THE UNIVERSITY OF WESTERN AUSTRALIA
FACULTY OF
Natural and
Agricultural Sciences

Sclerotinia

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Character	Species	Country
Sclerotinia	*B. napus* *B. juncea*	China, Australia India, Australia, China

GRDC Grains Research & Development Corporation
National Canola Pathology Workshop 23 February 2010
Australian Government
Australian Centre for International Agricultural Research

Objectives

1. Develop disease screening protocols, especially for Australia

2. Screen *B. napus* and *B. juncea* germplasm for resistance (India, China and Australia)

Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

1. Evaluated published leaf, petiole and stem as inoculation sites

In certain tests: such as petiole, detached leaves
Varietal differentiation occurs

BUT

can sometimes/frequently correlates poorly with infection from artificial stem inoculations or natural inoculations in the field

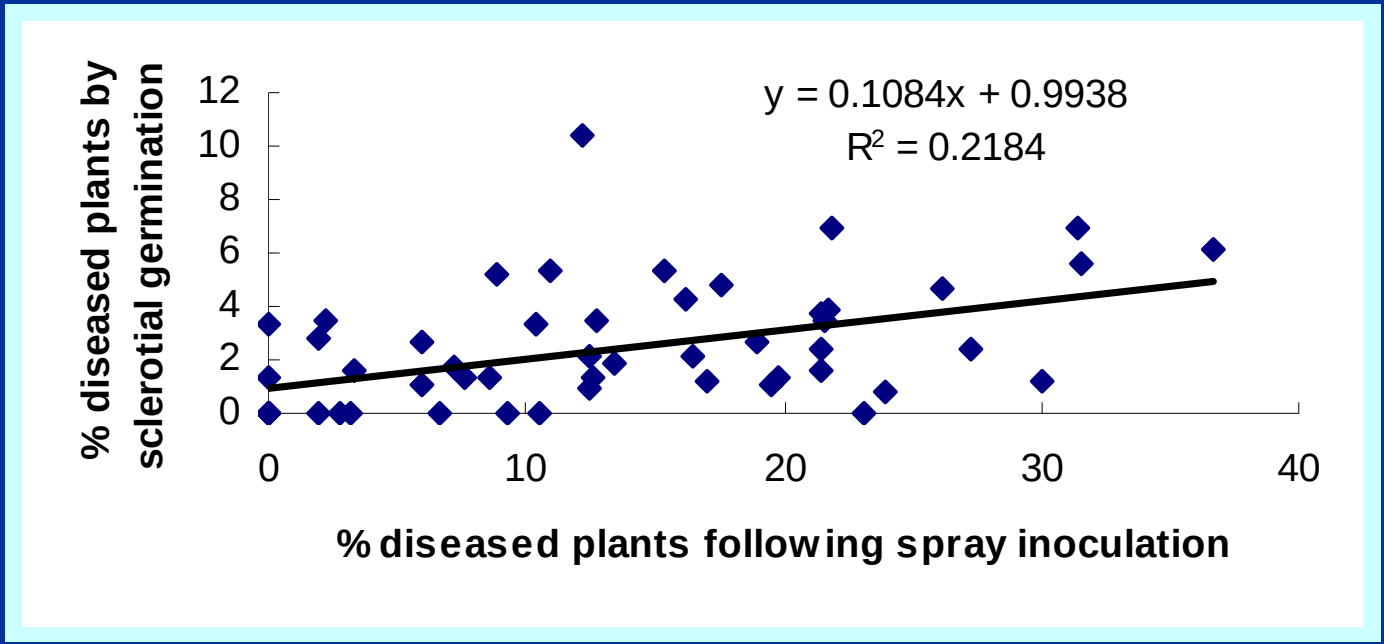
Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

