Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Plant Residue Decay in Diverse Canadian Soils

*E.G. Gregorich[1], B.H. Ellert[2], H.H. Janzen[2] , B.L. Helgason[3]

Agriculture and Agri-Food Canada, [1]Ottawa, ON; [2]Lethbridge, AB; [3]Saskatoon, SK

Introduction

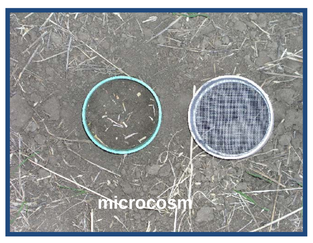
Decay of plant residues is tied to many ecosystem functions affecting atmospheric CO_2, plant-available nutrients, microbial diversity, soil organic matter quality, among others. The rate of decay, in turn, is governed by a range of management, soil, and environmental variables, some of which may be changing in coming decades.

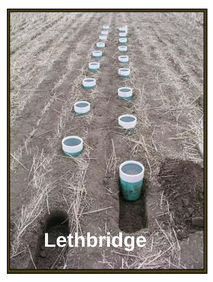
Objective

To evaluate effects of soil type and climate on plant residue decay and C stabilization in Canadian soils.

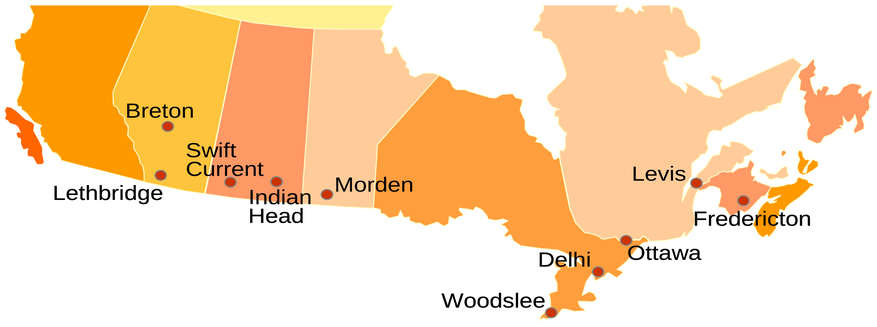
Materials and Methods

- ^{13}C-labelled barley residues (10.2 atom%) contained in open-ended cylinders, 10 cm diam. X 15 cm long, inserted 10 cm in soil.
- Annual residue rate: 200 g C m^{-2} (3.6 g dry matter/microcosm) ^{13}C-enriched residues added in 2007, unlabelled (^{12}C) residues thereafter. NH_4NO_3 added every spring (40 kg N ha^{-1}).
- Hourly soil temperature was logged throughout the year at each site.



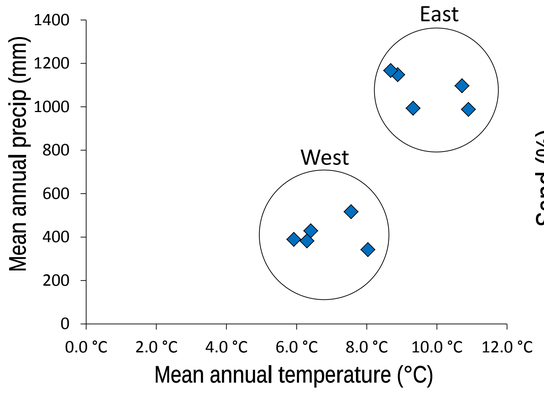


Study sites in Canadian agroecosystems

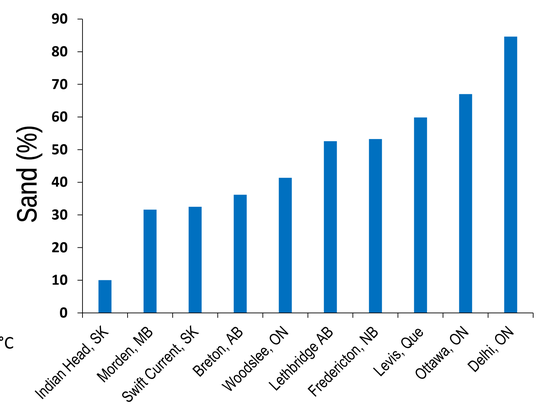


Site collaborators: B. Zebarth (Fredericton,NB), D. Angers (Levis, Que), R. Beyaert (Delhi, ON), C. Drury (Woodslee,ON), D. McAndrew (Morden,MB), G. Lafond (Indian Head,SK), B. McConkey (Swift Current,SK), R. Puurveen (Breton,AB).

