Pesticide reduction - what are the alternatives?

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President IOBC-WPRS

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The IPM strategy

Integrated Pest Management

Responsive (direct) crop protection

Risk assessment/ Monitoring

Preventive (indirect) crop protection

Tolerant/ Resistant cultivars

Enhancement of Natural enemies

Cultural control: Cultivation techniques
Fertilizer, Irrigation
Crop rotation

Threshold values

Warning/Forecasting/ Early diagnosis systems

Biological

Physical

Biotechnical

Chemical
## 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 (e.g., 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 (e.g., 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 (e.g., 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>Enhancement of nat. enemies</td>
<td>+</td>
<td>(+)</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

*Preventive measure has impact (+), has no impact (-)*

*Example given in this presentation*
## Direct non-chemical 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>Biological control</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pheromones: Mating disruption</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pheromones: Mass trap., A &amp; K</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sterile Insect Technique (SIT)</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exclusion netting</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Physical control (e.g. mechan., thermal)</td>
<td>(+)</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

*Preventive measure has impact (+), has no impact (-)*

*Examples given in this presentation*
Case studies of successful IPM measures

1. Field hygiene, crop sequence, resistant cultivars, tillage: Fusarium diseases
2. Crop rotation: Corn root worm
3. Biological control: European corn borer
4. Biological control: Pests and diseases in glasshouse
5. Sexual pheromones for insect control: rice borer
6. Sterile Insect Technique (SIT): Medfly in citrus
Effect of preventive methods on *Fusarium* incidence on wheat

Factors having impact on *Fusarium* incidence:
- Variety
- Crop rotation, crop sequence
- Tillage & residue management

*F. graminearum*  *F. avenaceum*

Vogelgsang et al. 2011
Fusarium graminearum life cycle

A. Schilder & G. Bergstrom

Vogelgsang et al. 2011
Effect of variety and crop sequence on *F. graminearum*

Vogelgsang et al. 2011
Crop rotation to prevent damage by the Western Corn Rootworm

**Barriers** Farmer’s economy, farm structure, 

**Incentives** Ban of insecticides, decrees, environment (e.g. water prot. zones)
Biological control of the European corn borer with *Trichogramma*

**Facts**
- *Trichogramma* is used on 150‘000 ha of maize
- Efficacy is comparable to insecticides

**Barriers**
- Costs are higher than insecticides
- Application on large farms is laborious
- Farmers have to learn a new system

**Incentives**
- Technical difficulties with insecticide applicat.
- No secondary pest outbreaks
- Appropriate for small/medium sized farms
- Subsidized in some countries/regions
IPM in protected crops - a multi-pest approach

**Facts**
- Intensive production of high value crops requires high protection level
- Uniform environment offers optimal conditions for pests
- Large areas of glasshouses concentrated in same location

Courtesy J.C. van Lenteren, Wageningen Univ., NL
From pesticides to IPM and biocontrol

- No pest resistance to pesticides
- Worker safety and pesticide use
- Less phytotox and higher yield
- Use of pollinators
- No waiting period for harvest, no residues

Incentives
- New systems to learn

Barriers

Courtesy J.C. van Lenteren, Wageningen Univ., NL
Worldwide use of pheromones for mating disruption in 2011

Use of Mating Disruption - 2011

**Total 770’000 ha**

**Examples of MD in Europe**
- Pome & stone fruit 110'000 ha
- Vineyard 133'000 ha

**Barriers**
- Local conditions
- Organisation of actions
- Pest species
- Pheromone efficacy
- Delivery systems

**Incentives**
- Resistance problems
- Market access
- Environment

Oriental fruit moth  CP:204’000 ha
Grape moth CM:58’000 ha
Pink bollworm LB:152’000 ha
Gypsy moth PG:78’000 ha
LD:154’000 ha
## European vineyards with mating disruption in 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Total vineyard surface (hectares)</th>
<th>Vineyard treated with MD (hectares)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>102,000</td>
<td>70,000</td>
<td>68.6</td>
</tr>
<tr>
<td>France</td>
<td>867,000</td>
<td>20,000</td>
<td>2.3</td>
</tr>
<tr>
<td>Italy</td>
<td>847,000</td>
<td>16,500</td>
<td>1.9</td>
</tr>
<tr>
<td>Spain</td>
<td>1,169,000</td>
<td>14,500</td>
<td>1.2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>14,800</td>
<td>7,000</td>
<td>47.3</td>
</tr>
<tr>
<td>Austria</td>
<td>49,900</td>
<td>2,400</td>
<td>4.8</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>17,700</td>
<td>1,300</td>
<td>7.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>248,000</td>
<td>1,200</td>
<td>0.5</td>
</tr>
<tr>
<td>Hungary</td>
<td>75,000</td>
<td>300</td>
<td>0.4</td>
</tr>
<tr>
<td>Slovakia</td>
<td>17,600</td>
<td>100</td>
<td>0.6</td>
</tr>
<tr>
<td>Cyprus</td>
<td>15,300</td>
<td>100</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,423,300</td>
<td>133,400</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Thomson and Jankins, 2012
Mass trapping of the Rice stem borer in the Ebro Delta, Spain

**Barriers**
- New technology

**Incentives**
- Environment (nat. res.)
- Fish production
- Tourism
- High income from rice
Sterile Insect Technique & CS against the Medfly in fruit crops

**Facts**
- Key pest in Med. Regions on many fruit crops
- Heavy insecticide use
- SIT technology used on 152'000 ha of fruit crops in 2010
- Traps with chemosterilant bait

**Barriers**
- New system, efficacy unknown, costs

**Incentives**
- Export to USA & CND (strict quarantine regulations, market)
- Areal application prohibited
- Good control of Medfly (SIT & chemosterilants)
Lessons learned from case studies

• IPM is a valid and solid concept for pesticide reduction in all crop types. IPM is resource efficient and economic.

• Major incentives for farmers to apply IPM are economic benefits e.g. market access, problems with pesticides (resistance, environment, residues, health), techn. difficulties, government decrees.

• Lots of alternatives are available and waiting to be adopted by farmers (slow technology transfer!)

• Added value to health and environment by IPM must pay off for farmers.
Thank you for your attention and join IOBC now!

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