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Control of insect and mite pests in grains – insecticide resistance and IPM

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Insecticide Resistance and RLEM

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The redlegged earth mite

- Important agricultural pest in Australia, New Zealand and South Africa
- Widely distributed within southern Australia
- Damage estimated > \$500 million/year
- Can be confused with other mite pests, e.g. *Penthaleus* spp.
- Thought to be responsible for more insecticide applications than any other invertebrate pest



Current control tactics

- Heavily reliant on broad-spectrum chemicals (often prophylactic applications)
- Attempts at introducing biological control agents
- Some crop rotations and grazing management strategies in pastures
- More recently seed dressings and Timerite® package (however, these still rely on chemicals)



The response of the major crop and pasture pest, the red-legged earth mite (*Halotydeus destructor*) to pesticides: dose–response curves and evidence for tolerance

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ABSTRACTS

We describe an assay for testing the response of the adult red-legged earth mite, *Halotydeus destructor*, to pesticides. This assay is used to generate dose response curves for an organophosphate (omethoate) and an organochlorine (endosulphan) commonly used to control these mites, as well as a synthetic pyrethroid (alfamethrin). Comparisons of the populations from five sites around Victoria indicated tolerance to omethoate. A heritable basis for the tolerance was demonstrated by comparing the stocks after they had been reared under laboratory conditions for a generation. No tolerance of endosulphan was detected, although this chemical was not used heavily at any of the sites. Some tolerance of alfamethrin was also suggested. These results suggest that alternative methods for controlling this pest will eventually need to be considered.

Key words: *H. destructor*, pesticides, resistance, tolerance, bioassay

INTRODUCTION

In southern Australia, the red-legged earth mite, *Halotydeus destructor* (Tucker) (Acari: Pentheleidae), is an important pest of pastures and field crops during autumn, winter and spring (Swan, 1934; Wallace and Mahon, 1971; Ridsdill-Smith, 1991). Organophosphates and other chemicals have been used as the main method of controlling this pest for more than 50 years. To date, the resistance of *H. destructor* to chemicals has not been evaluated, although there have been sporadic reports of control problems.

A number of factors make it likely that some degree of tolerance may have evolved in the *H. destructor* populations. Firstly, the selection pressures imposed by pesticides are likely to have been intense. In many areas, farmers spray with the same organophosphate every year and several applications are

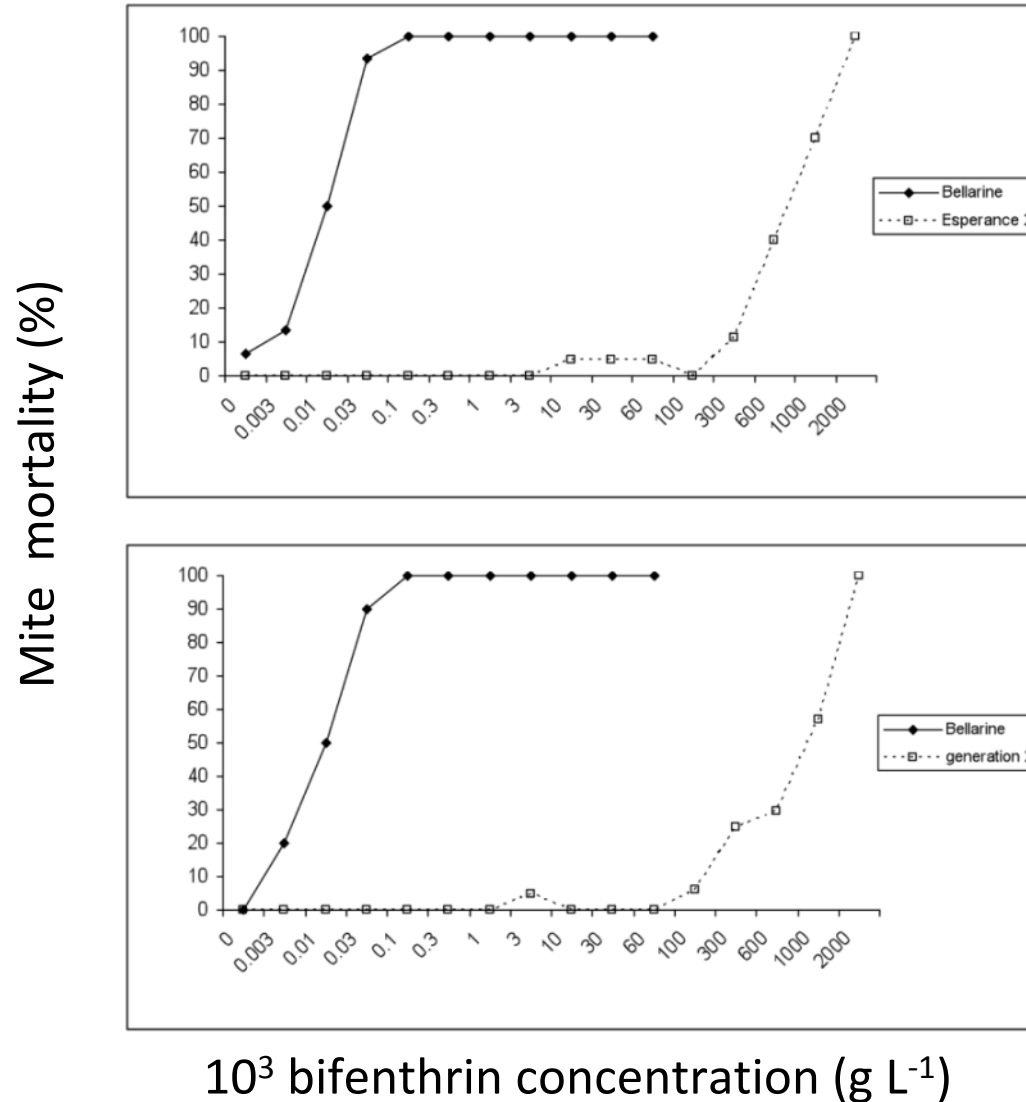
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Insecticide resistance detected

- Redlegged earth mites controlled using chemicals for > 50 years in Australia
- Chemical control failures experienced at 1 location
- Farmer sprayed 4 separate applications over a period of 3 weeks
- Paddock history: repeated applications of synthetic pyrethroids > 5 years



Resistance found to be heritable



High levels of resistance uncovered

Table 2. LC₅₀ values (and 95% confidence intervals) for populations of *Halotydeus destructor* computed from logit models for responses to different chemicals

