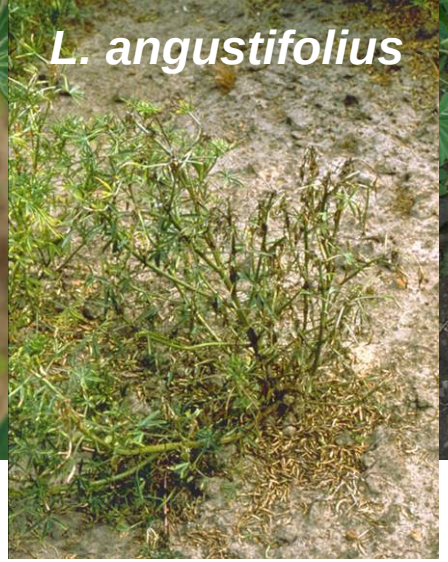

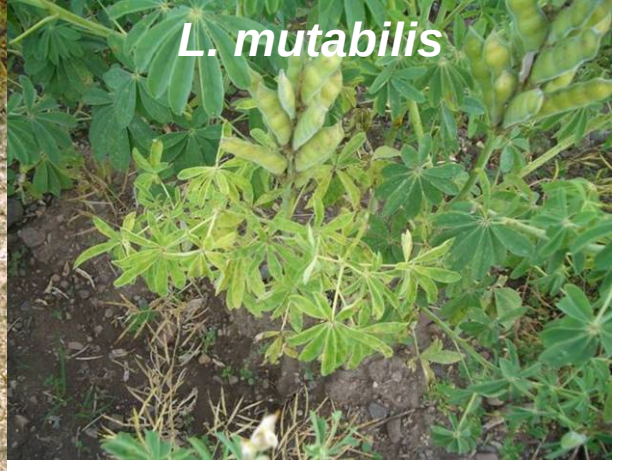

Bean yellow mosaic virus in lupins: strains, losses, epidemiology and control

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AGRICULTURAL RESEARCH WESTERN AUSTRALIA

CLIMA Centre for Legumes in Mediterranean Agriculture

GRDC Grains Research & Development Corporation

Bean yellow mosaic virus

- Studied in lupins since 1930s
- Non-persistently aphid-borne
- Wide host range, infects all lupin species
- Yield limiting potential considerable


