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A Bibliography of Scientific Publications Based on Long-Term Crop Rotation Studies in the Canadian Prairies

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Summary
Field Experiments conducted over the past 100 years in the Canadian Prairie provinces have resulted in voluminous agronomic knowledge that has propelled Canada to become a major exporter of agricultural products. Hundreds of scientific publications have been produced and this knowledge is now being used to address emerging issues such as climate change, sustainable cropping systems, carbon sequestration, nutrient cycling and water use efficiency. The objective of this paper was to create an aggregated bibliography for long-term crop rotation studies in the Canadian Prairies with the intention of facilitating the research which is and will be conducted by present and future generations. Of the numerous types of long-term studies that have been conducted, we have restricted this treatise to include only experiments that dealt with crop rotations and were conducted for a minimum of 20 years. The aggregated bibliography with 24 subject areas covers 13 crop rotation experiments at 6 research sites in the Canadian Prairies. This involved collaboration of individuals at specific locations and knowledge expertise to sort the publications. Overall, this effort is a very simple example of what needs to be done to create and maintain this body of scientific literature. In addition to a static version, a searchable version of the aggregated bibliography has been developed which will make it easier to access the information and permit multiple ways of exploring the data and findings. This will add value to the aggregated bibliography and make it globally accessible.

Introduction
The challenge of agriculture is to provide sufficient safe and nutritious food and fibre products to meet the needs of an ever increasing world population within the constraints and demands imposed by the soil resources, weather conditions, consumer preferences, and international markets. This has to be accomplished under the umbrella of sustainable development defined by Brundtland[1] (1987) as: "economic growth that meets the needs of the present without compromising the ability of future generations to meet their own needs".

To achieve these goals, Canada's agronomists have, over the years, conducted numerous long-term field experiments, many of which are still ongoing while others have been discontinued[2]. These experiments have been mainly conducted in the Prairie provinces, and they were designed to answer numerous questions that are important to the scientific community, to producers, the agricultural industry, to policy makers, and to society as a whole. Many of these studies are crop rotation, tillage, fertilizer, herbicide, and animal manure experiments that were designed to measure changes in such variables as crop production and produce quality, economic viability and risk assessment, energy use efficiency, water and nutrient use efficiency, crop pests, biodiversity, and soil, water, and air quality[2,3].

Hundreds of scientific publications, describing the many findings emanating from these studies, pervade the pages of numerous scientific journals throughout the world literature. A few of the scientists that have participated in these very valuable studies thought it might be useful and appreciated by the scientific community and policy makers if we could summarize and bring together a list of these publications in one place as a Bibliography, both as a PDF (static) form, and as a searchable database. Of the numerous types of long-term studies that have been conducted, we have restricted this treatise to include only experiments that dealt with crop rotations and were conducted for a minimum of 20 years.

Materials and Methods:

First, the long-term crop rotations in the Canadian Prairies were identified and notated (Fig. 1, Table 1). Detailed descriptions of the crop rotations are presented in separate chapters in this volume of the Prairie Crops and Soil Journal. In order to develop an aggregated bibliography, a list of major subject areas was first developed and publications for the site/crop rotations were compiled into 24 major subject areas (Table 2). The primary refereed scientific publications were separated from other publications (e.g., reviews, book chapters, etc.). In order to prepare an online-searchable version of the bibliography, each citation was appended with the acronym for specific site/crop rotation (Table 3).

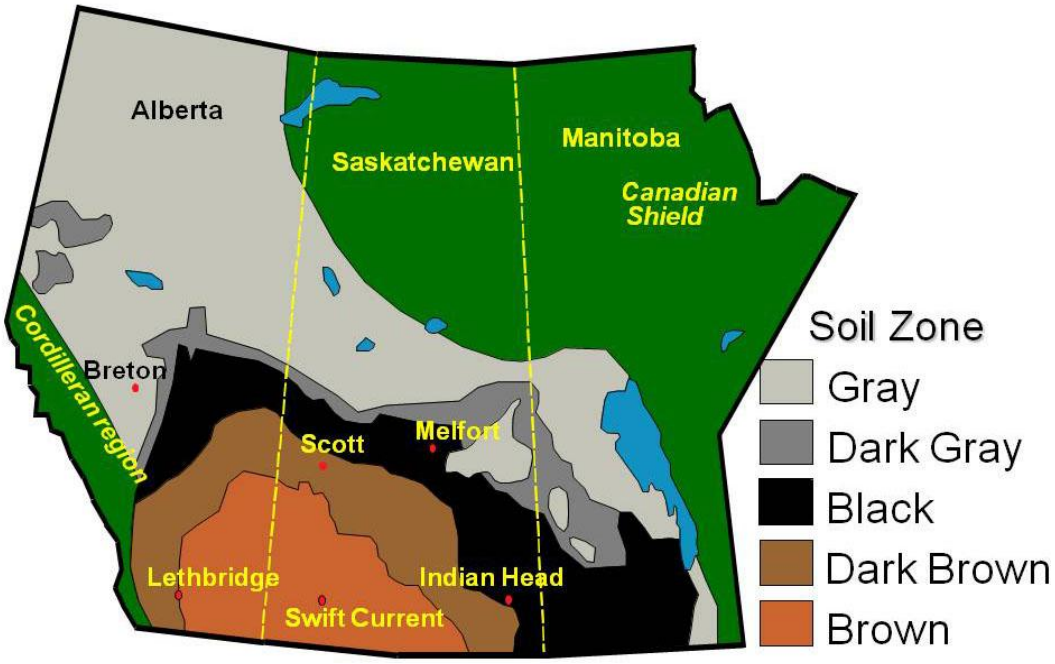

Fig. 1. Soil Zones of the Canadian Prairie Provinces showing locations of long-term crop rotation sites

Table 1. Notations used to designate crop rotation study sites

Notation	Site and Study	Duration of Study
Bret-AER	Breton Agroecological Rotation	1980 -
Bret-Class Rot	Breton Classical Rotation	1930 -
IH-Rot	Indian Head Rotation	1957 -
Leth-Rot 120	Lethbridge Rotation 120	1951 -
Leth-Rot ABC	Lethbridge Dryland Rotation	1911 -
Leth-Rot Chemist	Lethbridge Chemist plots	1911 -
Leth-Rot U	Lethbridge Irrigated Rotation	1911 -
Leth-Till POW	Lethbridge Tillage on POW	1955 - 1997
Mel-Rot	Melfort Rotation	1957 - 1994
SC-New Rot	Swift Current New Rotation	1987 -
SC-Old Rot	Swift Current Old Rotation	1966 -
SC-OMC Till	Swift Current Tillage	1982 –
Sco-Rot	Scott Rotation	1964 -

Table 2. Subject areas used to aggregate scientific publications for crop rotation studies in the Canadian Prairies

Code	Subject Area
A	Production (Yields) and Grain Quality (Protein)
B	Nitrogen Disposition in Plant and Soil
C	Nitrate Leached
D	Phosphorus Disposition in Plant and Soil
E	Phosphorus Leached
F	Soil Biological and Biochemical Properties
G	Soil Organic Matter (Fertility Perspective)
H	Soil Quality
I	Soil Physical Properties
J	Soil Moisture
K	Economics
L	Energy
M	Disease
N	Greenhouse Gases
O	Carbon Sequestration
P	Legume Green Manure
Q	Sustainable Agriculture
R	Modelling
S	Salinity
T	Trace Elements
U	Erosion
V	Irrigation
W	Soil Biota and Soil Micromorphology
X	Sulfur deficiency in Gray Luvisols

The data presented in Tables 1-3 were imported into spreadsheets to fix the format. Then these were imported into a MS-Access database. Specific queries were written in ColdFusion software to create a web-based interactive bibliography which is available at the following URL: http://www.pedosphere.ca/CanEduRes/crop_rotations/bibliography.cfm [5].

Results:

Table 3. Scientific publications classified by subject areas with notations for crop rotation study sites.

