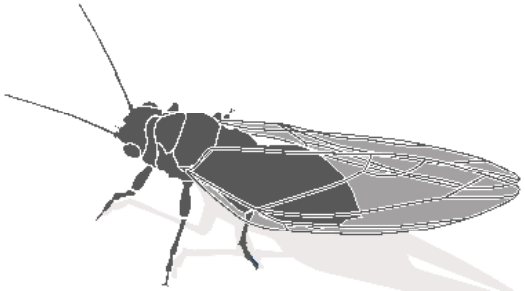
Native green lacewing in biological control of the invasive tomato potato psyllid

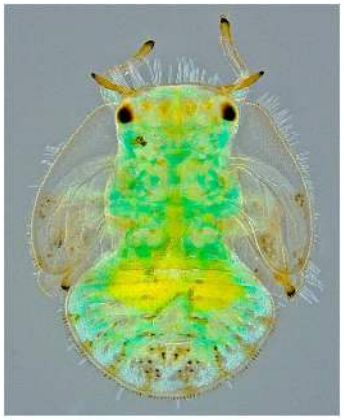
- Shovon Sarkar, Natasha Zhou, Frances Hoyle, Stephen Milroy, Wei Xu



Invasive pest tomato potato psyllid (TPP)

- Native to North and Central America
- More recently detected in New-Zealand and Norfolk Island
- Found in Australia (WA) in February 2017

Eggs



Nymph

Adults

20 plant families and over 40 species of solanaceous plants

- Solanaceae
- Convolvulaceae
- Lamiaceae

Psyllid yellow

Direct damage

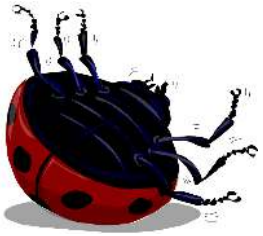
CLso (*Candidatus* Liberibacter solanacearum)

Indirect damage

Current management of TPP

Chemical insecticides

Resistance



Toxic to beneficials

Secondary pest

Residue

Alternative

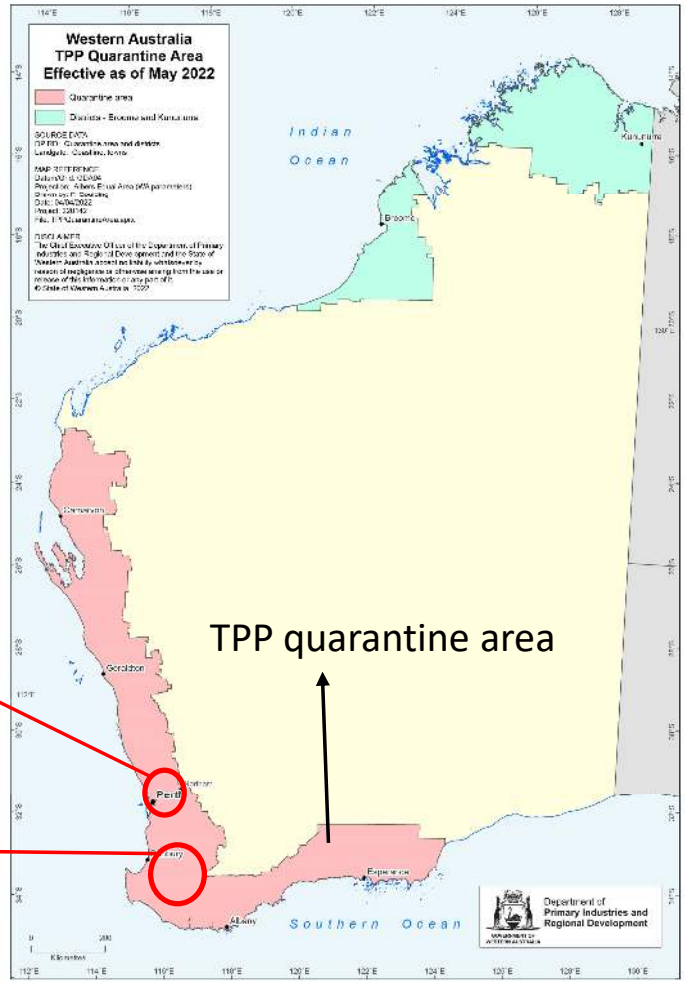
Generalist insect predators in biocontrol

- Generally, both adult and larvae can consume pest
- Can fly long distance and larvae are highly voracious
- More Immediate control capacity

