

Resilient Food Systems and Sustainable Diets

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I acknowledge this land as
the territory of the Huron-
Wendat and Petun First
Nations, the Seneca, and
most recently,
the Mississaugas of the
Credit River.

I appreciate that they
cared for the land in this
region of Earth, prior to
our arrival.





Photo by Justin Hofman, Barcroft Media

“We are living in the Anthropocene, an epoch where everything of Earth’s current matter and life... is being determined by the ruinous activities of just one soft-skinned, warm-blooded, short-lived pedestrian ape.”

Tim Dee. 2018. *Ground Work: Writings on Places and People*

Current Context

- >7 billion people (0.8 bn cats & dogs, 1.2 bn cars)
- 0.9 billion people suffer from too little food
- 1.6 billion people suffer from eating too much
- Waste about 40% of food in North America



Photo by P. Pauls

Plan A for 2050

- 9 - 10 billion people (30 – 40 % increase)
- In developing countries, average incomes rise, consume more meat and richer foods
- Thus increase food production by 70 – 100%



Plan B for 2050

- More and improved education for girls and women in developing countries with goal of < 9 billion people
- **Reduce** food waste (now 40% in Canada)
- Eat less meat (higher quality), more pulses and edible insects



<https://meetingplaceorganicfarm.ca>



Spicy cricket fritters

<http://entomofarms.com/>

1 Billion

The number of extra people that could be fed if we globally applied the best **current** methods to reduce wasted food.



www.guelphfoodwaste.com

Kummu et al. 2012. Sci. of the Total Environ. 438: 477-489

\$31 Billion - value of wasted food in Canada

Gooch and Felfel. 2014. "\$27 BILLION" REVISITED, THE COST OF CANADA'S ANNUAL FOOD WASTE. Value Chain Mgmt Intern

By reducing wasted food and not having to produce excess food, we all save:

CO₂, CH₄, N₂O
emissions

Energy, Water,
Soil, Biodiversity,
Labour, Money,
Future capacity.