Myzus persicae


Aphis craccivora

BYMV symptoms

Easter island – wild lupin

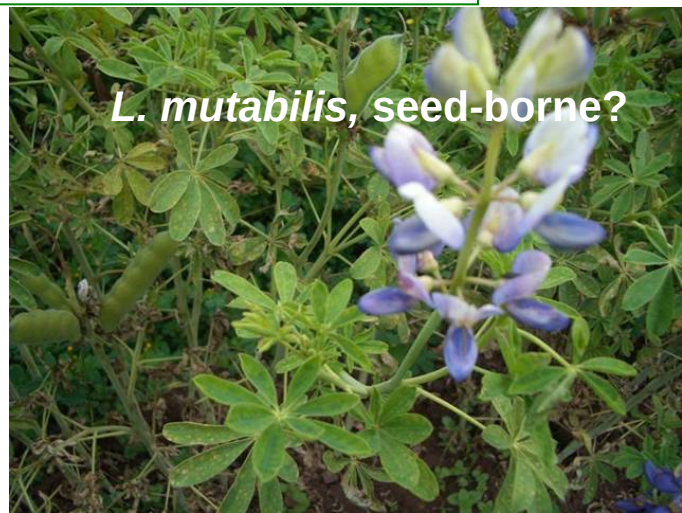
L. mutabilis

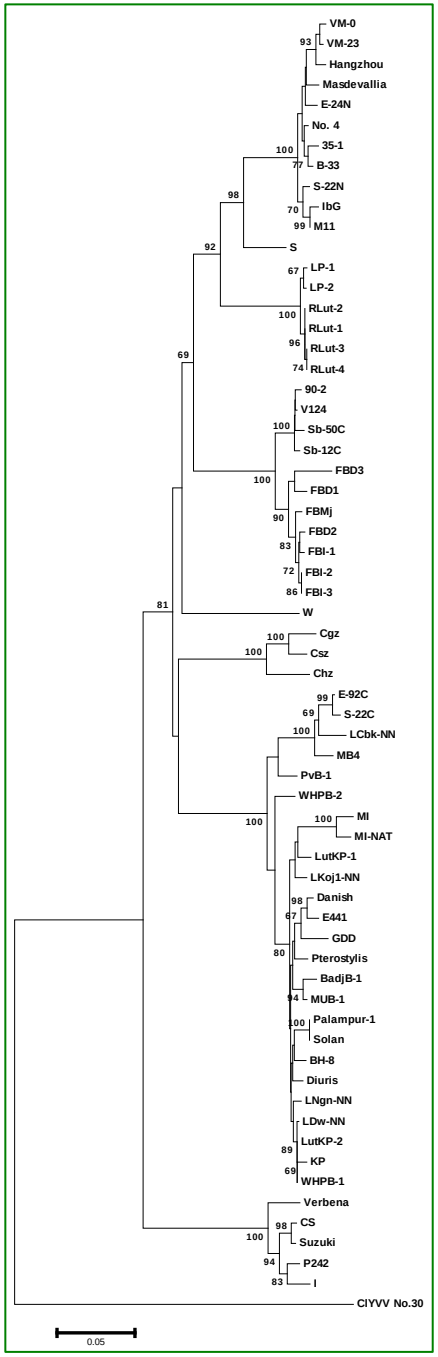
Trifolium subterraneum
(pasture source)

L. cosentinii

Seed transmission

- Strains in Europe, Middle East and North America seed-borne in *L. albus, L. luteus, L. pilosus*
- Strains in Australia not seed-borne in lupin, subject to post-entry quarantine





BYMV Phylogeny

- 64 coat protein gene sequences
- 7 distinct clades
- Seed-borne lupin isolates in Lupin clade
- Australian lupin isolates in Generalist clade
- 1 USA isolate forms monotypic clade W

(Wylie *et al*., 2008)

Strain differentiation in *L. angustifolius*

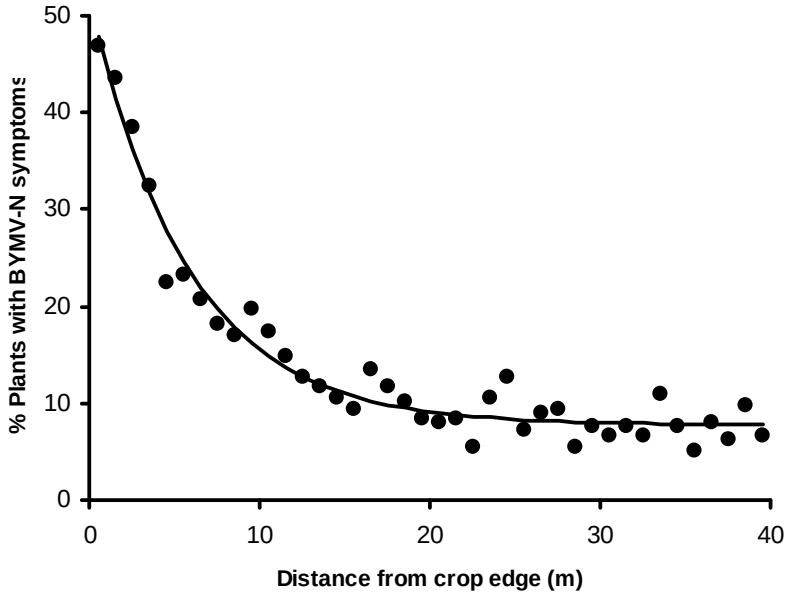
- *L. angustifolius* – necrotic, non-necrotic strain groups
- Non-necrotic spreads more in crops

(Cheng & Jones, 1999, 2000; Cheng *et al*., 2002)