A. Production (Yields) and Grain Quality (Protein):

Research Publications

McAllister, R.E. 1934. The effects of fertilizers on the yield and composition of crops from the wooded soils of Alberta. Scientific Agric. **14**: 249-256. **[Bret-Class Rot]**

Wyatt, F.A. 1934. The necessity for growing legumes on gray wooded soils. Scientific Agric. **14**: 327-335. **[Bret-Class Rot]**

Wyatt, F.A. and Leahey, A. 1936. Activated carbon as a fertilizer. Scientific Agric. **17**: 1-10. **[Bret-Class Rot]**

Wyatt, F.A. 1945. Fifteen years experiments on the gray wooded soils of Alberta. Scientific Agric. **25**: 626-635. **[Bret-Class Rot]**

Pittman, U. J. 1977. Crop yields and soil fertility as affected by dryland rotations in southern Alberta. Commun. Soil Sci Plant Analysis **8**:391-405. **[Leth-Rot 120]**

Freyman, S., Palmer, C. J., Hobbs, E. H., Dormaar, J. F., Schaalje, G. B. and Moyer, J. R. 1982. Yield trends on long term dryland wheat rotations at Lethbridge. Can. J. Plant Sci. **62**:609-619. **[Leth-Rot ABC]**

Campbell, C.A., Read, D.W.L., Zentner, R.P., Leyshon, A.J. and Ferguson, W.S. 1983. First 12 years of a long term crop rotation study in southwestern Saskatchewan - yields and quality of grain. Can. J. Plant Sci. **63**: 91-108. **[SC-Old Rot]**

Janzen, H. H. 1987. Effect of fertilizer on soil productivity in long-term spring wheat rotations. Can. J. Soil Sci. **67**:165-174. **[Leth-Rot ABC]**

Zentner, R.P., Spratt, E.D., Reisdorf, H. and Campbell, C.A. 1987. Effect of crop rotation and N and P fertilizer on yields of spring wheat grown on a Black Chernozemic clay. Can. J. Plant Sci. **67**: 965-982. **[IH-Rot]**

Campbell, C.A., Zentner, R.P. and Johnson, P.J. 1988. Effect of crop rotation and fertilization on the quantitative relationship between spring wheat yield and moisture use in southwestern Saskatchewan. Can. J. Soil Sci. **68**: 1-16. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P. and Selles, F. 1988. Regressions for estimating straw yields and N and P content of spring wheat and N mineralization in a Brown loam soil. Can. J. Soil Sci. **68**: 337-344. **[SC-Old Rot]**

Zentner, R.P., Bowren, K.E., Edwards, W. and Campbell, C.A. 1990. Effect of crop rotations and fertilization on yields and quality of spring wheat grown on a Black Chernozem in North Central Saskatchewan. Can. J. Plant Sci. **70**: 383-397. **[Mel-Rot]**

Campbell, C.A., Zentner, R.P., Selles, F., Biederbeck, V.O. and Leyshon, A.J. 1992. Comparative effects of grain lentil-wheat and monoculture wheat on crop production, N economy and N fertility in a Brown Chernozemic soil. Can. J. Plant Sci. **72**: 1091-1107. **[SC-Old Rot]**

Campbell, C.A., Lafond, G.P. and Zentner, R.P. 1993. Spring wheat yield trends as influenced by fertilizer and legumes. J. Prod. Agric. **6(4)**: 564-568. **[IH-Rot]**

Johnston, A.M., Janzen, H.H. and Smith, E.G. 1995. Long-term spring wheat response to summerfallow frequency and organic amendment in southern Alberta. Can. J. Plant Sci. **75**:347-354. **[Leth-Rot 120]**

Johnston, A.M., Larney, F.J. and Lindwall, C.W. 1995. Spring wheat and barley response to long-term fallow management. J. Prod. Agric. **8**:264-268. **[Leth-Till POW]**

Campbell, C.A., Lafond, G.P., Harapiak, J.T. and Selles, F. 1996. Relative cost to soil fertility of long-term crop production without fertilization. Can. J. Plant Sci. **76**: 401-406. **[IH-Rot]**

McConkey, B.G., Campbell, C.A., Zentner, R.P., Dyck, F.B. and Selles, F. 1996. Long-term tillage effects on spring wheat production on three soil textures in the Brown soil zone. Can. J. Plant Sci. **76**: 747-756. **[SC-OMC Till]**

Campbell, C.A., Selles, F., Zentner, R.P., McConkey, B.G., Brandt, S.A. and McKenzie, R.C. 1997. Regression model for predicting yield of hard red spring wheat grown on stubble in the semiarid prairie. Can J. Plant Sci. **77**: 43-52. **[SC-Old Rot, Sco-Rot]**

Campbell, C.A., Selles, F., Zentner, R.P., McConkey, B.G., McKenzie, R.C. and Brandt, S.A. 1997. Factors influencing grain N concentration of hard red spring wheat in the semiarid prairie. Can. J. Plant Sci. **77**: 53-62. **[SC-Old Rot, Sco-Rot]**

Campbell, C.A., Zentner, R.P., Selles, F., Biederbeck, V.O., McConkey, B.G., Lemke, R. and Gan, Y.T. 2004. Cropping frequency effects on yield of grain, straw, plant N, N balance and annual production of spring wheat in the semiarid prairie. Can. J. Plant Sci. **84**: 487-501. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P., Selles, F., Jefferson, P.G., McConkey, B.G., Lemke, R. and Blomert, B.G. 2005. Long-term effects of cropping system and nitrogen and phosphorus fertilizer on production and nitrogen economy of grain crops in a Brown Chernozem. Can. J. Plant Sci. **85**: 81-93. **[SC-Old Rot]**

Wang, H., McConkey, B.G., Zentner, R.P., Campbell, C.A., Selles, F., Lemke, R. and Cutforth, H. 2008. Long-term tillage effects on biomass production of wheat in a Canadian Brown soil. Adv. GeoEcol. **39**: 581-591. **[SC-OMC Till]**

Campbell, C.A., Lafond, G.P., VandenBygaart, A.J., Zentner, R.P., Lemke, R., May, W.E. and Holzapel, C.B. 2011. Effect of crop rotation, fertilizer and tillage management on spring wheat grain yield and N and P content in a thin Black Chernozem: a long term study. Can. J. Plant Sci. **91**: 467-483. **[IH-Rot]**

Other Scientific

Dubetz, S. 1954. The fertility balance in a ten-year sugar beet rotation after forty-two years of cropping. Proc. Am. Soc. Sugar Beet Technol. **8**: 81-85. **[Leth-Rot U]**

Robertson, J.A. 1979. Lessons from the Breton Plots. Agric. For. Bull. **2(2)**: 8-13. **[Bret-Class Rot]**

Robertson, J.A. and McGill, W.B. 1983. New directions for the Breton Plots. Univ. Alberta Agric. For. Bull. **6**: 36-41. **[Bret-Class Rot]**

Izaurralde, R.C., Janzen, H.H., and VanderPluym, H.P., eds. 1993. Long-term crop rotation studies in Alberta. Report of Progress of the Sustainable Cropping Systems Research Study. Alberta Agriculture Research Institute, Canada-Alberta Soil Conservation Initiative. Univ. of Alberta. Agriculture Canada, Alberta Agriculture, Edmonton, Alberta. 230 pp. **[Bret-Class Rot]**

Izaurralde, R.C., Janzen, H.H., and VanderPluym, H.P., eds. 1995. Long-term crop rotation studies in Alberta: Research Report 1993-1995. Canada-Alberta Environmentally Sustainable Agriculture Agreement. Univ. of Alberta, Agriculture Canada, Alberta Agriculture, Edmonton, Alberta. 92 pp. **[Bret-Class Rot]**

B. Nitrogen Disposition in Plant and Soil:

Research Publications

Campbell, C.A., Read, D.W.L., Biederbeck, V.O. and Winkleman, G.E. 1983. First 12 years of a long term crop rotation study in southwestern Saskatchewan nitrate N distribution in soil and N uptake by the plant. Can. J. Soil Sci. **63**: 563-578. **[SC-Old Rot]**

Carter, M. R. and Rennie, D. A. 1984. Nitrogen transformations under zero and shallow tillage. Soil Sci. Soc. Am. J. **48**:1077-1081. **[Leth-Till POW]**

Wani, S.P., McGill, W.B. and Robertson, J.A. 1991. Soil N dynamics and N yield of barley grown on Breton loam using N from biological fixation or fertilizer. Biol. Fertil. Soils. **12**: 10-18**. [Bret-AER, Bret-Class Rot]**

Bremer, E., Janzen, H. H. and Gilbertson, C. 1995. Evidence against associative N_2 fixation as a significant N source in long-term wheat plots. Plant Soil **175**:13-19. **[Leth-Rot ABC]**

