Agroscope
Switzerland

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 oposed 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

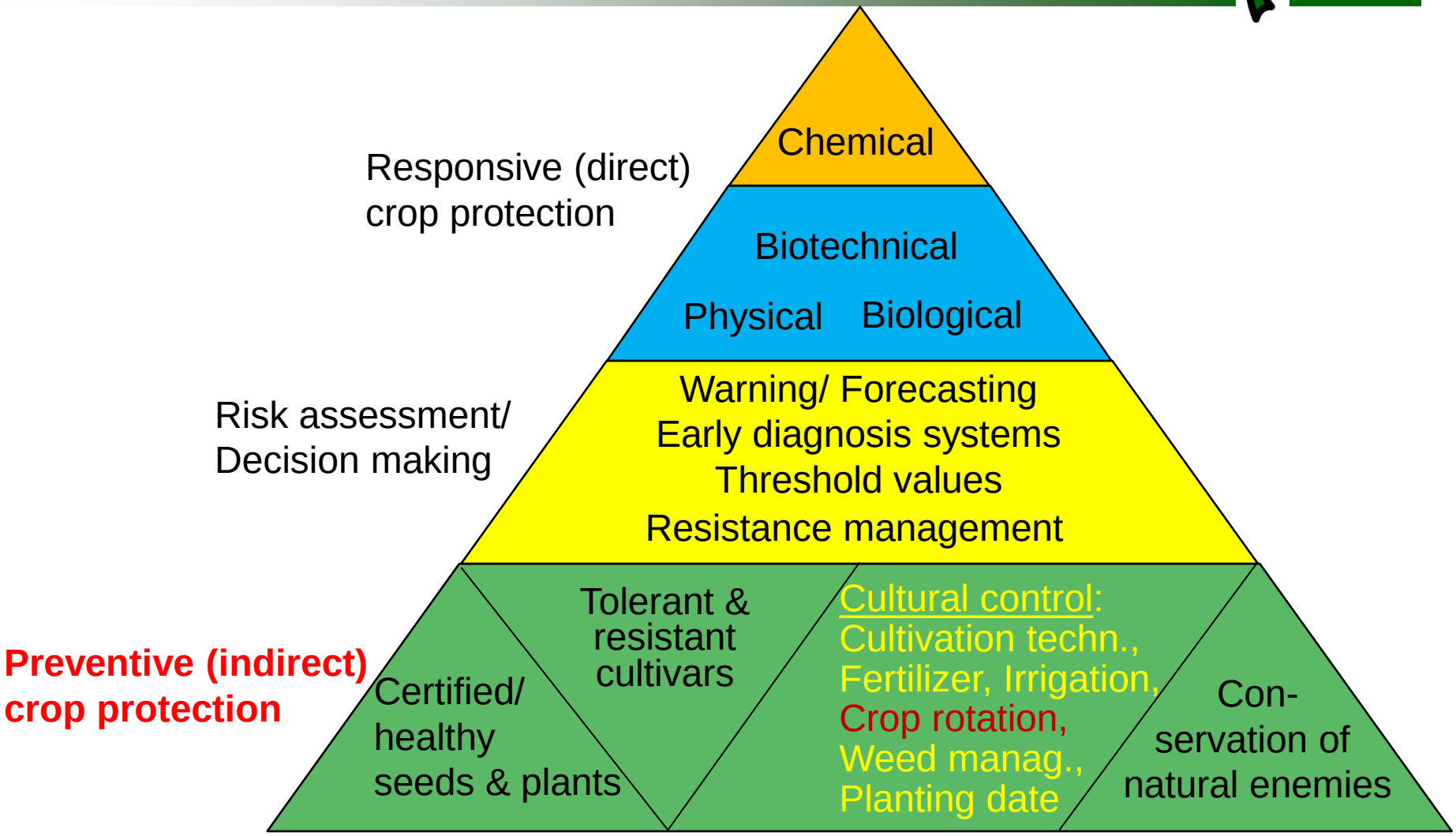
«Prevention» in the IPM concept of the EU Directive 2009/128/EC

- «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 adequat cultivation techniques
- …..