Climate across sites



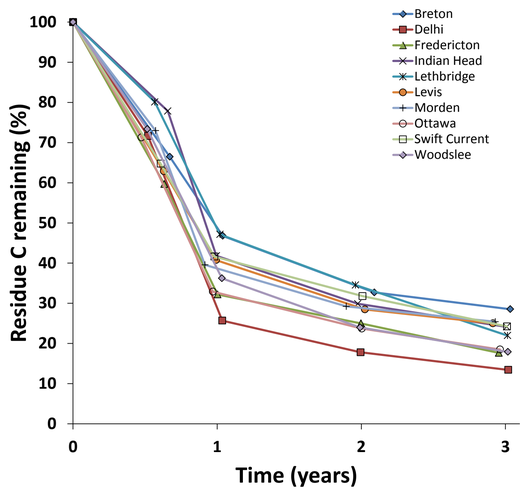
Soil texture across sites



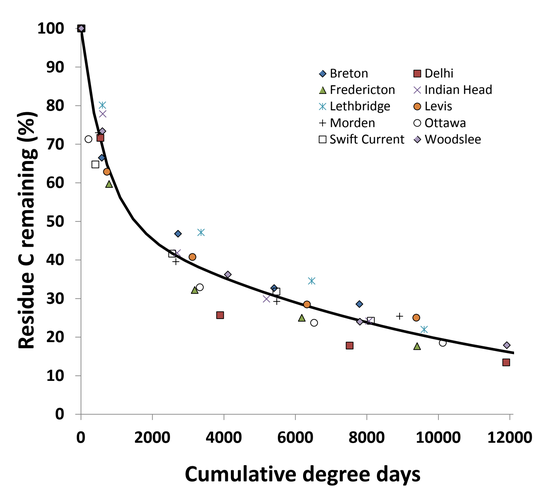
Results

Decomposition rate: Recovery of applied residue C declined quickly – roughly half was lost within 1 year – after that the rate of loss slowed

Residue C recovery – time

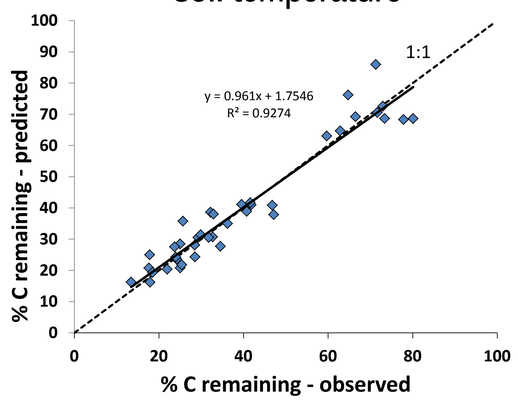


Residue C recovery – soil temperature

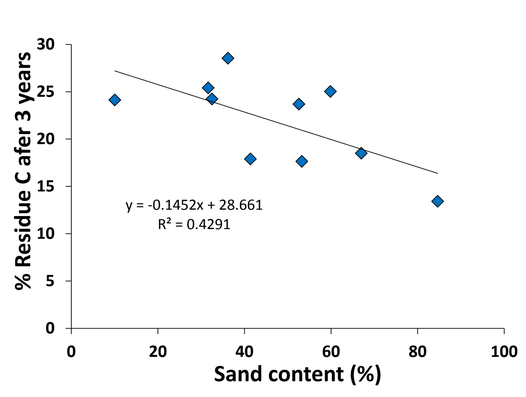


Residue C recovery: After 3 years, the amount of applied ^{13}C remaining ranged from 13 to 28%

soil temperature

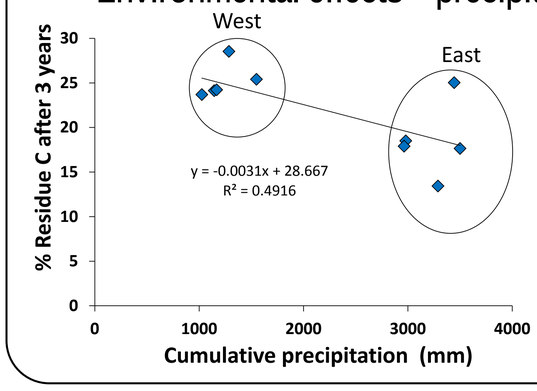


texture effects – sand content

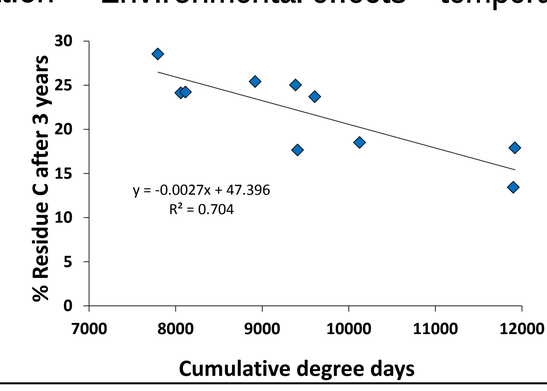


Soil temperature control: Most of the difference in observed loss among sites was related to variation in soil temperature

Environmental effects – precipitation



Environmental effects – temperature



Conclusions

- These findings illustrate the differences in initial decay rates across diverse sites, but suggest that prediction of decay rate can be improved with a simple algorithm based on cumulative thermal units

Canada