2. Evaluated different field inoculation types

(i). Application of a spray of mycelial suspension

(ii). Myceliogenic germination originating from sclerotia resident in soil



Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

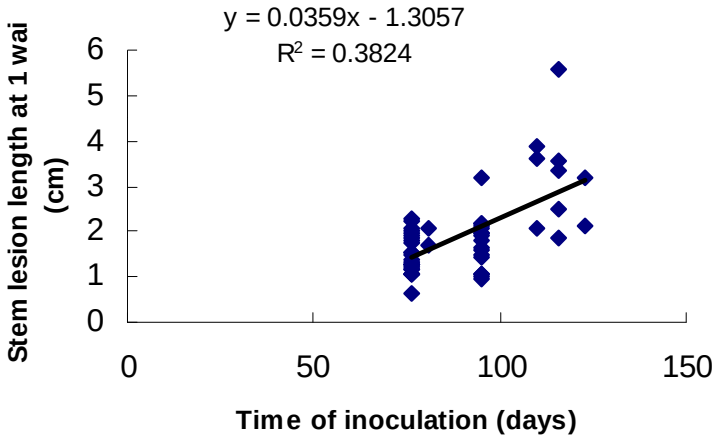
2(iii). Stem inoculation: Chosen for screening genotypes under field conditions at the flowering stage [single agar plug disc bearing actively growing mycelium according to Buchwaldt et al. (2005)]

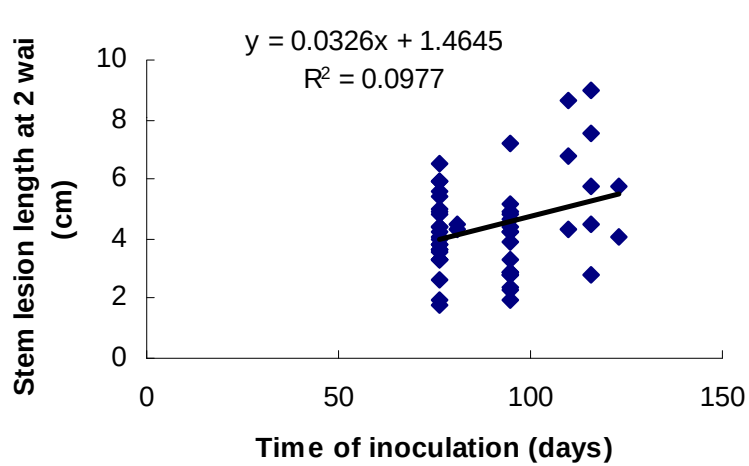
Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Stem inoculation

Time of disease assessment resolves challenge of different genotype maturities





BUT - No effect of flowering time if wait for 3 weeks post-inoculation to assess disease

i.e., **The impact of different flowering times rendered insignificant when assessment of stem inoculation is delayed until 3 wks post-inoculation**

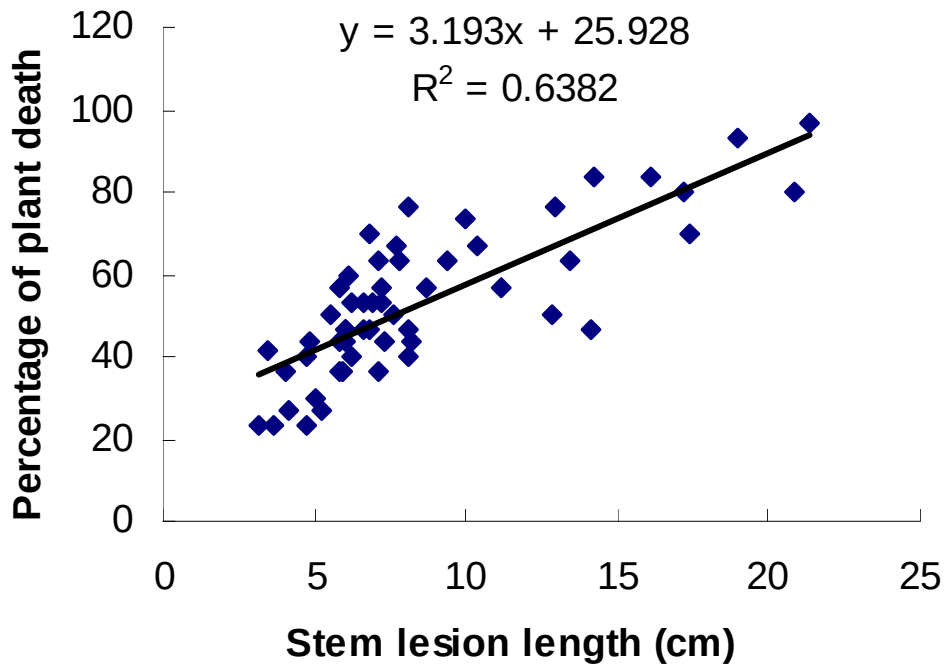
Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Stem inoculation