Identifying the predator community in Western Australia

Capsicum

Potato



TPP quarantine area

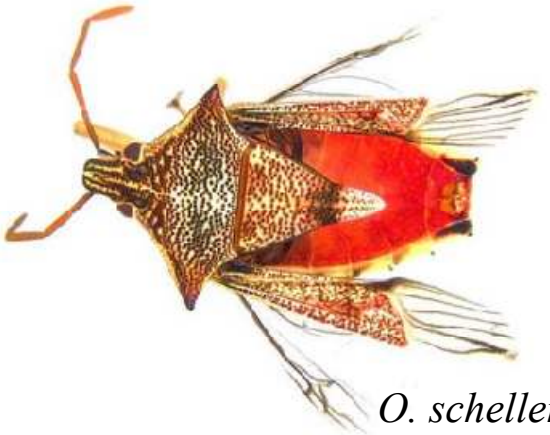
C. transversalis

H. variegata

H. conformis

C. sexmaculata

Mallada signatus



O. schellenbergii

Nabis sp.

Spiders

Oxyopidae oxyopes

Misumena vatia

Oxyopidae oxyopes

Lynx spider

Euryopis elegans

Backobourkia sp.

Oxyopidae oxyopes

Table 1. Potential predators of TPP found in the fields of solanaceous crops sampled in 2021 and 2022.

Order	Family	Genus/Species	2021				2022									
			Site -1			Total	Site -1				Site -2	Site -3		Site -4	Site -5	Total
			Capsicum				Capsicum				Potato	Potato		Potato	Potato	
			1st date	2nd date	3rd date		1st date	2nd date	3rd date	4th date	1st date	1st date	2nd date	1st date	1st date	
Araneae	Araneidae	*Argiope protensa*	2	3		5		1					1			2
		Backobourkia			1	1										
	Oxyopidae	*Oxyopes*	3	24	1	28	2	4	1	9		3	2		1	22
	Salticidae			1		1	1			3						4
	Tetragnathidae	*Tetragnatha*		1		1		1								1
	Theridiidae	*Euryopes*		3		3										
	Thomisidae	*Thomisus spectabilis*		1		1		1								1
	Unidentified spider species		2	6	2	10	2	5		3						10
Diptera	Syrphidae	*Melangyna viridiceps*		1	1	2				1			2	2		5
Coleoptera	Coccinellidae	*Harmonia conformis*		7		7	1	2	1	1						5
		Cheilomenes sexmaculata		2		2		3		1						4
		Coccinella transversalis	2	41		43		2	2	1		1		1	1	8
		Hippodamia variegata	1	9		10		5	2	8		1	2	1	3	22
Hemiptera	Anthocoridae	*Oechalia schellenbergii*	2	7		9						2				2
	Miridae	*Creontiades* sp.	24	52		76						1				1
	Nabidae	*Nabis* sp.		31		31										
	Rhyparochromidae	*Rhyparochromidae* sp.		3		3										
Neuroptera	Chrysopidae	*Mallada signatus*	Adult: 36 Larvae : 4	Adult:356 Larvae: 17	Adult: 43 Larvae: 13	469	Adult: 38 Larvae: 32	Adult: 268 Larvae: 73	Adult: 68 Larvae: 23	Adult: 300 Larvae: 46			Adult: 7 Larvae: 4			859
		Micromus tasmaniae								Adult:1	Adult: 2	Adult: 1		Adult: 1		5

Table 2. Developmental time for green lacewing feeding on TPP and GPA.

Stage	Developmental time (days) (mean ± SE)		*df*	*t*-value	*p*-value
	B. cockerelli	*M. persicae*			
1st instar	4.12 ± 0.13	4.58 ± 0.17	65	2.19	<0.05
2nd instar	3.31 ± 0.17	3.68 ± 0.16	64	1.52	0.13
3rd instar	4.48 ± 0.23	5.78 ± 0.22	46	2.99	<0.01
Pupa	13.18 ± 0.22	13.11 ± 0.15	39	0.28	0.78
Pre-adult duration	25.18 ± 0.28	26.84 ± 0.23	39	4.6	<0.01

Table 3. Green lacewing development and survival on TPP versus GPA diet.

Stage	Number of *M. signatus* developed to stage				*z*-value	*p*-value
	n	*B. cockerelli*	*n*	*M. persicae*		
2nd instar	35	33	35	34	0.59	0.56
3rd instar	33	32	34	34	1.52	0.13
Pupa	32	25	34	23	0.96	0.34
Adult	25	22	23	19	0.53	0.6
Female adult to day 83	7	2	7	4	1.08	0.28

Note: *n* = number alive at the start of the stage

Table 4. Differences in prey consumption between 2nd and 3rd instar green lacewing larvae at varying densities of TPP.