The visualised IPM concept



Meissle et al. 2011.Pest Manag. Science,67

Preventive control methods in IPM

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

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

(Adapted from Bajwa and Kogan, 2004)

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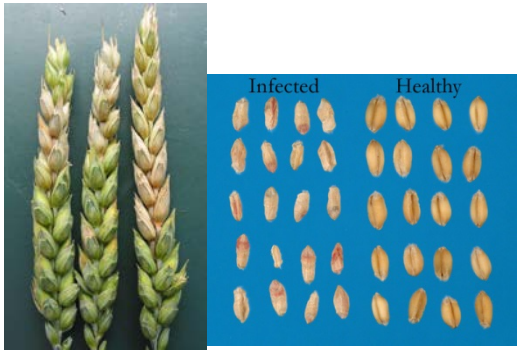
Crop rotation to prevent soil borne pests of arable crops in Europe

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 root worm)

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

Main crop	Max. Percent	Interval (years)
Cereals (without oat and maize)	66	1-2
Wheat and spelt	50	1-2
Oat	25	3
Beet	25	3
Potato	25	3
Soya bean	25	3
Protein pea	15	6
Oilseed rape	25	3
Sunflower	25	3
Oilseed rape and sunflower	33	3
Faba bean	25	3

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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

Challenges of crop rotation in modern agriculture (continued)

Market forces

a. Market forces determine crops and farm branches in whole regions

b. Whole regions are depending on big wholesale enterprises and retailers

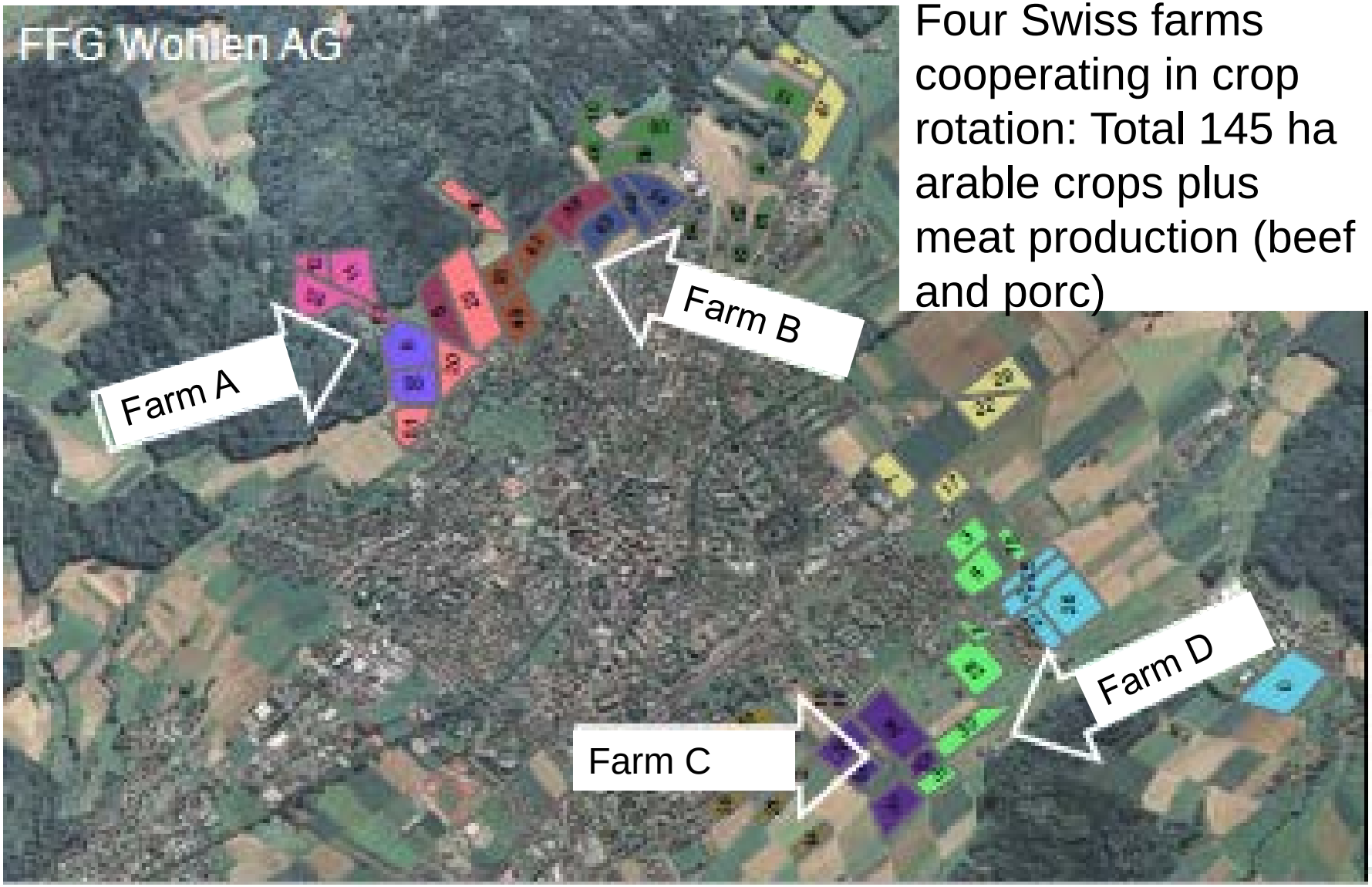
c. Crop diversification on small size farms is often difficult/impossible