Other advantages of field stem test

Stem lesion length relates well to plant death



Key findings

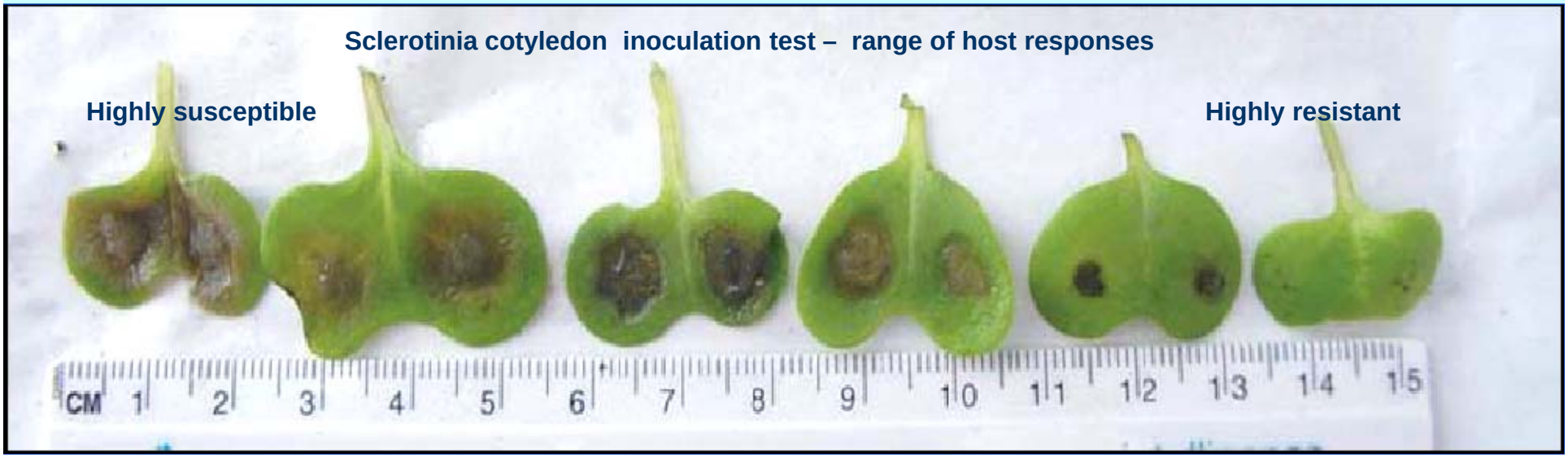
Garg, H., Hua Li, Sivasithamparam, K. and **Barbetti**, M.J. (2008). Cotyledon assay as a rapid and reliable method of screening for resistance against *Sclerotinia sclerotiorum* in *Brassica napus* genotypes. *Australasian Plant Pathology* 37: 106-111

DEVELOPMENT OF SCREENING PROTOCOLS

3. ***Cotyledon test*** already used for Sclerotinia disease on legumes (Grau and Bissonette, 1974) refined for *B. napus* [cotyledons drop-inoculated using macerated mycelium under controlled environmental conditions]

   Cotyledon test provided *B. napus* gentype responses that were:

   - repeatable between experiments
   - proved to be a relatively reliable indicator of field performance



Key findings

EXCELLENT RESISTANCE FOUND IN ACIAR PROJECT

Best =

B. napus ZY006 (China)

(stem lesion length <0.45cm)

Others excellent =

B. napus

06-6-3792 & ZY004 (China)

RT108 (Australia)

B. juncea

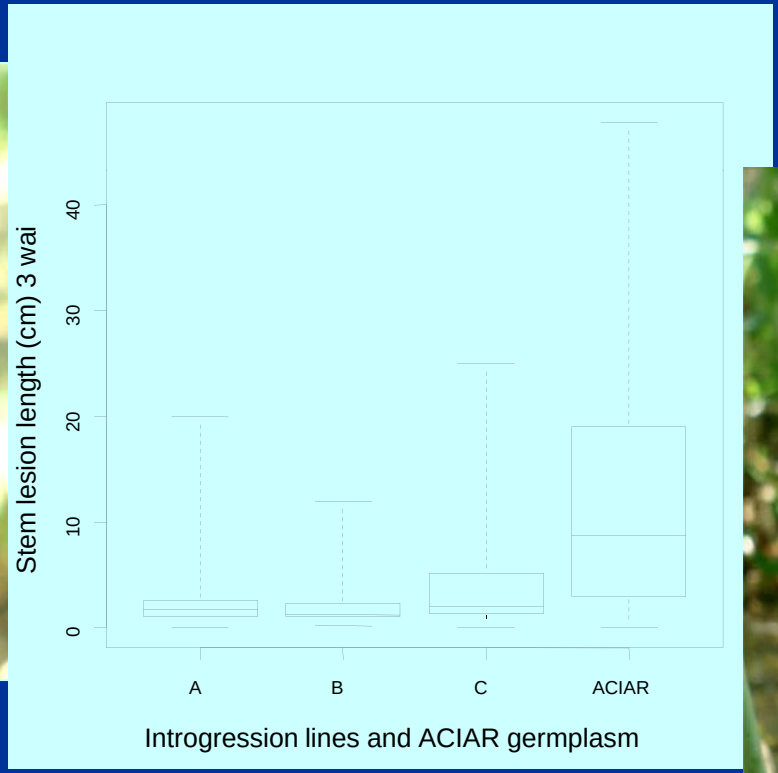
JM06018 & JM06006 (Australia)