Prey density	Prey consumed (mean ± SE)		*df*	*t*-value	*p*-value
	2nd instar	3rd instar			
5	4.1 ± 0.3	5.0 ± 0	17	2.87	<0.01
10	7.3 ± 1.1	10.0 ± 0	16	2.52	<0.05
20	8.7 ± 1.7	19.6 ± 0.4	18	6.17	<0.01
40	11.1 ± 1.7	39.1 ± 0.7	18	15.34	<0.01
80	14.4 ± 1.5	67.9 ± 4.6	18	11.00	<0.01
160	18.1 ± 1.4	75.1 ± 5.7	16	9.63	<0.01

Table 5. Functional response parameters

Stage	Attack rate *(a')*	Handling Time (T_h)
2nd instar	0.92	0.059
3rd instar	0.98	0.003

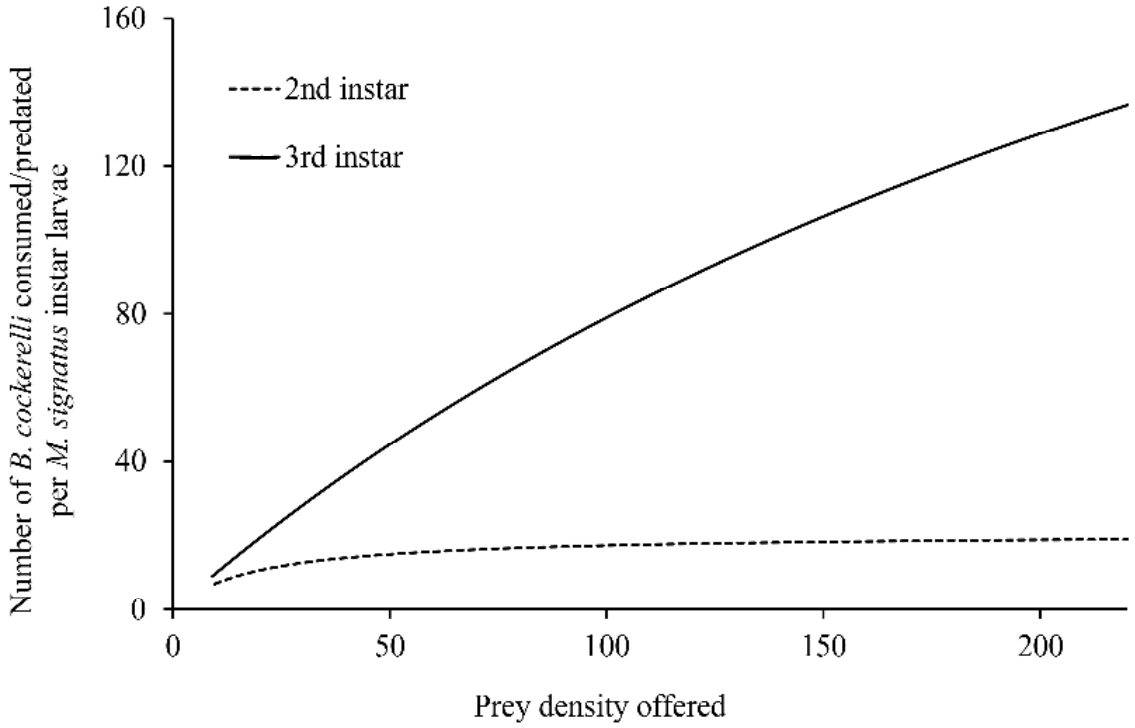


Figure. The functional response curves for the 2nd and 3rd green lacewing larvae fed on TPP

