Weed Biosecurity – Protecting Our Future

Sydney, Australia 9-13 September 2018

Editors:

Stephen Johnson Leslie Weston Hanwen Wu Bruce Auld

ISBN: 978-1-5108-8847-0

Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright[©] (2018) by Weed Society of New South Wales All rights reserved.

Printed by Curran Associates, Inc. (2019)

For permission requests, please contact Council of Australasian Weed Societies Inc. (CAWS) at the address below.

Council of Australasian Weed Societies Inc. (CAWS) Massey University, Private Bag 11-222 Palmerston North 4442 New Zealand

Phone: +61 6 350 4926 Fax: +61 8 9821 1028

www.caws.org.au

Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA Phone: 845-758-0400 Fax: 845-758-2633 Email: curran@proceedings.com Web: www.proceedings.com

Contents

DAY 1: MONDAY 10 SEPTEMBER

PLENARY PRESENTATIONS

1
4
5
0
1
2
5
6
20
1
2
3
4

A novel <i>psbA</i> mutation (Phe-274-Val) confers resistance to PSII herbicides in wild radish (<i>Raphanus raphanistrum</i>) Huan Lu, Qin Yu, Heping Han, Mechelle J. Owen and Stephen B. Powles	25
Metabolic herbicide resistance gene discovery in wild oat (<i>Avena fatua</i>) Qiong Peng, Qin Yu, Heping Han, Lianyang Bai and Stephen Powles	26
WEEDS OF CROPS AND PASTURES – ECOLOGY AND BIOLOGY	
Abutilon theophrasti – its biology and management in New Zealand Trevor K. James and Heidi M. Pene	27
Germination ecology of two Australian populations of African turnip weed (<i>Sisymbrium thellungii</i> L.) Gulshan Mahajan, Amar Matloob, Michael Walsh and Bhagirath S. Chauhan	32
Response of common sowthistle, <i>Sonchus oleraceus</i> L. to simulated herbivory Nagalingam Kumaran, Michelle A. Rafter, Kylie B. Ireland, Gavin Hunter, Louise Morin and S. Raghu	33
Allelopathic potential of pasture legume species and selected winter crops on barnyard grass and rice Jhoana Opena, Hanwen Wu, Sergio Moroni, Deirdre Lemerle and James Pratley	34
Inter-specific variations in seed germination biology and seedling emergence of bladder ketmia (<i>Hibiscus</i> spp.) Md Asaduzzaman and Eric Koetz	35
Predicting the mass emergence of <i>Vulpia bromoides</i> Claire A. Dowsett, Christopher E. Buddenhagen, Richard J. Chynoweth and Trevor K. James	36
Fact or Fiction: Do glyphosate resistant cropping systems reduce crop or soil health? Martin M. Williams II, Stephen O. Duke, Agnes M. Rimando, Jude E. Maul, Krishna N. Reddy and James V. Cizdziel	42
Allelopathic interference of annual ryegrass (<i>Lolium rigidum</i>) on lucerne nodulation H.M. Zubair, J.E. Pratley, G.A. Sandral, A.W. Humphries, S.G. Nielsen and A. Price	43
Seed germination ecology of <i>Sesbania cannibana</i> (Retz.) Poir. Nadeem Iqbal, Sudeesh Manalil, Bhagirath S. Chauhan and Steve Adkins	47
WEEDS OF CROPS AND PASTURES – STRATEGIC MANAGEMENT	
Developing a framework to prioritise plant biosecurity threats to New Zealand's dairy industry David Hodges, Trevor James and Petra Muellner	48
Exploring and extending integrated weed management opportunities in the Australian vegetable industry Michael Coleman, Christine Fyfe, Sita Tiwari Pokhrel, Graham Marshall, Brian Sindel and Paul Kristiansen	49
Developing new options for weed control in Australian cotton systems James Neilsen, Meredith Conaty and Kate Lang	54
An integrated approach to managing Noogoora burr in maize crops Shane R. Hona, Trevor K. James and Andrew Blayney	55