Campbell, C.A., Jame, Y.W., Akinremi, O.O. and Cabrera, M.L. 1995. Adapting the potentially mineralizable N concept for the prediction of fertilizer N requirements. Fert. Res. **42**: 61-75. **[SC-Old Rot]**

Campbell, C.A. and Zentner, R.P. 1996. Disposition of nitrogen in the soil-plant system for flax and spring wheat-containing rotations in the Brown soil zone. Can. J. Plant Sci. **76**: 407-412. **[SC-Old Rot]**

Schoenau, J. and Campbell, C.A. 1996. Impact of crop residues on nutrient availability in conservation tillage systems. Can. J. Plant Sci. **76**: 621-626. **[SC-OMC Till]**

McConkey, B.G., Curtin, D., Campbell, C.A., Brandt, S.A. and Selles, F. 2002. Crop and soil nitrogen status of tilled and no-tillage systems in semiarid regions of Saskatchewan. Can. J. Soil Sci. **82**: 489-498. **[SC-OMC Till, Sco-Rot]**

Liang, B.C., McConkey, B.G., Campbell, C.A., Curtin, D., Lafond, G.P., Brandt, S.A. and Moulin, A.P. 2004. Total and labile soil organic nitrogen as influenced by crop rotations and tillage in Canadian prairie soils. Biol. Fertil. Soils **39**: 249-257. **[SC-OMC Till, Sco-Rot]**

Ross, S.M., Izaurralde, R.C., Janzen, H.H., Robertson, J.A. and McGill, W.B. 2008. The nitrogen balance of three long-term agroecosystems on a boreal soil in western Canada. Agric. Ecosyst. Environ. **127**:241-250. **[Bret-AER]**

Kröbel, R., Campbell, C.A., Zentner, R.P., Lemke, R., and Desjardins, R.L. 2012. Effect of N, P and cropping frequency on nitrogen use efficiencies of spring wheat in the Canadian semiarid prairie. Can. J. Plant Sci. **92**: 141-154. **[SC-Old Rot]**

Other Scientific

Campbell, C.A. 1984. N Balance and efficiency of use with emphasis on Canadian Prairie soils. Pages 13-63 *in* Proc. 10th Argentine & 8th Latin American Congress of Soil Science. Mar del Plata, Argentina, Oct. 23-28. **[SC-Old Rot]**

C. Nitrate Leached:

Research Publications

Campbell, C.A., de Jong, R. and Zentner, R.P. 1984. Effect of cropping, summer fallow and fertilizer nitrogen on nitrate-nitrogen lost by leaching on a Brown Chernozemic loam. Can. J. Soil Sci. **64**: 61-74. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P., Selles, F. and Akinremi, O.O. 1993. Nitrate leaching as influenced by fertilization in the Brown soil zone. Can. J. Soil Sci. **73**: 387-397. **[SC-Old Rot]**

Campbell, C.A., Lafond, G.P., Zentner, R.P. and Jame, Y.W. 1994. Nitrate leaching in a Udic Haploboroll as influenced by fertilization and legumes. J. Environ. Qual. **23**: 195-201. **[IH-Rot]**

Beckie, H.J., Moulin, A.P., Campbell C.A. and Brandt, S.A. 1995. Simulating distribution of soil nitrate-N and water. Can. J. Soil Sci. **75**: 135-143. **[IH-Rot, Mel-Rot, SC-Old Rot, Sco-Rot]**

Izaurralde, R.C., Feng, Y., Robertson, J.A., McGill, W.B., Juma, N.G. and Olson, B.M. 1995. Long-term influence of cropping systems, tillage methods, and N sources on nitrate leaching. Can. J. Soil Sci. **75**: 497-505. **[Bret-AER, Bret-Class Rot]**

Campbell, C.A., Selles, F., de Jong, R., Zentner, R.P., Hamel, C., Lemke, R., Jefferson, P.G. and McConkey, B.G. 2006. Effect of crop rotations on NO_3 leached over 17 years in a medium-textured Brown Chernozem. Can. J. Soil Sci. **86**: 109-118. **[SC-New Rot]**

Campbell, C.A., Selles, F., Zentner, R.P., de Jong, R., Lemke, R. and Hamel, C. 2006. Nitrate leaching in the semiarid prairie: Effect of cropping frequency, crop type, and fertilizer after 37 years. Can J. Soil Sci. **86**: 701-710. **[SC-Old Rot]**

Other Scientific

Campbell, C.A. and Zentner, R.P. 1988. Proper agronomic practices will reduce leached nitrates in Prairie soils. Better Crops with Plant food **72**: 12-13. **[SC-Old Rot]**

Reynolds, W.D., Campbell, C.A., Chang, C., Cho, C.M., Ewanek, J.H., Kachanoski, R.G., MacLeod, J.A., Milburn, P.H., Simard, R.R., Webster, G.R.B. and Zebarth, B.J. 1995. Agrochemical entry into groundwater. Pages 97-109 *in* D.F. Acton and L.J. Gregorich, eds. The health of our soils - toward sustainable agriculture in Canada. Centre for Land and Biological Resources Research, Research Branch, Agriculture & Agri-Food Canada, Ottawa, Ont. **[IH-Rot, SC-Old Rot]**

D. Phosphorus Disposition in Plant and Soil:

Research Publications

Odynsky, W. 1936. Solubility and distribution of phosphorus in Alberta soils. Scientific Agric. **16**: 652-664. **[Bret-Class Rot]**

Wyatt, F.A. 1936. Fertilizers for the black and gray soils of central Alberta. Scientific Agric. **16**: 238-240b. **[Bret-Class Rot]**

Campbell, C.A., Read, D.W.L., Winkleman, G.E. and McAndrew, D.W. 1984. First 12 years of a long-term crop rotation in southwestern Saskatchewan - P distribution in soil and P uptake by the plant. Can. J. Soil Sci. **64**: 125-137. **[SC-Old Rot]**

O'Holloran, I.P., Kachanoski, R.G. and Stewart, J.W.B. 1985. Spatial variability of soil phosphorus as influenced by soil texture and management. Can. J. Soil Sci. **65**: 475-487. **[SC-Old Rot]**

O'Holloran, I.P., Stewart, J.W.B. and Kachanoski, R.G. 1987. Influence of texture and management practices on the forms and distribution of soil phosphorus. Can. J. Soil Sci. **67**: 147-163. **[SC-Old Rot]**

McKenzie, R.H., Stewart, J.W.B., Dormaar, J.F. and Schaalje, G.B. 1992a. Long-term crop rotation and fertilizer effects on phosphorus transformations: I. In a Chernozemic soil. Can. J. Soil Sci. **72**:569-579. **[Leth-Rot ABC]**

McKenzie, R.H., Stewart, J.W.B., Dormaar, J.F. and Schaalje, G.B. 1992b. Long-term crop rotation and fertilizer effects on phosphorus transformations. II. In a Luvisolic soil. Can. J. Soil Sci. 72: 581-589. **[Bret-Class Rot]**

Campbell, C.A. and Zentner, R.P. 1993. Overwinter changes in Olsen Phosphorus in a 24-year crop rotation study in southwestern Saskatchewan. Can. J. Soil Sci. **73**: 123-128. **[SC-Old Rot]**

Zentner, R.P., Campbell, C.A. and Selles, F. 1993. Build-up in soil available P and yield response of spring wheat to seed-placed P in a 24-year study in the Brown soil zone. Can. J. Soil Sci. **73**: 173-181. **[SC-Old Rot]**

Morel, C.H., Tiessen, J.O. and Stewart, J.W.B. 1994. Phosphorus transformations and availability under cropping and fertilization assessed by isotopic exchange. Soil Sci. Soc. Am. J. **58**: 1439-1445. **[Bret-Class Rot]**

Selles, F., Campbell, C.A. and Zentner, R.P. 1995. Effects of cropping and fertilization on plant and soil phosphorus. Soil Sci. Soc. Am. J. **59**: 140-144. **[SC-Old Rot]**

Selles, F., McConkey, B.G. and Campbell, C.A. 1999. Distribution and forms of P under cultivator- and zero-tillage for continuous- and fallow-wheat cropping systems in the semi-arid Canadian prairies. Soil Tillage Res. **41**: 47-59. **[SC-OMC Till]**