Chemical	Population	LC ₅₀ value (mg L ⁻¹)	95% confidence intervals (mg L ⁻¹)		Regression slope (b) (± SEM)	Resistance ratio
			lower	upper		
Bifenthrin	Bellarine	0.028	0.019	0.042	4.647(±1.168)	
	Esperance 2	6881.973	5435.857	8699.543	6.569(±1.483)	243 027
	Bellarine	0.027	0.017	0.039	3.832(±0.829)	
	Generation 2	7122.172	5020.558	10 713.009	3.990(±0.959)	268 694
Alpha-cypermethrin	Bellarine	0.016	0.004	0.030	2.387(±0.723)	
	Esperance 2	942.814	720.221	1269.063	4.862(±0.880)	59 353
Omethoate	Bellarine	0.097	0.045	0.163	3.040(±0.778)	
	Esperance 2	0.259	0.159	0.399	3.034(±0.567)	–

Resistance to other insecticides

Chemical Group	Active constituent	Status
Synthetic Pyrethroids – 3A	Bifenthrin	Resistant
	Alpha-cypermethrin	Resistant
	Esfenvalerate	Resistant
	Gamma-cyhalothrin	Resistant
	Lambda-cyhalothrin	Resistant
Organophosphates – 1B	Omethoate	Susceptible
	Chlorpyrifos	Susceptible
Carbamates – 1A	Carbosulfan	Susceptible
Phenylpyrazoles – 2B	Fipronil	Susceptible
Avermectins – 6A	Abamectin	Susceptible
Diafenthiuron – 12A	Diafenthiuron	Susceptible

Insecticide resistance in Australia

- Corn earworm (*Helicoverpa armigera*)
 - Diamondback moth (*Plutella xylostella*)
 - Silverleaf whitefly (*Bemisia tabaci*)
 - Western flower thrips (*Frankliniella occidentalis*)
 - Two-spotted mites (*Tetranychus urticae*)
 - Cotton aphid (*Aphis gossypii*)
 - Sheep blowfly, lice, grain storage insects.....
-
- **Green peach aphid**
(*Myzus persicae*)



Take Home Messages

Insecticide resistance likely to increase

- Spray only when necessary; avoid insurance sprays
- Correct identification critical
- Weed management (within crop & fencelines)
- Pasture grazing management/crop rotations
- Rotate insecticides; good understanding of resistance management (e.g. mixing insecticides)
- Inspect spray coverage

“Over use of pesticides hastens pesticide resistance in pests, leads to resurgences of pest problems, can create new pests, increases residues in the harvested product, and increases off target contamination”