With **respect** we
realize **resilience**

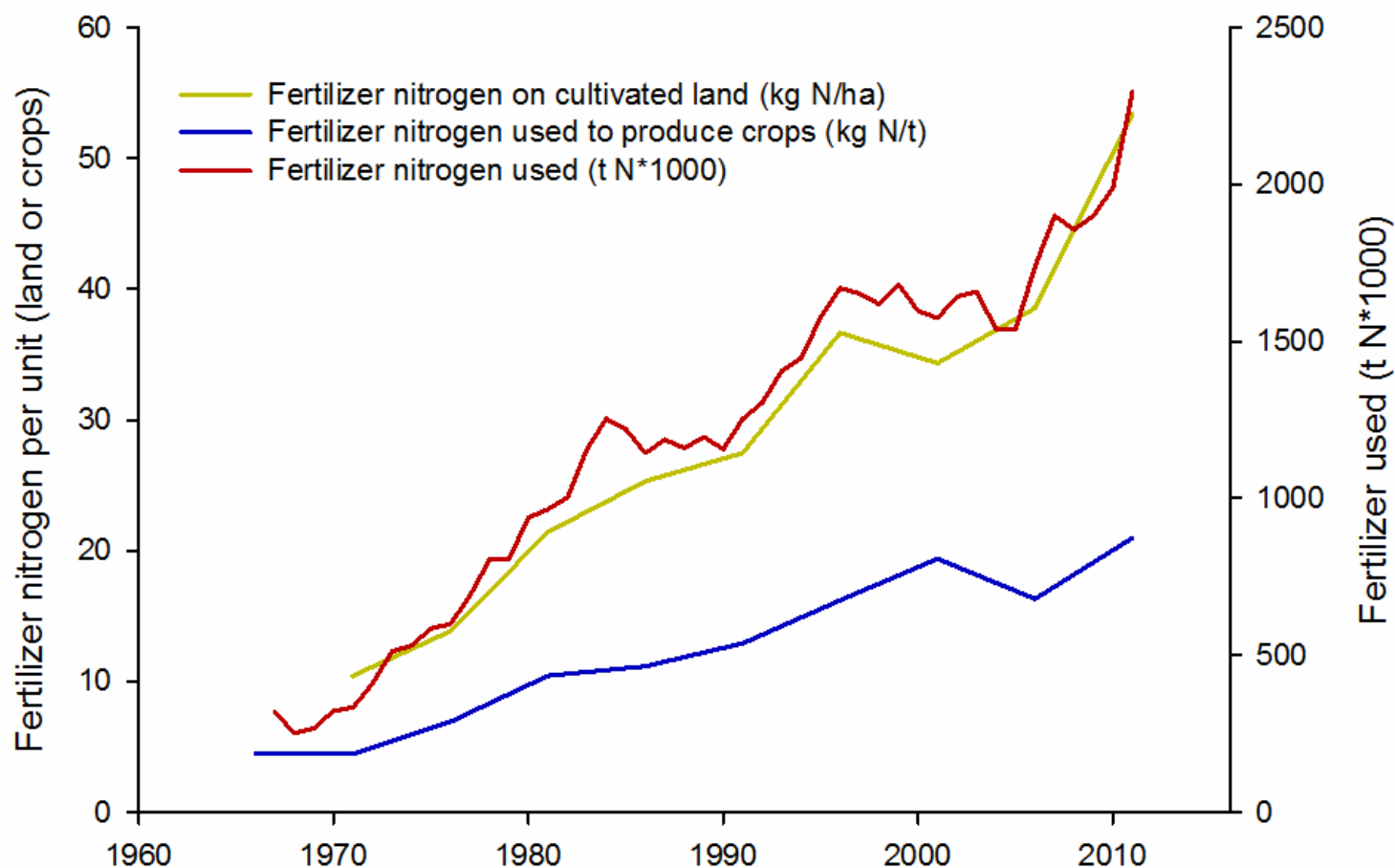
Photo by K. Howe



- About 50% of people today depend directly on the Haber-Bosch process for basic food
- Excess N losses to water (NO_3) and air (N_2O).
- N fertilizer is 1/3 of the global ag energy budget.

Total quantity of N used in fertilizer in Canada, quantity of fertilizer per t of principal crop produced & per ha of cultivated land, 1966-2011.

Statistics Canada, CANSIM database 2013.



**In 40 years,
global food production increased 2x
while N, P and K use increased 5 to 7x
(Hirel et al. 2007 <https://doi.org/10.1093/jxb/erm097>)**





Photo by W. Pfenning

O farms have no N fertilizer and lower yields (19 - 25%) but with small premiums of 5 to 7%, can match profits on non-O farms.

Profits are actually 22 to 35% higher on O farms, when current O premiums are applied.

Crowder and Reganold 2015 (www.pnas.org/content/112/24/7611)

N and P from Reliable Biological Source

Source separate sewage - All new homes could replace water carriage of sewage with compost toilets

- Extract struvite as P source from sewage

<http://crystalgreen.com/>

- If necessary, apply sewage to non-food crops



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Photo: <https://bit.ly/2l045zM>

From Many to Few and Back Again

- 350,000 plant species, 195,000 flowering plants, most have edible parts useful to humans
- < 300 plant species for food; only 17 species provide 90% human food
- Expand diversity of diverse crop species (not just varieties), adapt to climate change and improve health



Canada still gives \$3.3 billion in fossil fuel subsidies for oil and gas producers in reduced property taxes etc. <http://bit.ly/2bAKF97>

International Institute for Sustainable Development



Cover / Service crops
i) reduce synthetic inputs of N and P,
ii) improve diversity
iii) sequester C
plus

Service Crops

Photo by A.
Gaudin

Sources
Lupwayi et.
al , 1998;
Snapp et.
al, 2005;
Queen et.
al, 2009;
Blaser et.
al, 2011