BUILDING CAPACITY TO MANAGE WEEDS

From little things big things grow – A review of behaviour change initiatives for weeds management in NSW	(0)
Birgitte Verbeek, Elissa van Oosterhout and Wendy Gibney	60
Building capacity for weed management in the Lao PDR Deirdre Lemerle, John Burley, Sarah Hain, Brendon Bangma, Nicholas Pain, Sengphet Phantavong, Kylie Ireland, Madaline Healey and Lester Burgess	64
Floating Landcare: Bringing a bit of WOW to weedy hotspots on the Hawkesbury Estuary and NSW Central Coast waterways Rebecca Mooy and Tegan Burton	68
Using the Atlas of Living Australia to support weed biological control Greg Lefoe, Raelene Kwong and Kerinne Harvey	69
Practical best practice management of opuntioid cacti – from desk to dirt Shauna Potter, Matthew R. Sheehan, Kate Blood and Kay Bailey	70
STRATEGY – ASSESSING WEED RISK	
Introducing the Plant Sure Ornamental Plant Decision Support Tool Michelle Leishman, Nola Hancock, Victoria Graham, Vanessa Adams, Tim Maher and Anthony Manea	71
Refining the environmental weed risk assessment for non-indigenous plants which may have agricultural potential Christine J. Munday, Geoff Moore, Rachel Whitsed, Margaret Byrne and Clinton Revell	72
WRASP: A spatial weed risk assessment tool reveals critical variations in weed risks Darren J. Kriticos, Josef Beautrais and Mike B. Dodd	77
A national weed management decision-support system Graeme W. Bourdôt, Darren J. Kriticos and Michael B. Dodd	82
Futures in risk assessment: Challenges in preventing and mitigating weed threats Stephen B. Johnson, Belinda Mitterdorfer, Dorjee, Tony Buckmaster and Paul O. Downey	86
STRATEGIC PLANNING	
Let's get strategic: Weed management for conservation in Western Australia Kellie Passeretto	87
Buffel grass in South Australia: Progress and future directions Ross Meffin, Ellen Ryan-Colton, John L. Read, Troy Bowman and Michaela Heinson	91
An ounce of prevention: An accreditation scheme for ornamental plant industries Hillary Cherry, Stephen B. Johnson and Des Boorman	96
A new approach to managing invasive pests at the local government level Craig Magnussen	100

21st Australasi	ian Weeds Conference
Heritage or threat, conserve or destroy? The heritage plant management dilemma in pro David C. Havell and Angela L. Scott	tected landscapes 101
The changing weedscape: Policy and management implications of unknown knowns Paul O. Downey and Stephen B. Johnson	102
STRATEGIC MANAGEMENT APPLICATIONS	
Lake Benmore islands wilding conifer control Pete Caldwell	103
Managing WoNS for better drinking water Dennis J. Gannaway and Tim Odgers	104
Containment of Western Cape bridal creeper in peri-urban Adelaide – an eleven-year rev Henry Rutherford, Michaela Heinson, Susan Ivory and Phil Elson	view 107
WEED ERADICATION	
The research behind New Zealand's aquatic weed eradication programmes Paul D. Champion and Deborah E. Hofstra	108
10 years after Victoria's major Mexican feather grass incursion: Assessing eradication m germination behaviour Nicholas P. Moran, Alexei D. Rowles and Angela B. Constantine	nethods and 109
Pushing 37 weed species towards extinction in Queensland Steve Csurhes	115
The effects of cyclones on a tropical weed eradication program Simon J. Brooks and Mick Jeffery	119
The eradication of weed species in New Zealand's National Interest Pest Responses Pro Frances G. Velvin	gramme 124

DAY 2: TUESDAY 11 SEPTEMBER

PLENARY SESSION NEW TECHNOLOGIES – USING REMOTE DETECTION TO IMPROVE WEED BIOSECURITY	
Machine vision systems for robotic weed sensing in field environments Cheryl L. McCarthy, Steven R. Rees and Craig P. Baillie	125
Needle in a haystack – detecting hawkweeds using drones Mark Hamilton, Robert Matthews and Jo Caldwell	126
Multispectral imagery and weed biocontrol: A useful pairing? A.J. McConnachie, P. Jones, R. Shilpakar and P. Dawson	131