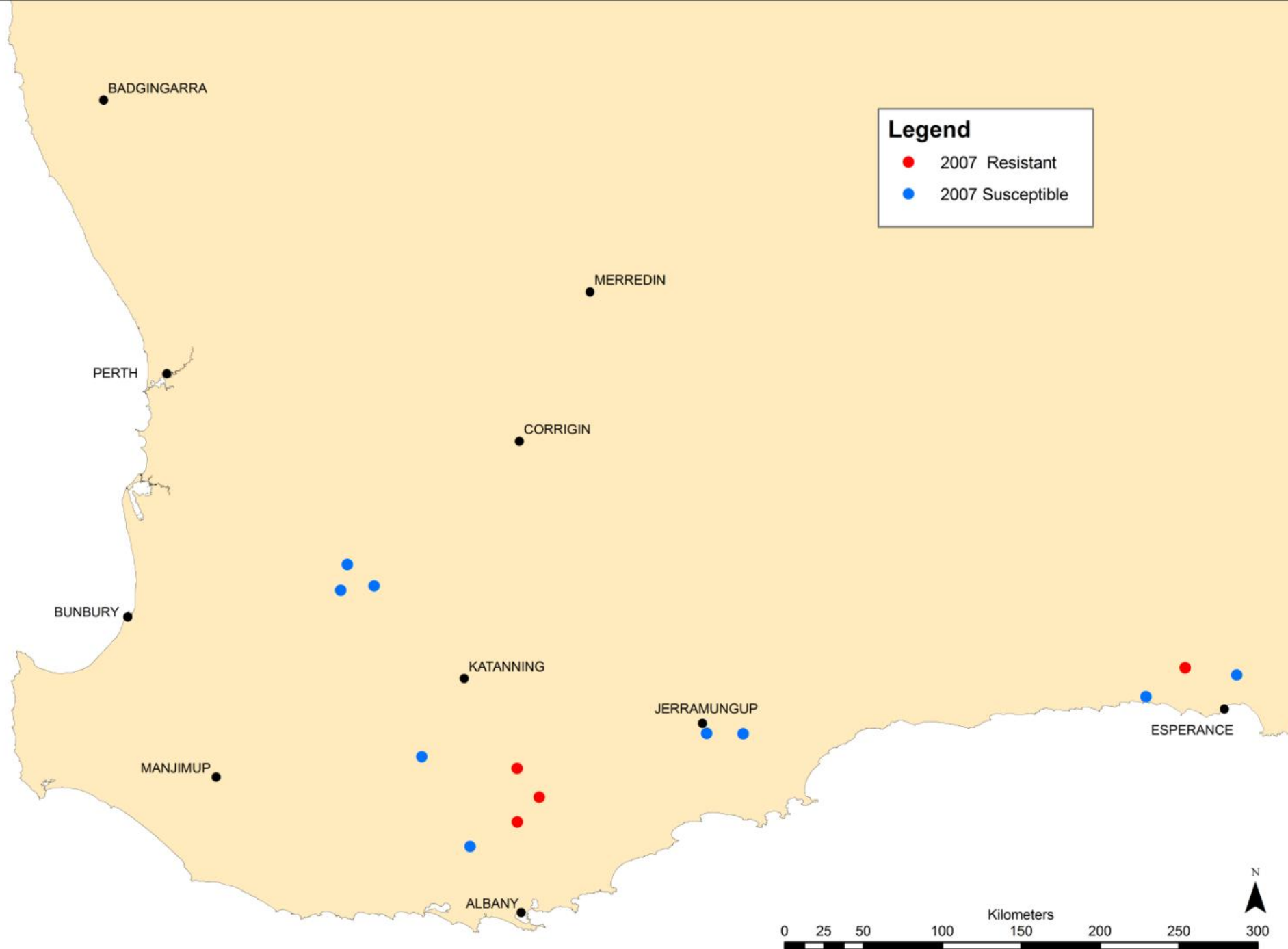


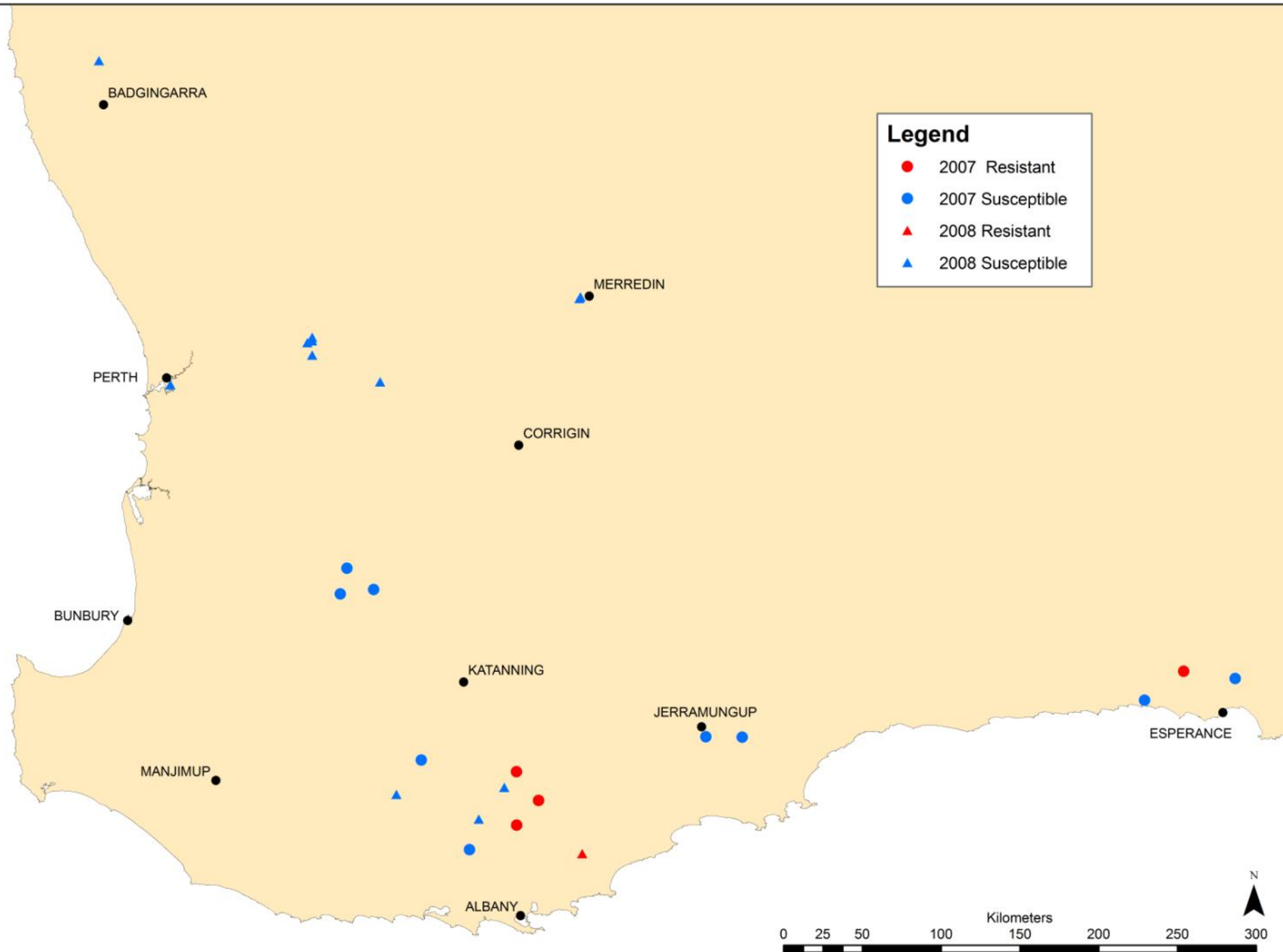
Extent of resistance in RLEM in WA from 2007-2010

