to the surface. There was relatively little difference between preplant,
Table 9: Grain and silage corn yields treated with urea (preplant), anhydrous ammonia (side-dress), and liquid cattle manure (LCM) applied before planting or side-dressed and either left on the surface or injected into the soil (1979).

<table>
<thead>
<tr>
<th>N Source and Rate Treatments (kg N/ha)</th>
<th>Yields (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain (15% H2O)</td>
</tr>
<tr>
<td>Check</td>
<td>2,880 g</td>
</tr>
<tr>
<td>Urea; preplant; 70; disced</td>
<td>5,070 cde</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>6,050 ab</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>5,700 bcd</td>
</tr>
<tr>
<td>LCM; preplant; 70; disced</td>
<td>4,890 de</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>4,900 de</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>5,810 bc</td>
</tr>
<tr>
<td>&quot; &quot; 560; &quot;</td>
<td>6,660 ab</td>
</tr>
<tr>
<td>LCM; preplant; 70; injected</td>
<td>4,370 ef</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>6,000 ab</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>6,860 a</td>
</tr>
<tr>
<td>LCM; sidedress; 70; surface</td>
<td>3,810 f</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>4,750 de</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>6,320 ab</td>
</tr>
<tr>
<td>LCM; sidedress; 70; injected</td>
<td>4,710 de</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>5,980 ab</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>6,640 ab</td>
</tr>
<tr>
<td>Anhyd; sidedress; 70; injected</td>
<td>5,020 cde</td>
</tr>
<tr>
<td>&quot; &quot; 140; &quot;</td>
<td>6,500 ab</td>
</tr>
<tr>
<td>&quot; &quot; 280; &quot;</td>
<td>6,640 ab</td>
</tr>
</tbody>
</table>

Data within columns followed by the same lower case letter are not significantly different at the 95% probability level.

Incorporating surface-applied LCM before planting resulted in a greater yield response than to surface-applied LCM as a side-dressing. This probably reflects a greater loss of ammonium-N through volatilization with the surface side-dress treatment due to a longer exposure period. Maximum yields with LCM tended to be slightly larger than with N fertilizers.

E.G. Beauchamp and J. Lovcanin
Response of Flax to Fertilizer and Seeding Date

Flax has been grown for many years on poor and imperfectly drained soils in parts of Grey, Bruce, Huron, Perth and Wellington Counties. It has usually been seeded in late May or early June and has received low rates of fertilization. Very little research has been done in Ontario to determine the response of flax to fertilizers.

A three-year experiment at the Elora Research Station designed to measure response to nitrogen as affected by seeding date was completed in 1979.

Brome grass was grown on the site for the preceding nine years and received 55 kg N/ha each year. Phosphate and potash were broadcast and worked in each year of the study and 4-10-4 (N-P₂O₅-K₂O) ha was drilled with or below the flax seed. The flax variety was Dufferin. The trial was grown on the same plots each year but nitrogen rates and seeding dates were re-randomized annually. Ammonium nitrate was broadcast and worked in before seeding to supply the nitrogen rates.

Correlations of 1978 and 1979 yields with nitrogen rate in the previous year showed no significant relation. Seed yield decreased markedly with delayed seeding and in 1978 the seed yield with June seeding was zero due to frost (Table 10 and Figure 13). We conclude

Table 10: Effect of nitrogen fertilizer and seeding date on seed yield of flax.

<table>
<thead>
<tr>
<th>Year</th>
<th>Seeding Date</th>
<th>Nitrogen Applied (kg/ha)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seed yield (kg/ha)</td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>April 29</td>
<td>1,420</td>
<td>1,900</td>
</tr>
<tr>
<td></td>
<td>May 17</td>
<td>1,200</td>
<td>1,350</td>
</tr>
<tr>
<td></td>
<td>June 7</td>
<td>190</td>
<td>160</td>
</tr>
<tr>
<td>1978</td>
<td>May 1</td>
<td>1,000</td>
<td>1,140</td>
</tr>
<tr>
<td></td>
<td>May 19</td>
<td>900</td>
<td>880</td>
</tr>
<tr>
<td></td>
<td>June 8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1979</td>
<td>May 2</td>
<td>1,270</td>
<td>1,300</td>
</tr>
<tr>
<td></td>
<td>May 18</td>
<td>1,350</td>
<td>1,340</td>
</tr>
<tr>
<td></td>
<td>June 6</td>
<td>850</td>
<td>610</td>
</tr>
<tr>
<td>Mean</td>
<td>Apr. 29-May 2</td>
<td>1,230</td>
<td>1,450</td>
</tr>
<tr>
<td></td>
<td>May 17-19</td>
<td>1,150</td>
<td>1,190</td>
</tr>
<tr>
<td></td>
<td>June 6-8</td>
<td>350</td>
<td>260</td>
</tr>
</tbody>
</table>

* An additional 4 kg/ha was drilled with or below the seed.
that June seedings are quite unsatisfactory at Elora and that date of seeding is as important for flax as it is for most crops.

Nitrogen response was much greater in 1977 than in the later years (Table 10). It was also appreciably greater with the earliest seeding. There appears to be response to nitrogen up to approximately 150 kg/ha (160 kg total) with the early seeding and 60 kg broadcast (70 kg total) with the mid-May seeding (Figure 13). Whether these rates are profitable will depend on the price of nitrogen and flax. On average, the June seeding did not respond to nitrogen beyond the 10 kg applied at seeding. In this study, June seeding was quite uneconomic at any nitrogen rate.

T.E. Bates, S. Sheppard and J. Lucas

Figure 13: Effect of nitrogen and seeding date on seed yield of flax, average 1977, 1978 and 1979.
Manganese on Winter Wheat

Work with manganese applications on winter wheat was reported in the 1978 Progress Report of the Department of Land Resource Science (pages 45 to 48). Four more trials on the sandy soils of Norfolk and Elgin Counties were harvested in 1979.

Two of these trials showed no significant response to manganese although the wheat crop was poor. Nematodes are suspected as the cause of poor growth in one of these and the cause in the other is not known. Results from the two trials showing manganese response are shown in Tables 11 and 12. Both of these trials were on severely manganese deficient areas which appears to have resulted from spreading the soil when ponds were dug.

Table 11: Manganese response on winter wheat, farm of F. Dendaw, R.R. # 5, Langton.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Yield</th>
<th>Straw Yield</th>
<th>Total Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>No manganese</td>
<td>0.57 b*</td>
<td>1.35 c</td>
<td>1.92 b</td>
</tr>
<tr>
<td>1 spring manganese spray</td>
<td>1.01 b</td>
<td>1.61 c</td>
<td>2.61 b</td>
</tr>
<tr>
<td>1 fall + 1 spring spray</td>
<td>2.08 a</td>
<td>2.94 b</td>
<td>5.01 a</td>
</tr>
<tr>
<td>1 fall + 2 spring sprays</td>
<td>2.34 a</td>
<td>3.95 a</td>
<td>6.30 a</td>
</tr>
<tr>
<td>Coefficient of variation (%)</td>
<td>40.0</td>
<td>37.5</td>
<td>32.8</td>
</tr>
</tbody>
</table>

* Means in any one column not followed by a common letter are significantly different at 0.05 probability.

Table 12: Manganese response on winter wheat, van Londersel farm, R.R. # 1, Simcoe.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Yield</th>
<th>Straw Yield</th>
<th>Total Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>No manganese</td>
<td>0.59 d*</td>
<td>1.12 d*</td>
<td>1.71 d*</td>
</tr>
<tr>
<td>5 kg manganese drilled</td>
<td>1.15 c</td>
<td>1.92 c</td>
<td>3.08 c</td>
</tr>
<tr>
<td>10 kg manganese drilled</td>
<td>1.54 b</td>
<td>2.31 b</td>
<td>3.86 b</td>
</tr>
<tr>
<td>20 kg manganese drilled</td>
<td>1.60 b</td>
<td>2.34 b</td>
<td>3.94 b</td>
</tr>
<tr>
<td>40 kg manganese drilled</td>
<td>2.04 a</td>
<td>2.79 a</td>
<td>4.87 a</td>
</tr>
<tr>
<td>1 fall spray, 2 spring sprays</td>
<td>2.08 a</td>
<td>2.79 a</td>
<td>4.87 a</td>
</tr>
<tr>
<td>Coefficient of variation (%)</td>
<td>17.3</td>
<td>13.2</td>
<td>14.2</td>
</tr>
</tbody>
</table>

* Yields in any one column not followed by a common letter are significantly different at 0.05 probability.
Conclusions:

There was a serious manganese deficiency in this field resulting in appreciable winter-kill and poor yields. At least one fall and two spring sprays with manganese were required to correct the deficiency.

Wheat was severely deficient in manganese on this site with at least one fall and two spring sprays or 40 kg manganese as manganese sulfate drilled with the seed required to correct the deficiency.

This large amount of manganese applied to the soil would only be economic if it remains available for a number of years. At the present time we do not know how long it remains available.

S. Sheppard, J. Lucas and T.E. Bates
TILLAGE AND DRAINAGE

Tillage Research on Ontario Soils

The kind, amount and timing of tillage is crucial for high yields and maximum profits on Ontario soils. No-till or minimum till is favoured from the standpoint of erosion control and reduced tillage costs. But yields on many soils are unacceptably reduced. We are studying the various components of soil physical conditions relative to crop growth in an effort to best utilize natural phenomena such as frost action, cropping practices such as rotation of crops, and fertility management to make tillage more efficient. A new NSERC grant to a group in Land Resource Science, Crop Science, Engineering and Agricultural Economics is helping financially.

A study completed recently with grain corn (Agronomy Journal 72: 540-542) showed that increasing fertility levels on plots by applying fertilizers above the levels recommended for conventional tillage, would not overcome the yield decrease associated with the no-till (Figure 14). Furthermore, N, P, K in leaf tissue responded similar to crop yield. Although levels increased with higher fertilizer, the increase pattern was similar on each tillage treatment. Soil tests, on the other hand, seem to be favoured by no-till. N and K tended to be higher near the surface, and the sum of the concentrations by depth increments to plow depth was greater with the no-till than with conventional tillage.

It is believed that for many Ontario soils, the lack of tillage leaves the soil too firm for good root development and high yield. If we can overcome this effect of mechanical impedance to roots by other means, maybe reduced or no-till can become tenable.

J.W. Ketcheson and E.L. Dickson

![Graph showing effect of rates of N, P, and K, each at the second rate of the remaining two, with different primary tillage treatments. Mean of 4 years, 1971, 1974, 1975 and 1976.](image-url)
Absorption of Fertilizer and Manure Phosphorus by Soil Aggregates

Studies conducted on runoff plots at Guelph between 1973 and 1976 indicated that phosphorus added to soil as manure was not as subject to loss by erosion as was that added as fertilizer. The NaHCO₃-extractable P enrichment ratio of sediment (ratio of P in sediment to that in soil) from manured plots was considerably lower than that from fertilizer plots (see 1976 Progress Report, page 49). This difference could not be accounted for by runoff characteristics such as clay enrichment ratio, runoff volume or sediment concentration. A project was established to determine the cause or causes of this difference.

