A REVIEW OF
DIFFERENT TRAPPING METHODS AND PURPOSES
FOR DIABROTICA VIRGIFERA VIRGIFERA LECONTE

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The place of different sampling methods

- Absolute methods (simple, easier to correlate)
- Relative methods (at low population densities, less labour intensive, often closer to every-day practice)
- A combination of different methods is optimal
A relative method...

... trapping with lures
Colour sensitivity:
Yellow sticky sheets
Several hues of bright yellow colour are known to be attractive towards WCR.
Sticky sheets painted these yellow hues can be used as simple monitoring tools.
These traps usually pretty non-discriminative - they catch many non-target insects, and relatively few WCR, because the effect of the colour is not very strong as compared to other stimuli. Despite these drawbacks, especially in very high populations, such yellow sticky sheets may be useful. In lower population densities catches tend to be too low to allow for meaningful conclusions.
Chemical attractants
Chemical stimuli which can be used for a monitoring trap are basically either of sex pheromonal, or food attractant (floral lure) activity.
In some high population areas the so-called "cucurbitacin traps" were also used. These are small tubes with dry plant material plus insecticide inside, and the plant material comes from Cucurbita spp., rich in cucurbitacin. This compound is a feeding stimulant for WCR, so it keeps the beetles arriving to the trap there, but DOES NOT ATTRACT them.
In usual population density situations "cucurbitacin traps" are of very low sensitivity
<table>
<thead>
<tr>
<th>Diabrotica species</th>
<th>Absolute structure</th>
<th>Chemical</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. balteata</td>
<td>6R,12R</td>
<td>6,12-dimethyl-pentadecane-2-on</td>
<td>McLaughlin et al. (1991)</td>
</tr>
<tr>
<td>D. undecimpunctata howardi</td>
<td>10R (++), 10R (+)</td>
<td>10-methyl-2-tridecanon</td>
<td>Guss et al. (1983a)</td>
</tr>
<tr>
<td>D. undecimpunctata undecimpunctata</td>
<td>10R (++), Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. undecimpunctata duodecimpunctata H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. virgifera virgifera</td>
<td>2R,8R (++), 2S,8R (+)</td>
<td>(8-methyl-2-decyl)propionate</td>
<td>Guss et al. (1982), Guss et al. (1984), Guss et al. (1985)</td>
</tr>
<tr>
<td>D. virgifera zeae</td>
<td>2R,8R (++), 2S,8R (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. barberi</td>
<td>2R,8R (++), 2S,8R (-), 2S,8S (-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. longicornis</td>
<td>2S,8R (++), 2R,8R (--)</td>
<td>(8-methyl-2-decyl)propionate</td>
<td>Guss et al. (1982), Guss et al. (1984), Krysan et al. (1986)</td>
</tr>
<tr>
<td>D. lemniscata</td>
<td>2S,8R (++), 2R,8R (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Porracea</td>
<td>2S,8R (++)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. cristata</td>
<td>2S,8R (++)</td>
<td>(8-methyl-2-decyl)acetate</td>
<td>Guss et al. (1983b)</td>
</tr>
</tbody>
</table>
Sex pheromone:

Female WCR emits a **pheromone** by which she attracts the males for mating. The pheromone is available in synthetic form, and can be used as a bait. Pheromone baited traps catch only **males**, but they are of very high **sensitivity**. Such traps are the **ideal** tools for detection purposes. Conventional sticky Delta trap designs are not suitable for catching WCR, instead, trap designs with **open sticky surface** are optimal.
The most widespread **pheromone trap** used in Europe today is the **CSALOMON® PAL** (sticky cloak) trap. Information on the spread and occurrence of WCR in European countries has largely been collected by using **PAL** traps in the past decade. The EU-research project **DIABROTICA (QLK5-CT-1999-01110)** recommends to use **PAL** traps baited with pheromone as the **standard detection tool** for *Diabrotica v. virgifera* in Europe.

In recent years similar pheromone traps became available from other manufactureres also (i.e. Serbios, etc.) It is **disadvantageous** to make such sticky traps **yellow**, because this will **increase non-target** insect captures and practically will not significantly increase WCR captures.
Floral lure:

In the case of WCR it was also known that certain floral compounds isolated from pumpkin flowers exerted strong attraction towards both sexes of adult beetles. This bait was tested in transparent and yellow sticky "cloak" traps, and it appeared that the presence of yellow colour as visual cue was more important for females than for males, increasing female catches significantly. Therefore it is advantageous to have the sticky surface in yellow colour in sticky traps baited with the floral lure.