→ Loss of crop rotation and diversification of crops in whole regions

Farmer's options to face the crop rotation challenges

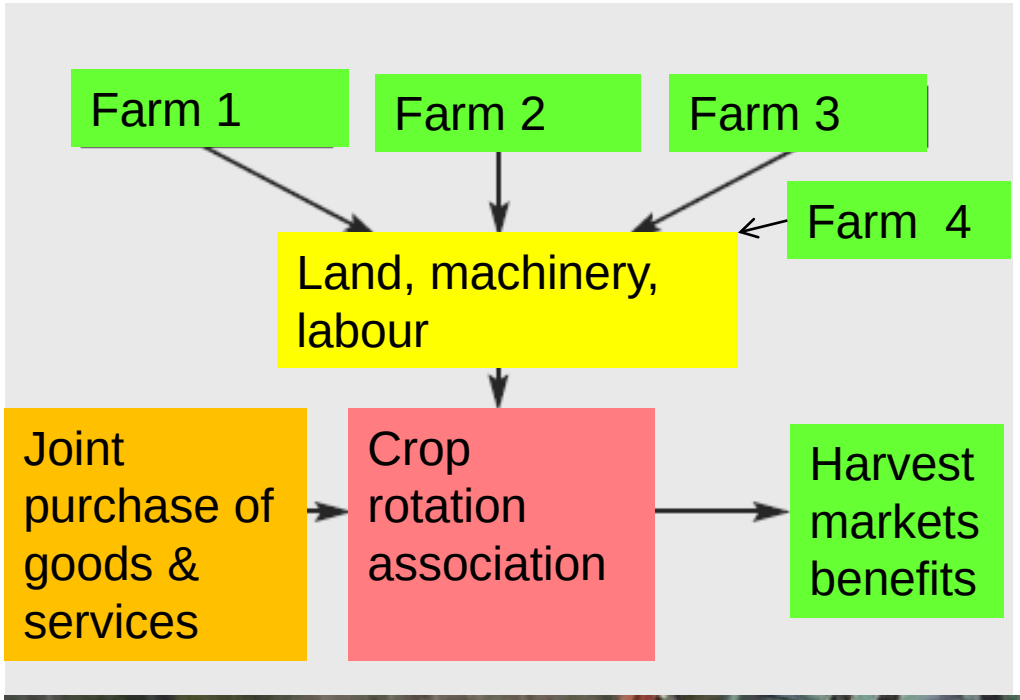
1. Reduce production costs by increasing farm/field size and efficiency of machinery ➡ crop rotation association
2. Diversify production with new crops ➡ market driven
3. Generate income from other farm activities (e.g. direct marketing of farm products, agritourism) ➡ location dependent of farm
4. Generate 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.

Agroscope

The necessity of change is the power of innovation

Thank you for your attention