Rates of phosphorus ranging from 0 to 400 µg P/g soil were applied as either a poultry manure slurry or reagent grade KH₂PO₄ to a Conestoga loam surface soil. The samples were incubated at 30 °C with a weekly wetting and drying cycle and sampled periodically.

The manure treatment markedly increased the stability of aggregates to wet-sieving (Table 13). This will partially explain the lower susceptibility to loss of P by erosion because those aggregates with which manure became associated would be more stable and hence less subject to breakdown and erosion. Thus the phosphorus associated with the manure would not be as subject to loss.

It was also observed that the NaHCO₃-extractable P content of the larger aggregates was greater than that of the smaller aggregates when P was added as manure. There was no difference in NaHCO₃-extractable P of the different sized aggregates when P was added in an

Table 13: Percent water-stable aggregates as influenced by fertilizer and manure addition.

<table>
<thead>
<tr>
<th>P Application Rate (µg P/g)</th>
<th>27 Days After Application</th>
<th>235 Days After Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fertilizer</td>
<td>Manure</td>
</tr>
<tr>
<td>0</td>
<td>22.7</td>
<td>29.7</td>
</tr>
<tr>
<td>25</td>
<td>32.4</td>
<td>35.9</td>
</tr>
<tr>
<td>50</td>
<td>34.6</td>
<td>39.0</td>
</tr>
<tr>
<td>100</td>
<td>33.6</td>
<td>44.0</td>
</tr>
<tr>
<td>200</td>
<td>25.5</td>
<td>45.9</td>
</tr>
<tr>
<td>400</td>
<td>23.7</td>
<td>50.7</td>
</tr>
</tbody>
</table>
inorganic form (Figure 15). This indicated that the manure with its associated P was being preferentially absorbed into the larger aggregates.

This preferential absorption was investigated further in field and laboratory studies. A similar effect was found using a dairy manure slurry in field applications indicating that the effect was not peculiar to the source or method of manure application used in the laboratory study. When the particulate matter was removed from the poultry manure slurry there was no difference in P content of the different sized aggregates. This indicates that the observed difference is due to preferential absorption of the particulate matter in the slurry by the larger sized aggregates. It is suggested that this may be due to a greater number of large pores in the larger aggregates which allow manure particles to penetrate into the aggregates. In the smaller aggregates, the particles may be confined to the external surface.

This observation has implications for the mechanism of aggregate formation and stabilization as well as for the impact of manure on phosphorus content of surface runoff. The P content of runoff would be greater from fertilizer application than from an equivalent amount of P added as manure.

V.K. Bhatnagar and M.H. Miller

Figure 15: Effect of source and P rates on the extractable P content of the dry-sieved aggregates (average of 4 times).
Response of Field Crop to Irrigation

A 'line' method irrigation experiment was conducted on field corn at Elora Research Station in 1979. This method is used in experiments in western U.S. but there is still some doubt whether it is feasible to use in eastern North America and whether the results can be analyzed by usual statistical methods as the irrigation treatment levels are not randomized. Results of the 1979 experiment indicate that a significant positive response was obtained from three irrigations (mid-July, end of July and mid-August) for both grain and silage yields using a statistical analysis based on a method developed in Utah. Tables 14 to 16 summarize the silage and grain yields for irrigated

Table 14: Corn silage yields (tonnes/ha) for irrigated and non-irrigated plots for two hybrids grown with three N-levels and two plant populations at the Elora Research Station in 1979.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Hybrids</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coop S259</td>
<td>P.A.G. SXIII</td>
</tr>
<tr>
<td>Non-Irrigation</td>
<td>10.10</td>
<td>10.20</td>
</tr>
<tr>
<td>Irrigation</td>
<td>11.76</td>
<td>11.75</td>
</tr>
<tr>
<td>Ratio: Irrigation/Non-Irrigation</td>
<td>1.16</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Table 15: Grain corn yields (tonnes/ha) for irrigated and non-irrigated plots for two hybrids grown with three N-levels and two plant populations at the Elora Research Station in 1979.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Hybrids</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coop S259</td>
<td>P.A.G. SXIII</td>
</tr>
<tr>
<td>Non-Irrigation</td>
<td>5.72</td>
<td>6.08</td>
</tr>
<tr>
<td>Irrigation</td>
<td>6.58</td>
<td>6.42</td>
</tr>
<tr>
<td>Ratio: Irrigation/Non-Irrigation</td>
<td>1.15</td>
<td>1.06</td>
</tr>
</tbody>
</table>
Table 16: Corn silage yields (tonnes/ha) for irrigated and non-irrigated plots for two populations with three N-levels and two hybrids at the Elora Research Station in 1979.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Population (plants/ha)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50,000</td>
<td>65,000</td>
</tr>
<tr>
<td>Non-Irrigation</td>
<td>10.06</td>
<td>10.22</td>
</tr>
<tr>
<td>Irrigation</td>
<td>11.15</td>
<td>12.35</td>
</tr>
<tr>
<td>Ratio: Irrigation/Non-Irrigation</td>
<td>1.11</td>
<td>1.21</td>
</tr>
</tbody>
</table>

* Ratio: (P65 with irrigation)/(P50 with no irrigation).

and non-irrigated plots showing the interactions with hybrids and populations. There was no interaction with N-levels. It is apparent that silage yields were increased about 15% for both hybrids (Table 14) and when coupled with a population increase, the yield boost was over 20% (Table 16). Grain corn yields were increased an average of 10% with irrigation, but with one hybrid (Coop S259), the gain was 15% (Table 15). The gain in grain yield due to irrigation was 11% at the higher plant population when averaged over both hybrids. A population increase to 65,000 pl/ha coupled with irrigation gave an increase of 18% over the standard population without irrigation (Table 17).

Table 17: Grain corn yields (tonne/ha) for irrigated and non-irrigated plots for two populations with three N-levels and two hybrids at the Elora Research Station in 1979.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Population (plants/ha)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50,000</td>
<td>65,000</td>
</tr>
<tr>
<td>Non-Irrigation</td>
<td>5.72</td>
<td>6.08</td>
</tr>
<tr>
<td>Irrigation</td>
<td>6.24</td>
<td>6.76</td>
</tr>
<tr>
<td>Ratio: Irrigation/Non-Irrigation</td>
<td>1.09</td>
<td>1.11</td>
</tr>
</tbody>
</table>

* Ratio: (P65 with irrigation)/(P50 with no irrigation).

The summer of 1979 would be considered to be moderately to severely dry at Elora as July rainfall was 37% of normal and in June and August 82% of normal.

D.M. Brown
The Effect of Fluctuating Temperatures on Leaf Number and Development Rate of Field Corn

A series of controlled environment chamber experiments were conducted in which two 2600 CHU hybrids were grown in a 3-day cycle of fluctuating temperatures in an attempt to simulate air mass changes under field conditions. The objective was to determine if the temperature level just prior to the tassel initiation stage caused a change in its expected time of occurrence and in total leaf number. It was concluded that high temperatures just prior to this stage increases final leaf number on plants compared to cool temperatures at that time. No conclusive results were obtained with respect to the effect of fluctuating temperatures on the time required to reach the tassel initiation stage, although it was apparent that this stage may be delayed somewhat if temperatures are high just prior to its occurrence. In addition, total development time, in terms of corn heat units, may be increased slightly due to the increase in total leaf number.

This research is continuing in the Department of Crop Science.

D.M. Brown and Jas. Walton

Estimation of Seed Depth Soil Temperatures Using Air Temperature Data

The main objective of this project was to develop a simple procedure for estimating seed depth soil temperatures from standard climatological records and soil conditions during the spring months of the year. A continuous record of seed depth soil temperatures in a loam-type soil seeded to corn in a small field adjacent to the Elora Research Farm climatological observing station were available for most days in May and June for a 5-year period up to and including 1978. A summarization and examination of these records and comparing them to daily records of air temperature (max. and min.), sunshine/radiation, soil temperatures at deeper depths, wind speeds, and soil moisture observations indicated that variations from day to day were most closely related to air temperatures and that other environmental factors had no consistent effect on the day to day differences noted between air and soil temperatures. Attempts to develop a soil temperature predictor using physically based principles and a surface temperature equation failed. It was found that an equation representing the sinusoidal pattern of daily temperature fluctuations was adequate to estimate 5-cm depth soil temperatures to within ±3°C. The equation uses the daily air temperature extremes (max. and min.) recorded in the Stevenson screen and the times of their occurrence as input. Soil temperatures at this depth are usually 2 to 4°C above air temperatures; except for a few hours after sunrise when the air warms faster than the soil. The magnitude of departure from air temperature appeared to be most closely related to the previous day's air temperature and its level
compared to normal. No significant improvement to this equation could be made by incorporating a soil moisture variable. It was concluded that soil moisture effects on seed-depth soil temperatures are reflected in the air temperature sinusoidal patterns.

D.M. Brown and B. Crawford

Estimation of Daily Soil Heat Flux in Spring

The soil temperature records for the 1974 to 1979 spring seasons at the Elora Research Station weather recording site were used to calculate daily soil heat flux. The objective of this study was to determine if soil heat flux \( G \) during spring days is a significant proportion of the net radiant energy \( R_n \) over each 24-hour period. In the past, \( G \) has been assumed to be 5% or less and disregarded when calculating the components of the heat budget equation for predictions of daily evapotranspiration.

This study concluded that a significant soil heat input occurs during periods in the spring and early summer months when temperatures are above normal, net radiation is high and daily wind speeds are low. Equations using these weather parameters were derived for the months of April, May and June for daily estimation of \( G \), based on the 1979 weather and soil temperatures records. These equations were then used to estimate daily values of \( G \) for the first half of the growing season of 1978 which were in turn introduced into the energy balance equation for calculation of potential evapotranspiration in the water budget of the forage crop growth and yield simulator (SIMFOY).

Comparisons of soil moisture estimates with, and without, \( G \) showed that there was a significant difference between the two methods of estimating soil moisture, although comparisons with actual measurements for the one year did not confirm an improvement in estimates compared to measured values. (Therefore other factors must be more important than inclusion of an estimate for \( G \).

Since \( G \) is significant with respect to the net radiation in the first half of the growing season, and the t-test confirmed that it has a significant effect on the level of daily potential evapotranspiration and an estimate of the total soil moisture content, it should be included in the energy budget equation for a better estimation of potential evapotranspiration.

