Survey for *Diabrotica* extension and management in France

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Diabrotica situation in 2009

In relation with motorways – Italy distance and maize monocrop

We suspected that Diabrotica which were mainly an air borne pest (by plane) 2002 to 2006 became a road or rail borne pest (by truck or by train)
Traps number evolution in France

- July
- Added in August

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>2006</td>
<td></td>
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<tr>
<td>2007</td>
<td></td>
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<tr>
<td>2008</td>
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<td>2009</td>
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<td>2010</td>
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<tr>
<td>2011</td>
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<tr>
<td>2012</td>
<td></td>
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</table>
Diabrotica situation in 2012 and previous years

<table>
<thead>
<tr>
<th>Year</th>
<th>Catches</th>
<th>Corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>294</td>
<td>294</td>
</tr>
<tr>
<td>2010</td>
<td>99</td>
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<tr>
<td>2011</td>
<td>1458</td>
<td>708</td>
</tr>
<tr>
<td>2012</td>
<td>1940</td>
<td>1870</td>
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</tbody>
</table>

Corrected: usual trap device (without catches added in CULOZ)

We verified that Diabrotica which were mainly an air borne pest (by plane) became a road or rail borne pest (by truck or by train).
In 2012
6 weeks of significant catches later than in 2011
**Diabrotica** situation in RA area in 2011 and previous years

<table>
<thead>
<tr>
<th></th>
<th>sum 2009</th>
<th>sum 2010</th>
<th>sum 2011</th>
<th>sum 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>84</td>
<td>53</td>
<td>1104</td>
<td>986</td>
</tr>
<tr>
<td></td>
<td>294</td>
<td>99</td>
<td>354</td>
<td>917</td>
</tr>
</tbody>
</table>

Corrected: usual trap device (without catches added in CULOZ)

An increase risk close to industries truck park in Culoz (788 catches)

Trap Map distribution and positive trap
Culoz case in 2011

Extended trap device = 650 for a late survey

Usual trap device = 100 catches

An usual trap device limited catches to 100 along the main road.

Main catches close to the city and industries under evaluated because late traps deployment
Diabrotica situation in RA area in 2012

Soil effect on final population

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
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<th>2011</th>
<th>2012</th>
</tr>
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<td>99</td>
<td>354</td>
<td>917</td>
</tr>
</tbody>
</table>

Culoz: soil very dam land
2011 -> 789 catches
2012 -> 69 catches

Aiton: Soil healthy clay
2011 -> 57 catches
2012 -> 241 catches

Blyes: healthy loam and stone soil
2011 -> 30 catches
2012 -> 227 catches

Under 110 mm rainfall in May (1st larvae stage)

Trap Map distribution and positive trap
Diabrotica situation in 2011 in Alsace, French Rhine side and previous years
Diabrotica situation in 2012 in Alsace, French Rhine side and in previous years.

<table>
<thead>
<tr>
<th>Year</th>
<th>sum catches</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>206</td>
</tr>
<tr>
<td>2010</td>
<td>29</td>
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<tr>
<td>2011</td>
<td>339</td>
</tr>
<tr>
<td>2012</td>
<td>882</td>
</tr>
</tbody>
</table>
Change in *Diabrotica* status in France after summer 2009:

- Small populations but established in several outbreaks, particularly in Alsace and Rhône-Alpes where eradication seemed no longer possible with measures on small areas (R=1 km focus + R=5 km safety).

- In these regions containment was considered more effective than eradication to prevent the spread of *Diabrotica*: measures lighter but implemented on larger areas.
### Possible strategies in France studied for economic and phytosanitary impact

