The Breton Plots

An Alberta Registered Historic Resource

Celebrating 70 years of Research and Outreach (1929-1999)

Location & Significance

The Breton Plots were established in 1929 near the village of Breton, 100 km southwest of Edmonton, by the Department of Soils, University of Alberta. These plots were originally designed to find "a system of farming suitable for the wooded soil belt". The Breton Plots are known worldwide in the Soil Science community, and are the only continuous, long-term plots on Gray Luvisols in Canada and possibly in the world.

Today, the Breton Plots provide a model of how diverse cropping practices affect typical Gray Luvisolic soils after 70 years of farming. Many farmers and rural communities have benefitted enormously from the work done over the past 70 years. The economic impact through improved crop production, especially in western Canada, has been significant. Currently, the plots are being used to assess the interaction among global environment, crop productivity and soil quality. The Breton Plots are a part of *the North American Great Plains Network* and *the Global Change and Terrestrial Environment Soil Organic Matter Network.*

The plots are managed by the Department of Renewable Resources, Faculty of Agriculture, Forestry and Home Economics, University of Alberta with full participation of the Agronomy Unit and the Conservation and Development Branch, Alberta Agriculture, Food and Rural Development, Edmonton. The Plots exist today due to the vision of Dr. F. A. Wyatt and Dr. J. D. Newton, the dedication of a large number of individuals, and the financial support from the Breton Plots Endowment Fund, Industry, National and Provincial Granting Agencies, and the Department of Renewable Resources, University of Alberta.

The Founders

Dr. Frank Wyatt came to Alberta from Illinois in 1919. He established the first Department of Soils in Canada at the University of Alberta. He was very familiar with the long-term Morrow Plots at the University of Illinois. **Dr. John Newton** studied at the University of California. He was appointed to the Department of Soils, University of Alberta in 1922. He, with Dr. Wyatt, started research at the Breton Plots site in 1929.

Dr. F. A. Wyatt

Dr. J. D. Newton

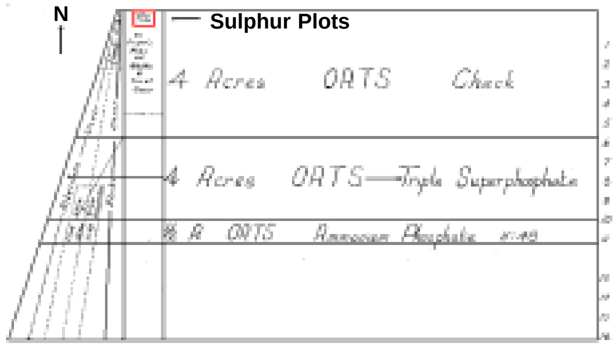
Mr. Ben Flesher provided the land for the first plots in 1929. Ben did many of the plot operations including tillage, seeding and harvesting. The 20-acre parcel of land on which the Breton Plots are located was purchased by the University of Alberta in 1946. Mr. Flesher was one of the founders of the Breton Plots and made a significant contribution to the research and outreach activities over a span of 40 years.

Predicting the Future from the Past

Internet: bretonplots.rr.ualberta.ca

Plot Layout

This was the layout of the preliminary plots in 1929. Note especially the small sulphur plot in the upper left corner (red rectangle). It was on this plot in 1931 that Dr. Newton noted a marked benefit of added sulphur on clover plants and established that the Breton loam was deficient in sulphur. The design as we know it today was laid out in 1930.



Breton Field Plan in 1929

An aerial photograph of the Breton Plots taken in 1992. The Classical Plots consist of 6 blocks and 11 treatments. The rotations are (1) a 2-year Wheat-Fallow (WF) rotation; and (2) a 5-year Wheat-Oat-Barley-Hay-Hay (WOBHH) rotation. These plots are located on north half of this research site. Several sets of medium-term experimental plots are located in the southern half. Current experiments include management of straw/tillage and phosphorus fertilizer. The research site is well documented and has a meteorological station.

The Soil and Climate

The Breton Plots are on Gray Luvisolic soils which are found in the Boreal Ecozone under mixed-forest vegetation. These soils have a thin leaf litter (L-H) horizon on the surface which is underlain by an ash-like Ae horizon. Below this horizon is a blocky, rather dense Bt horizon that is enriched in clay. In contrast, Chernozemic soils, found in the Prairie Ecozone, are endowed with a deep, surface horizon which is rich in organic matter (Ah). Gray Luvisolic soils are difficult to manage compared to Chernozemic soils.