D.M. Brown and M.M. Abdul-Ghani
Heat Unit Ratings of Check Hybrids (Field Corn)

The Heat Unit Tests initiated in 1978 were conducted in 1979 at the same locations - Ottawa, Inkerman, Elora, Ridgetown and Malden. Results are shown in Table 18. The official C.H.U. rating for each hybrid are given as well as the dates on which each hybrid reached the "desirable" kernel moisture percentage and the accumulated C.H.U.'s at each location.

The 1979 accumulated C.H.U.'s were: (1) closer to the published C.H.U. ratings than the 1978 tests showed for the earliest (2400) and latest (3300-3500) hybrids; (2) higher than the published rating for the 2500 to 3200 hybrids compared to a lower rating for the 3000 to 3300 hybrids in 1978; (3) not as close to the published rating for the 2500 to 2900 hybrids as in 1978. There are exceptions to these generalities at specific locations, e.g. Ottawa C.H.U. accumulations were relatively higher than expected in 1979. Dates of maturity were later for all hybrids at Ottawa than at Inkerman in 1979, whereas it was the reverse in 1978. This may have been due to the relative amounts of P and K fertilizers at the two locations in 1979 (Ottawa: 132-90-134 and Inkerman: 130-148-45 kg/ha) or to differences in rainfall distribution. Final dry down of all late season hybrids occurred in September, 1978. No doubt this caused some of the difference in CHU accumulations between the two years.

D.M. Brown, T. Francis (Harrow), R.C. Jenkinson (Kemptville), A.D. McLaren (Ridgetown), and Wm. Warren (Ottawa)

Table 18: 1979 corn heat unit test: C.H.U. required by check hybrids from planting date to dates of reaching "desirable" kernel moisture per cent.

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- Extrapolated to obtain date.
- Desirable kernel moisture not reached at final harvest.
Meteorological Aspects of Plant Disease Control

1. Weather-timed fungicide applications to control Botrytis onion leaf blight

Plots of onions (Autumn spice) were established at the Muck Research Station, Kettleby, Ontario in 1979. A weather-based index, accumulated after the onions reached the four leaf stage, was tested as a spray initiation criterion. There were five treatments each replicated four times: (1) no fungicide, (2) Bravo applied at 10 day intervals beginning 9 July, (3) Bravo applied before rainfall forecast to occur after the expiry of the manufacturer's recommended interval, beginning when the index reached 70, (4) same as treatment 3 but beginning at index of 100, (5) same as treatment 3 but beginning at index of 130 (Table 19).

Table 19: Fungicide timing trials on onions in 1979.

<table>
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<tr>
<th>Spray Program</th>
<th>Spray Initiation Date</th>
<th>Boyrytis Lesions/Leaf At Start Date</th>
<th>On 29 August</th>
<th>Yield Tonnes/ha</th>
<th>No. of Fungicide Sprays Applied</th>
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<td>1</td>
<td>9 July</td>
<td>0.5</td>
<td>2.6</td>
<td>42.4</td>
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<td>2</td>
<td>19 July</td>
<td>2.5</td>
<td>9.2</td>
<td>43.3</td>
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<td>3</td>
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<td>7.9</td>
<td>6.7</td>
<td>45.4</td>
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<td>4</td>
<td>1 August</td>
<td>9.1</td>
<td>7.6</td>
<td>47</td>
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Yields were not significantly different but each of the weather-timed and even the non-sprayed treatment had higher yields than the regular spray treatment, which received 5 applications of Bravo. The highest yield was from the treatment which started last and received only 3 applications of Bravo. These findings suggest that weather-timed fungicide applications commencing at about 5 to 10 Botrytis lesions per leaf or 1 to 2% leaf area diseased or an index of about 100 provide good control of Botrytis leaf blight, good yield and reduced fungicide usage.

2. Prediction of surface wetness duration from meteorological data

Research initiated last year concerning the relationship between surface wetness duration (SWD, caused by dew or rain) and standard weather data has continued. The original work, done on turf grass and apple leaves, has been expanded to include corn and soybean canopies. It has been found that SWD estimates accurate to ± 1/2h can be
made from standard weather data for dew events. The computer model used requires a good estimator of canopy temperatures from screen temperatures, but utilizes screen humidity directly and is remarkably insensitive to difficulties with extrapolation from 10 m tower winds under stable conditions.

P.A. Dzikowski, M.J. Pedro Jr. and T.J. Gillespie
**GEOLOGY RESEARCH**

**Geochemistry of Si, Al, and Fe in the Zone of Weathering**

The behaviour of Si, Al and Fe in the zone of weathering is fundamental to an understanding of the geochemistry of soil. As resistate, hydrolysate and oxidate elements they tend to accumulate at the earth's surface and to constitute with H₂O a residua system of weathering. As such, they form the basis of any attempt at phase rule modelling of soil systems and their mineralogy.

Furthermore, differential movements that lead to a vertical sorting of the three elements in the soil profile, give rise to various geochemical pathways for pedogenesis to take. For example, the downward transfer of Si at the expense of Fe and Al leads to the process of ferrallitisation and may produce oxisols, laterites or bauxites. By contrast, the preferential removal of Fe and Al from upper to lower horizons gives rise to podzools and eluviated forms of brunisol.

The parameters Eh and pH have long been recognized as important environmental factors in such differential movements and a particularly ingenious application of Eh-pH diagrams to a study of the origins of bauxites and laterites has been proposed by Norton (1973). Here I apply the same kind of diagram suitably modified to a consideration of the geochemistry of podzolisation.

Podzols are characterized by a succession of three horizons: a dark coloured, organic-rich, surface horizon, overlying an 'ashy', light coloured, quartz-rich (albic) horizon, which in turn overlies a brown to dark brown (spodic) horizon rich in amorphous combinations of organic matter, aluminum and iron. The geochemical problem in their genesis is to mobilise Fe and Al at the expense of Si to generate the albic horizon and then to precipitate both elements further down the profile to produce the spodic horizon.

Figure 16 shows an Eh-pH diagram with three isosolubility lines marking Eh/pH conditions in which the concentrations of each pair of Si, Al and Fe are equal. This divides the diagram into 6 segments each with its characteristic mobility sequence. To produce an albic horizon conditions of Eh and pH would need to fall in fields 1 and 2, and to produce the complementary spodic horizon below, would require a change to the environmental conditions of field 4.

In this form, the diagram could also be used to suggest that two geochemical classes of podzols should exist: one in which the vertical differentiation of the elements would be Si/Fe/Al (reading downwards) and a second with a vertical sequence Si/Al/Fe. The first
Figure 16: Mobility of Si, Al and Fe in terms of Eh and pH assuming solubility controlled by coarsely crystalline quartz, gibbsite and hematite. Presence of amorphous phases and organic ligands shifts the isosolubility point to lower Eh's and higher pH's.

would demand an Eh/pH evolution from field 2 to field 4, and the last would need a change from the conditions of field 1 to those of field 4.

Two things suggest however that the basic diagram needs modifying. These are (a) the acidity required by the model to mobilize Al and/or Fe at the expense of Si is higher than the generally accepted range in podzols, and (b) only one of the two geochemical types of podzol suggested, namely the Si/Fe/Al sequence appears to occur.

Modifications of the basic diagram are now being attempted in terms of (a) the nature of the phases that limit the concentrations of the various species in solution, (b) the degree of crystallinity of such phases, and (c) the presence of organic ligands in the aqueous phase.

W. Chesworth
Coastal Studies in Hudson /James Bay and North Shore of Lake Ontario

1. Hudson/James Bay

A comprehensive research project is being conducted in collaboration between the University of Guelph and the Department of the Environment along the Ontario coasts of Hudson/James Bay. Its major objectives are to establish a baseline data bank and reach a basic understanding of the evolution of the landscape, processes and biology of that remote virgin, emerging coast of a brackish inland, cold, arctic to sub-arctic sea (Figure 17). That coast has international importance as it contains breeding and staging grounds for much of the migratory avifauna of eastern America, and for a very important population of polar bears. Those habitats are continuously changing because of the fast rate of uplift of the coast, and human interference may generate unbearable stresses. The proposed development of lignite deposits along the Moose River and the predicted increased exploration for oil and gas in Hudson Bay, pose grave threats to the coastal environment, and the most sensitive areas must be identified and contingency plans made for their preservation.

Figure 17: Location map.

A five year research project (HBL Project) was initiated in 1977. The coast was systematically studied along representative transects from low tide mark to upper parts of marshes. Sediments, marsh soils, vegetation and infauna, particularly the concentration of Macoma balthica in intertidal zones were studied in detail. At the same time, observations and survey of shorebirds were made by personnel of the Canada Wildlife Service. The multidisciplinary approach of this study is illustrated in Figure 18.
Figure 18: Components of the James Bay multidisciplinary study.

The regional study of James Bay was completed in 1979, and detailed sedimentological and process oriented ecological studies on selected tidal flats, marshes and estuaries were initiated. The research project is scheduled to be completed in 1981 at which time a Symposium on Hudson/James Bay will be held at the University of Guelph (April 28-30, 1981) to try and integrate the coastal research with research done inland in Ontario, Quebec, Manitoba and Northwest Territories, and oceanographic work in the Bays.

I.P. Martini

2. Bowmanville-Scarborough Bluffs, Lake Ontario

Thick interlayered deposits of tills, glacio-fluvial and glacio-lacustrine sediments are exposed along the bluffs of the north shore of Lake Ontario between Toronto and Port Hope. They are eroded locally at a very fast rate, and considerable research has been done on the erosional processes and on the gross stratigraphy of the deposits. The objectives of the work are to establish a detailed stratigraphic framework for those materials, extending eastward the scheme Karro (1967) has established in the Scarborough area, and to reconstruct sedimentologically the events that lead to the emplacement and disruption of Great Lakes during Wisconsin and Holocene times.

To date, the stratigraphic framework has been established, and major exposures between Port Hope and Oshawa have been measured and sampled for detailed sedimentological work.

I.P. Martini, M. Brookfield, H. Gwinn (Dept. of Geography, Sherbrook, Quebec)
Hudson/James Bay
Symposium
University of Guelph
April 28-30, 1981

PURPOSE: To assess current knowledge and research on Hudson/James Bay and its hinterlands, to foster interdisciplinary discussion and to determine needs for future research.

Featuring lectures, poster sessions and informal discussions of general and specific interest on arctic and subarctic conditions.

Special presentations will be selected from abstracts submitted from the following disciplines:

- Biological Oceanography and Fisheries
- Limnology, Hydrology and Climatology
- Geology, Geomorphology, Coastal Sedimentology
- Physical and Chemical Oceanography
- Social Science
- Soils, Vegetation, Ecological Mapping
- Wildlife Biology

Refereed proceedings will be published.

Call for Papers: Papers on the above topics are invited. Abstracts (in English or French) of 300 words are required by November 1, 1980.

Accommodation: available in student residences or in local hotels/motels.

