final report

Project code: B.PAS.0356

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Date published: 30 June 2017

PUBLISHED BY
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Chemical review pasture dieback

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

Identification of productions losses from pasture dieback dates back to the 1990's in the Northern region of Australia originally identified in buffel grass, which then extended into other northern grass species including bluegrass. The extent of buffel dieback based on a survey of growers, particularly in Central Queensland and South Burnett regions has now extended to 35,000 ha and may potentially be greater than 50,000 ha in area.

This project reviewed Australian and international chemical databases and published literature to collate potential chemical control options for an identified list of potential candidate soil borne pathogens, potentially in a complex. In central Queensland livestock producers are seeing pasture death, describing it as 'dieback'. The cause of dieback is not known, with impacts not on any particular pastures species though most commonly seen on (though not exclusively) introduced grasses.

Outcomes of this review have been complied into a searchable pivot table Excel database. Of the 10 potential candidate causal pathogens of pasture dieback, through the review, 43 potential fungicide and five insecticide options were identified in total. Only four fungicides are already registered in Australia for use in pastures. The review has identified that there are potential solutions to all candidate pathogens identified to date. While five chemical options were identified which potentially provide multiple causal pathogen control, the optimal chemical solution is likely to be a mixture, combined with additional pasture management and grazing practices.

To develop effective strategies for the control of pasture dieback, the causal pathogen(s), potential complex and vector or contributing management factors first need to be identified. The use of the pivot table database developed through this project is a very useful tool in determining initial potential candidate solutions for controlled environment studies in unpacking the disease complex and also for fast tracking prioritisation of options for future field research studies.

Executive summary

Identification of productions losses from pasture dieback dates back to the 1990's in the Northern region of Australia originally identified in buffel grass, which then extended into other northern grass species including bluegrass. The extent of buffel dieback based on a survey of growers, particularly in Central Queensland and South Burnett regions has now extended to 35,000 ha and may potentially be greater than 50,000 ha in area.

This project is a review of Australian and international chemical databases and published literature to collate potential chemical control options for an identified list of potential candidate soil borne pathogens, potentially in a complex. In central Queensland livestock producers are seeing pasture death, describing it as 'dieback'. The cause of dieback is not known, with impacts not on any particular pastures species though most commonly seen on (though not exclusively) introduced grasses.

This project delivered a desktop study of potential Australian and International registered chemicals for potential control of the pasture dieback complex. Direct contact with the suppliers of candidate options may be a key component of future work. Outcomes of this review have been complied into a searchable pivot table Excel database.

Based on a desktop review of the US IR-4, Canadian MUP, APVMA database and published scientific studies for registered chemicals, options for pesticide solutions based on potential efficacy and strategic fit for control of pasture dieback to Australian livestock producers, initially scoped five candidate pathogens, this was subsequently expanded to 10 candidate pathogens following consultation with experts and pathologists. Of the 10 potential candidate causal pathogens of pasture dieback, through the review, 43 potential fungicide and five insecticide options were identified in total. Only four fungicides are already registered in Australia for use in pastures.

The review has identified that there are potential solutions to all candidate pathogens identified to date. While five chemical options were identified which potentially provide multiple causal pathogen control, the optimal chemical solution is likely to be a mixture, combined with additional pasture management and grazing practices. To develop effective strategies for the control of pasture dieback, the causal pathogen(s), potential complex and vector or contributing management factors first need to be identified. The use of the pivot table database developed through this project is a very useful tool in determining initial potential candidate solutions for controlled environment studies in unpacking the disease complex and also for fast tracking prioritisation of options for future field research studies.

As this industry issue, while significant for many growers is a relatively small market at a national scale for chemical registrants, the most cots effective mechanism to address delivery of chemical needs would be through the APVMA minor and emergency use permit program.

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1 Background

Identification of productions losses from pasture dieback dates back to the 1990's in the Northern region of Australia originally identified in buffel grass, which then extended into other northern grass species including bluegrass. The extent of buffel dieback based on a survey of growers, particularly in Central Queensland and South Burnett regions has now extended to 35,000 ha and may potentially be greater than 50,000 ha in area.