B. juncea-2 (China)

Key findings

FANTASTIC RESISTANCE FOUND IN PAU COLLABORATION (INDIA)

Introgression lines developed following hybridization of three wild crucifers (*viz*. *Erucastrum cardaminoides*, *Diplotaxis tenuisiliqua* and *E. abyssinicum*) with *B. napus* or *B. juncea*



A = Erucastrum cardaminoides
B = Diplotaxis tenuisiliqua
C = Erucastrum abyssinicum

Garg, H., Atri, C., Sandhu, P.S., Kaur, B., Renton, M., Banga, S.K., Singh, H., Singh, C., **Barbetti**, M.J., Banga, S.S. (2010). High level of resistance to *Sclerotinia sclerotiorum* in introgression lines derived from hybridization between wild crucifers and the crop *Brassica* species *B. napus* and *B. juncea*. *Field Crops Research* (Online at http://www.elsevier.com/wps/find/journaldescription.cws_home/503308/description#description

Impact of project for Australia

1. Now have a reliable field stem inoculation test

   - one that differentiates host resistance across germplasm from Australia, China and India under Western Australian field conditions

2. Now have high level host resistance is now available for oilseed *Brassica* breeding programs in Australia

3. Now have a cotyledon test developed for rapid growth room screenings for *B. napus* genotypes

4. Now have substantially better understanding of this pathogen and *Sclerotinia-Brassica* pathosystem, especially in terms of identifying host resistance

5. Now understand need for screening for *Sclerotinia* resistance to be undertaken in each country using regional pathogen isolates and that host resistances identified may not be applicable across countries

Opportunities-Challenges-Future

1. **Opportunity** to introgress resistance into Australian cultivars

2. **Opportunity** to screen the final ACIAR ‘trait-cross’ materials

3. **Opportunity** to identify wider range of sources of resistance

1. **Challenge** to define the pathotype-host interactions for Australia

2. **Challenge** to define/monitor Sclerotinia pathotypes in Australia

3. **Challenge** to find resistance that is independent of pathotype

Future prospect for using host resistance as a critical component of Sclerotinia management is, for the first time, a real possibility

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White rust or blister

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Character	Species	Country
White rust	*B. juncea*	Australia

GRDC Grains Research & Development Corporation
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Objectives

1. Develop disease screening protocols for Australia

2. Screen in Australia *B. juncea* germplasm for resistance

Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

1. Evaluated under Glasshouse conditions, the disease development on:
    - Cotyledons
    - Seedling plant leaves
    - Mature plant leaves
    - Leaves and flowers at flowering

2. Evaluated under Field conditions
    - Leaf incidence over time
    - Leaf severity over time
    - Stagheads

3. Compared Glasshouse and Field evaluations

Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Glasshouse testing: identifies most resistant genotypes irrespective of point of inoculation – e.g.