GRAINS RESEARCH AND DEVELOPMENT CORPORATION - GWAC SYMPOSIUM

What's over the horizon for weed management in Australia – science outcomes to benefit Australian growers from the Bayer/GRDC partnership	
Marco Busch	132
Research priorities for weed suppression by crops in Australia	
Michael Widderick, Deirdre Lemerle, Cameron Taylor, Chris Johansen, Abul Hashem, Vikki Osten, Tony Cook, Kerry Bell and Andrew Storrie	133
Managing clethodim-resistant annual ryegrass (<i>Lolium rigidum</i>) in canola with herbicides and competition	
Samuel G.L. Kleemann, Gurjeet S. Gill and Christopher Preston	137
Reduction in sowthistle biomass and seed production through manipulation of pulse population and row spacing	
Adam B. McKiernan, Greg Harvey, Linda Heuke, Michael Walsh and Michael Widderick	138
Glyphosate and 2,4-D amine resistance in common sowthistle (<i>Sonchus oleraceus</i>) and fleabane (<i>Conyza bonariensis</i>) in the Northern Grain growing region of Australia	
Adam Jalaludin, Michael Widderick, John Broster and Michael Walsh	139

4 research organisations
21 project partners
17 countries
10 weed species

As part of the Australian Government Department of Agriculture and Water Resources Rural R&D for Profit Program, AgriFutures Australia is working with departments of agriculture in NSW, Queensland and Victoria, and the CSIRO, to develop new biocontrol agents to target 10 nationally significant weed species.

Working domestically and abroad, the biocontrol of weeds project is developing novel biocontrol solutions to improve the long-term profitability of primary producers affected by the target weeds.

Contact

Jim Shovelton | 0407 953 445 jim.shovelton@agrifutures.com.au

() () ()

Learn more agrifutures.com.au/weeds-biocontrol



44 Australian Government Department of Agriculture and Water Resources



AgriFutures Biocontrol of Weeds

Microwave: A novel approach to tackle herbicide resistance in no-till farming systems Muhammad J. Khan, Graham I. Brodie and Dorin Gupta	140
Comparing the weed seed collection efficacy of stripper and draper type harvester fronts during harvest Annie Rayner, John Broster, Alison Chambers and Michael Walsh	144
The extent of herbicide resistance in ryegrass and wild oats in New South Wales and Queensland John C. Broster, Allison J Chambers, Adam Jalaludin, Michael J. Widderick and Michael J. Walsh	145
Metabolic profiling for benzoxazinoids in weed suppressive and early vigour wheat genotypes James M. Mwendwa, Paul A. Weston, Inge Fomsgaard, Bente B. Laursen, William B. Brown, Hanwen Wu, Jane C. Quinn, Jeffrey D. Weidenhamer and Leslie A. Weston	146
Opportunities for weed management using virtual fencing technology Rick Llewellyn, Danila Marini, Marta Monjardino, Sue Belson, Jackie Ouzman and Caroline Lee	147
Ecology of threehorn bedstraw (<i>Galium tricornutum</i>): Implications for management and harvest weed seed control Samuel G.L. Kleemann and Gurjeet S. Gill	148
Lime improves control of wild radish and annual ryegrass in acid soils of Western Australia Abul Hashem and Catherine Borger	153
Developing biological control options for the integrated management of <i>Conyza bonariensis</i> and <i>Sonchus oleraceus</i> L. Morin, K. Nagalingam, K.B. Ireland, V. Lesieur, M. Ollivier, M. Rafter, G.C. Hunter, T. Thomann, M. Jourdan, A. Sheppard, J.F. Martin, M.S. Tixier, M.D. Vitorino and S. Raghu	157
Recruitment and fecundity of annual ryegrass, great brome grass, barley grass, doublegee and sowthistle Catherine P.D. Borger and Abul Hashem	158
Impact of chaff lining/tramlining on the seed persistence and emergence of weeds Annie van der Meulen, Annie Rayner, Michael Widderick, Adam Jalaludin, John Broster, Alison Chambers, Linda Heuke, Shona Robilliard and Michael Walsh	163
Newly-developed RIM models for integrated management of brome and barley grass Marta Monjardino and Rick Llewellyn	164
Technical manuals and training on the soil behaviour of pre-emergent herbicides and modes of action (MOA's) of post-emergent herbicides Mark Congreve and John Cameron	169
NEW SURVEILLANCE TECHNOLOGIES	
How distinguishable are hawkweeds from co-occurring vegetation species in the eye of hyperspectral sensor? Hsing-Chung Chang, Kerrie Tomkins, Rene Heim, Will Farebrother, Chad Ajamian,	
Mark Hamilton and Hillary Cherry	175