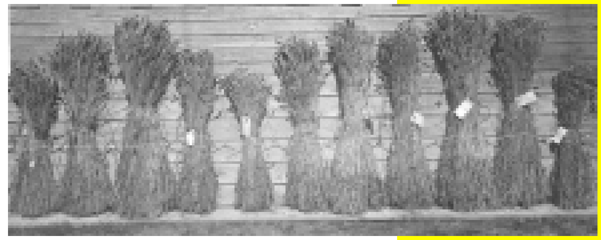
Gray Luvisol Dark Brown Chernozem

This is a recently broken area of Gray Luvisolic soils near Breton. Note that most of the L-H horizon has been buried and the gray Ae horizon is exposed. The Ae horizon is very low in organic matter and clay, and has a very weak structure which pulverizes easily. Continued agricultural use of these soils requires proper management and improvement of soil quality.

Discoveries

Overcoming Nutrient Deficiencies (The 1930's to 1960's)

The photograph on the right shows wheat yields following clover crops in 1931. The fertilizer treatments were; 1 = none, 2 = manure (M), 3 = NPKS, 4 = NS, 5 = none, 6 = lime (L), 7 = LP, 8 = P, 9 = MNPS, 10 = NPS, and 11 = none. N = Nitrogen, P = Phosphorus, K = Potassium and S = Sulphur. Sulphur deficiency in legumes was discovered in 1931. Since then, farmers have applied sulphur fertilizers to improve crop yields and quality.



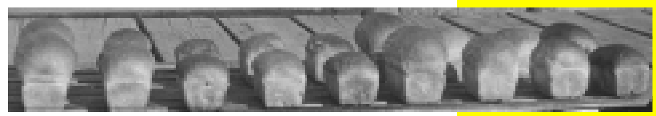
1 2 3 4 5 6 7 8 9 10 11

Plot Number

Yields of Reward wheat after clover in Series B in 1932

Improving Crop Quality (The 1930's to 1950's)

Loaves from plots 2, 3, 4, 9 and 10, all receiving sulphur fertilizer, were distinctly superior to the one from the check plot (1). These results suggested that sulphur fertilizer added to this sulphur deficient soils, changed the quality of the wheat protein.

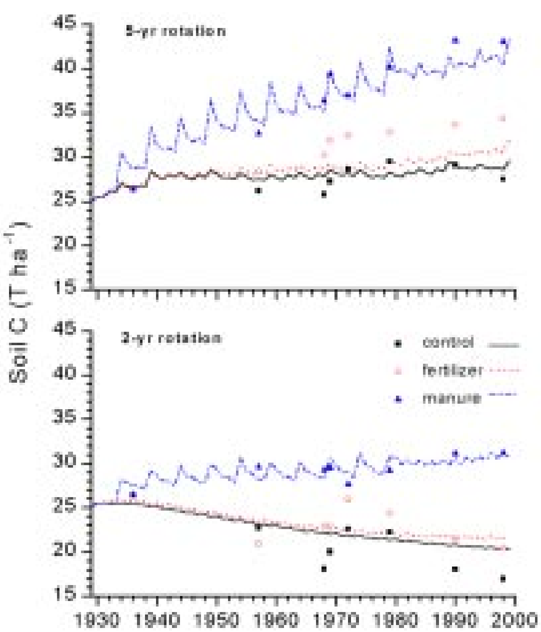


10 9 8 7 6 4 3 2 1

Plot Number

Loaves from wheat grown in 1938 following legumes in 1937

Improving Soil Quality (The 1930's to the Present)



Changes in soil carbon (organic matter) content in the top 15 cm for the 2-yr wheat fallow and the 5-yr cereal forage (WOBHH) rotations with three fertility treatments over a period of 70 years (1930-2000)