*For further information contact Dr. P. Morris, Department of Natural Sciences, University of Guelph, Guelph, Ontario, Canada  N1G 2W1, Telephone: (519) 824-4131.
Symposium
Hudson/James Bay

Name ____________________________
Address __________________________

☐ Please send further information.
☐ I plan to submit a paper; abstract to follow.
   Preliminary title: ____________________________
☐ I plan to prepare a poster session. (Indicate space required and preliminary title): ____________________________

☐ The following interdisciplinary/research topics are suggested for informal discussion: ____________________________

For further information on the Symposium on Scientific Studies on Hudson/James Bay please complete this form and return it to:
Dr. I. Peter Martini, Chairman
Symposium on Hudson/James Bay
Department of Land Resource Science
University of Guelph
Guelph, Ontario, Canada
N1G 2W1
Telephone: (519) 824-4120 ext. 2488

Symposium
Hudson/James Bay

Name ____________________________
Address __________________________

☐ Please send further information.
☐ I plan to submit a paper; abstract to follow.
   Preliminary title: ____________________________
☐ I plan to prepare a poster session. (Indicate space required and preliminary title): ____________________________

☐ The following interdisciplinary/research topics are suggested for informal discussion: ____________________________

For further information on the Symposium on Scientific Studies on Hudson/James Bay please complete this form and return it to:
Dr. I. Peter Martini, Chairman
Symposium on Hudson/James Bay
Department of Land Resource Science
University of Guelph
Guelph, Ontario, Canada
N1G 2W1
Telephone: (519) 824-4120 ext. 2488
Symposium on Scientific Studies on Hudson/James Bay - April 28, 29, 30 1981

The Symposium will focus on recent developments and current research in Hudson/James Bay. It will begin with a plenary address on April 28, 1981. Presentations by invited speakers will follow. Sessions will be scheduled covering various aspects such as:

- Biological Oceanography and Fisheries
- Limnology, Hydrology and Climatology
- Geology, Geomorphology, Coastal Sedimentology
- Physical and Chemical Oceanography
- Social Science
- Soils, Vegetation, Ecological Mapping

Ideas and submission of abstracts/papers are welcome. Deadline for 250-300 words abstracts is November 1, 1980, and for papers April 30, 1981. The papers will be refereed and published in special issues of a leading Canadian multidisciplinary journal.

For further information contact:

1. Peter Martini, Chairman
Hudson/James Bay Symposium
Department of Land Resource Science
University of Guelph
GUELPH, Ontario, Canada
N1G 2W1

(519) 824-4120, Ext. 2488
ACTIVE RESEARCH PROJECTS

SOIL SCIENCE

Soil Physical Chemistry

Factors affecting frost heaving of forage species. B.D. Kay.
Ontario Ministry of Agriculture and Food.

Quantitative characterization of heat, water and solute transport
in freezing soils. B.D. Kay.
Natural Sciences and Engineering Research Council, Inland Waters
Directorate of Environment Canada.

Study of freezing processes in soil columns using the dual
gamma sensing technique. B.D. Kay, P.H. Groenevelt.
Natural Sciences and Engineering Research Council.

Effect of envelope pressure on water flow in freezing soils.
P.H. Groenevelt, B.D. Kay.
Natural Sciences and Engineering Research Council.

Soil Physics

Natural Sciences and Engineering Research Council, Ontario
Ministry of Agriculture and Food.

Waste Disposal and Pollution Control

Ontario Lottery through the Ontario Ministry of Environment.

Agriculture and Water Quality

The movement of water and nutrients into the soil beneath
unlined manure storage ponds. M.H. Miller, J.B. Robinson,
J.G. Rowsell (Environmental Biology).
Ontario Ministry of Agriculture and Food and Agriculture Canada.

Surface movement of soil and nutrients as influenced by tillage
and stover management. J.W. Ketcheson, M.H. Miller.
Ontario Ministry of Agriculture and Food, Agriculture Canada.
Soil/Plant Relations

Reactions at the soil-root interface and their significance in plant nutrition. M.H. Miller.
Natural Sciences and Engineering Research Council.

Natural Sciences and Engineering Resource Council and Ontario Ministry of Agriculture and Food.


Characterization, identification, degradation and availability of phosphorus from organic phosphorus compounds in soil. R.L. Thomas.
Natural Sciences and Engineering Research Council.

Relationship of the complexing capacity of soil organic matter and the availability and measurement of metals in soils. R.L. Thomas.
Ontario Ministry of Agriculture and Food, Natural Sciences and Engineering Research Council.


Ontario Ministry of Agriculture and Food.


Ontario Ministry of Agriculture and Food.

Fertilizer use in the production of grass for esthetic purposes. R.W. Sheard.
Ontario Ministry of Agriculture and Food, Canadian Industries Ltd.


Ontario Ministry of Agriculture and Food, Imperial Oil Limited.

Surface movement of soil and nutrients as influenced by Cropping Practices. J.W. Ketcheson, B.D. Kay, M.H. Miller.

**Resources Inventory, Planning and Development**

Analysis of the characteristics of soil-plant systems which affect the backscattering coefficient of synthetic aperture radar systems. B. Brisco and R. Protz.
Agriculture Canada.

Genesis and Classification of selected soils from Sarawak, Malaysia. K.S. Loi and R. Protz.
Canadian International Development Agency.

Natural Sciences and Engineering Research Council of Canada.

Mineralogical and micropedological characterization of soils from active soil surveys in Ontario. R. Protz.
Ontario Ministry of Agriculture and Food.

Quantification of chemical and physical changes on individual mineral grains during soil genesis. R. Protz.
Natural Sciences and Engineering Research Council of Canada.

Quantification of soil structure. R. Protz.
Natural Sciences and Engineering Research Council of Canada.

Development of the methodology for examining the macro- and micromorphology of soil and the relation to plant roots to soil structure. R. Protz.
Natural Sciences and Engineering Research Council of Canada.

Ontario Ministry of Natural Resources, Industrial Minerals.

Investigation of the soil moisture regimes of some fine clayey soils of the Haldimand-Norfolk Region, Ontario. G.T. Patterson and E.E. Mackintosh.
Ontario Ministry of Agriculture and Food.

Phenolic acids and podzolization. L.J. Evans.
Natural Sciences and Engineering Research Council.
Ontario Ministry of Natural Resources.

Survey of environmentally sensitive areas on Manitoulin Island.
S.G. Hilts.
Federation of Ontario Naturalists.

Survey of natural areas in Middlesex County. S.G. Hilts.
Manpower and Immigration Canada.

McLean Foundation.

Development of an agricultural land productivity model for Ontario.
M.H. Miller, D.M. Brown, E.E. Mackintosh, R. McBride, T.P. Phillips (School of Ag. Econ. and Ext. Ed.) and B.E. Smit (Dept. of Geog.)
Agriculture Canada and Ontario Ministry of Agriculture and Food.

AGROMETEOROLOGY

Effect of climate on field crop production potential. D.M. Brown
and other O.M.A.F. and University personnel.
Ontario Ministry of Agriculture and Food.

Atmospheric Environment Service and O.M.A.F.

Observation, compilation and analysis of current and past weather records. D.M. Brown, T.J. Gillespie, K.M. King.
Ontario Ministry of Agriculture and Food.

Agriculture Canada and Ontario Ministry of Agriculture and Food.

Meteorological aspects of integrated pest control. T.J. Gillespie, J.C. Sutton (Environmental Biology).
Ontario Ministry of Agriculture and Food, Ontario Ministry of Environment.

Study on the potential air pollution damage to primary producers in Arctic and sub-Arctic environments. T.J. Gillespie.
Atmospheric Environment Service.
The effects of water potential on stomatal and internal plant diffusive resistances for water vapour and carbon dioxide. G.W. Thurtell.
Natural Sciences and Engineering Research Council.

Plant water status as related to crop productivity and crop production. G.W. Thurtell, L.A. Hunt (Crop Science).
Ontario Ministry of Agriculture and Food, National Research Council, Atmospheric Environment Service.

Soil-plant water relationships. G.W. Thurtell.
Agriculture Canada.

Turbulent transport processes above terrestrial surfaces and within plant canopies. G.W. Thurtell.
Atmospheric Environment Service.

Water potential and water movement in the soil-plant atmosphere system. G.W. Thurtell.
Natural Sciences and Engineering Research Council.

GEOLOGY

The chemical weathering of igneous rocks - a theoretical, experimental and field approach. W. Chesworth.
Natural Sciences and Engineering Research Council.

Mineral-equilibria in the system SiO2-Al2O3-Fe2O3-K2O-MgO-H2O applied to soils. W. Chesworth.
Natural Sciences and Engineering Research Council.

Natural Sciences and Engineering Research Council.

Geomorphology and sedimentology of the Ontario coast of Hudson/ James Bay. I.P. Martini.
Natural Sciences and Engineering Research Council.

Sedimentology and weathering of Pleistocene and modern lacustrine and fluvial sediments. I.P. Martini.
Natural Sciences and Engineering Research Council.

Geomorphological sedimentological and pedological studies in the coastal zone of the Hudson Bay Lowlands. I.P. Martini and R. Protz.
C.S.W., Fisheries and Environment.
Evolution of recent and ancient sand seas; presently of El Gran Desierto, Mexico. M.E. Brookfield.
Natural Sciences and Engineering Research Council.

Palaeoenvironments of the Middle Ordovician carbonates of southern Ontario. M.E. Brookfield.
Natural Sciences and Engineering Research Council.

Radiometric dating of rocks across the Indus suture zone, India and Pakistan. M.E. Brookfield (co-ordinator) with Universities of Toronto, McMaster, Dalhousie and Lahore (Pakistan) and Wadia Institute of Himalayan Geology (India).
Funded by various sources by the participants. Brookfield - Natural Sciences and Engineering Research Council.

Stratigraphy, palaeontology and tectonics of the mesozoic rocks of the Coast and Cascade Ranges, British Columbia. M.E. Brookfield.
Natural Sciences and Engineering Research Council.