This project is a review of Australian and international chemical databases and published literature to collate potential chemical control options for an identified list of potential candidate soil borne pathogens, potentially in a complex. In central Queensland livestock producers are seeing pasture death, describing it as 'dieback'. The cause of dieback is not known, with impacts not on any particular pastures species though most commonly seen on (though not exclusively) introduced grasses. Expert opinion suggests the origins of pasture dieback is most likely a soil borne pathogen, although the significant presence of mealybug at many of the sites indicates a potential vector for disease transmission.

2 Project objectives

This project is a desktop study of potential Australian and International registered chemicals for potential control of the pasture dieback complex. Direct contact with the suppliers of candidate options may be a key component of future work. Outcomes of this review have been complied into a searchable pivot table Excel database. Project objectives include:

1. Deliver a desktop review of the US IR-4, Canadian MUP, APVMA database and published scientific studies for registered chemicals, present options for pesticide solutions based on potential efficacy and strategic fit for control of pasture dieback to Australian livestock producers, for five candidate pathogens, noting this was subsequently expanded to 10 candidate pathogens following consultation with experts and pathologists.
2. In conjunction with pathologist(s) identified in agreement with MLA, elicit additional background information on any existing pesticide efficacy studies or suitability for control of the specific target pathogens/potential complex plus consideration of potentially relevant alternative candidate options that have broad efficacy on fungal and bacterial pasture pathogens.
3. For the options considered, identify product is that is currently registered for use in Australia and its current regulatory review status that is potentially relevant to pasture production including the active constituent, product name, registrant/manufacturer and main current registered use closely relevant to pastures.
4. For the options considered, identify product is that is not currently registered for use in Australia that is potentially relevant to international pasture production including the active constituent, product name, registrant/manufacturer and main current registered use closely relevant to pastures.

5. For the options considered, provide comment through a searchable pivot table to enable analysis of the potential breadth of control of various currently identified causal pathogens and if it is suitable for topical or soil applied systemic application.
6. Recommendations on potential pesticide candidate options that could be considered for future separately funded detailed feasibility review and efficacy studies for control of a 'pasture dieback disease complex', including statements.

3 Methodology

Based on a desktop review of the US IR-4, Canadian MUP, APVMA database and published scientific studies for registered chemicals, options for pesticide solutions based on potential efficacy and strategic fit for control of pasture dieback to Australian livestock producers, initially scoped five candidate pathogens, this was subsequently expanded to 10 candidate pathogens following consultation with experts and pathologists. This included input from a pasture dieback science workshop held in Brisbane in the 1 June 2017. This review includes the following specific target pathogens in a potential complex:

Fungi:
i. *Alternaria alternata*
ii. *Bipolaris indica*
iii. *Pyricularia grisea*
iv *Ramichloridium spp*
v *Humicola spp.*
vi *Magnaporthe spp.*
vii *Verticilium spp.*

Bacteria:
i. *Pantoea anthophila*
ii. *Enterobacter cowanii*
iii *Erwinia spp.*

In some cases there were no identified solutions for the candidate pathogen. In these cases, consideration was given to identified control options of pathogens in the same family or order. The use of the family and order information in the pivot table database enables search and potential identification of cross species control.

4 Results

Of the 10 potential candidate causal pathogens of pasture dieback, through the review, 43 potential fungicide and five insecticide options for mealybug control were identified in total. Only four fungicides are already registered in Australia for use in pastures, propiconazole in perennial ryegrass, phosphorus (Phosphic) acid in subterranean clover, iprodione in lucerne and Penflufen + trifloxystrobin seed treatments for pasture establishment. Where the review failed to identify control options for the specific genus or species, a search was conducted for pathogens in the same family of order. The review identified solutions for all the potential candidate pathogens:

Causal agent		No of chemical/biological solutions identified
Fungi:		
i.	*Alternaria alternata*	8
ii.	*Bipolaris indica*	12
iii.	*Pyricularia grisea*	2
iv	*Ramichloridium spp*	2
v	*Humicola spp.*	4
vi	*Magnaporthe spp.*	2
vii	*Verticilium spp.*	4
Bacteria:		
i.	*Pantoea anthophila*	3
ii.	*Enterobacter cowanii*	3
iii	*Erwinia spp.*	3
Mealybug		
i.	Family *Psuedococcidae* (various species)	5