<table>
<thead>
<tr>
<th>Eradication safety zone</th>
<th>Year</th>
<th>Management</th>
<th>Year</th>
<th>Management</th>
<th>Year</th>
<th>Management</th>
<th>Year</th>
<th>Management</th>
<th>Year</th>
<th>Management</th>
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</thead>
<tbody>
<tr>
<td>R0T0</td>
<td>Year 1</td>
<td>maize</td>
<td>Year 2</td>
<td>Rotation</td>
<td>Maize + larvicide</td>
<td>Year 3</td>
<td>Rotation</td>
<td>Year 4</td>
<td>Rotation</td>
<td>Year 5</td>
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<tr>
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<td>maize</td>
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<td>Maize</td>
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<td>Rotation</td>
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<tr>
<td>R3T0</td>
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<td></td>
<td>Rotation</td>
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<td></td>
<td>Rotation</td>
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<td>Rotation</td>
</tr>
<tr>
<td>R6T3</td>
<td></td>
<td>maize</td>
<td></td>
<td>Maize + larvicide</td>
<td></td>
<td>Maize + larvicide</td>
<td></td>
<td>Rotation</td>
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<td>Rotation</td>
</tr>
<tr>
<td>R6T4</td>
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<td>maize</td>
<td></td>
<td>Maize + larvicide</td>
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<td>Maize + larvicide</td>
<td></td>
<td>Rotation</td>
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<tr>
<td>R=1 km</td>
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*Implemented in Alsace and Rhone Alpes area since 2010*
Global cost for farmers
(Millions EUR/Year - actualisation on 12 year at 4%/year)

Grain lost harvest
(% global harvest 2008-09 due to rotation)

Production decrease maize for grain
(x 1000 tons/year)

Depending from scenario

Depending from soil conditions

More ? Contact: sylvain.rousset@cemagref.fr
For 1000 traps in 2011, there were 6020 catches for 487 traps. French strategy started after an open discussion with German colleagues in 2009.
French strategy starts after an open discussion with German colleagues in 2009.
**Chemical on Adults:** insecticides sprayed, pyrethroids, on adults risk to have partial repellent effect, if dose decrease
- what about other a.i as indoxacarbe?
- what about with attractive (cucurbitacin)?
- what about side effect of insecticide on *Ostrinia nubilalis* (ECB)?

**Agronomy on larvae:** rotation: the cornerstone but in a larger area to be more efficient. In a such surface, $\frac{1}{2}$ and even $\frac{1}{3}$ too difficult for growers, sillage production in the big milk crisis.
- Volunteers and poacea in spring crops may affect rotation efficacy.
- No physical separation between fields: affect efficacy of rotation.

**Chemical on larvae:** trials in Italy and Magyar -> interesting efficacy of pyrethroids granules (tefluthrine) in furrow:

- 60–70% regular reduction adult emergence on established population

Efficacy better in case of delayed sowing date or lower population.
-> delay sowing date to mid may improve efficacy and reach 80-90% and more with low infestations.
Diabrotica virgifera virgifera: 
Rotation efficacy is considered 98 % efficacy but…

Alternatives Hosts in field rotation

✖️ *Zea mays* volunteers in spring crops.

✖️ Good management but to undertake in patatoes, beets and sunflower.

✖️ Management **impossible** in sorghum, in soybean due to prohibition of trifluraline.

Arvales: *Digitaria sanguinalis, Panicum capillare, Setaria faberi,* and *Setaria viridis* …secondary host less efficient for larval survival.

Negative impact of those topics: ✖️

May reduce greatly rotation efficacy.

Has been observed in France by catches in fallows, soybeans (2007, 2008, 2009, 2011) close to maize volunteers.
Usual crops following corn in France:
food contaminant  impact

2011 study on contaminants in human alimentation EAT2
DON contamination is more awareness than pesticide residues in food in France
http://www.anses.fr/index.htm
Maize price in 2010, 2011, and 2012

Maize price is the main parameter for economic prospective on containment and eradication costs

Volatility will increase greatly in the future for agriculture commodities

P Chalmin

How to deal with ???
Monitoring and current spread of *Diabrotica virgifera* in France: 
An increasing economic problem: Yes

Pest not yet present at the damage threshold

Cost is surveillance and spread prevention

Need of sustainable complementary tools for control 
and feasible solutions for farmers

French experience in control strategies against *Diabrotica virgifera* 
were built with partnerships with Germans, Magyars and Italians

Cooperation between authorities responsible for plant health, experts and 
professionals allowed to share objectives and measures 
consistent with sustainable agriculture.

This led to significant changes in farming practices 
over very large portions of French territory.
The end of THE world:
Certainly not

The end of A world:
Perhaps

A world of limited resources:
Certainly

The end of THE maize crop in EU:
Certainly not

The end of A way to grow maize:
Perhaps

A world of limited options:
Certainly

But maize crop contributes to solve A world with limited resources.
Sustainability for this crop is the key.
We have to share it.

Thank you for your attention