Stratigraphy and sedimentology of the Pleistocene deposits between Oshawa and Port Hope, Ontario. M.E. Brookfield, J.P. Martini and Sherbrooke University.
Natural Sciences and Engineering Research Council.
## UNDERGRADUATE EDUCATION

Table 20: Diploma and undergraduate courses presented during 1979/80.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course</th>
<th>Enrollment</th>
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<td>87-010</td>
<td>Principles of Soil Science</td>
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<tr>
<td>87-011</td>
<td>Soil Management for Crop Production</td>
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<td>87-020</td>
<td>Land Use and Environmental Quality</td>
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<td><strong>Degree</strong></td>
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<tr>
<td>46-100</td>
<td>Principles of Geology</td>
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<td>46-202</td>
<td>Stratigraphy</td>
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<td>46-203</td>
<td>Paleontology</td>
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<td>46-205</td>
<td>Glacial Geology</td>
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<td>46-209</td>
<td>Structure and Tectonics</td>
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<td>Mineralogy</td>
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<td>46-307</td>
<td>Petrography</td>
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<td>Geology Field Camp</td>
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<td>Petrology</td>
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<td>Sedimentology</td>
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<td>64-303</td>
<td>Meteorology and Climatology</td>
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<td>64-304</td>
<td>Meteorology and Climatology</td>
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<td>64-315</td>
<td>Microclimatic Measurement</td>
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<td>64-403</td>
<td>Agrometeorology</td>
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<td>64-405</td>
<td>Microclimatology</td>
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<td>87-200</td>
<td>Soil Science</td>
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<td>87-201</td>
<td>Soil in Planned Environments</td>
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<td>87-302</td>
<td>Soil Classification</td>
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<td>87-305</td>
<td>Land Utilization</td>
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<td>87-310</td>
<td>Resources Management I</td>
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<td>87-320</td>
<td>Waste Management and Land Reclamation</td>
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<td>87-350</td>
<td>Land and Water Use in Tropical Countries</td>
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<td>87-401</td>
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<td>87-405</td>
<td>Soil Management</td>
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<tr>
<td>87-406</td>
<td>Problems in Land Resource Science I</td>
<td>7</td>
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<tr>
<td>87-407</td>
<td>Problems in Land Resource Science II</td>
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<tr>
<td>87-408</td>
<td>Environmental Quality</td>
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<tr>
<td>87-410</td>
<td>Soil Plant Relationships</td>
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<td>87-415</td>
<td>Resources Management II</td>
<td>18</td>
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<table>
<thead>
<tr>
<th>Name</th>
<th>Home Town</th>
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<tbody>
<tr>
<td><strong>Soil Science Majors</strong></td>
<td></td>
</tr>
<tr>
<td>John Laughlin Cruickshank</td>
<td>Truro, Nova Scotia</td>
</tr>
<tr>
<td>Cameron Douglas Grant</td>
<td>Hampton, Ontario</td>
</tr>
<tr>
<td>Chee Chow Lee</td>
<td>Guelph, Ontario</td>
</tr>
<tr>
<td>Judith Barbara McConney</td>
<td>Barrie, Ontario</td>
</tr>
<tr>
<td>Donald Keith Reid</td>
<td>Chesley, Ontario</td>
</tr>
<tr>
<td>Edward P. Taylor</td>
<td>Ottawa, Ontario</td>
</tr>
<tr>
<td>Carl James Warren</td>
<td>Englehart, Ontario</td>
</tr>
<tr>
<td>Stephen Jeffrey Bird</td>
<td>Burlington, Ontario</td>
</tr>
<tr>
<td>Marie Antoinette Danielle Villeneuve</td>
<td>St. Aylmer, Quebec</td>
</tr>
<tr>
<td><strong>Resource Management Majors</strong></td>
<td></td>
</tr>
<tr>
<td>William Alfred James Allison</td>
<td>Georgetown, Ontario</td>
</tr>
<tr>
<td>Elizabeth Moira Cairns</td>
<td>Winnipeg, Manitoba</td>
</tr>
<tr>
<td>Laura Mary Anne Cole</td>
<td>Ottawa, Ontario</td>
</tr>
<tr>
<td>Andrew Francis Graham</td>
<td>Cobourg, Ontario</td>
</tr>
<tr>
<td>Michael Gary McLelan</td>
<td>Surrey, B.C.</td>
</tr>
<tr>
<td>Janet Elizabeth Mews</td>
<td>Willowdale, Ontario</td>
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<tr>
<td>Beverley Jean Olsen</td>
<td>Scarborough, Ontario</td>
</tr>
<tr>
<td>Peter Gerald Prier</td>
<td>Guelph, Ontario</td>
</tr>
<tr>
<td>Maria Johanna Vanden Heuvel</td>
<td>Stratford, Ontario</td>
</tr>
<tr>
<td>Anthony Frank Camisso</td>
<td>Collingwood, Ontario</td>
</tr>
<tr>
<td>Terrence Findlay Hood</td>
<td>Owen Sound, Ontario</td>
</tr>
<tr>
<td>John Gary Lindblad</td>
<td>Rockwood, Ontario</td>
</tr>
<tr>
<td>Christopher James Pharo</td>
<td>St. John, New Brunswick</td>
</tr>
<tr>
<td>Anthony Aurel Vadlja</td>
<td>Mississauga, Ontario</td>
</tr>
<tr>
<td><strong>Earth Science Majors</strong></td>
<td></td>
</tr>
<tr>
<td>Calvin Chan</td>
<td>Guelph, Ontario</td>
</tr>
<tr>
<td>Roger Fife</td>
<td>Indian River, Ontario</td>
</tr>
<tr>
<td>Ross Kelly</td>
<td>Rodney, Ontario</td>
</tr>
</tbody>
</table>
Table 22: Graduate students and supervisors – Winter Semester, 1980.

<table>
<thead>
<tr>
<th>M.Sc. Students</th>
<th>Supervisor</th>
<th>Ph.D. Students</th>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Science Program</strong></td>
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<td></td>
<td></td>
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<tr>
<td>B.G. Brisco</td>
<td>R. Protz</td>
<td></td>
<td></td>
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<tr>
<td>V.J. Bulman</td>
<td>J.W. Ketcheson</td>
<td></td>
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<tr>
<td>D.L. Burton</td>
<td>E.G. Beauchamp</td>
<td></td>
<td></td>
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<tr>
<td>B.H. Cameron</td>
<td>L.J. Evans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K.E. Clarke</td>
<td>I.P. Martini</td>
<td></td>
<td></td>
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<tr>
<td>D.R. Doram</td>
<td>L.J. Evans</td>
<td></td>
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<tr>
<td>W.K. Elrick</td>
<td>J.W. Ketcheson</td>
<td></td>
<td></td>
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<tr>
<td>D.F. Grinham</td>
<td>I.P. Martini</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.A. King</td>
<td>I.P. Martini</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K.S. Loi</td>
<td>R. Protz</td>
<td></td>
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<tr>
<td>R.A. McBride</td>
<td>E.E. Mackintosh</td>
<td></td>
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<td>T.L. Honks</td>
<td>E.G. Beauchamp</td>
<td></td>
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<tr>
<td>P.A. Nelson</td>
<td>M.H. Miller</td>
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<td>M.J. Robin</td>
<td>D.E. Elrick</td>
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<tr>
<td>L.E. Smith</td>
<td>B.D. Kay</td>
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<td></td>
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<tr>
<td>J.M. White</td>
<td>J.W. Ketcheson</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.E. Worthy</td>
<td>E.E. Mackintosh</td>
<td></td>
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<tr>
<td><strong>Agrometeorology Program</strong></td>
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<td></td>
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<tr>
<td>D.J. Day</td>
<td>K.M. King</td>
<td>B.D. Amiro</td>
<td>T.J. Gillespie</td>
</tr>
<tr>
<td>P.A. Dzikowski</td>
<td>T.J. Gillespie</td>
<td>B.V. Grace</td>
<td>T.J. Gillespie</td>
</tr>
<tr>
<td>S. Foong</td>
<td>D.M. Brown</td>
<td>M.J. Pedro</td>
<td>T.J. Gillespie</td>
</tr>
<tr>
<td>M. Leclerc</td>
<td>T.J. Gillespie</td>
<td>W.G. Pierce</td>
<td>G.W. Thurtell</td>
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<td>N.J. Livingston</td>
<td>G.W. Thurtell</td>
<td>J.I. Walker</td>
<td>G.W. Thurtell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J.D. Wilson</td>
<td>G.W. Thurtell</td>
</tr>
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</table>
Table 23: Graduate degrees conferred October, 1979, February and June, 1980.

<table>
<thead>
<tr>
<th>Student</th>
<th>Degree</th>
<th>Supervisor</th>
<th>Thesis Title</th>
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<tbody>
<tr>
<td><strong>Soil Science Program</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>V.K. Bhatnagar</td>
<td>Ph.D.</td>
<td>M.H. Miller</td>
<td>Mechanisms responsible for differences in P enrichment of eroded sediment with additions of manure or fertilizer P.</td>
</tr>
<tr>
<td>C.A. Fox</td>
<td>Ph.D.</td>
<td>R. Protz</td>
<td>The soil micro-morphology of turbic cryosols from the MacKenzie River Valley and Yukon Coastal Plain.</td>
</tr>
<tr>
<td><strong>Agrometeorology Program</strong></td>
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<td></td>
<td></td>
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<tr>
<td>M.M. Abdul-Ghani</td>
<td>M.Sc.</td>
<td>D.M. Brown</td>
<td>Estimation of daily soil heat flux during the spring season in a perennial forage crop from climatological data.</td>
</tr>
<tr>
<td>O. Brunini</td>
<td>Ph.D.</td>
<td>G.W. Thurtell</td>
<td>New devices for in situ measurements of soil and root water potentials and transport of water in the soil-plant system.</td>
</tr>
<tr>
<td>P.A. Dzikowski</td>
<td>M.Sc.</td>
<td>T.J. Gillespie</td>
<td>The use of weather information to time fungicide applications for control of Botrytis onion leaf blight.</td>
</tr>
</tbody>
</table>
DEPARTMENTAL SEMINARS

I. Brooks, Department of Geography, York University, Toronto.  
Aspects of glacial history of Newfoundland.

J.S. Campbell, Safety Officer, University of Guelph.  
The new occupational health and safety act.

J.D. Colwell, C.S.I.R.O., Australia.  
Considerations in modelling for fertilizer use.

D.E. Elrick, Department of Land Resource Science, University of Guelph.  
Hydrodynamic dispersion during transient water flow in soils.

T.J. Gillespie, Department of Land Resource Science, University of Guelph.  
Weather input to pest management programs.

W. Glooschenko, National Water Research Institute, C.C.I.W., Burlington.  
Pollutant geochemistry of a Lake Ontario shoreline marsh.

P.H. Groenevelt, Department of Land Resource Science, University of Guelph.  
What are fertilizers and salts doing in the soil water?  
Disperse of diffuse?

S.G. Hilts, Department of Land Resource Science, University of Guelph.  
Designating environmentally sensitive areas: an approach to rural planning.

G. Jackson, Assistant Director, Food Land Development Branch, Ontario Ministry of Agriculture and Food.  
The forest agricultural resource inventory in Eastern Ontario (Farineo).

D. Keeney, Department of Soil Science, University of Wisconsin.  
Nitrogen in relation to pollution and agronomic production.

H. Kuipers, Tillage Laboratory, Wageningen, The Netherlands.  
Aims of tillage.  
Tillage research - motivation and management.  
Tillage practices in Western Europe.