Selles, F., Campbell, C.A., Zentner, R.P., Curtin, D., James, D.C., and Basnyat, P. 2011. Phosphorus use efficiency and long-term trends in soil available phosphorus in wheat production systems with and without nitrogen fertilizer. Can. J. Soil Sci. **91**:39-52. **[SC-Old Rot]**

Other Scientific

Selles, F., Campbell, C.A., Zentner, R.P., James, D. and Basnyat, P. 2007. Withholding phosphorus after long-term additions - Soil & Crop Responses. Better Crops with Plant Food **91**: 19-21. **[SC-Old Rot]**

E. Phosphorus Leached:

Research Publications

Campbell, C.A., Lafond, G.P., Biederbeck, V.O. and Winkleman, G.E. 1993. Influence of legumes and fertilization on deep distribution of available phosphorus (Olsen-P) in a thin Black Chernozemic soil. Can. J. Soil Sci. **73**: 555-565. **[IH-Rot]**

Letkeman, L.P., Tiessen, H. and Campbell, C.A. 1996. Phosphorus transformation and redistribution during pedogenesis of Western Canadian soils. Geoderma **71**: 201-218. **[SC-Old Rot]**

F. Soil Biological and Biochemical Properties:

Research Publications

Khan, S.U. 1969a. Some carbohydrate fractions of a gray wooded soil as influenced by cropping systems and fertilizers. Can. J. Soil Sci. **49**: 219-224. **[Bret-Class Rot]**

Khan, S.U. 1969b. Humic acid fraction of a gray wooded soil as influenced by cropping systems and fertilizers. Geoderma **3**: 247-254. **[Bret-Class Rot]**

Khan, S.U. 1971. Nitrogen fractions in a gray wooded soil as influenced by cropping systems and fertilizers. Can. J. Soil Sci. **51**: 431-437. **[Bret-Class Rot]**

Biederbeck, V.O., Campbell, C.A. and Zentner, R.P. 1984. Effect of crop rotation and fertilization on some biological properties of a loam in southwestern Saskatchewan. Can. J. Soil Sci. **64**: 355-367. **[SC-Old Rot]**

Dormaar, J.F. 1984. Monosaccharides in hydrolysates of water stable aggregates after 67 years of cropping to spring wheat as determined by capillary gas chromatography. Can. J. Soil Sci. **64**:647-656. **[Leth-Rot ABC]**

Monreal, C.M. and McGill, W.B. 1985. Centrifugal extraction and determination of free amino acids in soil solutions by TLC using tritiated 1-fluoro-2,4-dinitrobenzene. Soil Biol. Biochem. **17**: 533-539. **[Bret-Class Rot]**

McGill, W.B., Cannon, K.R., Robertson, J.A. and Cook, F.D. 1986. Dynamics of soil microbial biomass and water-soluble organic C in Breton L after 50 years of cropping to two rotations. Can J. Soil. Sci. **66**: 1-19. **[Bret-Class Rot]**

Insam, H. and Parkinson, D. 1989. Influence of macroclimate on soil microbial biomass. Soil Biol. Biochem. **21**: 211-221. **[Bret-Class Rot]**

Monreal, C.M. and McGill, W.B. 1989a. Kinetic analysis of cystine cycling through the solution of a Gray Luvisol and an Andept soil. Soil Biochem. **21**: 671-679. **[Bret-Class Rot]**

Monreal, C.M. and McGill, W.B. 1989b. Kinetic analysis of soil microbial components under perturbed and steady-state conditions in a Gray Luvisol. Soil Biol. Biochem. **21**: 681-688. **[Bret-Class Rot]**

Monreal, C.M. and McGill, W.B. 1989c. The dynamics of free cystine cycling at steady-state through the solutions of selected cultivated and uncultivated Chernozemic and Luvisolic soils. Soil Biol. Biochem. **21**: 689-694**. [Bret-Class Rot]**

Insam, H. 1990. Are the soil microbial biomass and basal respiration governed by the climatic regime? Soil Biol. Biochem. **22**: 525-532. **[Bret-Class Rot]**

Campbell, C.A., Biederbeck, V.O., Zentner, R.P. and Lafond, G.P. 1991. Effect of crop rotations and cultural practices on soil organic matter, microbial biomass and respiration in a thin Black Chernozem. Can. J. Soil Sci. **71**: 363-376. **[IH-Rot]**

Campbell, C.A., Bowren, K.E., Schnitzer, M., Zentner, R.P. and Townley-Smith, L. 1991. Effect of crop rotations and fertilization on soil organic matter and some biochemical properties of a thick Black Chernozem. Can. J. Soil Sci. **71**: 377-387. **[Mel-Rot]**

Campbell, C.A., LaFond, G.P., Leyshon, A.J., Zentner, R.P. and Janzen, H.H. 1991. Effect of cropping practices on the initial potential rate of N mineralization in a thin Black Chernozem. Can. J. Soil Sci. **71**: 43-53. **[IH-Rot]**

Campbell, C.A., Schnitzer, M., LaFond, G.P., Zentner, R.P. and Knipfel, J.E. 1991. Thirty-year crop rotations and management practices effects on soil and amino nitrogen. Soil Sci. Soc. Am. J. **55**: 739-745. **[IH-Rot]**

Campbell, C.A., Brandt, S.A., Biederbeck, V.O., Zentner, R.P. and Schnitzer, M. 1992. Effect of crop rotations and rotation phase on characteristics of soil organic matter on a Dark Brown Chernozemic soil. Can. J. Soil Sci. **72**: 403-416. **[Sco-Rot]**

Campbell, C.A., Moulin, A.P., Bowren, K.E., Janzen, H.H., Townley-Smith, L. and Biederbeck, V.O. 1992. Effect of crop rotations on microbial biomass, specific respiratory activity and mineralizable nitrogen in a Black Chernozemic soil. Can. J. Soil Sci. **72**: 417-427. **[Mel-Rot]**

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[Bret-Class Rot, Leth-Rot ABC]

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Other Scientific

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G. Soil Organic Matter (Fertility Perspective):

Research Publications

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Monreal, C.M. and Janzen, H.H. 1993. Soil organic-carbon dynamics after 80 years of cropping a dark brown Chernozem. Can. J. Soil Sci. **73**:133-136. **[Leth-Rot ABC, Leth-Rot Chemist]**

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Other Scientific

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Juma, N.G. 1995. Dynamics of soil C and N in a Typic Cryoboroll and a Typic Cryoboralf located in the Cryoboreal regions of Alberta. Pages 187-196 *in* R. Lal, J. Kimble, E. Levine, and B.A. Stewart, eds. Advances in Soil Science: Soil Management and Greenhouse Effect. Lewis Publishers, CRC Press. Boca Raton, FLA. **[Bret-Class Rot]**

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H. Soil Quality:

Research Publications

McCoy, D.A., and Webster, G.R. 1977. Acidification of a Luvisolic soil caused by low-rate, long-term applications of fertilizers and its effects on growth of alfalfa. Can. J. Soil Sci. **57**: 119-127. **[Bret-Class Rot]**

Carter, M.R. and Rennie, D.A. 1982. Changes in soil quality under zero tillage farming systems: distribution of microbial biomass and mineralizable C and N potentials. Can. J. Soil Sci. **62**: 587-597. **[Leth-Till POW]**

Campbell, C.A. and Zentner, R.P. 1984. Effect of fertilizer on soil pH after 17 years of continuous cropping in southwestern Saskatchewan. Can. J. Soil Sci. 64: 705-710. **[SC-Old Rot]**

Bremer, E., Janzen, H.H. and Johnston, A.M. 1994. Sensitivity of total, light fraction and mineralizable organic matter to management practices in a Lethbridge soil. Can. J. Soil Sci. **74**: 131-138. **[Leth-Rot 120]**

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Wani, S.P., McGill, W.B., Haugen-Kozyra, K.L., Robertson, J.A. and Thurston, J.J. 1994. Improved soil quality and barley yields with fababeans, manure, forages and crop rotations on a Gray Luvisol. Can. J. Soil Sci. 74: 75-84. **[Bret-AER, Bret-Class Rot]**

Bremer, E., Ellert, B. H. and Janzen, H. H. 1995. Total and light-fraction carbon dynamics during four decades after cropping changes. Soil Sci. Soc. Am. J. **59**: 1398-1403. **[Leth-Rot 120]**