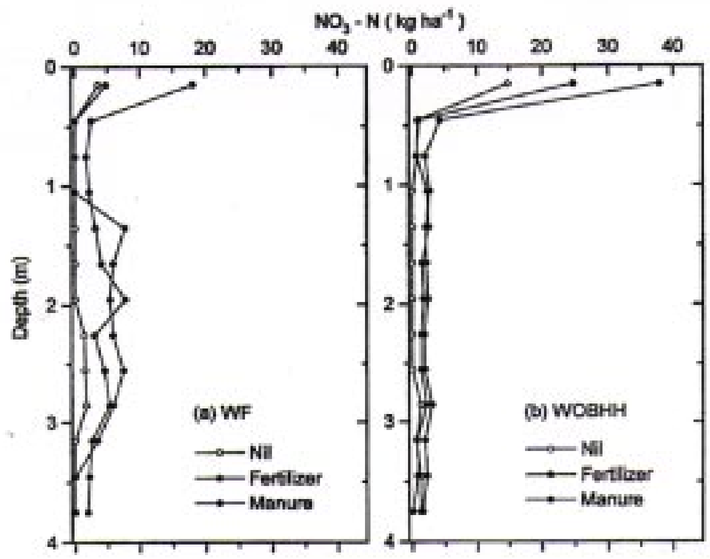
Soil organic (carbon) content has been affected by management practices. There is more organic matter in the plots of the five year rotation than in those of the wheat-fallow rotation. Also, there is generally more organic matter in fertilized plots than in control plots.

The rates of change of soil carbon in the 15 cm depth over a period of 70 years have been calculated using simulation modelling techniques. In the 2-yr rotation, soil C decreased at the rate of 140 and 70 kg ha^{-1} yr^{-1} in the control and fertilizer treatments but increased at the rate of 70 kg ha^{-1} yr^{1} in the manure treatment. In the 5-yr rotation, the rates of soil C increase were 40, 140 and 280 kg ha^{-1} yr^{-1} in the control, fertilizer and manure treatments.

The plots receiving manure and fertilizer have greater crop yields and below-ground organic carbon in form of roots. Also, manure application adds large amounts of organic matter to soil. Therefore, crop rotation and soil fertility greatly influence the amount and quality of soil organic matter, and water holding and nutrient cycling capacities.

Addressing Air & Water Quality (The 1990's to the Present)

Nitrate accumulation in the soil of the wheat-fallow and wheat-oat-barley-hay-hay rotations ranged from 0 to 67 kg N/ha. Considerably more NO_3-N moved below rooting depth (1 m) in the 2-year Wheat-Fallow (WF) rotation than in the 5-year Wheat-Oat-Barley-Hay-Hay (WOBHH) rotation.



Emissions of greenhouse gases (N_2O and CO_2) have been measured on cropping systems at Breton. With some practices, an additional 10 tonnes per hectare or more of carbon may be stored in soil. This is one of the methods of removing CO_2 from the atmosphere.

Assessing Local and Global Impacts (2001 and Beyond)

Farmers and society have already benefitted from lessons learned at the Breton Plots as outlined in previous pages. What can we learn from these long-term plots in the future? Here are some ideas for research projects:

- **Are deficiencies of phosphorus and sulphur, as well as nitrogen, limiting the amount of carbon (organic matter) that can be stored in these soils?**
- **Has the addition of atmospheric sulphur solved the original problem of sulphur deficiency in these soils?**
- **How frequently, and at what rate, must lime be added to neutralize acidity caused by the ammonium-based fertilizers?**
- **Is it possible to produce satisfactory crops and maintain soil quality by practical applications of manure?**
- **Is there a build up of harmful heavy metals found as trace components of phosphorus fertilizers?**
- **Can the results of the Breton Plots be used to develop simulation models which can then be extended to other areas?**
- **Can the increase in soil C (organic matter) be used to establish a basis for trading carbon credits?**

The Breton Plots are a living library containing much information about how management practices have affected soils and crops. Some of the information has been uncovered in past research; much awaits to be discovered by future researchers.

Can You Help ?

The Breton Plots Endowment Fund was established to accumulate a capital fund from which investment earnings will be used to help finance day-to-day operations. Our present goal is to raise $1.2 million. Private support will make the plots financially independent and ensure their continued relevance to industry and society.

To contribute to the endowment fund, please contact **Myrna Snart**, Development Officer, Faculty of Agriculture, Forestry & Home Economics, 2-14 AgFor Centre, University of Alberta, Edmonton, AB, Canada T6G 2P5
Phone: (780) 492-2118
E-mail: myrna.snart@ualberta.ca