Epidemiology – infection gradients

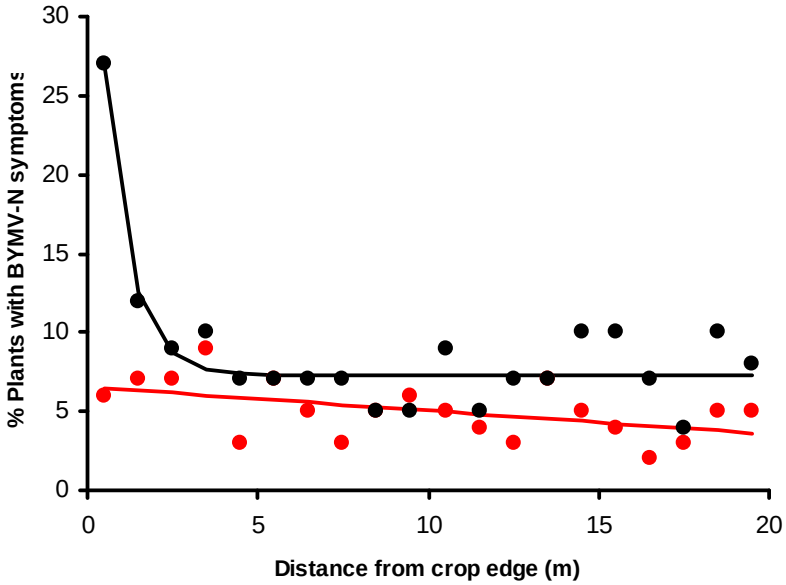
Necrotic BYMV in *L. angustifolius*

Spread from pasture into crop



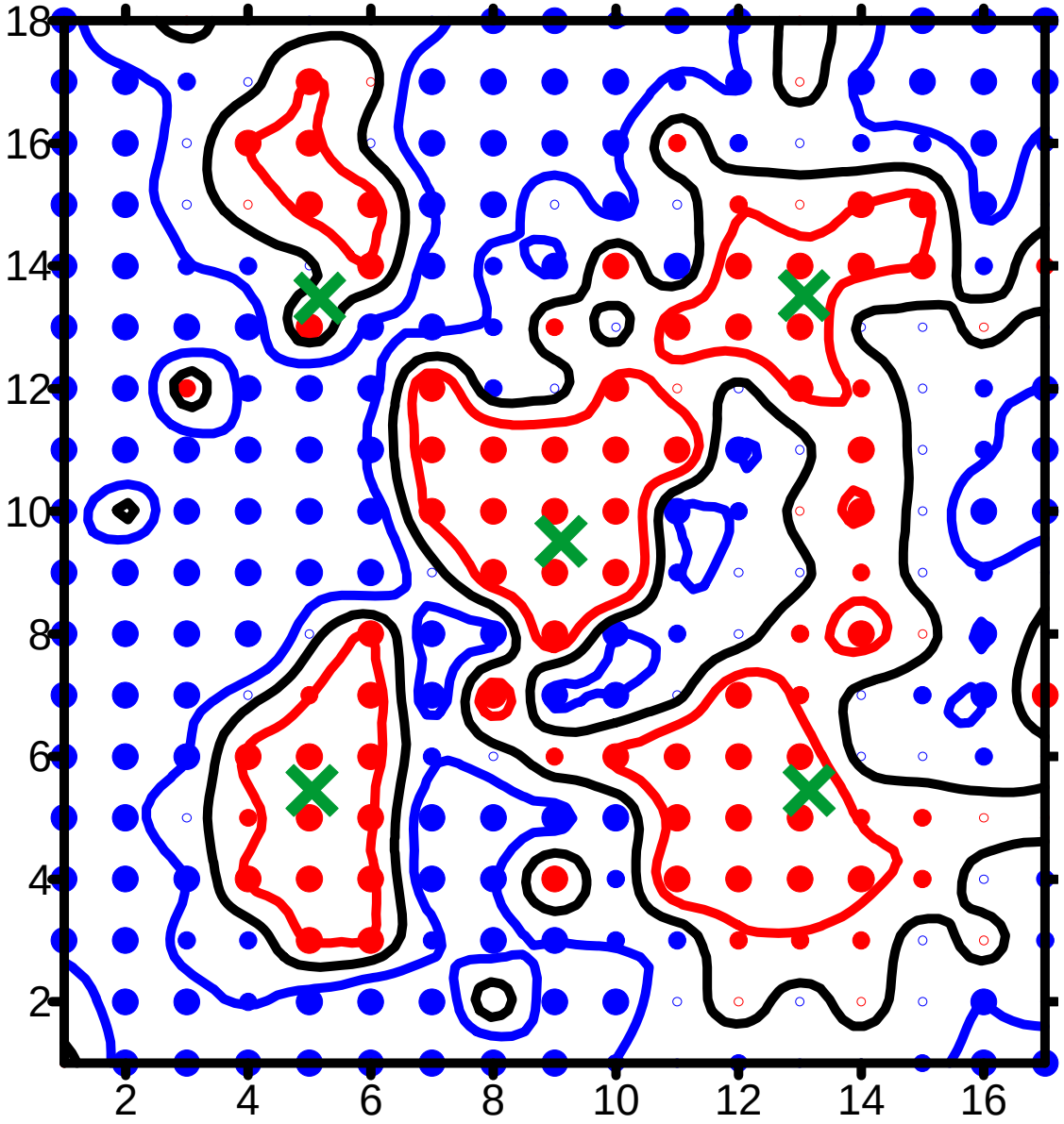
Spread +/- oat barrier crop

[red = + barrier]



(Cheng & Jones, 2002; Jones, 2005)