Use of GIS technology in weed management Paras Acharya

21st Australasian Weeds Conference

Unmanned aerial vehicles used to control giant reed (<i>Arundo donax</i> L.) Philip Milling	177
Collector app mapping to assess effectiveness of invasive grass control Steve Taylor, Jenny Conolly and Renee Brawata	181
Weed surveillance using search theory Oscar Cacho, Dane Panetta, Hillary Cherry, Susie Hester, Sue Bower and Hank Bower	187
FINDING AND MAPPING WEEDS – MAPPING, SURVEILLANCE AND CONTROL	
The state (and territory!) of data collection on national priority weeds Bo Raphael, Jessica Evans, Katherina Ng, Luke Maloney and Sandra Parsons	192
The Victorian Weed Spotters: Recruitment and training of citizen scientists Zachariah Munakamwe, Angela Constantine and Catherine McInerney	193
Weeds at the early stage of invasion: pilot project evaluation Kate Blood and Bec James	197

New chemistry New thinking New Paradigm

with the flexibility that you have always wanted

Paradigm

Arylex[™] active

HERBICIDE

Paradigm[®] herbicide with Arylex[®] active delivers a low dose, wide spectrum solution for the control of broadleaf weeds.

Widely compatible with the ability to safely go across wheat, barley, oats and triticale. Paradigm fits easily into your spray programme.

Increase your productivity with less downtime due to tank clean out, changing the spray mix or worrying about compatibilities.

Get some precious time back and make life easier.

Shift to the new Paradigm Arylex active.

For more information 1800 700 096



Visit us at corteva.com.au

First incursion, weed policy implementation and eradication of <i>Boerhavia erecta</i> (Nyctaginaceae) in northern Australia John O. Westaway, Bert Lukitsch and Roni Opden	200
Iris pseudacorus L. (Irideae, Iridaceae) in South Africa: Feasibility of eradication Thulisile P. Jaca, Reshnee Lalla and Menzi Nxumalo	201
Frogbit (<i>Limnobium laevigatum</i>) detection and eradication in New South Wales Charlie Mifsud and Terry Inkson	202
BIOLOGICAL CONTROL	
Australian weed biocontrol: A look at the past, present and future Kerinne Harvey and Andrew McConnachie	203
Impacts of a pre-dispersal seed predator on achene production in the aquatic macrophyte, Sagittaria platyphylla	204
Raelene M. Kwong, Jean Louis Sagliocco, Nathan E. Harms and Julie G. Nachtrieb Project summary of biocontrol agent <i>Eueupithecia cisplatensis</i> for <i>Parkinsonia aculeata</i> in	204
Queensland by Queensland DAF Kelli Pukallus, Joshua Nicholls, Centaine Ferris and Judy Clark	211
Progress towards biological control of bellyache bush and prickly acacia Dianne B.J. Taylor, Boyang Shi, Jason Callander and Kunjithapatham Dhileepan	215
Overwintering habitat and the survival of the biocontrol beetle, <i>Cassida rubiginosa</i> Michael G. Cripps, Sarah D. Jackman, Chikako van Koten, Cor J. Vink and Michael B. Dodd	216
Molecular analysis of ecological interactions for optimising biocontrol of the invasive weed Sonchus oleraceus L. (Asteraceae) in Australia M. Ollivier, V. Lesieur, M. Jourdan, T. Thomann, S. Raghu, L. Morin, A. Sheppard, M.S. Tixier and J.F. Martin	220
Biological control of <i>Sonchus oleraceus</i> : what is known, what is new and what is still missing? V. Lesieur, T. Thomann, M. Jourdan, M. Ollivier, A. Sheppard, J.F. Martin, M.S. Tixier, L. Morin and S. Raghu	221
Matching expectations and reality: Potential impact of biological control on flaxleaf fleabane Michelle A. Rafter, Kerri Moore, Nagalingam Kumaran, Gavin Hunter, Kylie B. Ireland, Louise Morin and S. Raghu	222
Genomics, lineages and phenotypes: Investigations into the stability of the <i>Puccinia chondrillina–Chondrilla juncea</i> pathosystem in Australia Gavin C. Hunter, Kylie B. Ireland, Mireille Jourdan, Jim Cullen and Louise Morin	223
Boxthorn rust (<i>Puccinia rapipes</i>): a potential biological control agent of African boxthorn (<i>Lycium ferrocissimum</i>) Kylie B. Ireland, Gavin Hunter, Alan Wood and Louise Morin	224
Water influences the impact of a native parasitic plant ('snotty gobble') on gorse Robert M. Cirocco, José M. Facelli and Jennifer R. Watling	225
Promising new biological control agents for Queensland Elizabeth L. Snow, Peter Jones, Natasha Riding and Michael Day	226