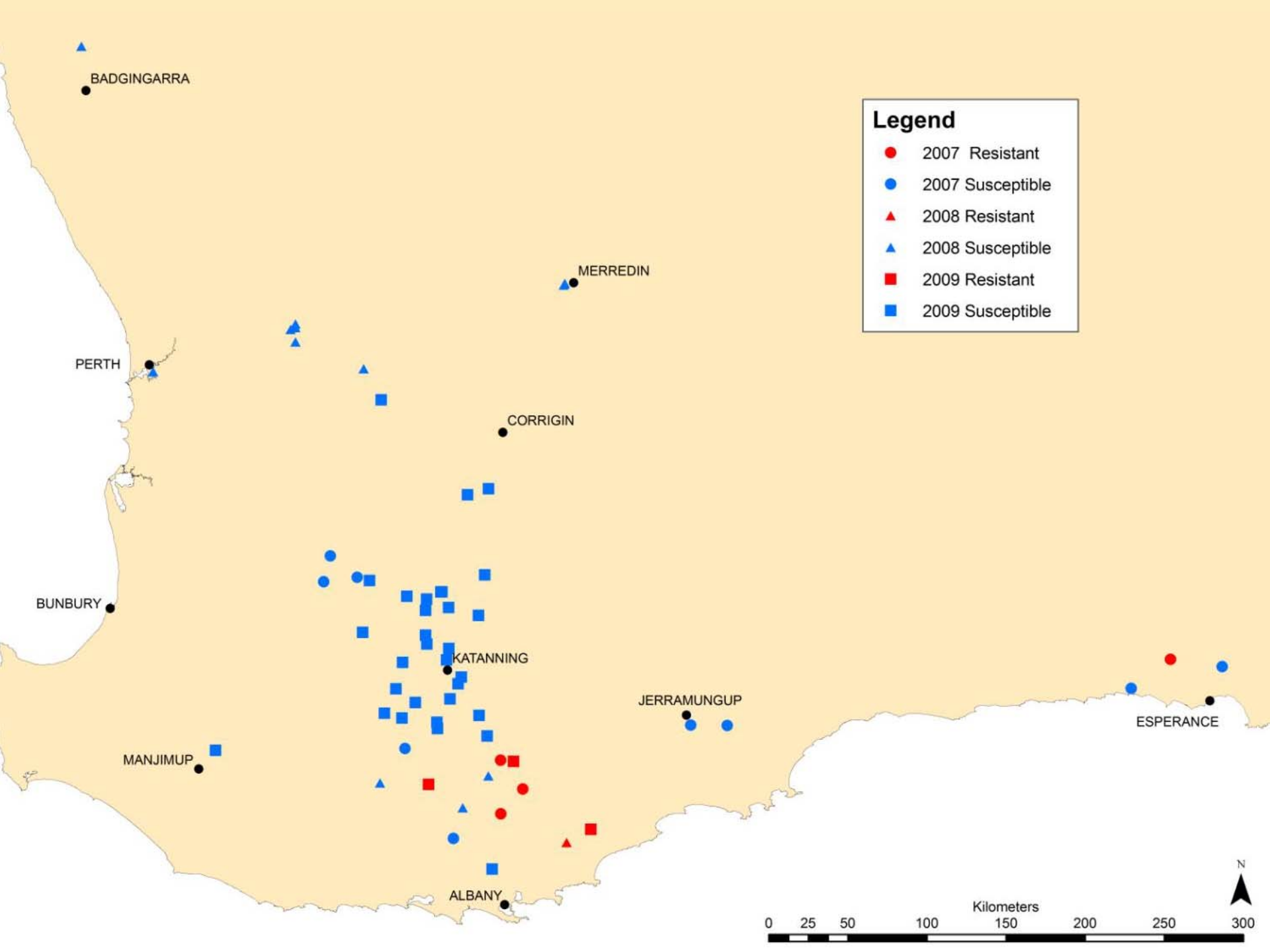
Svetlana Micic

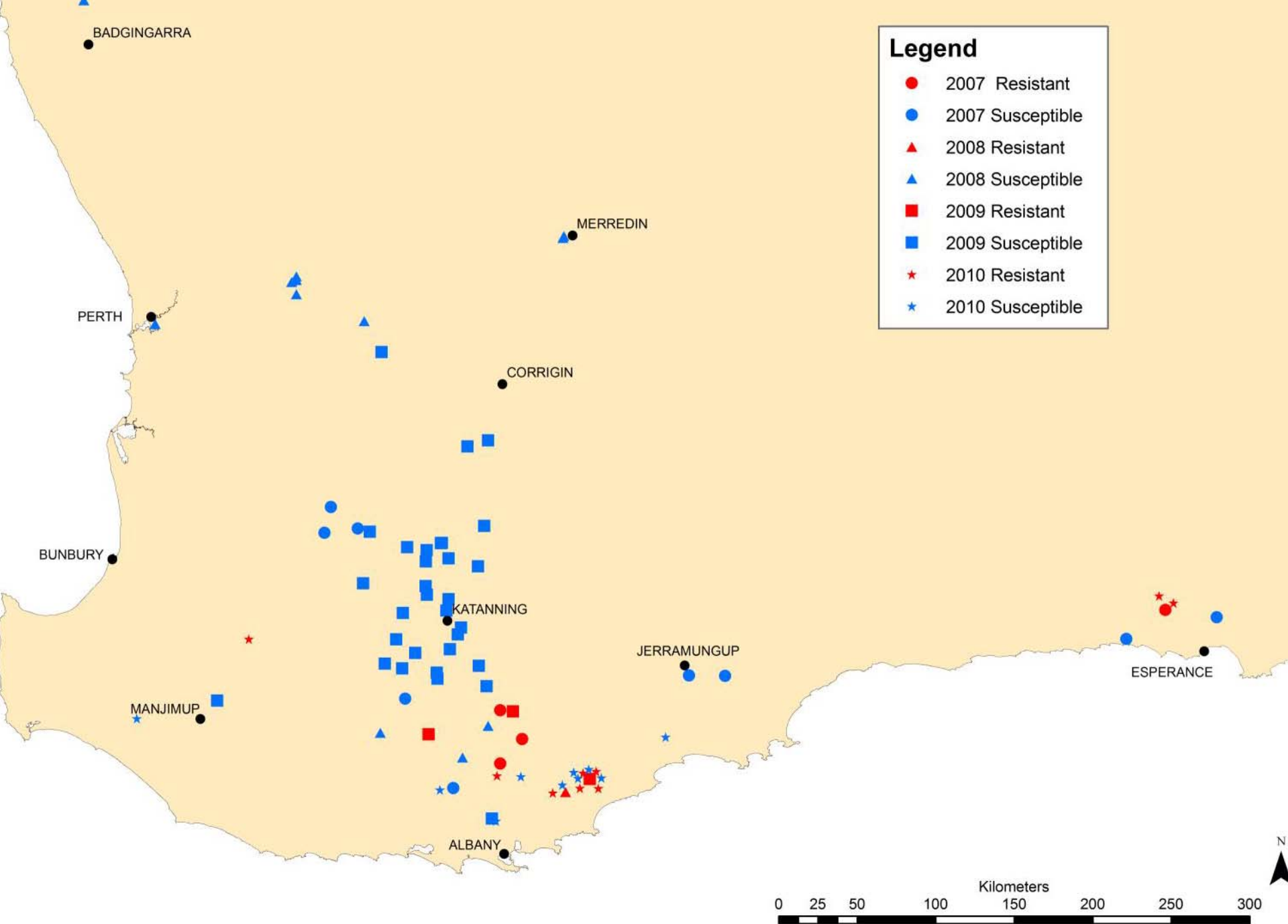
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Developing and Promoting Integrated Pest Management in Australian Grains

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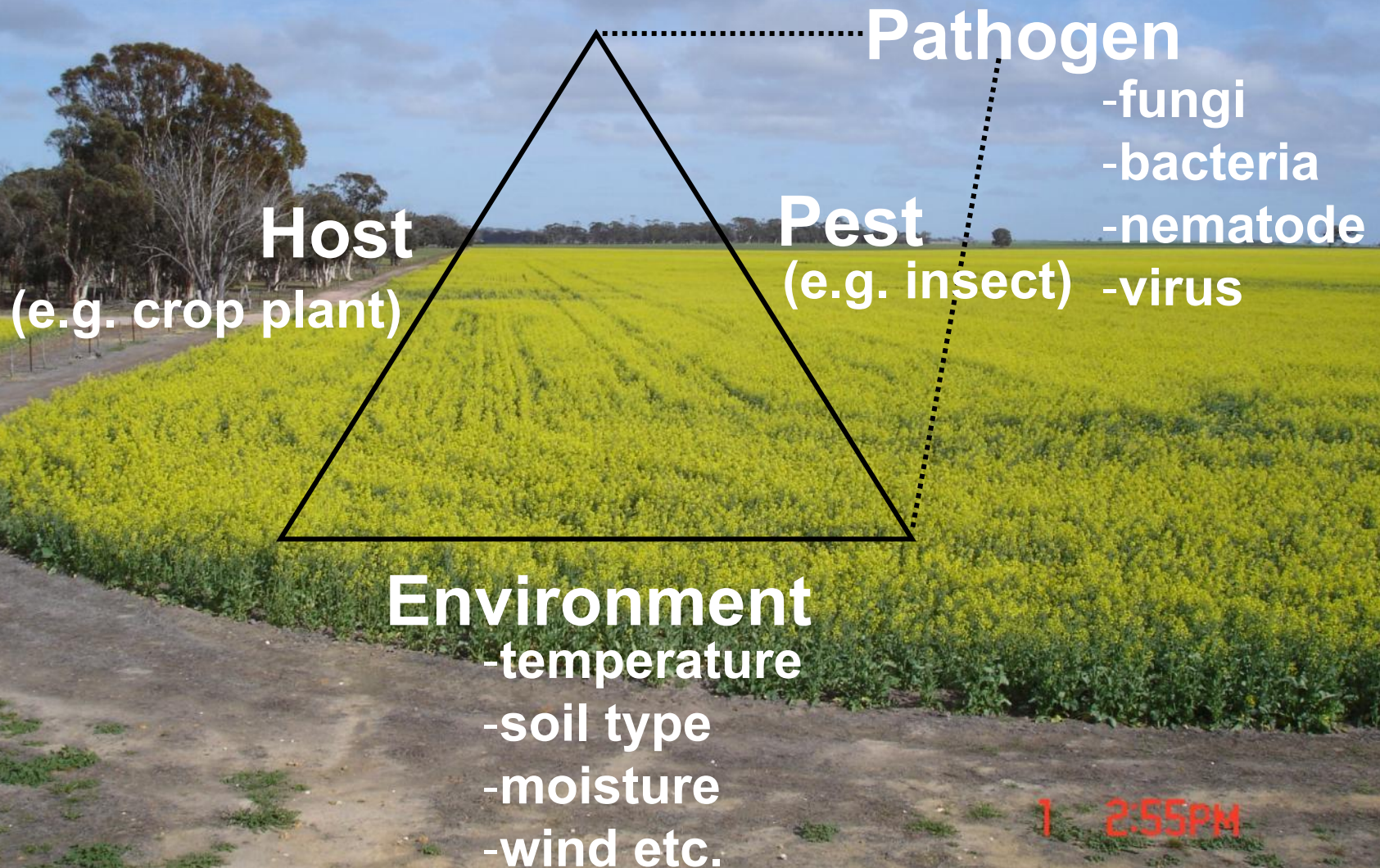
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Introduction



