ECOGEN Soil Quality Index

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SUMMARY

Context
EU project *ECOGEN*: Assessment of ecological and economic impacts of using genetically modified crops on soil.

Special emphasis: Soil biology and estimating soil quality from the observed biological parameters.
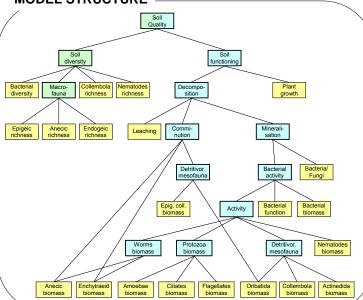
Goal
To produce a *soil quality* score based on soil *biodiversity* and *function* – tailored to determine effects of different *maize cropping systems* on these.
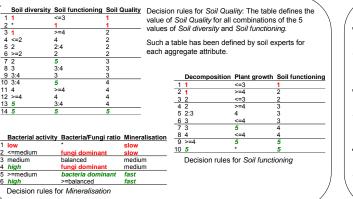
Approach
Qualitative multi-attribute modeling, using the software tool DEXi (http://kt.ijs.si/MarkoBohanec/dexi.html).
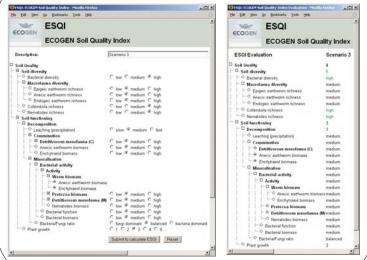
THE ESQI MODEL

ESQI (ECOGEN Soil Quality Index) is a qualitative hierarchical multi-attribute model that assesses the impact of cropping systems on soil quality and can subsequently be used to assess crop management options. Cropping systems are assessed qualitatively (using a 1-5 ordinal scale) and relatively with respect to some reference plot or treatment. ESQI consists of 34 attributes, hierarchically structured into 8 levels. There are 21 input attributes. The assessment of soil quality is based on two main aggregate indicators:

(1) soil diversity and
(2) soil functioning.

MODEL STRUCTURE

IMPLEMENTATION

Available on-line: http://kt.ijs.si/MarkoBohanec/ESQI/ESQI.php

SOME DECISION RULES

	Soil diversity	Soil functioning	Soil Quality
1	1	<=3	1
2	*	1	1
3	1	>=4	2
4	<=2	4	2
5	2	2:4	2
6	>=2	2	2
7	2	5	3
8	3	3:4	3
9	3:4	3	3
10	3:4	5	4
11	4	>=4	4
12	>=4	4	4
13	5	3:4	4
14	5	5	5

Decision rules for *Soil Quality*: The table defines the value of *Soil Quality* for all combinations of the 5 values of *Soil diversity* and *Soil functioning*.

Such a table has been defined by soil experts for each aggregate attribute.

	Decomposition	Plant growth	Soil functioning
1	1	<=3	1
2	1	>=4	2
3	2	<=3	2
4	2	>=4	3
5	2:3	4	3
6	3	<=4	3
7	3	5	4
8	4	<=4	4
9	>=4	5	5
10	5	*	5

Decision rules for *Soil functioning*

	Bacterial activity	Bacteria/Fungi ratio	Mineralisation
1	low	*	slow
2	<=medium	fungi dominant	slow
3	medium	balanced	medium
4	high	fungi dominant	medium
5	>=medium	bacteria dominant	fast
6	high	>=balanced	fast

Decision rules for *Mineralisation*

SOME RESULTS

- All the cropping systems give the same soil quality: 3
- The use of Bt-maize in Foulum positively effects *Soil functioning* (when using CT) and *Soil diversity* (with RT)
- RT positively affects *Nematodes richness*, *Detritivorous mesofauna* and *Protozoa biomass*, leading to better *Activity*
- Bt-maize reduces *Protozoa biomass*, but improves *Comminution* due to *Anecic earthworm biomass*
- At Varois and Narbons, Bt-maize reduced many faunal populations without affecting the higher level outcomes of *Soil functioning, diversity* or *quality*

LEGEND
- **Foulum**, **Narbons** and **Varois**: three ECOGEN site trial locations
- **c**: conventional maize
- **Bt**: Bt maize (genetically modified)
- **CT**: conventional tillage
- **RT**: reduced tillage
- **Reference**: three reference sites and cropping systems: 'Foulum c CT', 'Varois c' and 'Narbons c'

PUBLICATION

Bohanec, M., Cortet, J., Griffiths, B., Žnidaršič, M., Debeljak, M., Caul, S., Thompson, J., Krogh, P.H (2007).
A qualitative multi-attribute model for assessing the impact of cropping systems on soil quality. *Pedobiologia* 51(3), 239-250