Cotyledon test: The most resistant genotypes: CBJ-001, CBJ-002, CBJ-003, CBJ-004 from China and JR049 from Australia

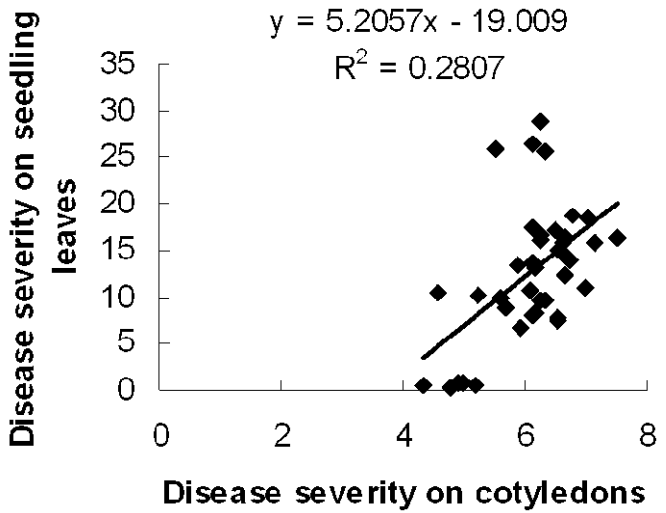
Seedling stage test: The most resistant genotypes were CBJ-001 CBJ-002, CBJ-003, CBJ-004 from China and JR049 from Australia

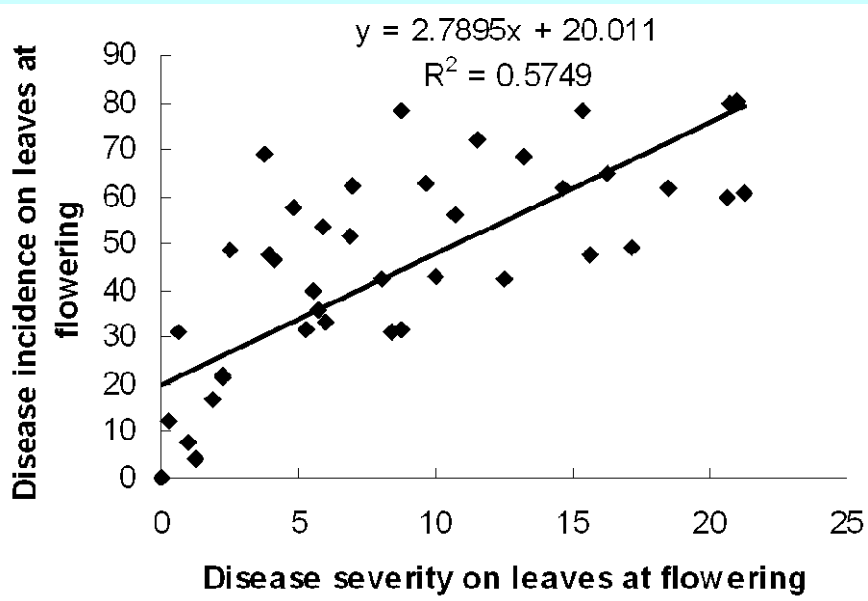
Flowering stage test: The most resistant genotypes: CBJ-001, CBJ-002, CBJ003 and CBJ004 from China and JR049 from Australia

Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Glasshouse testing: often good overall correlation but some individual genotype exceptions, e.g.