Epidemiology – spatial patterns of spread



Non-Necrotic BYMV in *L. angustifolius*

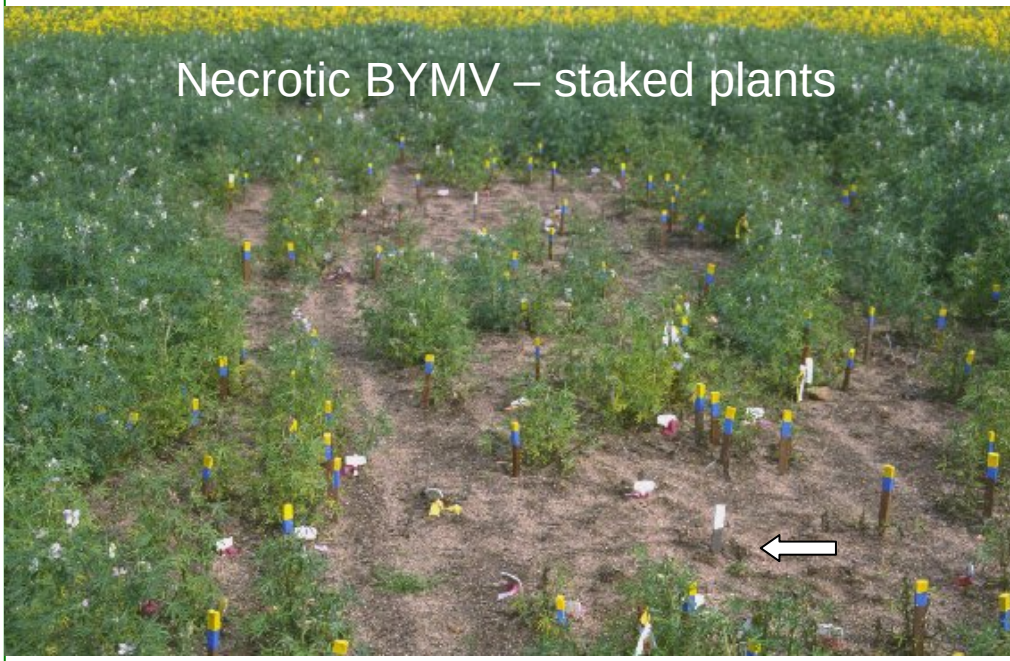
- 5 introduced foci/plot
- Mapped infected plant distribution
- Maps of spatial pattern

(Thackray *et al*., 2002)

Yield losses in *L. angustifolius*

Individual plants, natural spread:

- Necrotic BYMV – losses 100% (early), 80% (late)
- Non-necrotic BYMV – losses 99% (early), 48% (late)
- Both – fewer, smaller seeds