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Increase SOM

Prevent Erosion

**Increase Microbial
Activity**

**Improve Water
Holding Capacity**

Catch Nutrients

**Increase Soil
Aggregate Stability**

Build Soil Tilth

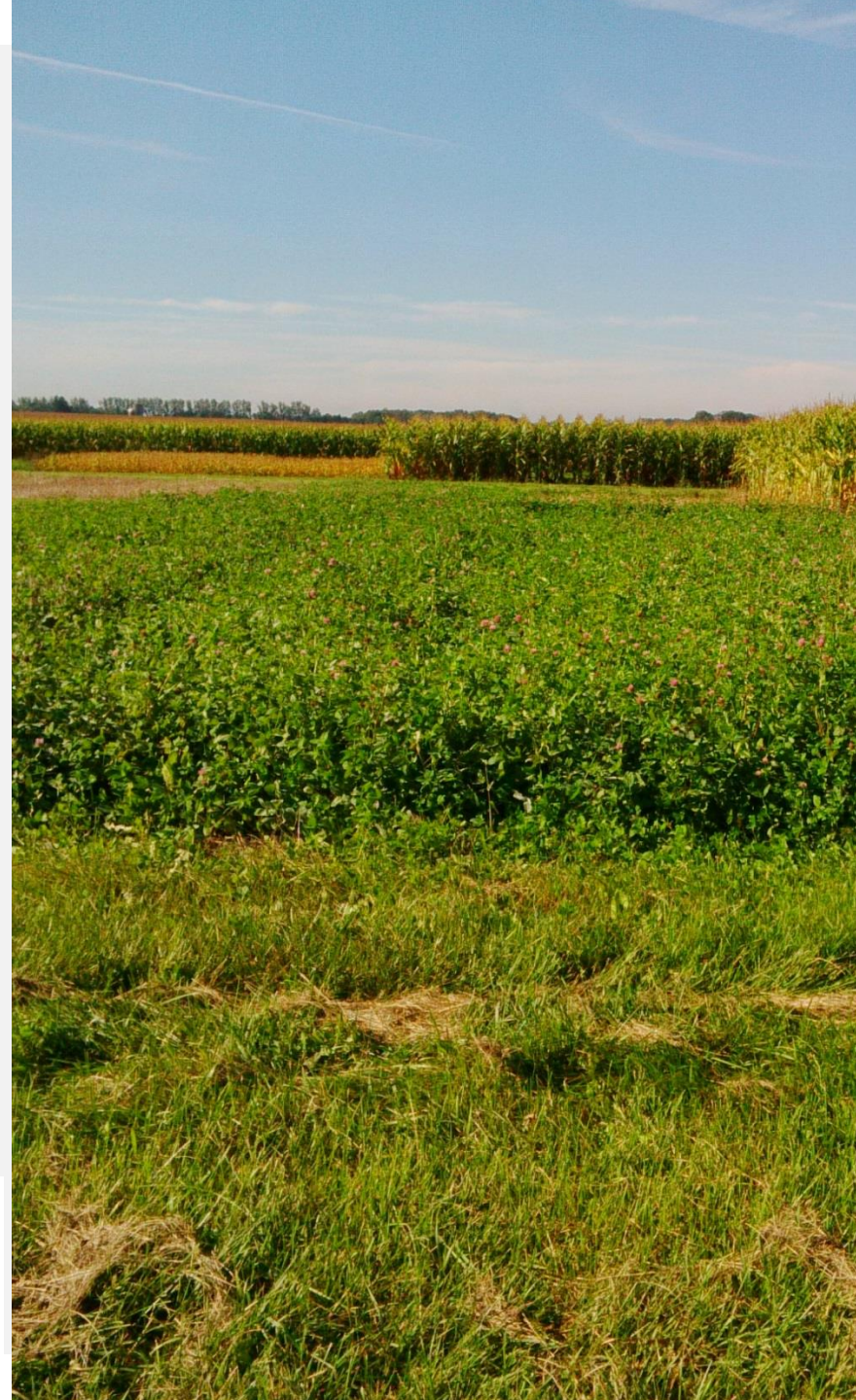
**Decrease Soil
Compaction**

Increase of corn and soybean yields, yield stability and SOM, when corn and soybean were integrated into more diverse rotations with **forages**

Complex Rot'n with Forages (C-C-S-WW**rc** or C-C-**A-A**) > Simple Rot'n for Cash Crops (C-C-C-C or C-C-S-S)

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Gaudin et al. 2015 PLoS ONE
10(2): e0113261. doi:
10.1371/journal.pone.0113261



Where Should SOM levels be in Ontario?