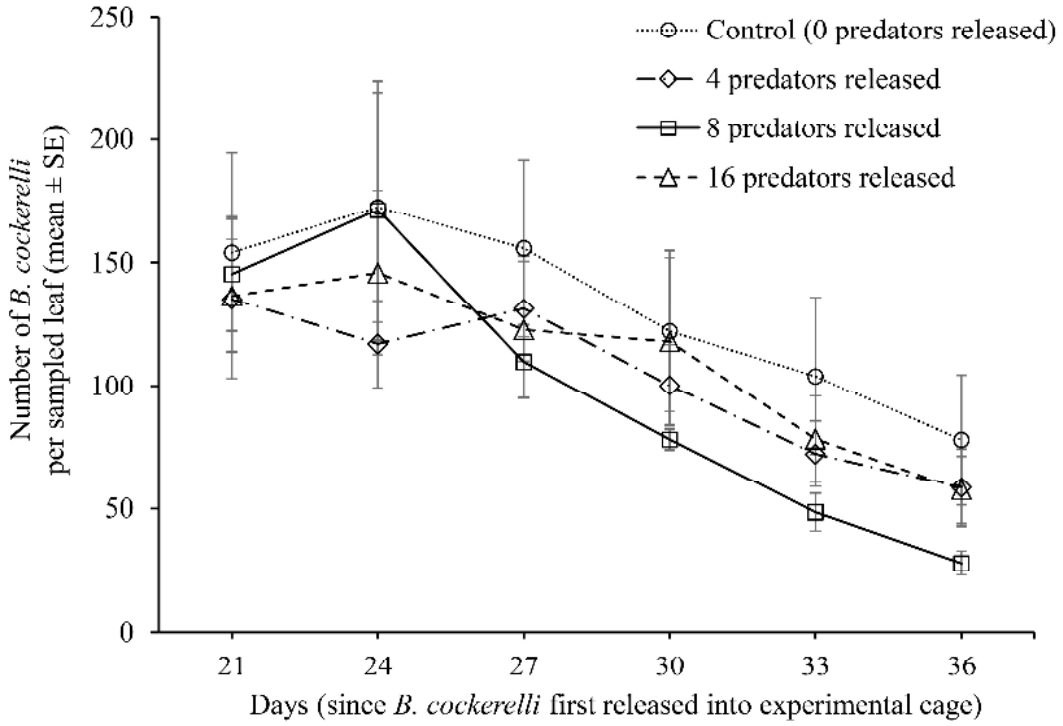


Figure. Population of TPP in greenhouse tomato plants under different density treatments of green lacewing.