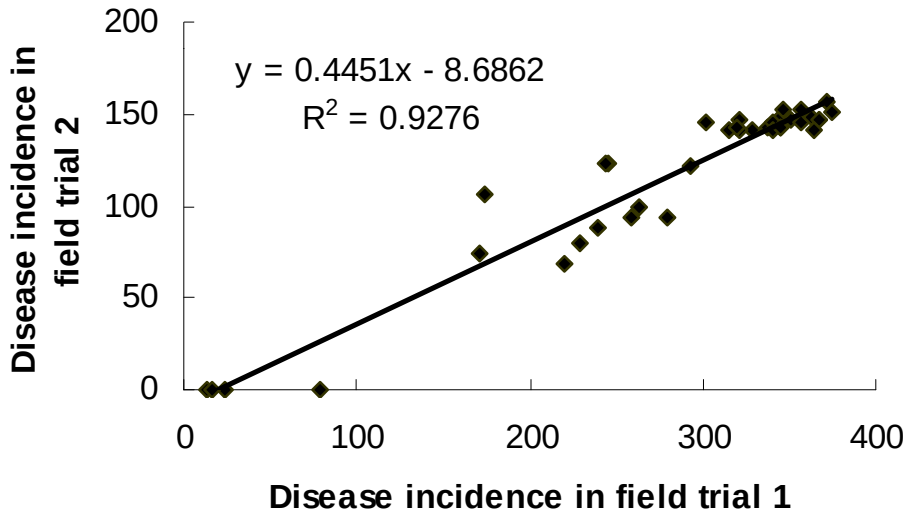


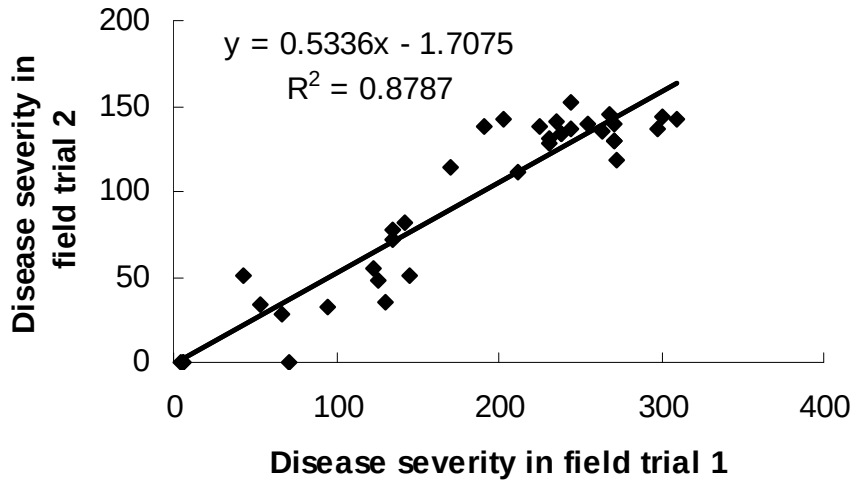


Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Field testing: excellent overall correlation between experiments but some individual genotype exceptions, e.g.

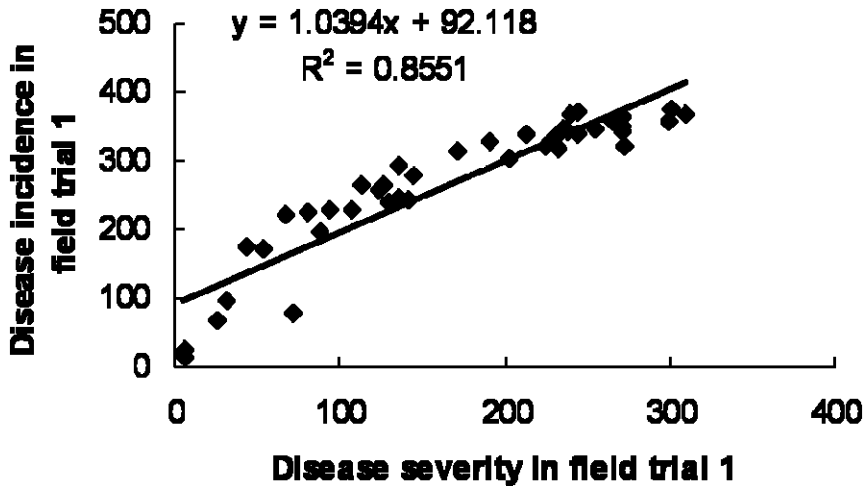


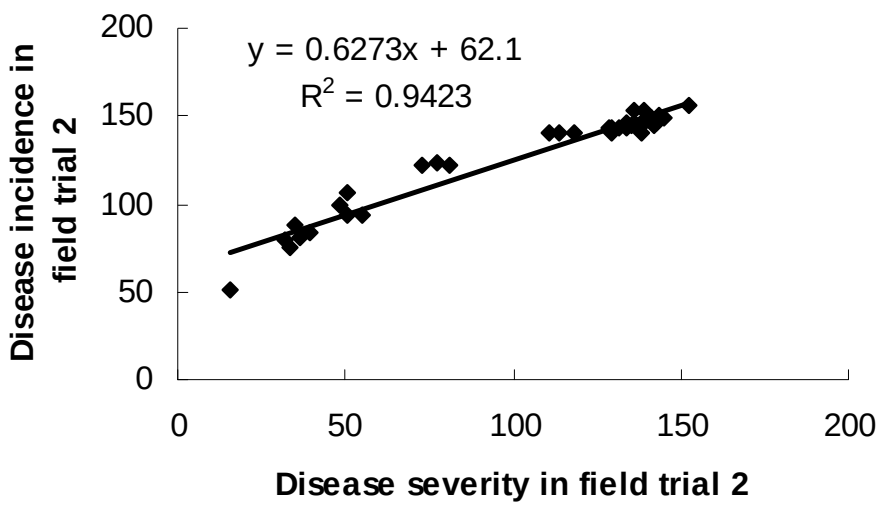


Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Field testing: excellent overall correlation between different disease parameters but some individual genotype exceptions, e.g.





