The corn rootworm in Bavaria
- local relevance and economic impact on single farms -

International Conference on the German Diabrotica Research Program

Berlin, 14th – 16th November 2012
Assessment of the possible regional significance of the Western corn rootworm (WCR)

Determination of the economic impact of different eradication and containment measures at farm level
Cultivation of maize in Bavaria

Maize growing area 2009

Bavaria: maize 2010
Source: Halama, LfL Bayern

Bavaria:
Maize growing area: 464,688 ha
Portion of maize in crop rotation: 22 %
Area increase: 11 %
Cultivation of maize in Bavaria

Proportion of maize in crop rotation

- 0 %
- 0 < 33,33 %
- 33,33 < 40%
- 40 < 50%
- > 50%

Source: InVeKoS Data 1996, 2011,
Study Approach:

Steps:

1. Selection of specific regions
2. Selection of case study farms
3. Economic calculations
4. Qualitative survey

Conclusion
**Method: Selection of case study farms**

<table>
<thead>
<tr>
<th>Selection of specific regions</th>
<th>Selection of typical single farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>➔ <em>Assuming that the economic importance of the beetle depends on the regional maize density</em></td>
<td></td>
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<tr>
<td>• Identification of regions in Bavaria with a high maize density</td>
<td>• Analysis of the InVeKoS-Database</td>
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<tr>
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<td>- Regional portion of maize in crop rotation (&gt; 50%)</td>
</tr>
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<td>- Regional portion of maize in crop rotation (&gt; 50%)</td>
<td>- Portion of maize grown on single farm (&gt; 66%)</td>
</tr>
<tr>
<td>- Area related development of maize production (2005-09)</td>
<td>• Different farm types (diary cattle, cash crop production, bull fattening, pig production, etc.)</td>
</tr>
<tr>
<td>• Expert interview</td>
<td>• Expert interviews</td>
</tr>
<tr>
<td></td>
<td>• Willingness of manager to participate</td>
</tr>
</tbody>
</table>
### Method: single farm survey

<table>
<thead>
<tr>
<th>1. Economic calculations</th>
<th>2. Qualitative survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>case study farms (n= 9 )</td>
<td>case study farms (n= 50)</td>
</tr>
<tr>
<td>➔ whole-farm simulation</td>
<td>➔ semi-structured interviews</td>
</tr>
</tbody>
</table>

#### 1. Data collection:
- accountancy data
- Interviews with farm manager

#### 2. Calculating the gross margin of the main production processes (five-year average)

#### 3. Economic evaluation of the different single farm adjustment measures

#### Purpose:
- prove the results of the case study
- obtain more information about the consequences on farm level
- evaluate the proposed cultivation alternatives for maize
### Results: Adjustment measures

Grain maize/silage maize is replaced by:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash crop production</strong></td>
<td>Winter wheat cultivation</td>
</tr>
<tr>
<td><strong>Swine production</strong></td>
<td>Change of feed ration: Substitution of grain silage by wheat and barley, purchase of wet maize, winter wheat cultivation</td>
</tr>
</tbody>
</table>
| **Dairy cattle**                | Change of feed ration: Substitution of maize silage by grass silage  
  • Diets with varying levels of grass silage (50 %, 70 %, 100 %)  
  • Purchase of feed wheat, reduction of soybean meal, increase of grass-clover cultivation |
| **Bull fattening:**             | Change of feed ration: Substitution of maize silage by grass silage  
  • Diets with a levels of 60 % grass silage  
  • Purchase of feed wheat, reduction of soybean meal, increase of grass-clover cultivation |
| **Biogas production**           | Purchase of substrate (silage maize), increase of grass-clover cultivation |
Results: Adjustment costs

<table>
<thead>
<tr>
<th>Farm type</th>
<th>Adjustment measure:</th>
<th>Costs [€/ha]</th>
</tr>
</thead>
<tbody>
<tr>
<td>cash crop production</td>
<td>winter wheat cultivation</td>
<td>100-200</td>
</tr>
<tr>
<td>swine production</td>
<td>change of feed ration: Substitution of grain silage by wheat and barley, purchase of wet maize, winter wheat cultivation</td>
<td>100</td>
</tr>
<tr>
<td>dairy cattle</td>
<td>change of feed ration: Substitution of maize silage by grass-clover silage</td>
<td>550 – 650 (extreme values: -500/ 1.200)</td>
</tr>
<tr>
<td>bull fattening</td>
<td>change of feed ration: Substitution of maize silage by grass-clover silage</td>
<td>100-350</td>
</tr>
<tr>
<td>biogas production</td>
<td>purchase of substrate, grass-clover cultivation</td>
<td>650 - 800</td>
</tr>
</tbody>
</table>

Adjustment costs depend on:

- Cash crop production: high gross margin of alternative crops
- Purchase cost of silage maize
- Land availability for enhanced forage production
- Necessity of farmland lease


Katrin Köhler 16.11.2012
Results: Economic impact per year

» great differences of the economic impact

Economic impact depends on:

- size of the affected area
- level of maize restriction (67%, 50%, 0%)
- level of farm-specific costs