Introduction



GRDC IPM Project

“Developing and Promoting Integrated Pest Management in Australian Grains”

- ✓ Benchmark current practices
e.g. National survey
- ✓ Examine alternative approaches
e.g. On-farm trials

Introduction

GRDC IPM Project

“Developing and Promoting Integrated Pest Management in Australian Grains”

Facey Group & Grower



Shenton College
Year 10 student



GRDC & UWA



Wickepin Grower



Beverley Grower

IPM team:

Western Australia

- University of Western Australia (UWA)
- Department of Agriculture and Food WA (DAFWA)
- Living Farm
- Facey Group



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South Australia

- South Australia Research and Development Institute (SARDI)
- YP Alkaline Soils Group

Victoria

- Centre for Environmental Stress and Adaptation Research (CESAR)
- Birchip Cropping Group



CESAR Consultants

New South Wales

- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- New South Wales Department of Industry & Investment
- FarmLink

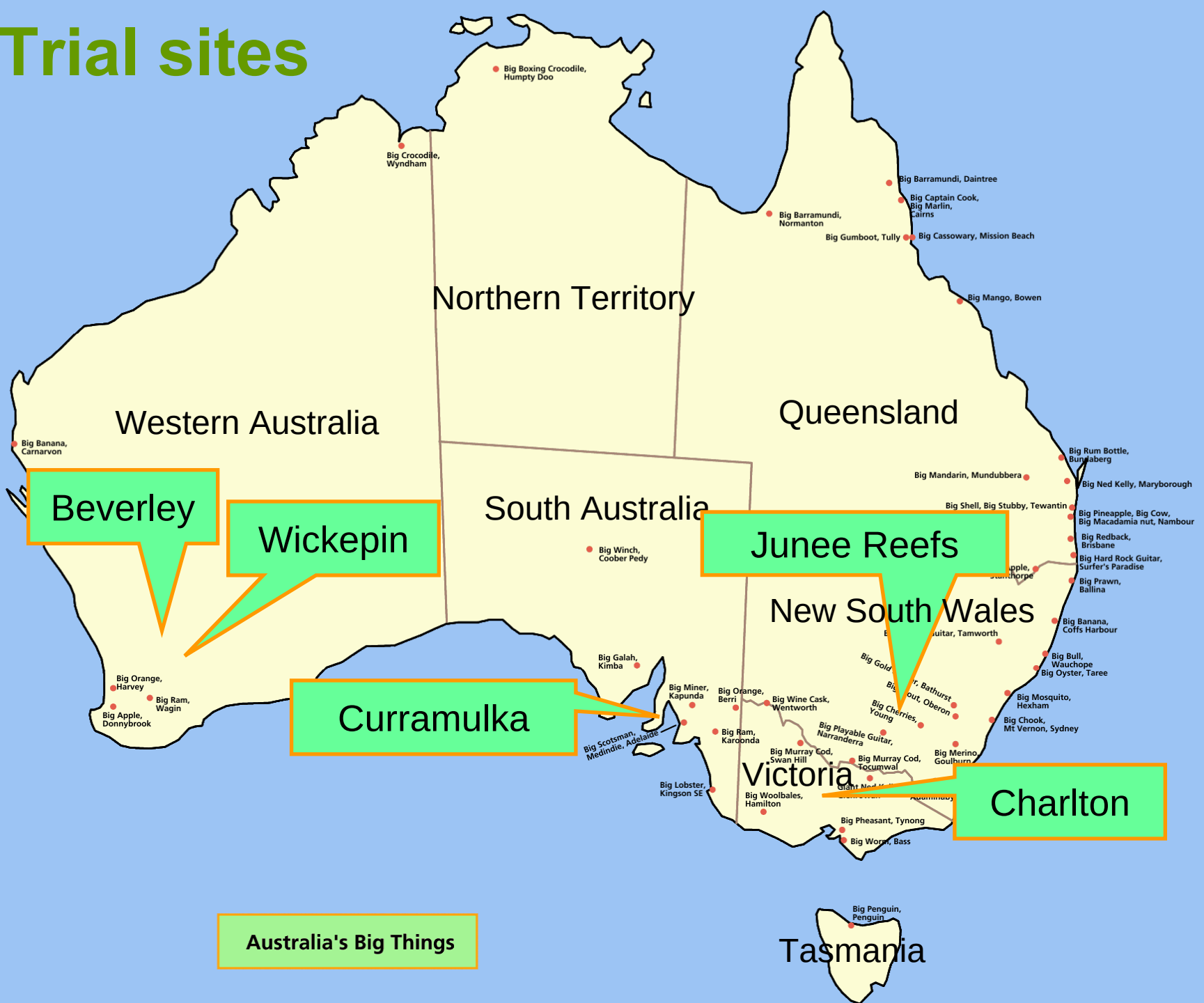


CSIRO



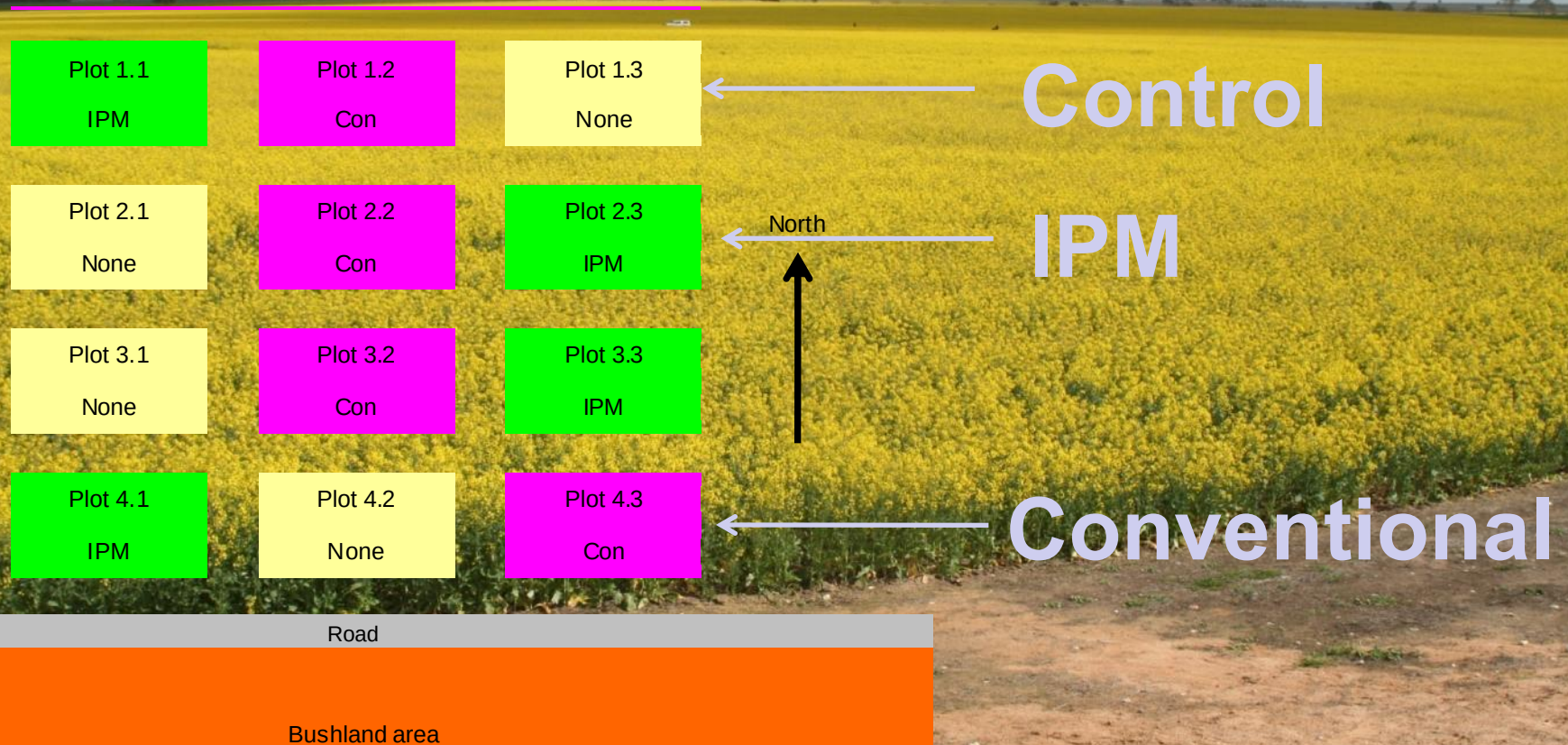
Industry &
Investment

Trial sites



Methods

Western Australia, 2010



Methods

Western Australia, 2010



Vacuum sampling

Methods

Western Australia, 2010



Pitfall traps

Methods

Western Australia, 2010



Methods

Western Australia, 2010



South Australia, 2010

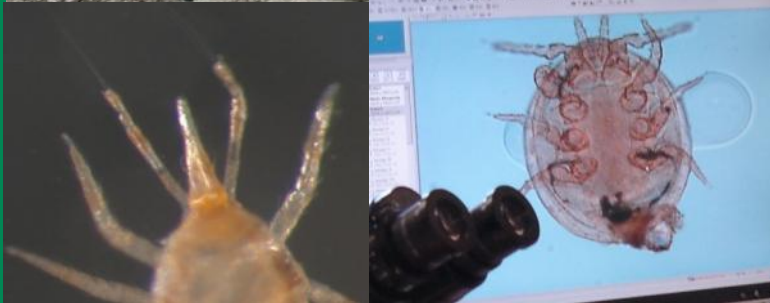


Western Australia, 2010



Sweep netting

Western Australia, 2010



Methods

South Australia, 2010



Western Australia, 2010



Western Australia, 2010



Methods



New South Wales, 2010



Western Australia, 2010



Western Australia, 2010



Western Australia, 2010



Methods

Western Australia, 2010

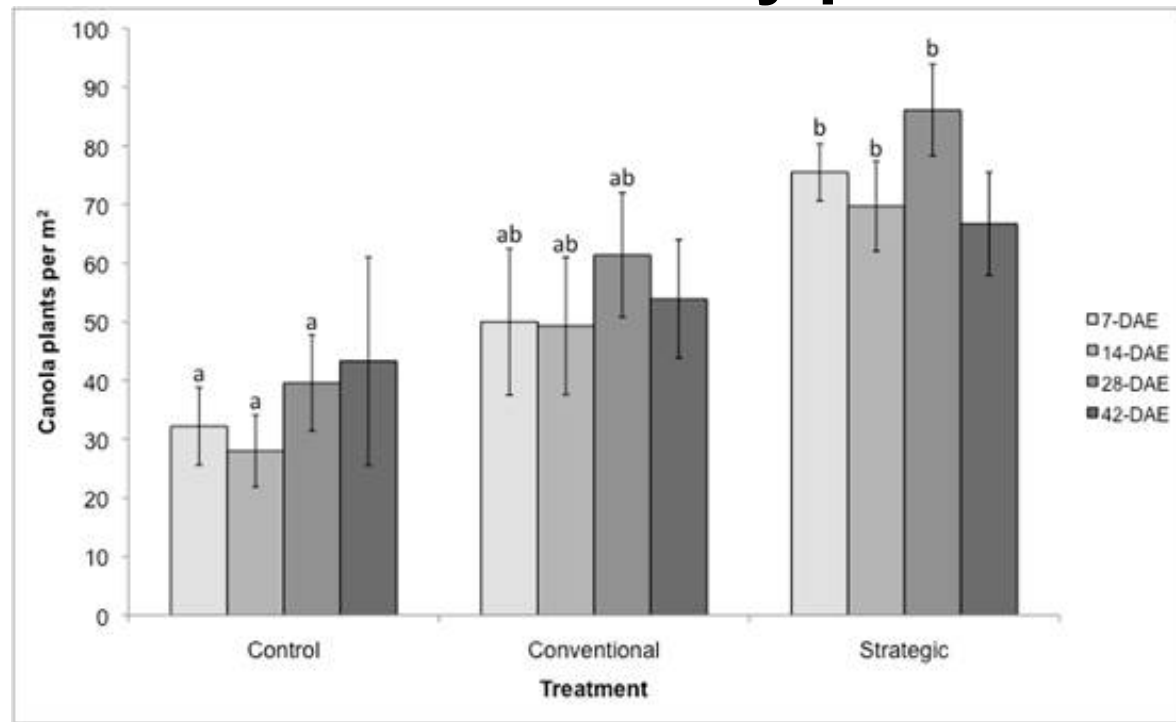


Results

Victoria, 2010



Canola density per m²



- Heaps of rainfall ☺
- Late growth ☺
- Low spring pests ☺



Canola Yield (not significant)