 Biological control of mistflower (Ageratina riparia) with a fungal agent facilitates native vegetation regeneration
 Ben Gooden, Louise Morin, Andrew White, Melissa Piper, Jamie Fagg, Kris French,

 Alice Yeates and Shon Schooler
 230

 Biocontrol post-release: could earlier failures lead to overlooked successes?
 231

 Biocontrol research for environmental weeds management in NSW
 232

 Weed biocontrol in temperate Australia – a new manual for best management practice
 232

 Weed Biocontrol in temperate Australia – a new manual for best management practice
 233



25 years of Australian innovation in Vegetation Management



Contact your Macspred Representative Paul Wilcox 0428 408 863 Ray Gurney 0427 766 304 Mark Frances 0407 607 989 www.macspred.com.au

xvi

DAY 3: WEDNESDAY 12 SEPTEMBER

PLENARY SESSION: WEED FUTURES

Drivers of change and adaptation tools for reducing the impact of invasive plants under a changing climate	
Michelle Leishman	234
Future weeds RD&E investment under a collaborative national biosecurity approach Andreas Glanznig and Richard J. Price	235
CHEMISTRY INNOVATIONS	
Trifludimoxazin: A new PPO inhibitor that controls PPO resistant weed biotypes G.R. Armel, I. Francis, R. Nielson, M. Witschel and R. Liebl	236
Trifludimoxazin: A new novel herbicide for grass and broadleaf weed control in Australian winter cereals Ian Francis, Marco Montagna, Russell Ison and Gavin Heard	237
	237
Cinmethylin – a new herbicide for cereals: Mode of action and biokinetic properties Ruth Campe, Eva Hollenbach, Lara Kämmerer, Janneke Hendriks, Wolfgang Höffken, Helmut Kraus, Jens Lerchl, Thomas Mietzner, Matthias Witschel, Johannes Hutzler,	
Laurent Picard and Klaus Kreuz	238
Agixa [™] herbicide – a new treatment for selective weed control in drill-sown rice Gregory S. Wells, Malcolm Taylor and Colin Plater	239
Innovations for weed management – From new herbicide modes of action to novel technologies for weed management	
Stefan Tresch	242
Topramezone (Frequency [®] Herbicide), a new flexible tool for weed control in winter cereals across Australia	
Ian Francis, Marco Montagna and Russell Ison	243
A new mode of action (MOA) pre-emergence herbicide for the control of annual ryegrass (<i>Lolium rigidum</i> Gaud.) and other monocotyledon weeds in cereals in Australia Ian Francis, Marco Montagna, Russell Ison and Gavin Heard	244
ForageMax [™] herbicide – a new treatment for selective weed control in graze and grain canola Gregory S. Wells and Colin Plater	245
Encapsulated dry herbicides: A novel approach for control of trees Ken C. Goulter, Victor J. Galea and Peter Riikonen	247

INNOVATIVE CHEMISTRY APPLICATION

Stopping the invasion of <i>Persicaria chinensis</i> (Chinese knotweed) – a herbicide solution Kim Hignell	251
Drive-by shooting: Increasing weed treatment speeds using a skattergun Nathan March and Wayne Vogler	257
A magic bullet for the Northern Australian neem nightmare? Jessica Miller and Louise Beames	261
Herbicidal control of environmental weeds from sub-Antarctic Macquarie Island Brian M. Sindel, Waqas Zahid, Paul E. Kristiansen, Susan C. Wilson, Justine D. Shaw and Laura K. Williams	265

New pest animal and weed management tools and strategies through collaborative research, development and extension