### Additional work: per 1 ha replaced maize area (at single farm level)

<table>
<thead>
<tr>
<th>Farm type</th>
<th>Adjustment measure:</th>
<th>Labour hour [LH/ha]</th>
</tr>
</thead>
<tbody>
<tr>
<td>cash crop production</td>
<td>winter wheat cultivation</td>
<td>0</td>
</tr>
<tr>
<td>swine production</td>
<td>purchase of wet maize, winter wheat cultivation</td>
<td>1</td>
</tr>
<tr>
<td>dairy cattle</td>
<td>change of feed ration: Substitution of maize silage by grass-clover silage</td>
<td>4.5 - 10</td>
</tr>
<tr>
<td>bull fattening</td>
<td>change of feed ration: Substitution of maize silage by grass-clover silage</td>
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<td>biogas production</td>
<td>purchase of substrate, grass-clover cultivation,</td>
<td>4.5 - 10</td>
</tr>
</tbody>
</table>

### Additional work depends on:

- **Cash crop production:** no significant difference between the crops
- **Forage production:** relatively high increase in labour
  - Silage maize causes less work than clover growing
  - Change of feed ration: 1 ha maize = 2 ha grass-clover

Source: LfL, own calculations

Katrin Köhler 16.11.2012
Results: Adjustment costs vs. yield loss (Bavaria)

<table>
<thead>
<tr>
<th>Proportion maize reduction</th>
<th>Proportion continuous maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2/3 portion of maize in crop rotation)</td>
<td>(3 years in a row)</td>
</tr>
</tbody>
</table>

- **500,000 ha**
  - **2%**
  - **8,850 ha**

- **44,000 ha**
  - **9%**

**Table:**

<table>
<thead>
<tr>
<th></th>
<th>economic damage yield loss 5%</th>
<th>economic damage yield loss 10%</th>
<th>Adjustment costs (min*) (2/3 maize reduction)</th>
<th>Adjustment costs (max*) (2/3 maize reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>affected area [ha]</td>
<td>132,150</td>
<td>132,150</td>
<td>8,850</td>
<td>44,000</td>
</tr>
<tr>
<td>silage maize [ha]</td>
<td>100,430</td>
<td>100,430</td>
<td>6,730</td>
<td>33,440</td>
</tr>
<tr>
<td>grain maize [ha]</td>
<td>31,720</td>
<td>31,720</td>
<td>2,120</td>
<td>10,560</td>
</tr>
<tr>
<td>silage maize [€/ha]</td>
<td>105</td>
<td>210</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>grain maize [€/ha]</td>
<td>70</td>
<td>130</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td><strong>costs [€]</strong></td>
<td><strong>12,800,000</strong></td>
<td><strong>25,000,000</strong></td>
<td><strong>4,400,000</strong></td>
<td><strong>21,700,000</strong></td>
</tr>
</tbody>
</table>

**Source:** InVeKoS 2010-2012, own calculations

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**Notes:**
- Proportion maize reduction: **2%**
- Proportion continuous maize: **9%**
- **500,000 ha**
- **8,850 ha**
- **44,000 ha**

**Adjustment costs:**
- **min*: based on single farms > 67% maize in crop rotation
- **max*: based on continuous maize

**Categories:**
- Maize area Bavaria
- Maize reduction
- Grain maize
- Silage maize

**Other notes:**
- Economic damage yield loss 5%
- Economic damage yield loss 10%
- Adjustment costs (min*) and (max*) (2/3 maize reduction)

**Source:** Katrin Köhler 16.11.2012
Results: Break-Even analysis

| Source: own calculations |

### Time to act?

**Cash crop:**
- Low adjustment costs
- Low tolerance for yield loss
- *Relatively quick response required*

**Dairy cattle:**
- Relatively high adjustment costs
- High tolerance for yield loss
- *Quick response not required*

#### Break-even points
- Cash crop: 8,5%
- Dairy cattle: 27,3%
Conclusion of calculation and survey

- Assessment of the possible regional significance of the Western corn rootworm (WCR)
- Determination of the economic impact of different eradication and containment measures at farm level

- Small-scaled, regional Problem

- The calculations and surveys show that necessary adjustments upon the occurrence of the WCR only in individual farms or very limited regions are a major problem.
  - even in most high-risk regions crop farms with high proportions of maize are relatively rare
  - comparatively low consequences for cash crop production
  - swine production: unexpectedly low impacts

- „special status“ region of Rottal-Inn ➔ substantial compliance costs
Conclusion of calculation and survey

- Assessment of the possible regional significance of the Western corn rootworm (WCR)
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- Grassland farms (forage production) comparatively strong impacts
  - Silage purchased almost impossible
  - Feed substitutes expensive
  - Solution: change of feed ration – avoid silage maize

- Most frequently mentioned consequences:
  - additional work
  - higher costs
  - higher demand of arable land

- Most farmers assessed the adaptation measure that maize can be at most 2/3 of crop rotation to be of a minor problem
Conclusion of calculation and survey

- Assessment of the possible regional significance of the Western corn rootworm (WCR)
- Determination of the economic impact of different eradication and containment measures at farm level

- Break-even analysis:
  - Cash crop production low tolerance for yield loss, because of comparatively low adjustment cost.
  - Single farms with high adjustment costs have a relative high tolerance for yield losses

- Analysis of Bavaria: Adjustment costs vs. Yield loss
  - continuous maize 26%
  - Proportion of maize reduction 2 – 9% (whole Bavaria)
    - gap of 7% - seems that many single farms have continuous maize, although the proportion of maize grown is much lower than 66% 
      = large potential for crop rotation – to reduce proportion of continuous maize
  - Adjustment costs between € 4 million – € 22 million
  - Economic damage yield loss (5%, 10%) between € 13 million - € 25 million
Thank you for your attention