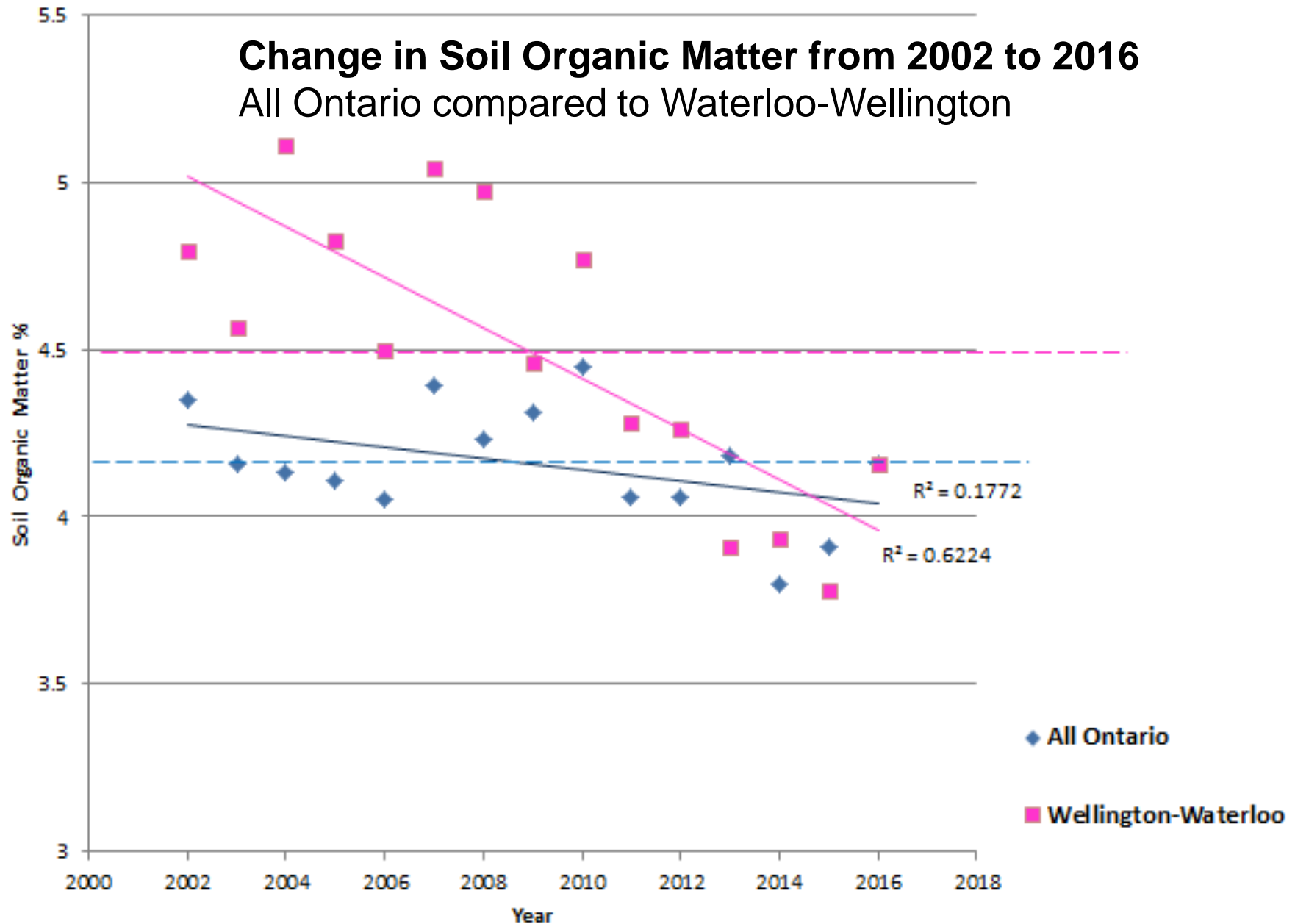
Organic Matter Level Rating for Different Soil Text