P.F. Low, Department of Agronomy, Purdue University, Indiana.  
Properties of water in colloidal systems and porous media.
E.E. Mackintosh, Department of Land Resource Science, University of Guelph. 
Land reclamation in Britain and Germany.

N.R. Richards, Department of Land Resource Science, University of Guelph. 
Suggested strategy for research related to land.

E.J. Thompson, Dean of Agriculture, University of Ghana. 
Agricultural problems in Ghana.

P.B. Tinker, Head, Department of Soils and Plant Nutrition, Rothamsted Experimental Station. 
Developments in root-soil relations.

WORKSHOPS

Student Seminar on Urban Resource Management, organized by S.G. Hilts, 
Land Resource Science.

Agrometeorology Workshop on Climatic Variability and Cold Damage to Peaches and Grapes at the Horticultural Research Institute of Ontario, Vineland, organized by D.M. Brown and W.D. Wyllie (A.E.S., Ontario Region).

Agricultural Sector Workshop of the Canadian Climate Program, organized by Agriculture Canada and Atmospheric Environment Service and held in Ottawa. D.M. Brown and K.M. King participated.

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W. Bond, Division of Environmental Mechanics, C.S.I.R.O., Canberra City, A.C.T., Australia.

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H. Kuipers, Tillage Laboratory, Wageningen, The Netherlands.

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J. Ritchie, Blacklands Experimental Station, Temple, Texas.

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A. Sinclair, Invermay Agricultural Research Centre, Mosgiel, New Zealand.
E.J. Thompson, Dean of Agriculture, University of Ghana.

SOURCES OF RESEARCH FUNDS

Federal Government Granting Council

NSERC

Federal Government Departments

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Energy Mines and Resources
Environment

Ontario Government Ministries

Agriculture and Food
Environment
Natural Resources

Other

Canadian Industries Ltd.
Canadian Turfgrass Research Foundation
Imperial Oil Ltd.
The Fertilizer Institute of Ontario
Wine Council of Ontario
INTRODUCTION

The Ontario Institute of Pedology officially became established three years ago to coordinate activities involving soil resource inventories and research in soil genesis, morphology, classification, characterization and interpretation of the soils of Ontario. The cooperating agencies include the University of Guelph, Department of Land Resource Science; Agriculture Canada, Land Resource Research Institute; and the Ontario Ministry of Agriculture and Food, Food Land Development Branch. The "Institute" is based at the University of Guelph, Ontario.

The program of inventory and research carried on by the Institute is intended to provide the necessary data on the soil and land resources of the province to assist in decision-making on the use of these resources. Inventory projects are being undertaken to provide more detailed and accurate information on the characteristics and distribution of the soil resources. Research conducted by Institute personnel is supportive of the inventory program, and assists in the understanding and use made of soil resource information. A coordinated program in these areas, through the Institute, is seen as a means of keeping pace with ever-increasing demands for more and varied information on the provinces land resources.
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Clerical/Technical Staff*

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T. McCarrick - Technician Resigned 1979
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A. McLennan - Cartographer (Ext. 3364)
C. Miller - Technician (Ext. 8175)
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*Supported through OMAF Programs 39 and 67
SOIL RESOURCE INVENTORY

INVENTORY PROJECTS

Soil inventory projects are presently underway in areas of the province where the existing soils information is not adequate to meet the demands imposed by competitive or intensive uses of land, or in areas which previously did not have information on the soil resources. Summaries of the activities and status of the various inventory projects are outlined in Table 1. The counties and regions of Ontario in which inventories are currently underway are indicated in Figure 1.

Figure 1: Ontario soil maps and reports in preparation (1979)
SOIL MAP REPRINTING

The program of reprinting out-of-print soil maps is progressing favourably, such that colored soil maps of many counties are again available. Maps for the counties of Essex, Kent, Elgin, Welland, Durham, Peel, Simcoe and Prince Edward have been reproduced using photographic techniques. For a selected group of other counties, representing those having more recent soil information, reprinting is being carried out on up-dated base maps. The maps are being re-drawn and the soil survey information digitized (stored in the soil data bank), which enables the computer generation of interpretive maps for the county. The counties which have already been re-printed using this approach, and those to follow are given below.

York - completed  
Glengarry - completed  
Perth - completed  
Huron - completed  
Lambton - completed  
Ontario - anticipated completion 1980  
Prince Edward - anticipated completion 1981

Grey - anticipated completion 1980  
Bruce - anticipated completion 1980  
Essex - anticipated completion 1981  
Simcoe - anticipated completion 1981  
Peel - anticipated completion 1981

On completion of map re-printing, the county soil maps again will be available through the Information Branch, Ministry of Agriculture and Food, Queen's Park, Toronto.

<table>
<thead>
<tr>
<th>Projects</th>
<th>Scale</th>
<th>Status in 1979</th>
<th>Anticipated Publication Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soils, Capability and Land Use in the Ottawa Urban Fringe</td>
<td>1:25,000</td>
<td>In process of printing.</td>
<td>1980</td>
</tr>
<tr>
<td>Peterborough County</td>
<td>1:63,360</td>
<td>Soil maps printed.</td>
<td>1980</td>
</tr>
<tr>
<td>Regional Municipality of Waterloo</td>
<td>1:20,000</td>
<td>Cartographic preparation of soil map of Beverly Township completed and printing in progress.</td>
<td>1980</td>
</tr>
<tr>
<td>Thunder Bay Map Sheet (52A)</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Soil map in preparation in Cartography Unit, Ottawa (digitizing completed); manuscript soils report completed.</td>
<td>1981</td>
</tr>
<tr>
<td>Timmins-Miranda Rouyn Map Sheet (52B, 52C)</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Soil maps printed; soils report nearly completed.</td>
<td>1981</td>
</tr>
<tr>
<td>Sault Ste. Marie-Bed River Map Sheets (432, 436)</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Field mapping completed; eight preliminary soil maps prepared for portions of the region in which mapping completed.</td>
<td>1982-83</td>
</tr>
<tr>
<td>Sudbury Map Sheet (441)</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Field mapping continued, bringing region to 92% completion. Preliminary soil maps prepared for 2 areas in which mapping completed.</td>
<td>1983</td>
</tr>
<tr>
<td>Brant County</td>
<td>1:25,000</td>
<td>Compilation of soils information on photo-mosaic base continued; first draft of soils report nearly completed.</td>
<td>1981</td>
</tr>
<tr>
<td>Middlesex County</td>
<td>1:50,000</td>
<td>Editing of photomosaic continued; preperation of the soils report in progress.</td>
<td>1982</td>
</tr>
<tr>
<td>Regional Municipality of London-Huron</td>
<td>1:25,000</td>
<td>Field mapping completed. Eight preliminary soil maps prepared for portions of the region in which mapping completed.</td>
<td>1982-83</td>
</tr>
<tr>
<td>Regional Municipality of Ottawa-Carleton</td>
<td>1:50,000</td>
<td>Field mapping continued, bringing region to 92% completion. Preliminary soil maps prepared for 2 areas in which mapping completed.</td>
<td>1983</td>
</tr>
<tr>
<td>Cochrane-Kapuskasing Map Sheets (42W, 42Q)</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Field mapping and first draft of soils report completed.</td>
<td>1983</td>
</tr>
<tr>
<td>Dryden (52E), Kenora (52F), International Falls (52H), Rainy River (520) map sheets</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Field mapping and manuscript soils completed; extended legends in preparation.</td>
<td>1981</td>
</tr>
<tr>
<td>North Bay (51A), Ville Marie (51B) and Moosonee (51F) map sheets</td>
<td>1:50,000 &amp; 1:250,000</td>
<td>Field mapping completed.</td>
<td>1981</td>
</tr>
</tbody>
</table>

Table 1: Status of active soil survey projects in Ontario.
Ontario Soils and Canada Soil Information System (CanSIS)

All Soil Data File information for Ontario in CanSIS was re-evaluated in 1979. Many of the early records were encoded from existing soil survey reports and lacked analytical data to support their classification. These records were deleted from the CanSIS file.

At present, CanSIS contains approximately 300 records with full descriptive and analytical data on Ontario soils. It is anticipated that between 200 - 250 detailed records will be added during 1980.

The Daily Field Sheet was modified to make it computer compatible with the analytical data file. This form will be used as the major tool for routine data collection during soil surveys.

The CanSIS Names File is a listing of all soil series in Canada. It gives the classification status at the subgroup level and a unique three letter code for each soil series. During 1979 - 80 the Names File for Ontario was checked and any errors or discrepancies were listed. These errors are being corrected.

As of April 1980, 12 soil maps for Ontario have been digitized and can be used for the production of derived or interpretive maps. These include maps for Peterborough, York, Ontario, Huron and Lambton counties, and for the townships of Nepean, Gloucester in the R.M. of Ottawa-Carleton and Beverly in Waterloo County. In addition, 35 other Ontario soil maps are presently being digitized.

A unique symbol list for each digitized soil map is routinely coded by O.I.P. staff for the production of soil capability for agriculture maps. Other interpretive maps also can be prepared on request.

In order to make interpretive maps more easily available to users, CanSIS has developed a computerized extended legend file. The development of extended legends for digitized soil maps is the CanSIS alternative to a partial symbol retrieval. This alternative to computerized decoding of map symbols (partial symbol retrieval) simply codes the interpretive information from the map symbol and other sources into an interpretive table in fixed format. The extended legend contains properties which are present as part of the map symbol and specifies many of the characteristics which are implied in the symbol. The extended legend also classifies the map symbol for many standard interpretations. The extended legend, when finalized and hooked into the cartographic file, will make interpretive map retrievals relatively simple, and available to users without having to contact the soil surveyor responsible for the original map preparation. The technique should also ensure that consistent, accurate interpretations are achieved.

The O.I.P. is in the process of developing the extended legend format for use with Ontario soil maps.
RESEARCH PROJECTS

Soil Moisture Regimes of Some Fine Textured Soils of the Haldimand-Norfolk Region

Problems in the classification of fine textured soils of the region have been recognized where strict interpretation of mottling characteristics of some soils has led to drainage and Taxonomic classification which is inconsistent with the landscape.

Two sequences of soils of the Haldimand catena were studied; one under forage crops and the other in a stand of mature, native mixed hardwoods. Intact core samples were collected to determine water retention characteristics, hydraulic conductivity and to study the micromorphology of pores, mottles, etc. Samples also were taken for determination of particle size, PH, CaCO₃ equivalent, organic matter, clay-size mineralogy and extractable iron and aluminum.

Preliminary results indicate that the moisture content of the upper solum responds quickly to rainfall or snowmelt events. However, the zone below approximately 60 cm appears to be rarely, if ever, saturated even in lower slope positions. Results from water retention parameters are generally corroborated by apparent water table measurements made in tube wells. The study is continuing.