Results of the review are detailed in the Excel pivot table database - MLA Potential chemical solutions for identified diseases of pasture dieback complex.xlsx

5 Discussion

Of the candidate chemicals, a number of options have been identified that would potentially control a complex of pathogens. These include:

Azoxystrobin	*Bipolaris indica, Pyricularia grisea, Magnaporthe spp.*
Chlorothalonil	*Bipolaris indica, Ramichloridium spp.*
Fluopyram	*Alternaria alternate, Humicola spp.*
Kasugamycin	*Pantoea anthophila, Enterobacter cowanii, Erwinia spp.*
Mancozeb	*Alternaria alternate, Bipolaris indica, Ramichloridium spp.*

Verticillium spp. are particularly problematic with limited control options. The main chemical historically used for control Benlate, is now banned for use in Australia and many countries globally. Literature suggest that the biological control PolyversumTM (*Pythium oligandrum*) registered in the USA offers potential efficacy.

One of the identified fungicide products has already been banned from use in Australia, 15 have been prioritised for reconsideration including dithiocarbanates and triazole fungicides, including propiconazole which is one of the few fungicides already registered in pastures. Two of the insecticide options already registered for control of mealybug in pastures are currently in progress of APVMA review.

Control of the potential disease vector mealybug with existing registered chemical products is potentially feasible as long as withholding periods for grazing are carefully managed. The chemical

products chlorpyrifos and methomyl have low withholding periods of 2 and 3 days respectively, which would enable feasible livestock grazing management.

Of the anti-microbial solutions identified for control of the potential bacterial candidate pathogens, the product Kasugamycin is the preferred candidate. This product has been registered for control of the bacterial disease fire blight in pome fruit crops in the USA. There are currently no antimicrobial products registered for use in plant crops in Australia.

As Kasugamycin is a different antimicrobial to the other key products oxytetracycline and streptomycin used extensively in clinical human medicine and animal health, it is the product of choice if an anti-microbial product is introduced to the Australian market. This would potentially reduce issues and risks of community sentiment. While FSANZ has indicated it would support a registration of streptomycin1, should an exotic fireblight incursion occur in Australia, public opposition to its introduction would be potentially difficult to manage.

6 Conclusions/recommendations

For industry to develop effective control strategies for pasture dieback, the causal pathogen(s), potential complex and vector or contributing management factors first need to be identified. The use of the pivot table database is a very useful tool in determining initial potential candidate solutions for controlled environment studies in unpacking the disease complex and also for fast tracking prioritisation of options for future field research studies.

The review has identified that there are potential solutions to all candidate pathogens identified to date. As additional pathogens are identified, it is recommended that the same review process be undertaken to build on the capability of this review and search tool.

There is likely to be a need for a mixture of multiple chemical actives to deliver a solution to a disease complex. This will make the delivery of data to support an industry permit or registration potentially more expensive than historical pasture registrations due to the need to develop multiple chemical residue trials in plants and animals. Trials should initially focus on efficacy and control of the disease with the optimal mixture of chemical product, before any residue trials are initiated.

As this industry issue, while significant for many growers is a relatively small market at a national scale for chemical registrants, the most cots effective mechanism to address delivery of chemical needs would be through the APVMA minor and emergency use permit program.

MLA participation in the ongoing AgVet Collaborative Forum program would be an effective and efficient mechanism to assist in increased chemical company engagement and initial participation in identifying potential technical and commercial support for minor use and registered solutions. There is also a Federal Government grant program to incentivise participation in this process.

[1] https://www.foodstandards.gov.au/publications/documents/Streptomycin_apples_FINAL.pdf

7 Key messages

The review has identified that there are potential solutions to all candidate pathogens identified to date. While five chemical options were identified which potentially provide multiple causal pathogen control, the optimal chemical solution is likely to be a mixture, combined with additional pasture management and grazing practices. To develop effective strategies for the control of pasture dieback, the causal pathogen(s), potential complex and vector or contributing management factors first need to be identified. The use of the pivot table database developed through this project is a very useful tool in determining initial potential candidate solutions for controlled environment studies in unpacking the disease complex and also for fast tracking prioritisation of options for future field research studies.

8 Appendix

8.1 Excel pivot table database - MLA Potential chemical solutions for identified diseases of pasture dieback complex.xlsx