COMMUNITY ENGAGEMENT AND ENVIRONMENTAL WEED MANAGEMENT

More than a Chore: The pleasures of weed management in high amenity rural landscapes	0.00
Nicholas Gill	266
Buffel grass management in Indigenous communities Troy A.J. Bowman	267
Restoring coastal ecosystems for the Great Barrier Reef and the RAMSAR wetlands of Bowling Grean Bay	
Green Bay Scott Fry	271
Managing bitou and boneseed on Long Reef Headland Jillian Macintyre	272
Weed management is not quite 'Bush Regeneration' – An opinion Peter Harper and Nimal Chandrasena	273
WEEDS IN NATURAL SYSTEMS (WINS) HOW DO WEEDS WIN?	
Effects of soil nitrogen reduction on competition between <i>Phragmites australis</i> and <i>Melaleuca ericifolia</i> Md N. Uddin, Randall W. Robinson and Takashi Asaeda	280
The invasive <i>Parthenium hysterophorus</i> L. has limited impact on soil chemistry and enzyme activities but influences above and below ground biodiversity Olusegun O. Osunkoya, Boyang Shi, Kerri Moore and Kunjithapatham Dhileepan	281
Weeds in Natural Systems (WINS): Weighing up the importance of different invasion mechanisms Kristine French	285
CAWS INTERACTIVE FORUM	
Global learnings for research impact in weed management in Australia Rachel Melland	286
WEEDS OF CROPS AND PASTURES – APPLIED MANAGEMENT	
Emergence patterns and herbicide control of prickly lettuce (<i>Lactuca serriola</i> L.) Hanwen Wu, Adam Shephard and Michael Hopwood	290
The effect of integrating defoliation with herbicides on barley grass survival in a legume pasture Jane E. Kelly, William Brown, John Broster, Paul A. Weston, Wayne Robinson, Jane Quinn and Leslie A. Weston	295
Performance of INTERCOM for predicting rice-barnyard grass interference in dry seeded rice systems Tahir Hussain Awan and Bhagirath Singh Chauhan	300
Effect of high temperature and soil moisture on seed germination of four summer weeds Sudheesh Manalil and Bhagirath S. Chauhan	301

GENETICS IMPROVING WEED MANAGEMENT

Specificity of LAMP for genetic diagnostics of Chilean needle grass and serrated tussock David Gopurenko, Aisuo Wang and Hanwen Wu	302
Molecular identification of <i>Solanum elaeagnifolium</i> in Australia using DNA barcoding, a solution for better management	
Xiaocheng Zhu, David Gopurenko, Laurence A.R. Haegi and Hanwen Wu	307
Identification of eight <i>Panicum</i> species in Riverina region of NSW using DNA sequence analysis Yuchi Chen, Xiaocheng Zhu, David E. Albrecht, Panayiotis Loukopoulos, Jane C. Quinn and Leslie A. Weston	312
Screening of gene regions for genetic diversity in global parthenium weed (<i>Parthenium hysterophorus</i> L.) populations Ali A. Bajwa, Xiaocheng Zhu, Bhagirath S. Chauhan, Steve W. Adkins and Leslie A. Weston	318
The Duj nu, Dawoneng Zhu, Daughtun St Chaulian, Steve Wirthanis and Elesie II. Weston	510



THINKING OUTSIDE THE SQUARE

 A conversation starter: Standardising terminology and definitions for weeds status in Australia –
 What do you think?

 Chris Brodie, Peter Lang and Michelle Waycott
 322

 The challenges of herbicide resistance in non-agricultural weed management systems
 323

 Andrew Storrie
 323

 Using detection dogs to assist weed eradication in conservation areas
 327

POSTER PRESENTATIONS

Evolved resistance to glyphosate in barley grass (<i>Hordeum</i> spp.) in South Australia Patricia Adu-Yeboah, Jenna Malone, Benjamin Fleet, Samuel Kleeman, Gurjeet Gill and Christopher Preston	328
Longevity of blady grass (<i>Imperata cylindrica</i>) seeds Husham A. Alqaderi, Brian M. Sindel, Paul E. Kristiansen and Ralph D.B. Whalley	329
Efficacy of some selective herbicides against broad leaved weeds of wheat crop grown under moisture deficit conditions of Pakistan Muhammad Asad, Muhammad Mudassar, Zahid Mahmood and Muhammad Rasheed	333
Effect of parthenium weed on maize yield at different competition durations in Ethiopia Ali A. Bajwa, Tamado Tana, Bhagirath S. Chauhan and Steve W. Adkins	334
The effects of parthenium weed density on yield attributes and yield of maize in Ethiopia Ali A. Bajwa, Tamado Tana, Bhagirath S. Chauhan and Steve W. Adkins	338
Emergence of great brome grass and barley grass Catherine P.D. Borger and Abul Hashem	341
Management of <i>Chromolaena odorata</i> in the Douglas Shire Simon J. Brooks and Peter Logan	345
Progress in the eradication of <i>Mikania micrantha</i> from Australia Simon J. Brooks and Mick Jeffery	350
The effects of burial depth and water stress on Melastome weed seeds Simon J. Brooks, Rose K. Easton and Kirsty L. Gough	354
The NSW Biological Control Taskforce – collaborating to maintain a functional biocontrol agent delivery pipeline Troy R.F. Brown	359
Geospatial assessment to predict potential African olive (<i>Olea europaea</i> spp. <i>cuspidata</i>) infestation sites in remnant vegetation communities Doug Campbell	360

