Virus diseases of cereals in Sweden – an overview

Anders Kvarnheden
Department of Plant Biology
Three viral diseases of cereals have caused large crop losses in Sweden

- Wheat dwarf disease (vetedvärgsjuka)
- Oat sterile dwarf disease (dvärgskottsjuka)
- Barley yellow dwarf disease (rödsotsjuka på havre, gulsotsjuka på korn)
Additional diseases have been recorded

- Cereal tillering disease on barley and oats; Maize rough dwarf virus

- European wheat striate mosaic on oats, wheat and barley; European wheat striate mosaic virus

- Oat blue dwarf virus, Brome mosaic virus, Tobacco necrosis virus, Ryegrass mosaic virus
Wheat dwarf disease

Wheat dwarf virus transmitted by the leafhopper *Psammotettix alienus*
Wheat dwarf disease

Outbreak in Sweden 2009: 80% crop loss in some fields

Affected fields with reduced tillage
Wheat dwarf disease

Outbreak in Sweden 1918: 5.1 million SEK of estimated loss in counties of Södermanland and Östergötland

A. Tullgren, Landmannen (1918)
Oat sterile dwarf virus transmitted by the planthopper
*Javesella pellucida*
Oat sterile dwarf is widely distributed in central Sweden

Distribution of planthopper-borne viruses in Sweden 1960-1973

OSDV=Oat sterile dwarf virus
CTDV= Cereal tillering disease virus
WSMV=Wheat striate mosaic virus

Lindsten 1974 Microbiologija 11: 55-66
Disease cycle of oat sterile dwarf (in oats and forage grass)

Viruliferous planthopper

Winter

Spring

Summer

Plowing

No plowing

Autumn

After Waern & Berggren
Barley yellow dwarf

Spring infection of oats

Autumn infection of barley; Photo Roland Sigvald

Infection of cereals and grasses by barley yellow dwarf-associated viruses are common
Three variants of barley yellow dwarf-associated viruses identified by ELISA in Sweden

- Barley yellow dwarf virus-PAV transmitted by *R. padi*/*S. avenae*

- Barley yellow dwarf virus-MAV transmitted by *S. avenae*

- Cereal yellow dwarf virus-RPV transmitted by *R. padi*

Often detected in mixed infections
Transcapsidation

Transmission by *R. padi* or *S. avenae*

Transmission by *S. avenae*
ELISA detects closely related viruses of different species

<table>
<thead>
<tr>
<th>Serotype (ELISA)</th>
<th>Species (Sequence analyses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BYDV-PAV</td>
<td>BYDV-PAV, BYDV-PAS, BYDV-OYV</td>
</tr>
<tr>
<td>BYDV-MAV</td>
<td>BYDV-MAV, BYDV-GAV</td>
</tr>
<tr>
<td>CYDV-RPV</td>
<td>CYDV-RPV, CYDV-RPS, BYDV-GPV, BYDV-RMV</td>
</tr>
</tbody>
</table>
High diversity of BYD-associated viruses in Sweden

Triticale on Gotland: BYDV-PAV, BYDV-PAS, BYDV-OYV

Cereals and grasses at Ultuna: BYDV-PAV, BYDV-PAS, BYDV-OYV, BYDV-MAV, BYDV-GPV, BYDV-RMV
Phylogenetic analysis of BYD-associated viruses
Important factors for virus spread and its effects

- Presence of virus sources; Plowing, fallows
- Presence and activity of vectors
- Timepoint for infection; Sowing time
- Treatment: Insecticides

- With a milder climate, the problems with autumn and spring infections with viruses will probably increase
Virus infections in grasses are common but often symptomless.

Wheat dwarf virus, Oat sterile dwarf virus and Barley yellow dwarf virus persist in grasses, which may act as sources for transmission to cereals.
Acknowledgments

- Swedish Farmers’ Foundation for Agricultural Research (SLF)
- Stiftelsen Oscar and Lili Lamms Minne
- The Royal Swedish Academy of Agriculture and Forestry (KSLA)
- Formas

- All present and former group members
- Collaborators