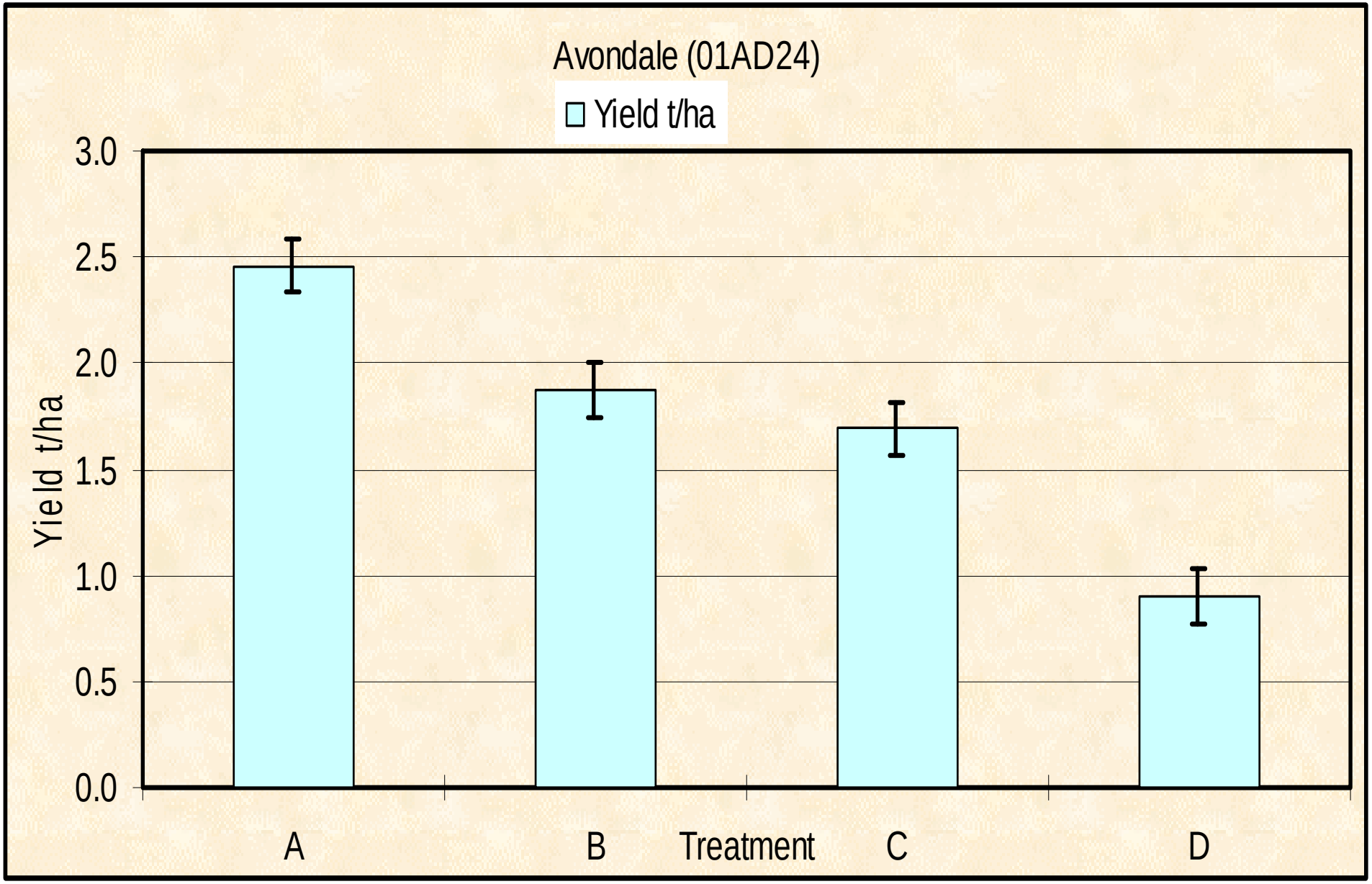


(Jones *et al.*, 2003)

Yield losses in *L. angustifolius*

Large-scale field experiments:-

- Necrotic BYMV, many expts
  - At low plant densities, % infection = % losses
  - At high plant densities, compensation reduces losses
- Non-necrotic BYMV, 2 expts
  - 4 foci/plot – losses 21 to 24%
  - 8 foci/plot – losses 31 to 34%
  - 16 foci/plot – losses 64 to 66%



Effect of non-necrotic BYMV on yield of lupin cv. Tanjil. Bar = lsd. Treatment A = no infector plants; B = 4; C = 8 and D = 18 infector plants/plot (Jones *et al.*, 2003)

Breeding for resistance

- All *L. angustifolius* cultivars have strain-specific, systemic hypersensitive resistance
- Selection for ‘infection resistance’
- Field screening used
- Transgenic approach

Segregation studies with hypersensitive resistance in *L. angustifolius*

- BYMV necrotic isolate MI
- *Myzus persicae* inoculations, 5 aphids/plant
- F2 progeny of 6 cross combinations between:

  90L423-07-13 & P26697 (non-necrotic), and cvs Danja & Merrit (necrotic)

BYMV in *L. angustifolius,* F2 segregation ratios

Crosses:
3 = P26697 x Danja
4 = P26697 x Merrit

Cross	HS	NHS	Total	*Chi sq**	*P*
3	147	50	197	0.015	0.9
4	92	21	113	2.481	0.1

* Test for fit to 3:1 ratio

(Jones & Smith, 2005)

Transgenic resistance

- Synthetic ‘hairpin’ replicase (Nib) gene
- Many transgenic *L. angustifolius* plants
- At generations T2 and T3, 3 independent transgenic lines resistant to 1 BYMV isolate
- Resistance silenced in their progeny when tested with five isolates

(Wylie., unpubl.)

IDM strategy for BYMV in *L. angustifolius*

- Sow perimeter non-host barrier crop
- Avoid fields with large perimeter:area ratios
- Promote early canopy formation
- Sow at narrow row spacing
- Maximise stubble groundcover/ minimise tillage
- Crop rotation/weed control/ early maturing cultivars
- DSS from predictive model

(Jones, 1991; Maling *et al.,* 2008)

Conclusions

- Economically most damaging virus for lupins
- Seed-borne strains of quarantine concern
- Generalist and specialist strain groups
- Non-necrotic strains break *Nbm-1 res.* gene and cause greater losses in *L. angustifolius*
- Transgenic resistance not yet available
- Epidemiology and cultural control measures well studied for *L. angustifolius*
- IDM package available for *L. angustifoilus*

Acknowledgements

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