Causing a stink: <i>Paederia foetida</i> found on mainland Australia Joel Daniels and Stephen B. Johnson	361
Effect of nitrogen rate and weed control treatments on quantitative and qualitative yield of sugar beet Mohammad A. Dastorani and Mohammad Armin	362
The impact of two biological control agents, <i>Passalora ageratinae</i> and <i>Baeodromus eupatorii</i> , on <i>Ageratina adenophora</i> (crofton weed): synergism or antagonism? Juliette Fontaine, Gavin C. Hunter and Louise Morin	363
Seed-set reduction of milk thistle (<i>Sonchus oleraceus</i> L.), wild turnip (<i>Rapistrum rugosum</i> L.) and flaxleaf fleabane (<i>Conyza bonariensis</i> L.) following a crop topping application of saflufenacil (Sharpen [®] WG Herbicide) in cereals Ian Francis, Marco Montagna, Russell Ison and Adam Perfrement	364
Integrated weed management cotton (<i>Gossypium hirsutum</i> L.) in conventional and ultra narrow row spacing system Ali R. Ghavi and Mohammad Armin	365
A useful <i>in vitro</i> bioassay for evaluation of weed suppression provided by cover crop residues Saliya Gurusinghe, Sajid Latif, William Brown, Paul Weston and Leslie A Weston	366
Egeria (<i>Egeria densa</i> Planch.) presents an increasing threat to Australian waterways Peter Harper and Nimal Chandrasena	367
Vacuum weeding: the removal of wild oats (<i>Avena ludoviciana</i>) and annual ryegrass (<i>Lolium rigidum</i>) seed from wheat stubble Linda M. Heuke, Shona L. Robilliard, Asad Shabbir and Michael J. Walsh	368
Host testing and taxonomic clarification of a potential fungal biological control agent of sea spurge (<i>Euphorbia paralias</i>) Gavin C. Hunter, John Lester, Isabel Zeil Rolfe, Mireille Jourdan, John K. Scott and Louise Morin	369
Evaluation of herbicide mixtures and manual weed control methods in maize (<i>Zea mays</i> L.) production E.O. Imoloame	370
African boxthorn stakeholder survey: Impacts and management goals for biocontrol Kylie B. Ireland, Michelle Rafter, Nagalingam Kumaran, S. Raghu and Louise Morin	371
Early invader Opuntioid cacti in Victoria Bec James and Kate Blood	372
Using detection dogs as part of an integrated weed management strategy – A local government perspective Melanie Kelly and Nicole Gill	373
Triticale competitive ability with annual ryegrass (<i>Lolium rigidum</i> Gaudin) as affected by variety, sowing rate and row spacing Husam S.M. Khalaf, Brian M. Sindel, Paul E. Kristiansen, Robin S. Jessop and Craig Birchall	374
Effect of moisture stress on morphological and physiological attributes of <i>Amaranthus viridis</i> and <i>A. retroflexus</i> Asad M. Khan, James P. Hereward, Jeff A. Werth, Gimme H. Walter and	
Bhagirath Singh Chauhan	378