From Agronomy Guide for Field Crops - Publication 811

Texture	Very Good	Good	Fair	Poor
Sand	3.1 % +	2.1 – 3.0 %	1.2 – 2.0 %	< 1.1%
Sandy loam	3.6% +	2.6 – 3.5 %	1.6 – 2.5 %	< 1.5 %
Loam	4.1 % +	3.1 – 4.0 %	2.1 – 3.5 %	< 2.0 %
Clay loam	4.6% +	3.6 – 4.5 %	2.6 – 3.5 %	< 2.5 %
Clay	4.6 % +	3.6 – 4.5 %	2.6 – 3.5 %	< 2.5 %



Change in Soil Organic Matter from 2002 to 2016 All Ontario compared to Waterloo-Wellington



- Measure the outcome of SOM in every field in ON, every 5 years, with a scientific protocol
- Adjust farm property tax, accordingly.
If SOM good, v good or increasing, pay less
If SOM fair, poor or decreasing, pay more



Costs of cheap and convenient food

- Two-thirds of health-care costs can now be attributed to chronic diseases associated with unhealthy eating
- CAPI. 2009. Toward an Integrated Health & Agri-Food Strategy for Canada. http://capi-icpa.ca/pdfs/BuildingConvergence_Aug2009.pdf



U.S. food industry **targets \$2 billion/yr to market to children**; 73% promotes food and beverages high in sugars and fats, yet low in recommended nutrients <http://foodtank.com/>
Annual global spending on soft drinks is \$200 – 400 billion.

Where should we aim?



www.theguardian.com/artanddesign/gallery/2016/sep/09/the-world-nomad-games-in-pictures

The Kids are Not Alright

www.heartandstroke.ca/what-we-do/media-centre/report-on-health



Can of pop close to recommended daily max of sugar.

PHAC notes that 25% of children consume sugary drinks every day.

Canadian children & youth spend 8 hrs /d on screens and view > 25 million food and beverage ads; > 90% for unhealthy foods. Before age 5, most children not distinguish ads from unbiased programming.

Industry should pick on someone its own age

- In 1982, avg Chinese person ate 13 kg of meat/yr but now eats 63 kg/yr, rising to 93 kg/yr by 2030 if nothing is done.
- New goal to go back to 30 kg meat/person/yr and reduce GHG emissions by 1 bn tonnes by 2030, and lessen country's problems with obesity and diabetes.

Oliver Milman, Stuart Leavenworth, Guardian, June 20, 2016

<http://bit.ly/2bSQaO3>



Photo by Wong Campion, Reuters



Sustainability at Maple Leaf Foods

mapleleafsustainability.ca

- **Mississauga, ON (June 6, 2017)** – Maple Leaf Foods (MFI: TSX) today announced its ambition to be the most sustainable protein company on earth.
- North American's consume 4x more meat than non-industrial countries, which is unsustainable, while global meat consumption is forecast to rise 80% by 2050
- Broadening reach: expanding in plant-based proteins and better meat (1 of 6 strategies)

Healthy Food from Healthy Animals



- Pastured animals exercise more and express natural behaviour
- Meat and milk from **forage-fed** animals have higher CLAs and omega 3 levels and minimal or no antibiotics

Option to Reduce Chronic Diseases and Health Costs

- Hypothesis - It is cheaper to provide free Ontario fruits and vegetables for all low income citizens *than to continue paying their health costs if they continue with their current diet*



Photo by P. Pauls

Annual Health Care Costs (AHCC) in contrast to **Food-Secure Households**

Tarasuk et al. 2015. CMAJ. DOI:10.1503 / cmaj.150234

- Marginal food insecurity, AHCC 23% higher
- Moderate food insecurity, AHCC 49% higher
- Severe food insecurity, AHCC 121% higher



Is Food insecurity a problem of sufficiency or poverty?