G.T. Patterson
B.K. Hohner

Micromorphological Investigation of Mottling Characteristics of Soils Developed on Fluvial Sands, Haldimand-Norfolk Region

Determination of the drainage class of soils on coarse textured materials presents problems as a consequence of difficulties in distinguishing mottles from the usual heterogeneous matrix colours of these soils. Intact samples were collected from 11 soil profiles in the region and prepared for micromorphological analysis. Preliminary study of the thin-sections has commenced. Micromorphological analysis will be continued on existing profiles, and further sampling is anticipated.

M. N. Langman
Variation in Soil Fertility Level in Soils of the Haldimand-Norfolk Region

Knowledge of the variability of properties of field soils is necessary in designing sampling programs. Therefore, some method of estimating the amount of variability present in various soils is essential. This study was designed to investigate sampling intensities required for accurate soil tests involving Mg, P, K, and pH. Surface soils developed from three different parent materials were sampled to determine if variability of fertility levels was related to soil type. No significant differences were found between different parent materials, or between different drainage classes on similar materials. P and K levels, however, appear to be log-normally distributed, so that there is a positive correlation between the variance and the mean. This suggests that, for acceptable accuracy, more intensive sampling will be necessary where fertility levels are very high.

D.K. Reid
G.T. Patterson

Investigation of Surficial Ground Water Properties of Soil

In areas of active soil surveys, studies have been initiated to characterize surficial groundwater properties of soils. Stand-pipes have been installed at 24 sites in the Haldimand-Norfolk region representing the major soil parent material groups. Measurement of water table levels are made at two week intervals throughout the spring and summer seasons, decreasing to once every three to four weeks during the fall and winter seasons. Most sites are situated on farms where precipitation also is being recorded.

This project is continuing in order to provide data on the response of soil water table levels to precipitation for a period of at least five years duration. Similar studies will be carried out in other regions of the province in the course of soil inventory projects in these areas.

E.W. Presant
B.K. Hohner
Agricultural Sources of Stream Sediment Loads

A detailed study regarding areas that contribute sediment into the streams of two small agricultural watersheds in Canada has revealed that these areas may be expected to (i) constitute a relatively small percentage of the total watershed area, (ii) be highly variable from season to season, year to year, and basin to basin, and (iii) be in close proximity to streams. The sediment contributing area during high basin moisture spring conditions is essentially equivalent to the run-off contributing area. Areas contributing run-off during low moisture conditions in the spring and fall are considered to be potential rather than active sediment producing areas. High sediment producing areas are located close to stream channels, but the distribution and significance of sediment producing categories and their location varies from basin to basin. Management strategies for controlling sediment production in agricultural areas should therefore be closely linked to a consideration of sediment source areas and their variability in time and space.

G.J. Wall

Forest Ecosystem Classification

An ecological forest site classification program for the Northern Clay Belt, Site Region 3E was initiated during the summer of 1979. With the support and guidance of the Ministry of Natural Resources Northern Region, the program has the following objectives:

1. To develop an ecological classification of forest ecosystems (both disturbed and undisturbed) with an emphasis on the commercial forest.

2. To provide an initial interpretation and evaluation of the ecosystem types for forest (land) management purposes.

3. To develop practical aids to identifying, recognizing and mapping the ecosystem types both on the ground and on large scale aerial photographs.

Due to limited time and manpower, the following strategy for the 1979 field program was adopted:

1. Field work should concentrate on meeting the first objective through a series of "approximation" with possibly the 1st approximation by the spring of 1980.

2. Field work would be conducted in Site Region 3E, Clay Belt, mainly in the Kapuskasing and Cochrane Districts and that district foresters and technicians should be encouraged to participate when time permits.
3. Sampling would focus on relatively undisturbed forest stands close to road access.

4. The data collected at each site should include a description of the site, the vegetation, the forest floor, the soil, stand age and height and the natural regeneration.

A total of 54 sites were studied, about an equal number in each district. The minimum data for each site included a complete species list, a short soil description (horizons, parent material texture, organic matter decomposition, forest floor, depth of rooting, drainage/moisture regime soil classification) and basic site parameters (slope, aspect, landscape position and configuration). The detailed plot descriptions (43 sites) also included species cover and species distribution estimates stratified by layer; detailed soil descriptions and profile sampling; water samples on wet sites; stand heights, ages, basal area, and a detailed regeneration assessment using 2 x 2 m quadrats.

From preliminary studies conceptual landscape models have been developed to demonstrate the landform, terrain/soil, hydrologic and vegetation relationships. The ecosystem models have been presented to field staff and their use in forest management interpretation demonstrated.

Investigation of additional sites will be undertaken in the region to further develop the classification system for the Boreal forests of the Clay Belt.

R.K. Jones

Collation of Historic and Current Soil Resource, Soil Productivity, and Soil Management in Ontario

The objective of this project is to provide a computerized data base for assessing soil-productivity-management-climate relationships for the major crops and crop producing areas of Ontario. This data will be beneficial for improving soil interpretations for agronomic uses, for determining climate-productivity relationships, and for land evaluation studies.

The initial work under this contract investigated the sources of crop performance data in Ontario. Crop variety evaluation trials performed by federal and provincial government research agencies, and variety trials conducted by the various seed companies in Southern Ontario were identified as being the most useful and accessible sources of data for the purpose of the P/M File. Historic crop trial data also was collected at this time.
In a second phase of the study the objectives were:

1. to obtain complete documentation for crop trials as they were being conducted;

2. to classify the soil at the series level for as many trials as possible, and obtain the specific location of those trials not visited;

3. to complete more fully the documentation of the historic crop trial data already collected in terms of classifying the soil and obtaining more soil/crop management information.

Data from 451 well documented crop trial plots have been collated to date. The majority of these crop trials are replicated variety trials, although a number of soil/crop management trials are also represented. The crop types included are: Wheat, Oats, Barley, Winter Wheat, Winter Barley, Corn, Soybeans, Whitebeans, Fababean, Flax, Lentils, Lupines, Mustard, and Rapeseed. The parameters recorded for the majority of the trials collated are: plot location, site description, soil classification, soil test data, previous crop, past management, fertilizer applications, herbicide applications, insecticide applications, fungicide applications, tillage practices, soil amendments, experimental design, nearest Atmospheric Environment Service weather station, planting date, harvest date, crop damage, and yield and quality data.

Information from over one-half of the crop trials have been coded onto the Performance/Management file Input forms, and keypunching commenced. This phase of the project is continuing.

R. Purdon

Use of Ontario Soil Survey Reports by Selected User Groups

A study was conducted as a graduate program in the School of Agricultural Economics and Extension Education, University of Guelph, to assess some of the information needs and preferences of soil survey report users. Relationships between these needs and preferences, and selected personal characteristics of users were also investigated.

Two hundred and twenty-nine questionnaires were sent to staff of three Branches (Extension, Food Land Development, and Soils and Crops) of the Ontario Ministry of Agriculture and Food during November, 1978. A total of 195 personnel responded (yielding an 85 per cent response rate).

The majority of the respondents indicated that, in general, they were moderately satisfied with Ontario Soil Survey Reports. When
asked to indicate why they felt this level of satisfaction or dissatisfaction, 23 per cent expressed a need for larger-scale and more accurate maps. Advising land buyers and real estate agents was listed most frequently as the major reason for using soil survey reports.

In general, the desirability of additional help (e.g., workshops, training sessions, etc.) to improve one's understanding of soil survey information was quite evident. The area indicated most frequently by respondents as requiring particular attention in a soils workshop was that of soil survey methods and the resultant reliability and variability of the soils map.

The respondents as a group rated (1) "capability for agriculture" as the most important information category. This was followed (in decreasing importance) by (2) "internal drainage", (3) "soil productivity", (4) "soil texture", (5) "susceptibility to erosion", (6) "surface stones", (7) "crop adaptability ratings", (8) "soil management", (9) "depth to bedrock", (10) "agrometeorology", (11) "soil engineering properties", (12) "soil waste disposal properties", and (13) "bedrock geology". In general, the respondents with a greater number of soils courses tended to rate these information categories at a higher level of importance than those with fewer courses.

The concept of a single purpose interpretive map was only slightly favoured over the presently used soil map. A higher proportion of respondents who strongly favoured interpretive maps also considered additional help in understanding soil survey information extremely desirable.

The most frequently recommended changes were: firstly, to make the reports more available, and secondly, to produce larger-scale more accurate maps.

M.D. McKnight
C.J. Blackburn
C.J. Acton
Pedological Studies on the James Bay Coastal Zone

The soils of the James Bay Lowlands have not been systematically studied in the past. Present interest in the Lowlands is due to the; (a) possibility of exploration for natural gas and uranium, (b) coal mining and forestry activities in the headwaters of rivers flowing into the Bay, and (3) the use of peat as fuel. Each of these activities could have deleterious effects on the coastal soils which could influence the fauna of the Lowlands.

This systematic study of the soils was undertaken to collect baseline data and subsequently to understand the key soil formation processes. Specifically the objective is to characterise the major soil types in the Lowlands and determine the genetic processes occurring in these young soils.

Soils were sampled along surveyed transects from within all the major vegetative zones of each of the major geomorphological land units on the James Bay Coast. Inland sampling sites were not on surveyed transects but all sites were located on aerial photographs. Inland sites were chosen to cover the range of vegetative types.

All sites were extensively photographed and catalogued for future reference.

Bulk samples were taken to characterize the horizination and the parent material variations. Undisturbed samples were taken from most soil profiles for subsequent micropedological studies. Quadruplicate bulk density samples were taken of most of the major horizons.

Soil temperature measurements were made at 1 meter above the soil surface and at the 1, 5, 20, 50 centimeter depths in most soil profiles at the time of sampling.

Thus during the last four field seasons 141 soil profiles have been sampled from the James Bay Lowlands. These are grouped by landform and/or parent material in Table 2. In addition to these

Table 2: Numbers of soil profiles sampled for detailed studies from various landforms and/or parent materials.

<table>
<thead>
<tr>
<th>Year</th>
<th>Beach Ridges (Regosols + Podzols)</th>
<th>Inter-ridge Swales (Regosols + Gleysoils)</th>
<th>River Banks (Regosols)</th>
<th>Peat Areas (Organic soils)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>6</td>
<td>20</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1977</td>
<td>13</td>
<td>26</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1978</td>
<td>6</td>
<td>21</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1979</td>
<td>11</td>
<td>20</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Totals</td>
<td>36</td>
<td>87</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
several soil samples have been collected for special studies.

The following laboratory determinations were made on most of the soil samples; (a) particle size distribution, (b) organic matter content, (c) pH, (d) CaCO₃ equivalent, (e) Na-pyrophosphate extractable Fe and Al and (f) electrical conductivity. Clay mineralogy was determined on at least one soil profile per transect. Soil test P, K, Ca and Mg were determined on selected horizons of most soil profiles. Total elemental Si, Al, Fe, Mn, Ti, Ca, Mg, Na, K, P and S have been determined on selected horizons of most soil profiles. Thin sections have been prepared from undisturbed soil samples collected during 1976, 1977 and 1978. Thin sections are being prepared from the 1979 samples.