Key findings

DEVELOPMENT OF SCREENING PROTOCOLS

Across four field trials:

- Found that both incidence and severity of white rust disease reflected host resistance in *B. juncea* germplasm from Australia, China and India

Conclusions from glasshouse and field testings:

- Differentiation of high levels of resistance among genotypes is similar in field as for artificially-inoculated seedlings or adult plants under glasshouse conditions – BUT, field is preferable (at least to confirm critical resistances)

- Leaf disease *vs* staghead disease relationship still needs further investigation – generally little or no correlation across genotypes

Key findings

Kaur, P., Sivasithamparam, K. and **Barbetti**, M.J. (2008). Pathogenic behaviour of strains of *Albugo candida* from *Brassica juncea* (Indian mustard) and *Raphanus raphanistrum* (wild radish) in Western Australia. *Australasian Plant Pathology* 37: 353-356

DEVELOPMENT OF SCREENING PROTOCOLS – must know the pathotypes present

Reactions of different cruciferous host differentials to Western Australian isolates of *Albugo candida*

Host differential	Disease reaction	
	B. juncea isolate	*R. raphanistrum* isolate
Brassica carinata 94024.2	-	-
Brassica juncea cv. Vulcan	+	-
Brassica juncea cv. Commercial Brown	+	+
Brassica napus cv. FAN 189 (China)	+	+
Brassica napus cv. Surpass 501TT	-	-
Brassica nigra 90745	+	+
Brassica oleracea var. *italica* cv. B sprouts	-	-
Brassica rapa cv. Torch	-	-
Brassica rapa cv. Reward	-	-
Raphanus raphanistrum WARR25	-	+
Raphanus sativus cv. White Icicle	+	+
Brassica tournefortii BTO2	+	-
Eruca vesicaria MJB1-06	-	-

***B. juncea* pathotype 2V is in Australia and infects:**

- ***B. napus* from China (FAN 189)**
- ***B. tournefortii* (wild turnip)**
- ***B. nigra***
- ***Raphanus sativus***

***R. raphanistrum* pathotype infects:**

- ***B. juncea***
- ***B. napus* from China**
- ***B. nigra***
- ***R. sativus***

Warning: breeders to take care if:

(i) sourcing white rust resistance from *B. napus*

(ii) using China *B. napus* for breeding

(iii) if these species are to be utilized commercially in Australia

Currently testing common host differentials to characterise WR races in India with PAU collaboration

Key findings

EXCELLENT RESISTANCE FOUND

After glasshouse trials and then four field trials over four seasons:

- Most resistant genotypes were JM06011, JM06010, JM06021, JM06004 and JM06013 from Australia and CBJ-001, CBJ-003, CBJ-004 from China
- The very best resistance was on JM06011 that was similar to that of CBJ-003 and CBJ-004 from China, with incidence and severity scored zero
- JM06010, JM06021, JM06004 and JM06013 were more resistant than JR049 which was the best of the Australian genotypes from series 1 germplasm

Impact of project for Australia

- Have reliable means to differentiate levels of resistance to white rust in germplasm under glasshouse or field tests
  (can utilise glasshouse screening initially and then confirm with field screening)
- Now have first high levels of resistance (foliage and stagheads) to pathotype 2V available for Australian oilseed Brassica breeding programs
- Now have substantially better understanding of this pathogen and *Albugo-Brassica* pathosystem, especially in terms of identifying host resistance (both foliage and stagheads)
- Now understand need for screening for White Rust resistance to be undertaken in each country using regional pathogen isolates and that host resistances identified may not be applicable across countries
- Now developing a clearer picture of the pathogen race status in Australia and the implications of this for disease screening and *Brassica* breeding and cultivation

Opportunities-Challenges-Future

1. **Opportunity** to introduce resistance to pathotype 2V into all new Australian *B. juncea* cultivars

2. **Opportunity** to screen the final ACIAR 'trait-cross' materials

3. **Opportunity** to identify wider range of sources of resistance

1. **Challenge** to define the pathotype-host interactions for Australia

2. **Challenge** to fully define/monitor White Rust pathotypes in Australia (need set of standard host differentials to characterise races worldwide)

3. **Challenge** to manage White Rust if many different susceptible *Brassica* crops

Future prospects for using host resistance as a critical component of effective White Rust management in Australia are promising