Control 1670kg/ha < IPM 1700kg/ha < Conventional 1790kg/ha

Harvest Index (control significant)

IPM (0.37) < Conventional (0.38) < Control (0.43)

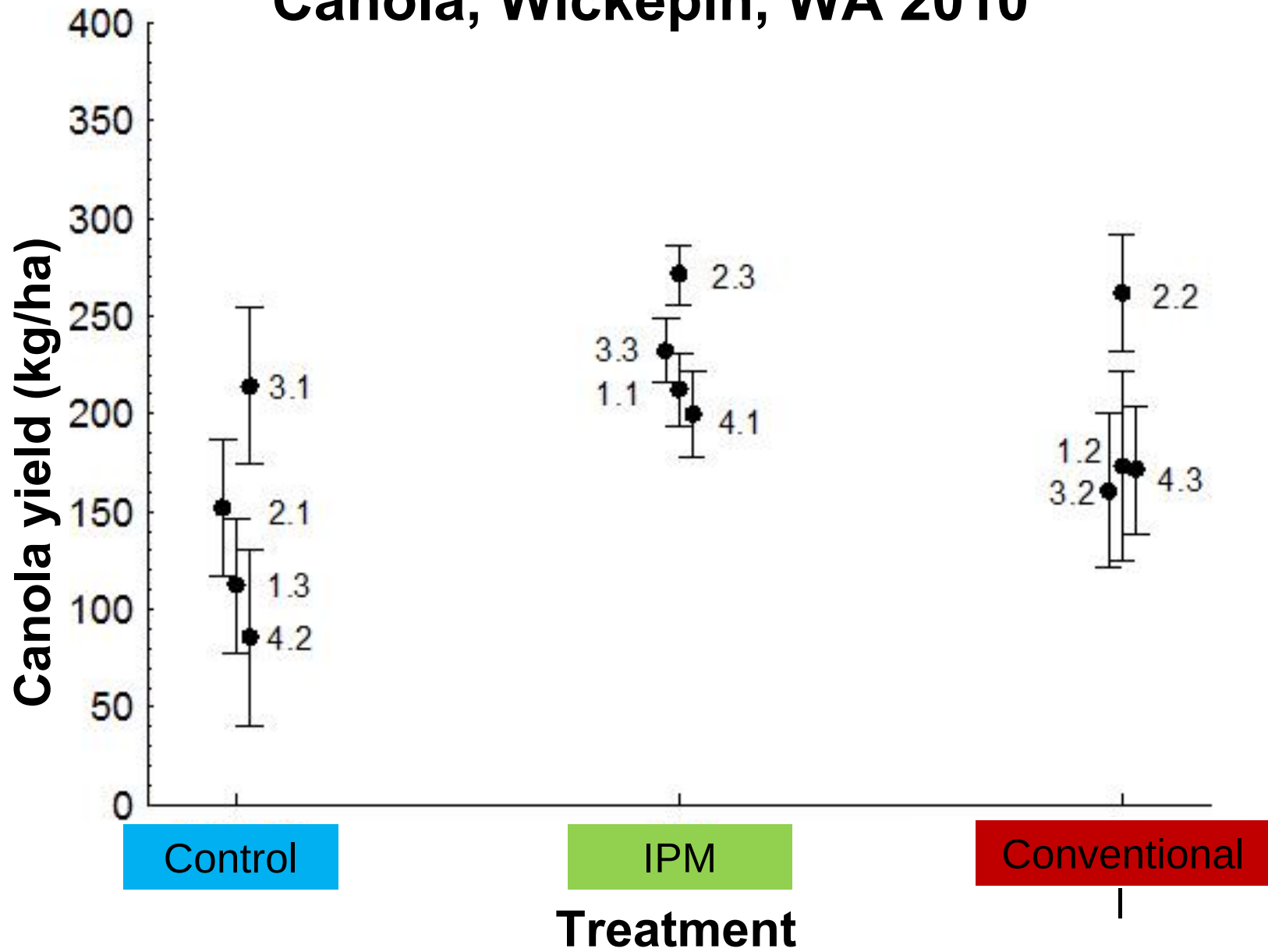
Results

Crop yield (kg/ha)