Larney, F.J., Bremer, E., Janzen, H.H., Johnston, A.M. and Lindwall, C.W. 1997. Changes in total, mineralizable and light fraction soil organic matter with cropping and tillage intensities in semiarid southern Alberta, Canada. Soil Tillage Res. **42**:229-240. **[Leth-Till POW]**

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Wienhold, B.J., Pikul, J.L., Liebig, M.A., Mikha, M.M., Varvel, G.E., Doran, J.W. and Andrews, S.S. 2006. Cropping systems effects on soil quality in the Great Plains: Synthesis from a regional project. Renew. Agric. Food Syst. **21**: 49-59. **[SC-Old Rot]**

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Other Scientific

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Campbell, C.A., Janzen, H.H. and Juma, N.G. 1997. Case studies of soil quality in the Canadian Prairies: Long-term field experiments. Pages 351-397 *in* E.G. Gregorich and M.R. Carter, eds. Soil Quality for Crop Production. Elsevier Science Publishers, Amsterdam. **[Bret-Class Rot, IH-Rot, Leth-Rot 120, Mel-Rot, SC-Old Rot]**

Janzen, H.H., Campbell, C.A., Ellert, B.H. and Bremer, E. 1997. Soil organic matter dynamics and their relationship to soil quality. Pages 277-292 *in* E.G. Gregorich and M.R. Carter, eds. Soil Quality for Crop Production. Elsevier Science Publishers, Amsterdam. **[Leth-Rot 120]**

I. Soil Physical Properties:

Research Publications

Toogood, J.A., and Lynch, D.L. 1959. Effect of cropping systems and fertilizers on mean weight-diameter of aggregates of Breton Plot soils. Can. J. Soil Sci. **39**: 151-156. **[Bret-Class Rot]**

Chang, C. and Lindwall, C. W. 1989. Effect of long-term minimum tillage practices on some physical properties of a Chernozemic clay loam. Can. J. Soil Sci. **69**: 443-449. **[Leth-Till POW]**

Campbell, C.A., Curtin, D., Brandt, S.A. and Zentner, R.P. 1993. Soil aggregation as influenced by cultural practices in Saskatchewan. II. Brown and Dark Brown Chernozemic soils. Can. J. Soil Sci. **73**: 597-612. **[SC-Old Rot, Sco-Rot]**

Campbell, C.A., Moulin, A.P., Curtin, D., Lafond, G.P. and Townley-Smith, L. 1993. Soil aggregation as influenced by cultural practices in Saskatchewan. I. Black Chernozemic soils. Can. J. Soil Sci. **73**: 579-595. **[IH-Rot, Mel-Rot]**

Curtin, D., Campbell, C.A., Zentner, R.P. and Lafond, G.P. 1994. Long-term management and clay dispersibility in two Haploborolls in Saskatchewan. Soil Sci. Soc. Am. J. **58**: 962-967. **[IH-Rot, SC-Old Rot]**

Monreal, C.M., Zentner, R.P. and Robertson, J.A. 1995. The influence of management on soil loss and yield of wheat in Chernozemic and Luvisolic soil. Can. J. Soil Sci. **75**: 567-574. **[Bret-Class Rot, SC-Old Rot]**

Pikul, J.L., Schwartz, R.C., Benjamin, J.G., Baumhardt, R.L. and Merrill, S. 2006. Cropping system influences on soil physical properties in the Great Plains. Renew. Agric. Food Syst. **21**: 15-25.6 **[SC-Old Rot]**

J. Soil Moisture:

Research Publications

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Zentner, R.P., Campbell, C.A., Selles, F., McConkey, B.G., Jefferson, P.G. and Lemke, R. 2003. Cropping frequency, wheat classes and flexible rotations: Effects on production, nitrogen economy, and water use in a Brown Chernozem. Can. J. Plant Sci. **83**: 667-680. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P., Basnyat, P., McConkey, B.G., Gan, Y.T. and Cutforth, H.W. 2007. Water use efficiency and water and nitrate distribution in soil in the semiarid prairie: Effect of crop type over 21 years. Can J. Plant Sci. **87**: 815-827**. [SC-Old Rot]**

DeJong, R., Campbell, C.A., Zentner, R.P., Basnyat, P., Cutforth, H. and Desjardins, R. 2008. Quantifying soil water conservation in the semiarid region of Saskatchewan, Canada. Can. J. Soil Sci. **88**: 461-475. **[SC-Old Rot]**

DeJong R., Campbell, C.A., Zentner, R.P., Basnyat, P., Grant, B. and Desjardins, R. 2011. Cropping frequency and N fertilizer effects on soil water distribution from spring to fall in semiarid Canadian prairies. Agric. Sci **2**: 220-237. **[SC-Old Rot]**

Kröbel, R., Campbell, C.A., Zentner, R.P., Lemke, R., Steppuhn, H., Desjardins, R.L. and De Jong, R. 2012. Nitrogen and phosphorus effects on water use efficiency of spring wheat grown in the semiarid region of the Canadian Prairie. Can. J. Soil Sci. **92**:573-587. **[SC-Old Rot]**

K. Economics:

Research Publications

Toogood, J.A. 1972. Effects of fertilizers, species, and maturity on yields, economic returns, and nutritive value of grasses and legumes grown on a gray wooded soil. Can. J. Soil. Sci. **52**: 245-252. **[Bret-Class Rot]**

Zentner, R.P., Campbell, C.A., Read, D.W.L. and Anderson, C.H. 1984. An economic evaluation of crop rotations in southwestern Saskatchewan. Can. J. Ag. Econ. **32**: 37-54. **[SC-Old Rot]**

Zentner, R.P. and Campbell, C.A. 1988. First 18 years of a long-term crop rotation study in southwestern Saskatchewan - yields, grain protein, and economic performance. Can. J. Plant Sci. **68**: 1-21. **[SC-Old Rot]**

Zentner, R.P., Stephenson, J.E., Johnson, P.J., Campbell, C.A. and Lafond, G.P. 1988. The economics of wheat rotations on a heavy clay chernozemic soil in the Black soil zone of east-central Saskatchewan. Can. J. Plant Sci. **68**: 389-404**. [IH-Rot]**

Zentner, R.P., Bowren, K.E., Stephenson, J.E., Campbell, C.A., Moulin, A. and Townley-Smith, L. 1990. Effects of rotation and fertilization on economics of crop production in the Black soil zone of north-central Saskatchewan. Can. J. Plant Sci. **70:** 837-851. **[Mel-Rot]**

Zentner, R.P., Brandt, S.A., Kirkland, K.J., Campbell, C.A. and Sonntag, G.J. 1992. Economics of rotation and tillage systems for the Dark Brown soil zone of the Canadian Prairies. Soil Tillage Res. **24:** 271-284. **[Sco-Rot]**

Zentner, R.P., Dyck, F.B., Handford, K.R., Campbell, C.A. and Selles, F. 1993. Economics of flex-cropping in southwestern Saskatchewan. Can. J. Plant Sci. **73**: 749-767. **[SC-Old Rot]**

Smith, E.G., Johnston, A.M. and Janzen, H.H. 1994. Influence of organic amendments on the economic performance of long-term spring wheat rotations in southern Alberta. J. Sustain. Agric. **4:** 31-45. **[Leth-Rot 120]**

Smith, E.G., Peters, T.L., Blackshaw, R.E., Lindwall, C.W. and Larney, F.J. 1996. Economics of reduced tillage fallow-crop systems in the Dark Brown soil zone of Alberta. Can. J. Soil Sci. **76**: 411-416. **[Leth-Till POW]**

Zentner, R.P., Brandt, S.A. and Campbell, C.A. 1996. Economics of monoculture cereal and mixed oilseed-cereal rotations in west-central Saskatchewan. Can. J. Plant Sci. **76**: 393-400. **[Sco-Rot]**

Zentner, R.P., McConkey, B.G., Campbell, C.A., Dyck, F.B. and Selles, F. 1996. Economics of conservation tillage in the semiarid prairie. Can. J. Plant Sci. **76**: 697-705. **[SC-OMC Till]**

Zentner, R.P., Wall, D.D., Nagy, C.N., Smith, E.G., Young, D.L., Miller, P.R., Campbell, C.A., McConkey, B.G., Brandt, S.A., Lafond, G.P., Johnston, A.M., and Derksen, D.A. 2002. Economics of crop diversification and soil tillage opportunities in the Canadian Prairies. Agron. J. **94:** 216-230. **[IH-Rot, Leth-Rot 120, Leth-Rot ABC, SC-Old Rot, SC-OMC Till]**

