Assessment of economic impacts of Western Corn Rootworm (*Diabrotica virgifera virgifera*) in Germany

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Outline

- Aim and methodology of the project
- Short overview on German maize production and the Diabrotica situation with respect to costs
- Economic impact of Diabrotica
- Control scenarios, their costs and efficacy
- Spread of Diabrotica for some of the control scenarios
- Benefits of control measures
- Conclusions
Aim

- evaluate the overall economic impact of *Diabrotica virgifera* for the whole of Germany
- compare different management strategies against the beetle with their costs and benefits compared to a „do nothing“ and a „do little“ szenario
- estimate if the official control measures eradication and containment (still) „pay“
Methodology

apply the new dynamic spread model for Germany (Krügener, Balschmiter et al. 2012) to predict areas where impacts are expected to occur (ex-ante analysis based on spatial explicit data)

take the observed situation in Germany into account concerning plant health control measures and costs incurred by those regions where measure have been applied (ex-post analysis based on „real data“)

Szenario analyses for different assumptions on the efficacy of control measures

Benefit-Cost-Analysis of different crop management strategies
Maize production acreage in Germany

Overall Maize acreage

Production value (2010) of Grain Maize: 703 Mill €

Source: Stat. Bundesamt, DMK, BMELV

Green/Silage Maize

Grain Maize

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Biogas production in Germany

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- number of biogas plants
- output of electricity

Years

output of electricity

number of biogas plants
Maize production areas and eradication and containment zones

Green /Silage Maize 2010

Grain Maize 2010

Diabrotica situation in 2012

Source: DMK

Containment zone: 1.854.739 ha
about 15-20% Maize:
278.210 – 370.947 ha Maize

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Costs of official control measures

- Estimation from the solidarity claims
- Monitoring costs (about 250,000 – 280,000 €/year)
- Eradication costs
## Costs of official control measures

<table>
<thead>
<tr>
<th>Year</th>
<th>RPPOs (monitoring, insecticide treatment, administration, etc.)</th>
<th>Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>680.000 €</td>
<td>- no documented data available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- up to now no yield losses reported (low Dvv abundances)</td>
</tr>
<tr>
<td>2008</td>
<td>1.025.000 €</td>
<td>- If crop rotation is applied →</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in case of &gt; 50% continuous maize:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Grain maize about 150€/ha</td>
</tr>
<tr>
<td>2009</td>
<td>345.000 €</td>
<td>• Silage/green maize about 250€/ha</td>
</tr>
<tr>
<td>2010</td>
<td>141.000 €</td>
<td>• Maize for biogas 150 – 350€/ha (Bavaria: 650-800 €/ha, Köhler 2012)</td>
</tr>
<tr>
<td>2011</td>
<td>190.000 €</td>
<td>• Animal production – 100 – 650€/ha (see Köhler 2012)</td>
</tr>
<tr>
<td>Total</td>
<td>2.381.000 €</td>
<td></td>
</tr>
</tbody>
</table>
Estimation of economic impact of Diabrotica

Direct effects

- Yield loss - 10-30% (up to 50% under very favourable conditions for the beetle)
  Economic injury level (EIL) assumption: 1 beetle per plant (80,000 beetles per ha)
- Costs of control measures

Indirect effects

- Side effects of control measures (e.g. effects on bees, problems with contracts for biogas production in case of crop rotation)
Estimation of economic impact of Diabrotica

Potential impact:

- all German maize producing areas are infested and suffer from yield losses or control costs

- Time horizon: depends on the control scenario (30 years)
## Control Szenarios

<table>
<thead>
<tr>
<th>Control option</th>
<th>Expected efficacy</th>
<th>Direct costs per ha and year</th>
<th>Indirect costs</th>
<th>Number of years until potential impact reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: “do nothing”</td>
<td>0 %</td>
<td>0</td>
<td>----</td>
<td>30</td>
</tr>
<tr>
<td>Maize growers start to apply control <strong>after 5 years</strong> and if beetle numbers exceed <strong>EIL</strong></td>
<td>40 %</td>
<td>70 €</td>
<td>Depend on measure</td>
<td>30</td>
</tr>
<tr>
<td>Maize growers start to apply control options <strong>immediately</strong> irrespective of the EIL</td>
<td>90 %</td>
<td>90€ or &gt;</td>
<td>Depend on measure</td>
<td>---- (no beetles after 10 years)</td>
</tr>
<tr>
<td>Maize growers start to apply control options <strong>after 5 years</strong> and then irrespective of the EIL</td>
<td>90 %</td>
<td>90€ or &gt;</td>
<td>Depend on measure</td>
<td>takes very long</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>100%</td>
<td>150 – 650 (800) €</td>
<td>Depend on measure</td>
<td>Never ?</td>
</tr>
<tr>
<td>Eradication of 3 new introductions</td>
<td>10% Maize: 8.64 - 13.56 M€</td>
<td>50% Maize: 11.61 - 19.74 M€</td>
<td>70% Maize: 13.10 - 22.83 M€</td>
<td></td>
</tr>
</tbody>
</table>
Maize production areas in the spread model

Green / Silage Maize 2010

Grain Maize 2010

Maize areas in the spread model

Source: DMK

Maize area of districts in ha

Maize area of districts in ha

< 1 ha or no data

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Spread of Diabrotica for some of the control scenarios – simulation results

Baseline: “do nothing”

measures after 5 years, EIL (40% efficacy)

measures after 5 years, no EIL (60% efficacy)

Reproduction 10, spread after 30 years

number of beetles / ha maize

- 1.000 - 29999.999
- 30000 - 79999.999
- 80000.000 - 479999.999
- 480000 - 2514367.876

1 – 5 beetles / plant

> 6 beetles / plant

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Spread of Diabrotica for some of the control scenarios – simulation results

measures after 5 years, EIL (40% efficacy)

measures after 5 years, no EIL (60% efficacy)

measures immediately, no EIL (60% efficacy)

Reproduction 10, spread after 30 years

number of beetles / ha maize

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Spread of Diabrotica for some of the control scenarios – simulation results

measures immediately, no EIL (60% efficacy)
measures immediately, no EIL (70% efficacy)
measures immediately, no EIL (90% efficacy)

Reproduction 10, spread after 30 years

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Spread of Diabrotica for some of the control scenarios – simulation results

Measures immediately, no EIL (90% efficacy)

1 year  2 years  3 years  5 years  8 years

number of beetles / ha maize

1,000 - 29999.999
30000 - 79999.999
80000,000 - 479999.999
480000 - 2514367.876

1 – 5 beetles / plant
> 6 beetles / plant
Benefits of control measures

- Avoided/delayed impact (yield losses and/or control measures) of *Diabrotica* in non-infested regions

- only to be expected, if control measures are effective and spread is avoided (eradication of small populations) or delayed (consequent and regularly applied measures)

- crop rotation most effective

- high percentages of continuous maize (> 66%) require additional insecticide applications and may cause environmental impacts and decrease benefit
Benefits of control measures – delay of spread

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Conclusions

- Spatial explicit spread model for Germany works fine and can help with estimating cost and benefits of control options.

- Costs and benefits strongly depend on the chosen control option, the assumed efficacy and regional differences.

- No final results yet – cost benefit calculations need to be done for the new spread data.

- Future: how can we deal with expected yield losses / thresholds in Germany?
Thank you for your kind attention!