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Virus diseases of canola: *Turnip yellows virus (TuYV)* and *Turnip mosaic virus (TuMV)*

with an overview of DAN00202

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Turnip yellows virus

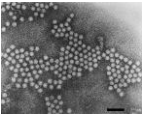
Turnip yellows virus (TuYV)
Family: *Luteoviridae*; genus: *Polerovirus*

First described in 1950s and now worldwide


Reported in Australia 1980s

Characteristics
Not seed-borne
Phloem-limited
Persistently transmitted by aphids

Symptoms in canola
Reddening of lower leaves
Interveinal yellowing
Leaf distortion
Plant stunting



100 um
Turnip yellows virus particles




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Hosts

100 species from 13 families


Crops

- Pea, chickpea, faba bean, sub clover, lucerne
- Lettuce
- Cabbage, cauliflower, broccoli
- Watermelon, cucumber



Weed hosts – infection often symptomless

- Wild radish
- Wild turnip
- Marshmallow
- Nightshade
- Fleabane
- Afghan melon
- Stinkweed



TuYV and aphid vectors survive between growing seasons in weed hosts


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Aphid vectors

Transmitted by persistently aphids

- Green peach (*Myzus persicae*)
- Cabbage aphid (*Brevicoryne brassicae*)
- Cotton aphid (*Aphis gossypii*)
- Pea aphid (*Acyrtosiphon pisum*)
- Potato aphid (*Macrosiphum euphorbiae*)
- Oat aphid (*Rhopalosiphum padi*)
- Corn aphid (*Rhopalosiphum maidis*)

Systemic insecticides are effective in controlling TuYV spread as taken up by feeding aphid.



Cabbage aphid Oat aphid Green peach aphid


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WA Field trials – yield losses

- Four replicated field trials at 3 sites – yield losses from TuYV in canola (Pinnacle)
- Treatments:
 - Insecticide (seed dressing-Gaucha; foliar-Fastac & Confidor; combo)
 - Untreated control plots
 - Infector plants introduced (virus and aphids)

Measurements:

- Virus testing
- Aphid counts
- Yield
- Seed Quality



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Yield loss field trials



Healthy canola BWYV-infected canola

Yield loss

- Losses due to early season infection
- TuYV plot infection up to 100% (untreated)
- Yield losses up to 46% due to BWYV
- Yield loss due to fewer seeds
- For each 1% increase in TuYV = reduce yield 6-12kg/ha

Example: Badgingarra

Jones, Coutts and Hawkes, 2007 AJAR

Oil content **Erucic acid content**

Oil content decreased by up to 3% Erucic acid content increased up to 44%

Jones, Coutts and Hawkes, 2007 AJAR

UK study (Coleman 2013) – Oil content decreased 3%,
- some changes in fatty acid profile
- Varietal differences

Screening for TuYV resistance

- 18 varieties
- 12 susceptible (45-100%)
Trilogy, Beacon, Boomer
- 3 moderately resistant (5- 25%)
Jade, Banjo, Tanami
- 1 resistant (2%)
Stubby
- 2 highly resistant (0%)
Tranby, Trigold

Coutts, Webster and Jones, 2010 Crop and Pasture Science

TuYV - conclusions

- Early season infection in canola leads to yield and seed quality losses
- Seed dressing limit early season infection
- Potential resistant canola varieties

Further research

- Yield and quality losses from later season infection?
- Resistance in current canola varieties?
- Cowpea aphid potential to transmit?
- Effect on pulse crops?

Turnip mosaic virus (TuMV)

Family: *Potyviridae*; genus: *Potyvirus*

First described in 1920s and now worldwide

NSW - High levels reported in *B. juncea*, occasionally infects canola
WA – very occasional in canola

Characteristics
Very wide host range (>20 families) – including all brassica species
Not seed-borne
Non-persistently transmitted by aphids (40-50 species)

Symptoms in mustard
Severe mosaic

Photo: J. van Leur

Turnip mosaic virus studies in Australia

NSW (DPI NSW - J. van Leur)

- Surveys, field and glasshouse screening canola and *B. juncea*
- Presence of a highly virulent TuMV strain confirmed.
- No complete resistance TuMV resistance found among the tested germplasm.
- Indications of differences in TuMV resistance in field screening.