Photo by M Kenny



Dr. Noralou Roos
Dr. Evelyn Forget

Fraser Institute



- Guaranteed Annual Income (GAI) \$17 billion (as in Dauphin, in 2015 \$) to luxury GAI of \$58 billion
- Total cost of Canada's current income support system (payout plus admin. costs) was \$185 billion in 2013.

www.theglobeandmail.com/report-on-business/rob-commentary/the-time-for-a-guaranteed-annual-income-might-finally-have-come/article25819266/

Balancing Production and Consumption

If mainstream agriculture had evolved differently, and we produced high quality food, with yields about 25% lower than now (current O yields);
If wasted food was 15% and not 40% as now;
Then, would we aspire to produce 25% more food, so that we could waste 40%?



Photos by M. Arseneault

Organic Crop Quality

Barański, M., Średnicka-Tober, D.,
Volakakis, N., Seal, C., Sanderson, R., Stewart, G.B., Benbrook, C., Biavati, B.,
Markellou, E., Giotis, H., Gromadzka-Ostrowska, J., Rembiałkowska, E., Skwarło-
Sonta, K., Tahvonen, R., Janovská, D., Niggli, U., Nicot, P. and Leifert, C. (2014)

**Higher antioxidant and
lower cadmium
concentrations and
lower incidence of
pesticide residues in
organic crops**

British J. Nutrition **112**, 794-811

<http://research.ncl.ac.uk/nefg/QOF>

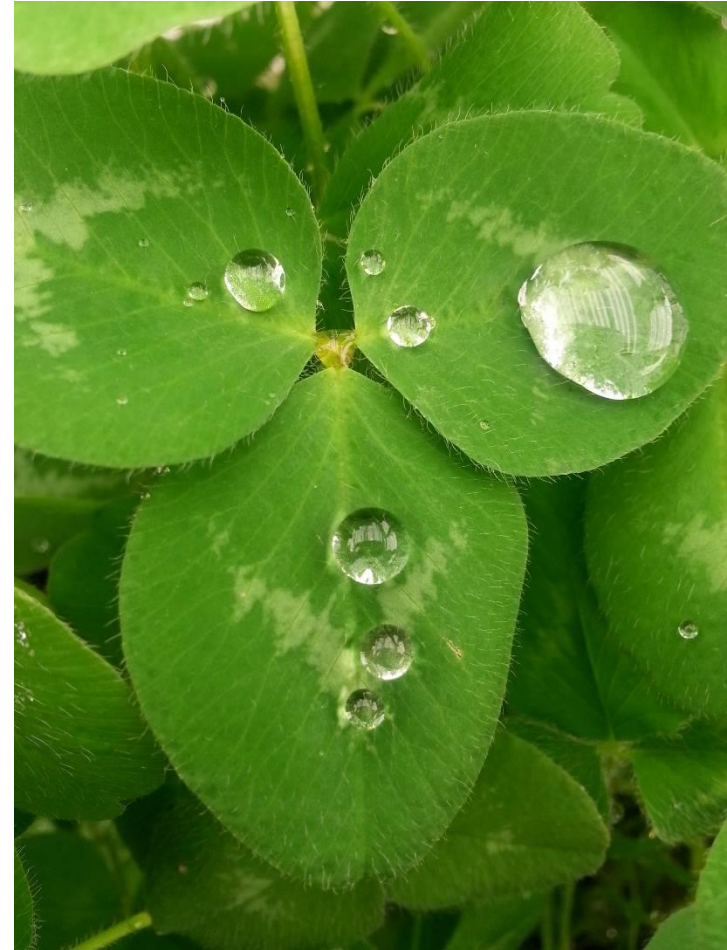


Photo by C. Loucks

Organic Ag provides a long term contrast to mainstream ag.
O ag follows the precautionary principle and is slow to accept potential harm.

O ag offers alternative options which may be needed by other ag systems if there is:
harm,
lack of efficacy,
a cost-price squeeze.

Photo of Southbrook Vineyards



In every country
a mystique of the
land is needed to
counter the
industrial mystique....
The earth will solve its
problems, and possibly our own, if we let the
earth function in its own ways. We need
only listen to what the earth is telling us.

(Berry, T. 1990. The Dream of the Earth. Sierra Club Books. pp. 33 - 35)

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Photos by A. Hammermeister