Effect of yellow colour on WCR captures in traps baited with the floral bait


<table>
<thead>
<tr>
<th>Transparent</th>
<th>Yellow</th>
<th>Total caught in test: 247 beetles</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>no</td>
<td>1.0</td>
</tr>
<tr>
<td>YES</td>
<td>no</td>
<td>3.0</td>
</tr>
<tr>
<td>YES</td>
<td>no</td>
<td>2.0</td>
</tr>
</tbody>
</table>

floral bait (sticky "cloak")
Sticky “cloak” traps baited with the floral lure in most situations are not as sensitive as sticky traps baited with the pheromone. The great advantage of such traps is that they catch predominantly females, and to a lesser extent also males.
The basic requirement for a sampling tool (i.e. trap) used for the study of quantitative aspects (i.e. estimation of population density, threshold catch levels, etc.) is that it should sample constantly the same proportion of the population over time (= its efficiency should remain constant). Although very sensitive in detection, sticky traps have the inherent deficiency that their efficiency will constantly change over time (due to meteorological and many other factors), which makes them unsuitable for the study of such quantitative aspects. The development of non-saturating, non-sticky traps may be an answer.

The first non-sticky type available in Europe was the CSALOMON® VARs+ trap, which could be baited with both the pheromone and floral lures.
"KLPfero+

- it is highly **sensitive** for detection of occurrence and monitoring;
- it is baited with the synthetic **sex pheromone**;
- it catches only **male** insects;
- it has **high catch capacity** (5-6000 beetles);
- (it is highly **selective**;
- simple design, easy-to-use, **no more sticky fingers**!

"PAL"

- it is highly **sensitive** for detection of occurrence and monitoring.
- it is baited with the synthetic **sex pheromone**
- it catches only **male** insects;
- sticky sheet is transparent;
- it has a catch capacity of 3-400 beetles;
- it is of simple design
"KLPflor+":
- it is of the same design as "KLPfero+", but:
- it is baited with the **floral** lure;
- it catches mainly **females** – to a lesser extent also males);
- especially suitable for detecting the occurrence of females);
- it is highly **selective**).

"PALs"
- it is of similar design as the "PAL", but the sticky sheet is **yellow**;
- it attracts by the synergistic combination of **chemical** (floral bait) and **visual** (yellow) stimuli;
- it catches **females** and also males;
- its use is recommended in areas where populations of *Diabrotica* have already been established.

*Comparison of trap types KLPflor vs. PALs*

Debrecen, Hungary, 2004
Total caught: 66890 beetles

![Graph showing comparison of trap types](chart.png)

<table>
<thead>
<tr>
<th>Month</th>
<th>KLPflor</th>
<th>PALs</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>August</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>September</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>October</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

*P=0.8217  N.S.*

*Bar chart showing total catch of beetles*

<table>
<thead>
<tr>
<th>Trap Type</th>
<th>Total Catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>KLPflor</td>
<td>34058 beetles</td>
</tr>
<tr>
<td>PALs</td>
<td>32832 beetles</td>
</tr>
</tbody>
</table>
KLPflor+ vs. PALs: female % in catch

Debrecen, 2004

The KLPflor+ caught females in significantly higher ratio than the PALs!

% mean female 

34058 beetles

32832 beetles

P<0.0001

mean female % (+SE)

normalized against ratio in PALs

mean female ratio (+SE)

70
60
50
40
30
20
10
0

KLPflor+
PALs

July
August
September
1
15
2
16
30
1
8 October
Szekszárd, Tolna county, Hungary

Total caught in test: 1764 beetles

Bait composition:
- rac-8-methyldecane-2-yl propanoate
- rac-8-methyldecane-2-yl acetate
- rac-8-methyldecane-2-one
- (±)-8-methyldecane
- (±)-8-methyl-1-decene

**Bait composition:**
- Pheromone
- Floral bait
- Inhibitor (rubber)
- Inhibitor (PE vial)

**Total caught:**
- 8140 males
- 5384 females

**Ratio of females (%)**
- N=29
- N=34
- N=29

Only sex ratio of single catches exceeding 10 specimens were included into the analyses.

**Total caught:** 8198 beetles
CLICK BEETLE AND WIREWORM MONITORING

• PHEROMONE TRAPS pest species occur in EUROPE
• ONE inspection plus maintenance!!
• 2-3 pest species/site

• Wireworms could be trapped in areas of high pheromone trap catches

• Preliminary thresholds are available
PAL for Diabrotica males

KLPflor+ for Diabrotica females

RAG for many moths

VARb3k for Tropinota (Epicometis)

VARL+ for noctuids

VARb3 for Cossus or Anomala

VARLz for Rhagoletis

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