Long term trials in Europe and North America: experience and research approaches

Joachim Raupp

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My background: research and international co-operation

- IBDF, Institute for Biodynamic Research

Long-term field studies on organic farming (25):

- Austria (1)
- Canada (3)
- Denmark (2)
- Finland (1)
- Germany (6)
- Italy (2)
- Sweden (1)
- Switzerland (1)
- United Kingdom (2)
- United States of America (6)

• Probably, there is a number of other trials that are not shown.
When did these field studies start?

- 11 experiments (46%) are carried out for more than 15 years
  → 231 experimental years
Research approaches:

- Experiments with field plots and factorial design (22)
- Farm studies (3)
Research approaches: farm study

- Landscape monitoring, e.g. hedges
- Fertilisation trial
- Farm area
Nutrient management, crop performance and soil properties are most important.

→ Sustainability indicators
Key results:

Effects of organic vs. conventional systems or of organic vs. mineral fertilisation:

• organic carbon ($C_{org}$), microb. carbon ($C_{mic}$): $>$
• soil bulk density: $<$
• soil dehydrogenase activity: $>$
• $qCO_2 = CO_2 : C_{mic}$ $<$
• crop yields: $<$ or $>$ or $=$
  depending on crop and situation
Results on crop yield, example 1:
The Farming Systems Trial
(since 1981)

Comparison of 3 cultivation systems:
- organic / manure-based
- organic / legume-based
- conventional
Maize yield (kg ha$^{-1}$) in the conversion period (1981-85) and later (1986-2001) in 3 cropping systems

Hepperly et al. (2006)
Maize yield (kg ha$^{-1}$) on average of 5 drought years (<350 mm vs. 500 mm precipitation) with 3 cropping systems

Hepperly et al. (2006)
Results on crop yield, example 2:
The Fertilisation Trial Darmstadt (IBDF) (since 1980)

Comparison of 3 fertilisers:
- CM: composted manure
- CMBD: composted manure + biodynamic preps.
- MIN: mineral fertilisers
Correlation between spring wheat yields with composted manure (CM) and mineral fertilizer (MIN); results of 4 replicates and 14 years (n=55)

Confidence ellipse (p<0.05): major axis regression:

\[ Y_1 = 15.96 + 0.62 \, Y_2 \]

slope (b):

\[ 0.416 < b < 0.868 \]
Long-term experiments are essential for the assessment of

- sustainability
- biodiversity
- effects on climate change (carbon budget, GHG emission)
- effects on nature and landscape

→ In all these fields, organic agriculture wants to achieve the targets to the highest possible degree.

→ Organic agriculture needs long-term experiments to evaluate and to improve its methods.
Some inherent drawbacks of long-term experiments (LTEs):

→ LTEs are relatively capital-intensive and labour-intensive;
  • they occupy capacity (area, machinery) for a long time;
  • fixed cost (usually not covered by project grants).

→ LTEs are less flexible to deal with new questions (agricultural, scientific, social).

→ LTEs are no optimal basis to obtain a high ranking scientific or academic merit;
  • some years are needed to establish the experimental system;
  • who pays for the start-up phase?
“Wisely used, long-term experimental sites provide information on the long-term sustainability of agricultural systems that can be obtained in no other way.”

David S. Jenkinson, 1991
Thanks!

• Many thanks for your attention!

• Many thanks to CAU and ICROFS for inviting me!