Zentner, R.P., Campbell, C.A., Selles, F., Jefferson, P.G., Lemke, R., McConkey, B.G., Fernandez, M.R., Hamel, C., Gan, Y. and Thomas, A.G. 2006. Effect of fallow frequency, flexible rotations, legume green manure, and wheat class on the economics of wheat production in the Brown soil zone. Can. J. Plant Sci. **86**: 413-423. **[SC-New Rot]**

Zentner, R.P., Campbell, C.A., Selles, F., Lemke, R., McConkey, B.G., Fernandez, M.R., Hamel, C. and Gan, Y.T. 2007. Economics of spring wheat production systems using conventional tillage management in the Brown soil zone - Revisited. Can. J. Plant Sci. **87**: 27-40. **[SC-Old Rot]**

Other Scientific

Zentner, R.P., Campbell, C.A., Brandt, S.A., Bowren, K.E. and Spratt, E.D. 1986. Economics of crop rotations in western Canada. Pages 254-317 *in* A.E. Slinkard & D.B. Fowler, eds. Wheat Production in Canada - A Review. Proc. of the Canadian Wheat Production Symposium, Saskatoon, Sask. **[IH-Rot, Mel-Rot, SC-Old Rot, Sco-Rot]**

L. Energy:

Research Publications

Zentner, R.P., Campbell, D.W., Campbell, C.A. and Read, D.W. 1984. Energy considerations of crop rotations in southwestern Saskatchewan. Can. Agric. Eng. **26:** 25-29. **[SC-Old Rot]**

Zentner, R.P., Stumborg, M.A. and Campbell, C.A. 1989. Effect of crop rotations and fertilization on energy balance in typical production systems on the Canadian Prairies. Agric. Ecosystems Environ. **25:** 217-232. **[SC-Old Rot]**

M. Disease:

Research Publications

Wani, S.P., McGill, W.B. and Tewari, J.P. 1991. Mycorrhizal and common-root rot infection, and nutrient accumulation in barley grown on Breton loam using N from biological fixation or fertilizer. Biol. Fert. Soils **12:** 46-54. **[Bret-AER, Bret-Class Rot]**

Fernandez, M.R., Zentner, R.P., McConkey, B.G. and Campbell, C.A. 1998. Effects of crop rotations and fertilizer management on leaf spotting diseases of spring wheat in southwestern Saskatchewan. Can. J. Plant Sci. **78:** 489-496. **[SC-Old Rot]**

Fernandez, M.R. and Zentner, R.P. 2005. The impact of crop rotation and N fertilizer on common root rot of spring wheat in the Brown soil zone of western Canada. Can. J. Plant Sci. **85:** 569-575. **[SC-Old Rot]**

N. Greenhouse Gases:

Research Publications

Curtin, D., Selles, F., Wang, H., Campbell, C.A. and Biederbeck, V.O. 1998. Carbon dioxide emissions and transformation of soil carbon and nitrogen during wheat straw decomposition. Soil Sci. Soc. Am. J. **62**: 1035-1041. **[SC-Old Rot]**

Curtin, D., Wang, H., Selles, F., McConkey, B.G. and Campbell, C.A. 2000. Tillage effects on carbon fluxes in continuous wheat and fallow-wheat rotations. Soil Sci. Soc. Am. J. **64**: 2080-2086. **[SC-OMC Till]**

Curtin, D., Wang, H., Zentner, R.P., Selles, F., Biederbeck, V.O. and Campbell, C.A. 2000. Legume green manure as partial fallow replacement in semiarid Saskatchewan: Effect on carbon fluxes. Can. J. Soil Sci. **80**: 499-505. **[SC-New Rot]**

Curtin, D., Wang, H., Selles, F., Campbell, C.A. and Zentner, R.P. 2002. Soil fertility effects on carbon fluxes under two spring wheat rotations in a semiarid agroecosystem. Can. J. Soil Sci. **82**: 155-163. **[SC-New Rot]**

Lemke, R., Zhong, Z., Campbell, C.A. and Zentner, R.P. 2007. Can pulse crops play a role in mitigating greenhouse gases from north American agriculture. Agron. J. **99**: 1719-1725. **[SC-Old Rot]**

Ellert, B.H. and Janzen, H.H. 2008. Nitrous oxide, carbon dioxide and methane emissions from irrigated cropping systems as influenced by legumes, manure and fertilizer. Can. J. Soil Sci. **88**: 207-217. **[Leth-Rot U]**

O. Carbon Sequestration:

Research Publications

Campbell, C.A., McConkey, B.G., Zentner, R.P., Dyck, F.B., Selles, F. and Curtin, D. 1995. Carbon sequestration in a Brown Chernozem as affected by tillage and rotation. Can. J. Soil Sci. **75**: 449-458. **[SC-OMC Till]**

Campbell, C.A., McConkey, B.G., Zentner, R.P., Selles, F. and Curtin, D. 1996a. Tillage and crop rotation effects on soil organic matter in a coarse-textured Typic Haploboroll in southwestern Saskatchewan. Soil Tillage Res. **37**: 3-14. **[SC-OMC Till]**

Campbell, C.A., McConkey, B.G., Zentner, R.P., Selles, F. and Curtin, D. 1996b. Long-term effects of tillage and crop rotations on soil organic C and N in a clay soil in southwestern Saskatchewan. Can. J. Soil Sci. **76**: 395-401. **[SC-OMC Till]**

Campbell, C.A., Selles, F., Lafond, G.P., McConkey, B.G. and Hahn, D. 1998. Effect of crop management on C and N in long-term crop rotations after adopting no-tillage management: Comparison of soil sampling strategies. Can. J. Soil Sci. **78**: 155-162. **[IH-Rot]**

Dumanski, J., Desjardins, R.L., Tarnocai, C., Monreal, C., Gregorich, E.G., Kirkwood, V. and Campbell, C.A. 1998. Possibilities for future carbon sequestration in Canadian agriculture in relation to land use changes. Climate Change **40**: 81-103. **[SC-Old Rot]**

Janzen, H.H., Campbell, C.A., Izaurralde, R.C., Ellert, B.H., Juma, N., McGill, W.B. and Zentner, R.P. 1998. Management effects on soil C storage on the Canadian prairies. Soil Tillage Res. **47:** 181-195. **[Bret-Class Rot, IH-Rot, Leth-Rot 120, Leth-Rot ABC, Mel-Rot, SC-Old Rot]**

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[Leth-Rot 120, Leth-Rot ABC, Leth-Rot U, Leth-Till POW]

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Juma, N.G., Izaurralde, R.C., Robertson, J.A., McGill, W.B. 1997. Crop yield and soil organic matter trends over 60 years in a Typic Cryoboralf at Breton, Alberta. Pages 273-281 *in* E.A. Paul, E.T. Elliott, K. Paustian and C.V. Cole, eds. Soil Organic Matter in Temperate Agroecosystems: Long-term Experiments in North America. CRC Press, Boca Raton. **[Bret-Class Rot]**

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Lafond, G.P., Campbell, C.A., Moulin, A.P., Townley-Smith, L. and Zentner, R.P. 1997. Indian Head, Saskatchewan: Crop Rotation and Fertilization Interactions. *In* E.A. Paul, E.T. Elliott, K. Paustian and C.V. Cole, eds. Soil organic matter in temperate Agro-ecosystems: Long term experiments in North America. Part IV: Soil, Crop, and Management of Long-Term Experiments in North America. CRC Press, Boca Raton, FL. *(On disk in book)* **[IH-Rot]**

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Izaurralde, R.C., Haugen-Kozyra K.L., Jans, D.C., McGill, W.B., Grant, R.F. and Hiley, J.C. 2001. Soil organic carbon dynamics: measurement, simulation and site to region scale-up. Pages 553-575 *in* R. Lal, J.M. Kimble, R.F. Follett and B.A. Stewart, eds. Assessment methods for soil carbon. Lewis Publishers. Boca Raton, FL. **[Bret-Class Rot]**

Liang, B.C., McConkey, B.G., Campbell, C.A., Johnston, A. and Moulin, A. 2001. Short-term crop rotation and tillage effects on soil organic carbon on the Canadian prairies. Pages 287-293 *in* J.M. Kimble, R. Lal and R.F. Follett, eds. Agricultural Policies and Practices for carbon sequestration in soil. Lewis Publishers, Boca Raton, USA. **[SC-OMC Till]**