The data collected each year has been tabulated in year end Technical Memo's, i.e. Martini and Protz, 1978; Martini, Protz, Grinham, King and Clarke, 1979; Martini and Protz, 1980. In each of these reports only an initial cursory analysis of the data have been made. An in-depth analysis of all results will be done within the next two years. However, at this time some conclusions have been made.

Inter-ridge Soils (Gleysols)

1. The surface organic matter accumulations are very rapid.
2. Gleysols have not been weathered much as CaCO₃ equivalent is not depleted and the pH ranges from 7.0-8.5. ³
3. Exchange Na and electrical conductivity are rapidly decreased as the landmass uplift takes place.
4. Bulk densities of B and C horizons varied from 1.6 to 1.8 gm/cm³.
5. Bulk densities of Ah horizons varied from 0.9 to 1.2 gm/cm³.
6. Soil test P was low and K was low to medium, Mg and Ca were high.

Beach Ridge Soils (Podzols)

1. Soil temperature of podzols was 5-8°C cooler than the gleysoils at the time of sampling.
2. Montmorillonite was found in the Ae horizons of podzols.
3. Low quantities of Na-pyrophosphate Fe and Al is a function of the small amount of weathering of dolomitic parent material.
4. Decreases in pH and depletion of CaCO₃ equivalent in podzols increases with distance from the Bay. ³
5. Soil test P was low, K was low, Ca and Mg were lower in more weathered soils.

R. Protz
Classification and Characteristics of the Brookston Series

The soil resource data-base for much of Southern Ontario is limited, chiefly because approximately 90% of the area was mapped prior to the mid-sixties when analytical facilities were limited. This lack of soil data has become increasing acute with the increased use in Ontario of soil survey reports. Many of the more commonly mapped soil series were originally described in the twenties and thirties and hence the lack of analytical data has made correlation between series difficult, if not impossible.

Amongst the major soil series found in Ontario is the Brookston series, first described in the soil survey report of Kent County in 1927. The Brookston series is a heavy textured till soil with poor natural drainage and is generally found on level to gently undulating topography. Taxonomically, they are usually classified as Humic Gleysols. Their mapped extent covers some 8,000 km², chiefly in extreme Southwestern Ontario. They occupy approximately 65% of Essex County, 49% of Kent County and 42% of Lambton County. The particularly favourable climate of the area (mean annual growing degree days of 3,700 and a water deficit of 5 to 10 cm), coupled with their inherent characteristics, has made these soils when tile drained probably the most productive in Ontario, if not in Canada. The six-year average (1973-1978) of grain corn, winter wheat and soybeans for Essex, Kent and Lambton Counties averaged 90, 52 and 29 bu/acre respectively (Agricultural Statistics for Ontario, 1973-1978).

Over 50 soil profiles were investigated in Southwestern Ontario and on the basis of these profiles it has been possible to define the Brookston Family: Orthic Humic Gleysol, fine clayey, mixed, alkaline, strongly calcareous, mild aquic. Most of the soil profiles studied outside of extreme Southwestern Ontario were either too calcareous or too coarse textured. Cluster analysis grouped the soils of Essex and parts of Kent County into a single 'series'. It is proposed that this series be called the Brookston Series. Its major characteristics are: CaCO₃ equivalent 6-20%; depth to Ckg > 80 cm; dolomite contents > 6%; family particle size clay contents 35-50%. Some major properties of the Ap horizons are: organic carbon 2-3.5%, C.E.C.'s 20-40 meq/100 g; surface areas 40-100 m²/g and oven-dry bulk densities 1.5-1.8 g/cm³.

L.J. Evans
Predictive Soil Mapping for Forest Management in Northern Ontario

The time that elapses between the initiation of a soil survey and the publication of the final report is of necessity considerable. This time period increases markedly as the scale of mapping increases and hence the accumulation of soil inventory information is slow. Considerable areas in Northern Ontario will not be surveyed for many years, even though soil information is required now for the land use planning in Northern Ontario. For example, with a productive forest area in Northern Ontario of approximately 38 million hectares, nearly 1,600 man years will be required to map this area, at a scale of 1:15,840, assuming a mapping rate of 24,000 ha/man year. Whilst this scale of mapping may be useful for intensive forest management, more generalized soil information at scales of 1:50,000 or 1:250,000 is required in a shorter time period to accumulate the soil inventory information necessary for long-term planning for forest management. Soil maps at these smaller scales are also very useful in establishing field legends when larger scale surveys of specific areas are undertaken.

It is proposed to use existing land resource information, such as bedrock geology maps, quaternary geology maps, Northern Ontario Engineering Terrain Study maps, Ontario Land Inventory land classification maps and Landsat Imagery to predict soil distribution for the Foleyet and Chapleau areas. Field transects and an intensive soil sampling program will aid in the testing of the predictive map. By refining predictive soil boundaries by field observation, it is hoped to produce a soil map of the Foleyet and Chapleau areas at a scale of 1:250,000 within a three-year period. The predictive soil map will contain information, in an expanded legend format, describing soil texture, soil depth, soil moisture regime, soil drainage, soil pH and landform or topography. The soils will also be classified at the subgroup level using the Canadian System of Soil Classification in order to tie in with the Ontario Institute of Pedology soil survey program.

L.J. Evans, B.H. Cameron and J.M. Bellisle
Evaluation of Conflict Between Agricultural Land and Aggregate Extraction Areas in Southern Ontario

Members of the Institute of Pedology acted as Scientific Authority for a research contract to the Foundation for Aggregate Studies supported through Supply and Services Canada. The objective of the research was to document those areas of prime agricultural land in Southern Ontario which presently were in conflict, or had the potential for conflict, with aggregate extractive land use. Information sources included agricultural capability maps; geological reports and maps; MHR Open file reports, licensing records; MTC strip maps, etc.

Unfortunately, during the data compilation phase of the project, financial support was withdrawn and the project was discontinued.
ACTIVE RESEARCH PROJECTS

Soil Survey and Land Use

Ontario Soil Surveys.
Brant County - C.J. Acton
Haldimand-Norfolk Region - E.W. Presant, B. van den Broek,
M. Langman, A. Montgomery, G. Patterson.
Middlesex County - B. Cameron.
Ottawa-Carleton Region - L. Schut, E. Wilson.
Timmins-Noranda Rouyn Map Sheet - G. Wall.
Agriculture Canada, Land Resource Research Institute and Ontario
Ministry of Agriculture and Food, Food Land development Branch.

Collation of historic and current soil data on an annual basis in
Agriculture Canada.

Reclamation of mined aggregate lands for agriculture production -
E.E. Mackintosh, A. Montgomery.
Geoscience Research Grant, Ontario Ministry of Natural Resources.

Erosion losses from agricultural land - G. Wall.
Agriculture Canada.

Investigation of the soil moisture regimes of some fine clayey soils
of the Haldimand-Norfolk region - G. Patterson.
Ontario Ministry of Agriculture and Food.

Classification of the Brookston soil series - L. Evans.
Ontario Ministry of Agriculture and Food.

Coastal geomorphology, sedimentology and pedology of Northern James
Canadian Wildlife Service, NSERC, Ontario Ministry of Agriculture
and Food.

Mineral weathering and micromorphological research on soils from
active surveys. - R. Protz.
NSERC, Ontario Ministry of Agriculture and Food.
CURRENT PUBLICATIONS
Land Resource Science and Ontario Institute of Pedology

REFEREED JOURNALS AND CHAPTERS IN BOOKS
Underlined authors are members of the Department or of the Institute


Chesworth, W., Jean Dejou and Pierre Larroque, 1980. The weathering of basalt at Belbex, France. Geochimica Cosmochimica Acta. IN PRESS.

Chesworth, W., Jean Dejou, 1980. Weathering of the Mancoles granite and its bearing on the size of the equilibrium system in soils. Soil Science. IN PRESS.


Martini, I.P., 1981. Ice effect on erosion and Sedimentation of the Ontario Shores of James Bay, Cahada: Geographie Physique et Quaternaire. IN PRESS.


NON-REFEREED JOURNALS, REPORTS, CONFERENCE PAPERS AND ABSTRACTS


BOOK REVIEWS


NEWSPAPER ARTICLES


ONTARIO MINISTRY OF AGRICULTURE AND FOOD INFORMATION SERVICES

Factsheets and Publications


Bates, T.E. Guidelines for safe rates of nutrients applied at seeding.


**Information for Industry Personnel (I.F.I.P.) and Extension Personnel (I.F.E.P.)**

Bates, T.E. Soil testing for Ontario.

Bates, T.E. and R.W. Sheard. Sulfur and Sulfate fertilizers - Do we need them?

Ketcheson, J.W. Tillage practices for field crops in Ontario.


**Radio Tapes and Television**


Bates, T.E. Sewage sludge (CKNX-TV, Wingham).

Bates, T.E. Soil testing (CKNX-TV, Wingham).


Bates, T.E. Sewage sludge (TV-John Bradshaw program).

Bates, T.E. Acid rain (CBC radio noon).


Beauchamp, E.G. Manure utilization (CKNX-TV, Wingham).

Brown, D.M. Agrometeorology and land evaluation (CKNX-TV, Wingham).

Brown, D.M. 1980 spring conditions and prospects (radio and CKNX-TV, Wingham).

Sheard, R.W. Sulfur response of field crop (CKNX-TV, Wingham).

Sheard, R.W. Acid rain (CHML-TV, Hamilton and CFPL-TV, London).
TECHNICAL MEMORANDA AVAILABLE FROM THE DEPARTMENT
OF LAND RESOURCE SCIENCE

and pedology of southern James Bay, Ontario, Canada. Tech.
Memo 78-1.

Selirio, I.S., D.M. Brown and K.M. King, 1978. Soil moisture observa-

looking airborne radar on the University of Guelph test strip.
Tech. Memo 78-3.


Brisco, B. and R. Protz, 1979. Analysis of the characteristics of soil-
plant systems which affect the backscattering coefficient of

Martini, I.P. and R. Protz, 1980. Coastal Geomorphology, Sedimentology,
and Pedology of Northern James Bay, Ontario, Canada. Dept.
Land Resource Science, Tech. Memo 80-1, University of Guelph,
117 p.

CURRENT PUBLICATIONS AVAILABLE FROM THE ONTARIO
INSTITUTE OF PEOLOGY

Patterson, G.T., 1979. Soil survey of six agricultural subwatersheds
in Southern Ontario. Ontario Institute of Pedology No. 79-1.

A guide to the use of land information. Ontario Institute
of Pedology No. 79-2. Cost $12.00.

Institute of Pedology No. 79-3.