Mallada signatus

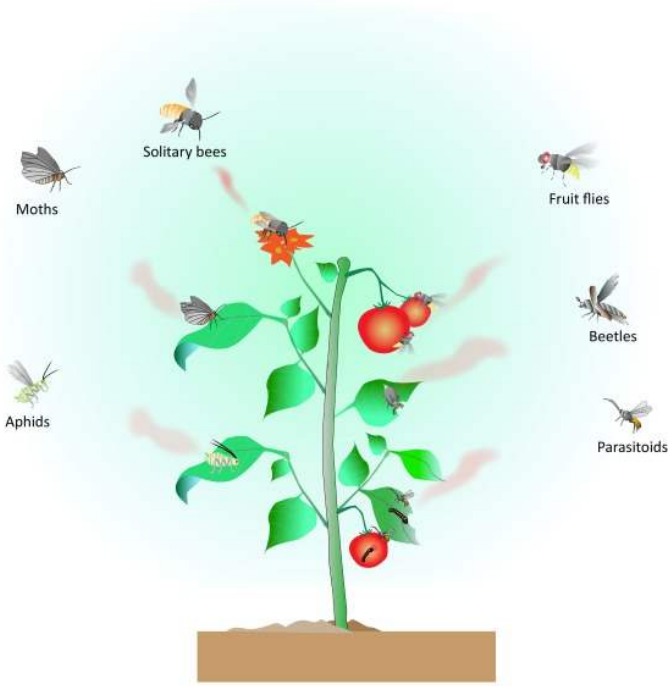
JOURNAL OF APPLIED ENTOMOLOGY

ORIGINAL ARTICLE | Open Access

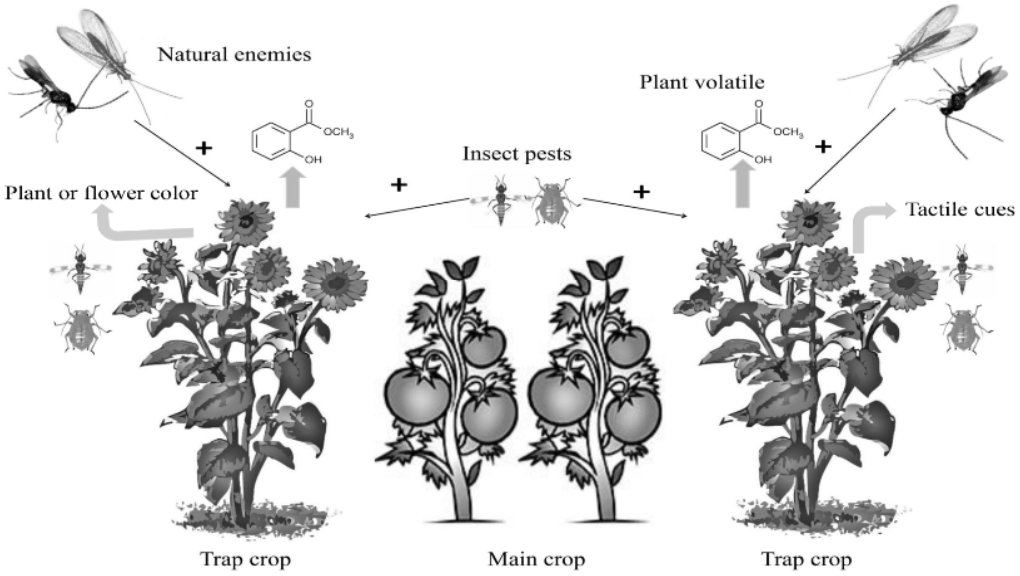
Evaluation of the green lacewing, *Mallada signatus* as a biological control agent for the invasive tomato potato psyllid, *Bactericera cockerelli*

Natasha Zhou and Shovon Chandra Sarkar contributed equally to this research.

Plant volatiles as cues for Insects and natural enemies

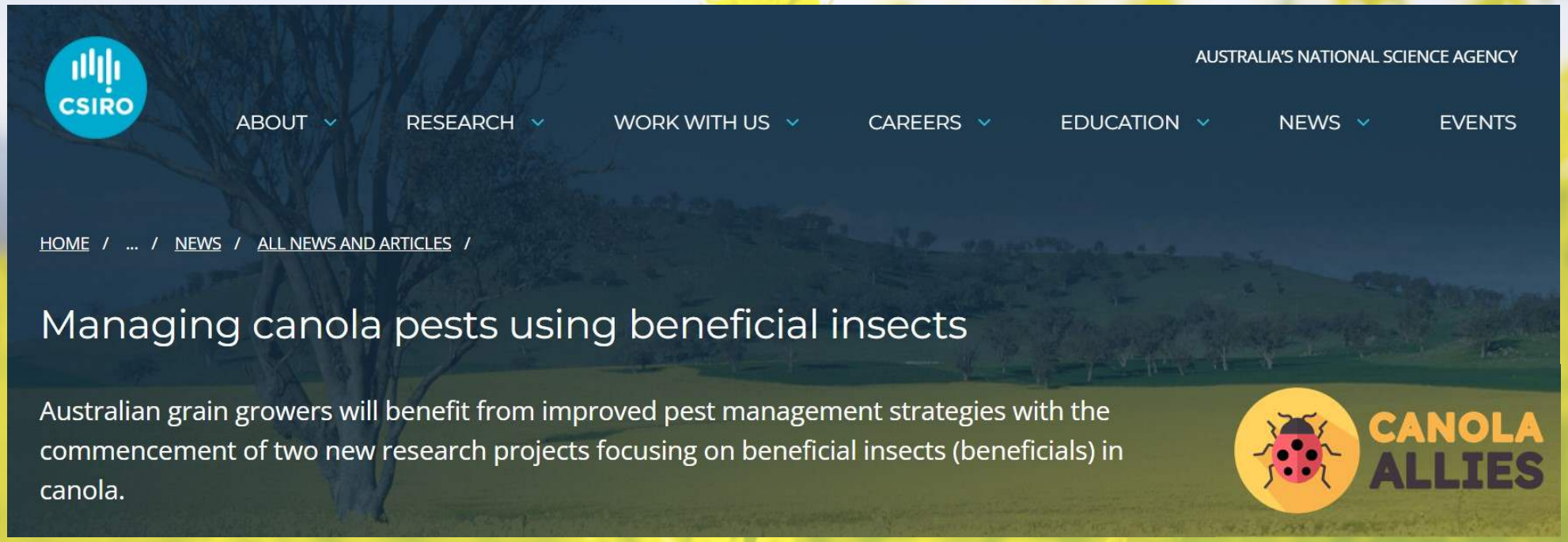


Xu & Turlings, 2018; *trends in plant science*



Sarkar et al., 2018; *insects*

Current project: Attractant Strategies for Beneficial in Canola



GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CSIRO

Acknowledgements

Murdoch University
CANOLA ALLIES
CSIRO
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA
apc AGRICULTURAL PRODUCE COMMISSION Supporting Producers' Initiative
BIOLOGICAL SERVICES

Thank you

Shovon.Sarkar@murdoch.edu.au