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P. Legume Green Manure:

Research Publications

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Zentner, R.P., Campbell, C.A., Biederbeck, V.O. and Selles, F. 1996. Indianhead black lentil as green manure for wheat rotations in the Brown soil zone. Can. J. Plant Sci. **76**: 417-422. **[SC-New Rot]**

Q. Sustainable Agriculture:

Research Publications

Campbell, C.A., Myers, R.J.K. and Curtin, D. 1995. Managing nitrogen for sustainable crop production. Fert. Res. **42**: 277- **[IH-Rot, Mel-Rot, SC-Old Rot]**

Janzen, H.H. 1995. The role of long-term sites in agroecological research: A case study. Can. J. Soil Sci. **75**: 123-133**. [Leth-Rot ABC]**

Rasmussen, P.E., Goulding, K.W.T., Brown, J.R., Grace, P.R., Janzen, H.H. and Korschens, M. 1998. Long-term agroecosystem experiments: Assessing agricultural sustainability and global change. Science **282**(5390): 893-896. **[Bret-Class Rot, Leth-Rot ABC]**

Zentner, R.P., Campbell, C.A., Biederbeck, V.O., Miller, P.R., Selles, F. and Fernandez, M.R. 2001. In search of a sustainable cropping system for the semiarid Canadian prairies. J. Sustain. Agric. **18**: 117-136. **[SC-Old Rot]**

Grant, C.A., Peterson, G.A. and Campbell, C.A. 2002. Nutrient considerations for diversified cropping systems in the northern great plains. Agron. J. **94**: 186-198. **[IH-Rot, SC-Old Rot]**

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Campbell, C.A., Zentner, R.P., Janzen, H.H. and Bowren, K.E. 1990. Crop rotation studies on the Canadian Prairies. Canadian Gov't. Publ. Centre, Supply & Services Canada, Hull, P.Q. Publ. No. 1841/E, 133 pp. **[IH-Rot, Leth-Rot 120, Leth-Rot ABC, Mel-Rot, SC-Old Rot, Sco-Rot]**

Zentner, R.P., Campbell, C.A., Janzen, H.H. and Bowren, K.E. 1990. Benefits of crop rotation for sustainable agriculture in dryland farming. Agriculture Canada Publication No. 1839/E**. [Leth-Rot 120, Leth-Rot ABC, Mel-Rot, SC-Old Rot]**

Elliott, E.T., Janzen, H.H., Campbell, C.A., Cole, C.V. and Myers, R.J.K. 1993. Principles of ecosystem analysis and their application to integrated nutrient management and assessment of sustainability. Pages 35-57 *in* R.C. Wood and J. Dumanski, eds. Sustainable Land Management for the 21st Century. Proc. of Int'l. Workshop, Univ. of Lethbridge, Lethbridge, Canada, June 20-26, 1993. **[Leth-Rot 120, Leth-Rot ABC, SC-Old Rot]**

Campbell, C.A., Rennie, D.A. and Bailey, L.D. 1994. Nitrogen, phosphorus, potassium, sulphur: Answers to your questions. *In* P. Brand, ed. Bulletin from Prairie Farm Rehabilitation Administration, Regina, Sask. **[Bret-Class Rot, IH-Rot, Leth-Rot ABC, Mel-Rot, SC-Old Rot, Sco-Rot]**

R. Modelling (SPAW, EPIC, ECOSYS, CENTURY, LEACHMN, HERMES, CAMPBELL, ICBM):

Research Publications

DeJong, R. and Zentner, R.P. 1985. Assessment of the SPAW model for semi-arid growing conditions with minimal local calibration. Agric. Water Manage. **10**: 31-46. **[SC-Old Rot]**

Moulin, A.P. and Beckie, H.J. 1993. Evaluation of the CERES and EPIC models for predicting spring wheat grain yield over time. Can. J. Plant Sci. **73**:713-719. **[Mel-Rot]**

Beckie, H.J., Moulin, A.P., Campbell C.A. and Brandt, S.A. 1995. Simulating distribution of soil nitrate-N and water. Can. J. Soil Sci. **75**: 135-143. **[IH-Rot, Mel-Rot, SC-Old Rot, Sco-Rot]**

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Grant, R.F. 1997. Changes in soil organic matter under different tillage and rotation: Mathematical modelling in *ecosys*. Soil Sci. Soc. Am. **61**: 1159-1175. **[SC-OMC Till]**

Roloff, G., DeJong, R., Zentner, R.P., Campbell, C.A. and Benson, V.W. 1998a. Estimating spring wheat yield variability with EPIC. Can. J. Soil Sci. **78**: 541-549. **[SC-Old Rot]**

Roloff, G., DeJong, R., Zentner, R.P., Campbell, C.A. and Benson, V.W. 1998b. EPIC estimates of soil water and soil nitrogen and carbon under semiarid temperate conditions. Can. J. Soil Sci. **78**: 551-562. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P., Liang, B.C., Gregorich, E.G., Roloff, G. and Blomert, B. 2000. Organic C accumulation in soil over 30 years in semiarid southwestern Saskatchewan - Effect of crop rotations and fertilizers. Can. J. Soil Sci. **80**: 179-192. **[SC-Old Rot]**

Campbell, C.A., Zentner, R.P., Selles, F., Biederbeck, V.O., McConkey, B.G., Blomert, B. and Jefferson, P.J. 2000. Quantifying short-term effects of crop rotations on soil organic carbon in southwestern Saskatchewan. Can. J. Soil Sci. **80**: 193-202. **[SC-New Rot]**

Campbell, C.A., Zentner, R.P., Selles, F., Liang, B.C. and Blomert, B. 2001. Evaluation of a simple model to describe carbon accumulation in a Brown Chernozem under varying fallow frequency. Can. J. Soil Sci. **81**: 383-394. **[SC-Old Rot]**

Grant, R.F., Juma, N.G., Robertson, J. A., Izaurralde, R. C., and McGill, W. B. 2001. Long-term changes in soil carbon under different fertilizer, manure, and rotation: testing the mathematical model ecosys from data from the Breton Plots. Soil Sci. Soc. Am. J. **65**: 205-214. **[Bret-Class Rot]**

Akinremi, O.O., Jame, Y.W., Campbell, C.A., Zentner, R.P., Chang, C. and DeJong, R. 2005. Evaluation of LEACHMN under dryland conditions. Can. J. Soil Sci. **85**: 223-232. **[SC-Old Rot]**

Liang, B.C., Campbell, C.A., McConkey, B.G., Padbury, G. and Collas, P. 2005. An empirical model for estimating carbon sequestration on the Canadian Prairies. Can., J. Soil Sci. **85**: 549-556. **[SC-Old Rot]**

Izaurralde, R.C., Williams, J.R., McGill, W.B., Rosenberg, N.J., and Quiroga Jakas, M.C. 2006. Simulating soil C dynamics with EPIC: Model description and testing against long-term data. Ecol. Modelling **192**: 362-384. **[Bret-Class Rot]**

Kersebaum, K.C., Wurbs, A., DeJong, R., Campbell, C.A., Yang, J. and Zentner, R.P. 2006. Long-term simulation of soil-crop interactions in semiarid southwestern Saskatchewan/Canada. Eur. J. Agron. **29**: 1-12. **[SC-Old Rot]**

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VandenBygaart, A.J., Angers, D.A., Gregorich, E.G., Bolinder ,M.A., Janzen, H.H. and Campbell, C.A. 2008. Modelling soil organic carbon change in Canadian agroecosystems: Testing of the Introductory Carbon Balance Model. *In* R. Lal and R.F. Follett, eds. Soil carbon sequestration and the greenhouse effect. 2nd Edition. SSSA Special Publication **57**: 13-28. **[SC-Old Rot]**

S. Salinity

Research Publications

Beke, G.J., Janzen, H.H. and Entz, T. 1994. Salinity and nutrient distribution in soil profiles of long-term crop rotations. Can. J. Soil Sci. **74:** 229-234. **[Leth-Rot 120, Leth-Rot ABC]**

T. Trace elements

Research Publications

Selles, F., Clarke, J.M., Zentner, R.P. and Campbell, C.A. 2003. Phosphorus source and placement effects on Cd concentration of durum wheat cultivars. Can. J. Plant Sci. **83**: 475-482. **[SC-Old Rot]**

