Innovation in crop rotation for better IPM – the Swiss model

Franz Bigler
President IOBC-WPRS

IOBC
www.iobc-wprs.org
Crop rotation

Definition (Marshall D. 1997)

Crop rotation is the planned sequence of different crops in a field over time (as opposed to growing a single crop continuously in the same field).

- Crop rotation is an old technique to prevent pests, diseases and weeds, and it was commonly practiced for centuries.
- Intensification and simplification of production after the 1950s has lead to the tendency of continuous growing of the same crop in the same field.
Contents

• The concept of prevention in the IPM context
• Crop rotation and its usefulness in IPM
• Crop rotation in the Swiss direct payment scheme
• Challenges of crop rotation and innovative solutions
• Conclusions
• «Prevention» is mentioned in several articles of the SUD Directive (e.g. article 1, 4, 14), but different wording is used such as “non-chemical techniques”, “non-chemical methods”, “alternative approaches and techniques”.

• Annex III explicitly states:
  - “Prevention of harmful organisms should be achieved or supported among other options especially by:
    - crop rotation
    - use of adequate cultivation techniques
    - …..
# Preventive control methods in IPM

<table>
<thead>
<tr>
<th>Method/Measure</th>
<th>Insects</th>
<th>nematods</th>
<th>diseases</th>
<th>weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified seeds &amp; plants</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Field hygiene (eg residue man.)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Choice of varieties, cultivars</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Crop rotation, crop sequence</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fertilization (eg N)</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Timing of field management (e.g. sowing, harrowing)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pruning (eg trees, grapevine)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Cover crops, tillage</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Conservation of nat.enemies</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

*Preventive measures available (+), not available (-)*

(Adapted from Bajwa and Kogan, 2004)
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Crop rotation to prevent soil borne pests of arable crops in Europe

**Cereals**

*Gaeumannomyces graminis*  
(Take all)

*Pseudocercosporella herpotrichoides*  
(Eye spot)

*Fusarium graminearum*  
(Fusarium head blight)

*Heterodera avenae*  
(Cereal/Oat cyst nematode)
Crop rotation to prevent soil borne pests of arable crops in Europe

**Oilseed rape**

- *Phoma lingam* (Black leg disease)
- *Sclerotinia sclerotiorum* (White mold)
- *Plasmodiaophora brassicae* (Clubroot)

**Sugar beet**

- *Atomaria linearis* (Pigmy mangold beetle)
- *Ditylenchus dipsaci* (Stem nematode)
- *Heterodera schachtii* (Beet cyst nematode)
Crop rotation to prevent soil borne pests of arable crops in Europe

Potato

Agriotes spp.
(Wireworm)

Rhizoctonia solani
(Black scurf)

Globodera rostochiensis
(Golden nematode)

Maize

Diabrotica virgifera
(Corn rootworm)

Fusarium spp., Pythium sp.
(Root and stem rot)
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Cross compliance in the Swiss direct payment scheme for arable crops

• Balanced fertilizer regime (N, P)
• Regulated crop rotation
• Compulsory measures for soil protection
• Reduced use of approved pesticides (to be used with special permission only)
• 7% of farm land to be used as ecological compensation areas
• Compulsory buffer strips (3-6m wide) without fertilizers and pesticides along waterways, hedgerows, forest edges, and some other ecol. comp. areas
Crop rotation in the Swiss legislation: Ordinance for direct payments

Cross compliance: General principles for crop rotation

• Crop rotations must be established to prevent pests and diseases, erosion, soil compaction, soil loss, surface wash off and leaching of fertilizers and pesticides

• Crop rotation must encompass all arable land of the farm

• Farms with >3 ha of arable land must have at least 4 main crops per year
Crop rotation in the Swiss legislation:
Ordinance for direct payments

Cross compliance: General principles for crop rotation (continued)

• One crop must cover at least 10% of the arable land of the farm (crops <10% are summed up to 1 crop)

• Records on crop rotation must include the crop and crop sequence of the last 5 years for each arable field

• Records on crop rotation (and all other cross compliance features) must be stored for at least 6 years
### Maximum percentage of main crops per year and crop intervals

<table>
<thead>
<tr>
<th>Main crop</th>
<th>Max. Percent</th>
<th>Interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals (without oat and maize)</td>
<td>66</td>
<td>1-2</td>
</tr>
<tr>
<td>Wheat and spelt</td>
<td>50</td>
<td>1-2</td>
</tr>
<tr>
<td>Oat</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Beet</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Potato</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Soya bean</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Protein pea have</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Oilseed rape</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Sunflower</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Oilseed rape and sunflower</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>Faba bean</td>
<td>25</td>
<td>3</td>
</tr>
</tbody>
</table>
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Challenges of crop rotation in modern agriculture

Economic pressure

a. Small and medium sized farms are widespread (in CH and EU)
b. Leads to trends for specialising in a few crops and farm branches
c. Mechanisation and automation with high financial investment is needed
d. Growing different crops requires the farmer to invest more time in training/education
Market forces

a. Market forces determine crops and farm branches in whole regions
b. Whole regions are depending on big wholesale enterprises and retailers
c. Crop diversification on small size farms is often difficult/impossible

Loss of crop rotation and diversification of crops in whole regions
Farmer’s options to face the crop rotation challenges

1. Reduce production costs by increasing farm/field size and efficiency of machinery —> crop rotation association
2. Diversify production with new crops —> market driven
3. Generate income from other farm activities (e.g. direct marketing of farm products, agritourism) —> location dependent of farm
4. Generate income with off-farm activities —> depending on location of farm and time constraints
Organisational model for a crop rotation association

Four Swiss farms cooperating in crop rotation: Total 145 ha arable crops plus meat production (beef and porc)
Organisational model for a crop rotation association

Organisational and legal questions

- Different types of cooperation models are possible
- Adopt an appropriate legal model with written agreement and exit clause
- Support by advisory/legal service is needed
- Full agreement on crops and production system (e.g. IP Suisse) needed
Organisational model for a crop rotation association

Results of national projects since 2008:

Incentives to participate in CRA

- Better economic result ➔ cost reduction
  - 10-20% less work hours per ha
  - up to 30% lower investment in machinery
  - purchase of pesticides, fertilizers, seeds, etc.
- More flexibility and better planning of work
  - fewer work peaks
  - crops can be grown on appropriate soils (e.g. potato)
- More time to generate additional income (on/off-farm)
- Less time investment in education (specialization of each partner in one or two crops or in one farm branch)
Organisational model for a crop rotation association

Hurdles and difficulties

- Personal relations among farmers/families
- Equal level of knowledge and professional performance
- Trust and tolerance of all partners needed
- Partial loss of independence in decision making

There is a huge potential in Europe for innovative models for crop rotation associations
Conclusions

1. Crop rotation is a powerful preventive tool to reduce pesticides in arable crops and to stabilise yield.
2. Traditional agronomic knowledge on crop rotation and modern technologies must be combined now to make crop protection less dependent of pesticides.
3. Challenges of crop rotation can be overcome with innovative sustainable farming concepts.
4. More emphasis should be given by EU and MS to preventive crop protection methods, in particular crop rotation, if pesticide reduction should become real.
The necessity of change is the power of innovation

Thank you for your attention