WA (DAFWA – Jones, Coutts, Kehoe; UWA - Nyalugwe)

- Surveys of canola crops
- Various studies on resistance phenotypes in *Brassica* species (oilseeds)
- Studies of Australian isolates
- biological - isolates differed in reaction on hosts and virulence
- molecular - NSW isolates different to WA

NSW Department of Primary Industries THE UNIVERSITY OF WESTERN AUSTRALIA GRDC Grains Research & Development Corporation

Virus threats to canola and pulse crops

- TuYV (BWYV) in canola – SA 2014
- Increased areas of canola production
- Little known on virus resistance/susceptibility in current varieties
- Increasing virus infection in pulse crops
- Impact of canola viruses (strains) on pulse crops

Photo: J. van Leur

New tools and germplasm for Australian pulse and oil seeds breeding programs to respond to changing virus threats (DAN00202)

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Priority viruses (endemic to Australia) in pulse and brassica field crops

Virus	Abbr.	Genus	Faba bean	Chickpea	Field pea	Lentil	Lupins	Canola	Mustard
Bean leafroll	BLRV	Luteovirus	high	moderate	high	high	low	no	no
Soybean dwarf	SBDV	Luteovirus	high	high	high	high	low	no	no
Phasey bean ^a	PhBV	Potyvirus	?	high	?	?	?	no	no
Turnip yellows (syn: West western yellows) ^b	TuYV (BWYV)	Potyvirus	low	high	low	high	low	high	high
Bean yellow mosaic	BYMV	Potyvirus	moderate	low	low	low	high	no	no
Pea seed-borne mosaic	PSbMV	Potyvirus	low	low	high	potentially high	no	no	no
Turnip mosaic	TuMV	Potyvirus	no	low	low	no	no	potentially high	high
Alfalfa mosaic	AMV	Alfamovirus	low	high	moderate	moderate	moderate	no	no
Cucumber mosaic	CMV	Cucumovirus	low	high	moderate	high	high	no	no
Cauliflower mosaic	CaMV	Caulimovirus	no	no	no	no	no	low	low

CMV - Kabuli and Desi chickpea BYMV - lupin AMV - chickpea

Project activities

- Identify and confirm resistant pulse and oilseed lines (field and glasshouse screening, NVT evaluation) – NSW, WA, ICARDA (5 years)

	Luteo	TuYV	CMV	BYMV	TuMV	PSbMV
Faba bean	X	X				
Chickpea	X	X				
Field pea	X	X				
Lentil	X		X			X
Canola	X	X			X	
Lupin	X	X		X		

- Diagnostic test for *Luteoviridae* (develop, validate and implement) – Qld
 - multiplex PCR (5 viruses)
 - species specific PCRs
- Biological and molecular characterisation of luteoviruses and potyviruses isolates – Qld, WA, Vic
- Antibodies evaluated/produced for reliable detection of luteoviruses (endemic and exotic) – Qld, ICARDA
- Reference collection of virus isolates - Qld

- Deliver information on virus and crop to industry – Vic, NSW, Qld, WA
- Virus control strategies (chemical and cultural) – TuYV in canola (field trials) – WA
- Surveys (yearly) for virus diversity in pulse and oilseed crops – Vic, NSW, Qld, WA

Project starts March 2015



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Insecticide seed dressings

	Aphids/plant 89DAS	% BWYV	Yield loss %
Seed dressing	2	35	0
Seed dressing +foliar spray	2	27	9
Foliar spray	38	96	39
No insecticide	25	97	46

Example: Avondale

Aphids and virus introduced to plots
 Seed dressing – imidacloprid
 Foliar spray - alpha-cypermethrin* – 3 and 7 weeks after emergence

Jones, Coutts and Hawkes, 2007 AJAR

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Management strategies for BWYV

- Assess risk late summer/early autumn
- Early season control
- Control weeds and minimise green bridge (reduce virus and vector)
- Avoid planting when peak aphid populations present (early sowing)
- Use insecticide seed dressing (4-6 wk protection)
- Sow after all weeds are killed (avoid carry-over)
- Sow into standing stubble (reduce aphid landing)
- Early canopy cover - high seeding rate (reduce aphid landing)
- Control aphid vectors of appropriate and strategic use of insecticides (seed dressings, rotation chem groups, resistance issues)
- Late season infection (mid podding) – little effect on yield