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Canola, Wickepin, WA 2010

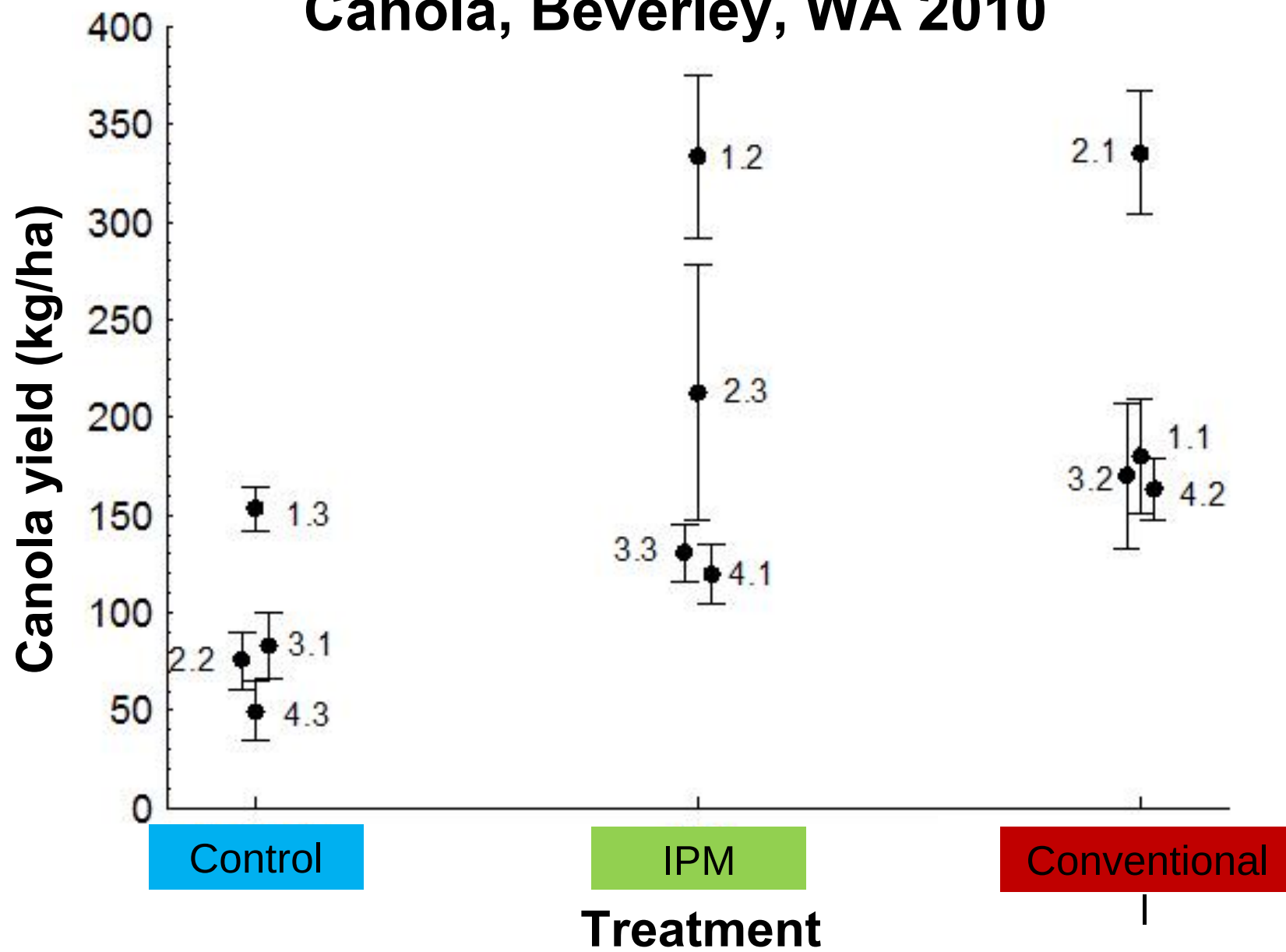


Results



Crop yield (kg/ha)

Canola, Beverley, WA 2010

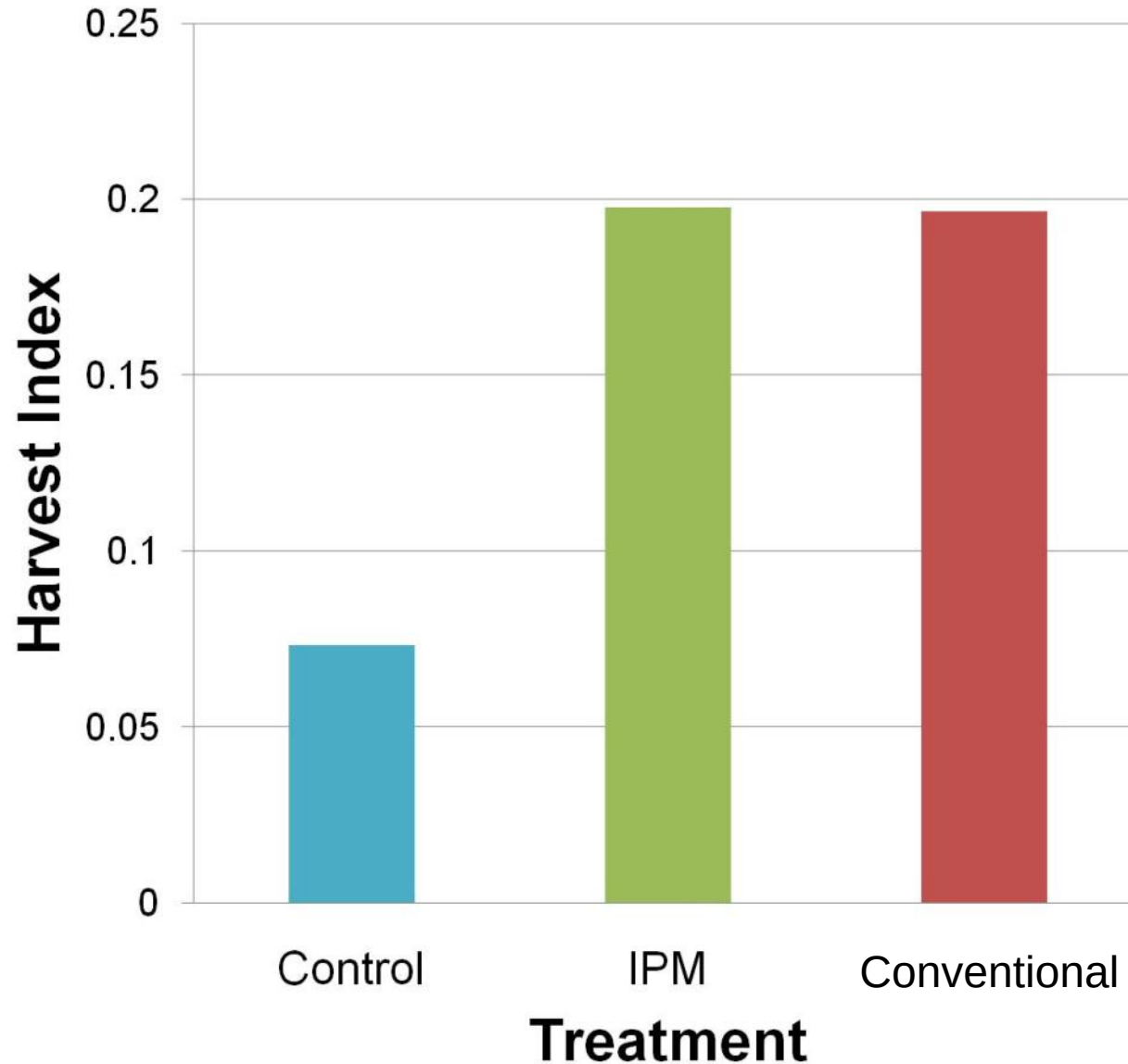


Results



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Harvest Index Canola, Beverley 2010



Conclusion

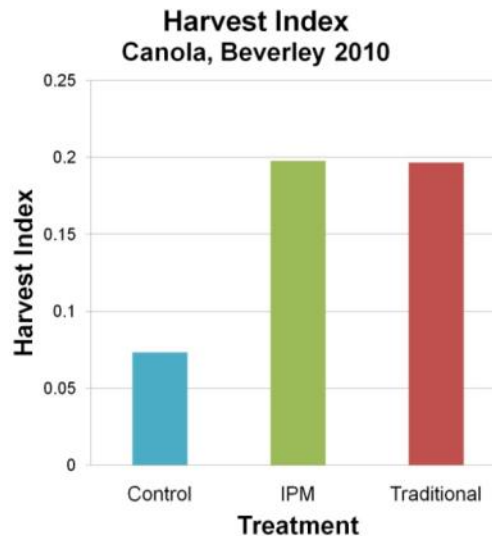
Cost – Benefit Analysis



CESAR Consultants

Conventional approach ~\$11/ha

IPM approach ~ \$1.35/ha



Developing and Promoting Integrated Pest Management in Australian Grains

**[http://www.surveygizmo.com/s3/348554/IP
M-benchmarking-survey](http://www.surveygizmo.com/s3/348554/IPM-benchmarking-survey)**



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Queensland
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Lifecycle

Life cycle of redlegged earth mite (*Halotydeus destructor*)