U. Erosion

Research Publications

Monreal, C.M., Zentner, R.P and Robertson, J.A. 1995. The influence of management on soil loss and yield of wheat in Chernozemic and Luvisolic soils. Can. J. Soil Sci. **75**: 567-574. **[Bret-Class Rot]**

Other Scientific

Larney, F.J., Bullock, M.S. and Lindwall, C.W. 1997. Residue cover versus soil clods for wind erosion production on fallow. CAESA factsheet CSQ04. **[Leth-Till POW]**

V. Irrigation

Research Publications

Hill, K.W. 1951. Effects of forty years of cropping under irrigation. Science Agriculture **31**: 349-357. **[Leth-Rot U]**

Dubetz, S. and Oostervald, M. 1979. Sixty-year trends in irrigated crop yields-barley, wheat, and oats. Can. J. Plant Sci. **59:** 685-689. **[Leth-Rot U]**

Dubetz, S. and Dudas, M.J. 1981. Potassium status of a Dark Brown Chernozem soil after sixty-six years of cropping practices under irrigation. Can. J. Soil Sci. **61**:409-415. **[Leth-Rot U]**

Dubetz, S. and Oostervald, M. 1986. Effects of weather variables on the yields of sugar beets grown in an irrigated rotation for fifty years. J. Am. Soc. Sugar Beet Tech. **19**:143-149. **[Leth-Rot U]**

W. Soil Biota and Soil Micromorphology

Research Publications

Pawluk, S. 1980. Micromorphological investigations of cultivated Gray Luvisols under different management practices. Can. J. Soil Sci. **60:** 731-745. **[Bret-Class Rot]**

Berg, N.W., and Pawluk, S. 1984. Soil mesofaunal studies under different vegetative regimes in north central Alberta. Can J. Soil Sci. **64**: 209-223. **[Bret-Class Rot]**

Fyles, I.H., Juma, N.G. and Robertson, J.A. 1988. Dynamics of microbial biomass and faunal populations in long-term plots on a Gray Luvisol. Can. J. Soil Sci. **68**: 91-100. **[Bret-Class Rot]**

Juma, N.G. and Mishra, C.C. 1988. Effect of an annual and a perennial crop on trophic group dynamics of nematodes. Can. J. Soil Sci. **68**: 101-109. **[Bret-Class Rot]**

X. Sulfur Deficiency in Gray Luvisols

Research Publications

Newton, J.D. 1931. Sulphur oxidation in Alberta soils and related experiments. Scientific Agric. **11**: 612-622. **[Bret-Class Rot]**

Newton, J.D. 1936. The fertilizing value of sulphate in natural 'alkali' for gray wooded soils. Scientific Agric. **16:** 241-244. **[Bret-Class Rot]**

Cormack, D.V., Bentley, C.F. and Scott, D.B. 1951. Fertilizer studies with radioactive sulphur. I. Scientific Agric. **31**: 41-51. **[Bret-Class Rot]**

Renner, R., Bentley, C.F., and McElroy, L.W. 1953. Nine essential amino acids in the protein of wheat and barley grown on sulfur-deficient soil. Soil Sci. Soc. Am. Proc. **17**: 270-273. **[Bret-Class Rot]**

Bentley, C.F., Hoff, D.J. and Scott, D.B. 1955. Fertilizer studies with radioactive sulphur. II. Can. J. Agric. Sci. **35**: 264-281. **[Bret-Class Rot]**

Bentley, C.F., Gareau, L., Renner, R., McElroy, L.W. 1956. Fertilizers and nutritive value of hays. I. Sulphur-deficient gray wooded soils. Can. J. Agric. Sci. **36**: 315-325. **[Bret-Class Rot]**

Bentley, C.F., Carson, J.A. and Bowland, J.P. 1960. Fertilizers and the nutritive value of wheat grown on sulphur-deficient gray wooded soil. Can J. Plant Sci. **40**: 146-155. **[Bret-Class Rot]**

Discussion

We have created an aggregated bibliography for long-term crop rotation studies in the Canadian Prairies with the intention of facilitating research which is and will be conducted by present and future generations. It has been our experience that it takes time to sort through voluminous literature to get appropriate literature citations. It is generally easier to access papers published in referred scientific journals compared to those in the grey literature, such as conference proceedings, technical and extension bulletins, abstracts and so on. The other daunting task faced by students, professional and scientists is the availability of citations for comparative or scientific analysis of a particular topic for a number of related research sites. In our case, we have produced an aggregated bibliography for 13 crop

rotation experiments at 6 research sites in the Canadian Prairies. This involved collaboration of individuals at specific locations and knowledge expertise to sort the publications. Overall, this effort is a very simple example of what has to be done to create and maintain literature being produced for different crop rotations studies at different locations.

In our case, we have also set out to develop a searchable, version of the aggregated bibliography by entering all the data into a database. The second step of this activity was to develop queries to make the data searchable through web pages. We built on our experience of creating a searchable version of the Canadian System of Soil Classification[7], which is currently residing on the pedosphere.ca website[6]. The advantage of a searchable version of a classification book or a bibliography is the ease of accessing information and multiple ways of exploring the data. For example, if one wanted to see all the work done at the Breton Plots across 24 subject headings, one would have to pull the references from the print or e-version of this document. It is much easier through a query via the web. The other advantage is the ease of global access.

Chinn and Beldsoe[4] undertook a project to develop a US LTER All-site bibliography for 18 LTER sites that make up the LTER Network and make it accessible through the internet. They encountered enormous problems in gathering the information because it was being stored differently at individual sites. They used a simple, well-behaved dataset to learn how to assemble, structure and store data for online access. They also noted that it was more difficult to gather online information. Consistency of database is a primary problem and much computer programming is needed to create uniformity. By 1996, LTERnet had 12,000 citations. During the first five months of 1996, there were 1420 searches per month and by the end of the September 1996, the total was 34,119[4]. The key point from the above study is cutting-edge technology brings new problems and demands resources. However, if the database is maintained, then the utility of the searchable version increases exponentially.

This bibliography focussed only on the primary refereed journal papers and on other research publications such as reviews and book chapters that have evolved from these long-term crop rotation experiments. These are no doubt invaluable, especially to the scientific community. However, we did not include graduate student theses and hundreds of technology transfer type articles and talks that emanated from these studies, which provided information in language designed to facilitate the understanding of our findings to producers, policy makers and agricultural industry personnel. Some may even argue that the latter aspect was even more important than the scientific writings. Unfortunately, space and practicality did not allow the inclusion of such information in this treatise. Readers requiring technology transfer type information are encouraged to contact the research establishments to unearth such material. Nevertheless we hope that this bibliography will serve to provide evidence that the tremendous amount of money, effort and time that has been expended on these studies have not been wasted; in fact, the knowledge generated from these studies is now being used to address emerging issues such as climate change, sustainable cropping systems, carbon sequestration, nutrient cycling and water use efficiency, many of which were not envisioned when the studies were first established.

As with any large data set compiled over many decades by many researchers, the findings presented in this bibliography will include some errors, misinterpretations, and oversimplifications. As research continues and understanding grows, these weaknesses are gradually corrected. For that reason, readers using this bibliography are steered to the most recent publications from a specific study, wherever possible. Further, they are encouraged to contact research personnel directly for current updates.

Table 4. Locations of crop rotation studies, names of research contacts and their respective institutions.

Location	Research Contacts	Institution
Breton	Dr. Miles Dyck Mr. Dick Puurveen Dr. Jim Robertson	Dept. Renewable Res., Univ. Alberta, Edmonton
Indian Head	Dr. Guy Lafond	SPARC, AAFC*, Indian Head, SK
Lethbridge	Dr. Elwin Smith Dr. Henry Janzen Dr. Ben Ellert Dr. Frank Larney	LRC, AAFC, Lethbridge, AB
Melfort	Dr. Alan Moulin	BRC, AAFC, Brandon, MB
Scott & Swift Current	Dr. Reynald Lemke	SRC, AAFC, Saskatoon, SK
	Dr. Con Campbell	ECORC, AAFC, Ottawa, ON

*AAFC, Agriculture and Agri-food Canada

Intellectual property and copyright issues are important considerations. In our particular case, we have been given permission to create an online version of the aggregated bibliography from the management of the Prairie Soils and Crops Journal. This is most notable because permission from journal publishers is absolutely necessary in order to add value to the resource and make it globally accessible in alternate ways.

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