Weed suppressive potential of selected pasture legumes against annual weeds in southeastern Australia Sajid Latif, Paul A. Weston, John W. Piltz, Saliya Gurusinghe, William B. Brown, Jane C. Quinn and Leslie A Weston	379
Angled onion, <i>Allium triquetrum</i> L., a beautiful flower with a bitter taste V. Lesieur, M. Jourdan, T. Thomann, A. Sheppard, J.F. Martin, M.S. Tixier, L. Morin, S. Raghu and B. Gooden	383
Diversity and extent of mutations endowing resistance to AHAS-inhibiting herbicides in <i>Sisymbrium</i> orientale in Australia Weihua Long, Peter Boutsalis, Mahima Krishnan, Jenna M. Malone and Christopher Preston	384
Growth responses of two Australian biotypes of common sowthistle (<i>Sonchus oleraceus</i> L.) to varied soil moisture regimes Gulshan Mahajan, Michael Walsh and Bhagirath S. Chauhan	385
<i>Phalaris minor</i> resistance is increasing and solutions urgently needed to farmers of Punjab and Haryana Malwinder Singh Malhi and Pavitarpal Singh Pangli	386
Allelopathic activity of <i>Hosta alismifolia</i> against <i>Lactuca sativa</i> L. Mohammad Shamim Hasan Mandal	387
The role of biochar pyrolysis temperature on hexazinone sorption-desorption in soil using the batch-equilibrium method Kassio F. Mendes, Gustavo M. Chitolina, Mayara C. Arruda, Leonardo V. Junqueira, Cássio S. Almeida and Valdemar L. Tonisielo	388
Could <i>Phytophtora</i> species associated with declining populations of invasive European blackberry be used for biological control? Louise Morin, John Lester, Patrick Gleeson, Treena I. Burgess, Giles E. St. J. Hardy and John K. Scott	389
Germination ecology of resistant and susceptible populations of barnyard grass (<i>Echinochloa colona</i> (L.) Link.) collected from Queensland Navneet Kaur Mutti, Gulshan Mahajan and Bhagirath S. Chauhan	390
Field evaluation of selected canola competitive cultivars for suppression of natural weed populations James M. Mwendwa, William B. Brown, Paul A. Weston, Shamsul K.M. Haque, Jeffrey D. Weidenhamer and Leslie A. Weston	391
An inventory of Queensland prioritised invasive plant species for management and research Olusegun O. Osunkoya, Christine Perrett, Kerri Moore, Sam Nicol, Jens Froese, Kristy Gooding and Shane Campbell	392
Flupropanate resistant serrated tussock (<i>Nassella trichotoma</i>) identified at multiple locations in the Monaro, New South Wales Jo Powells	397
The effect of weed interference with cotton in conventional and ultra narrow row spacing condition Ahmad Rafeizade, Mohammad Armin and Matin Jamimoeini	398
Studies on tolerance of chickpea (<i>Cicer arietinum</i> L.) to some pre- and post-emergence herbicides K. Rahamdad, I.A. Khan and S.S. Shah	399
Competitive wheat (<i>Triticum aestivum</i>) cultivars: A potential tool for managing herbicide resistant weeds Abhimanyu Rinwa and Manpreet Singh	s 400

Efficacy of harvest weed seed control systems on wild oats Shona L. Robilliard, Linda M. Heuke, Asad Shabbir and Michael J. Walsh	401
Interventional weed management methods in direct seeded rice Pasoubady Saravanane	402
Bionomics and effectiveness of Aak fruit fly: A potential biocontrol candidate for calotrope in Australia Asad Shabbir, Shahid Ali and Kunjithapatham Dhileepan	405
Managing barnyard grass through crop competition: The role of row spacing and crop density Asad Shabbir and Michael J. Walsh	406
Successful biocontrol of <i>Echium</i> spp. Paul R. Sullivan	407
Influence of resource conservation techniques on weed control in green manure maize-pulse	
cropping system R. Thirumalaikumar, N.S. Venkataraman, K. Balakrishnan, R. Babu and A. Rathinasamy	408
Comparison of site-specific, whole field and seedbank physical weed control treatments Michael J. Walsh, Salah Sukkarieh and Guy R. Coleman	409
Environmental weed advisory list update, Victoria Matt White, Kate Blood and Bec James	410
Physiological and biochemical resistance cost of multiple herbicide resistance in <i>Echinochloa crus-galli</i> Xia Yang, Yongfeng Li, Zichang Zhang and Tao Gu	411
Efficacy of pyrazosulfuron-ethyl to manage weeds of rainy season rice under non-puddled field condition and its effect on the subsequent wheat crop Taslima Zahan, Abul Hashem and Md. Moshiur Rahman	412
Alterations in the 5 'untranslated region of the <i>EPSPS</i> gene influence <i>EPSPS</i> over-expression in glyphosate-resistant <i>Eleusine indica</i> Chun Zhang, Li Feng and Xing-shan Tian	416
Investigation of root exudation and phytotoxic potential of diverse <i>Sorghum</i> spp. through regulation of sorgoleone Xiaocheng Zhu, Paul A. Weston, Ian D. Godwin, Sally Norton and Leslie A. Weston	417
AUTHORS' INDEX	418
KEYWORD INDEX	422