Final Report

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Developing whole farm Integrated Management programs for Unpalatable grasses

Workshops & District management plans

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Abstract

Producers and land managers from three distinct management zones for serrated tussock (ST) and Chilean needle grass (CNG) have validated the inputs for a lifecycle model developed for paddock level management, and the financial aspects associated with managing these weeds.

The workshops were held at Goulburn, Glen Innes and Attwood, and presented a typical farm scenario designed by members of the technical reference group for each district. CNG was used for the Glen Innes and Attwood workshops, whilst ST was used for the Goulburn workshop.

Facilitated discussion was used to validate the inputs that were used to create the model, including the expected cost and benefit of each treatment option. The thoughts of participants working in groups were captured by using a financial spreadsheet to forecast the expected returns of managing the typical farm.

The management options proposed by the participants at the workshops for the different weeds and land classes were collated and aligned to the lifecycle model to validate its outcome. These management programs have formed the basis of district management plans. These plans have month by month management objectives with associated benefits and costs analysed to calculate farm profit.

Executive summary

This project was initiated to better understand the true cost of managing unpalatable grasses such as CNG and ST. Previous research into the management of these weeds had identified tactics that could be used. Although these trials formed the basis of national best practice guides, they did not consider how the control strategies could fit in different farming systems, or the economic costs of undertaking such programs. This project aimed to validate the control strategies with producers and also undertake economic analysis of the control programs.

What was achieved?

A lifecycle model, for both CNG and ST, was developed and used as the basis of discussions with technical experts and producers about the effectiveness and cost of control tactics. The model was fine tuned at district workshops and used in conjunction with a financial spreadsheet to calculate the economic cost of undertaking a whole farm weed control program. This exercise highlighted the practicalities of not only managing the weed in different land classes, over multiple years, but also the expected returns and financial implications across the farm system.

The information from each district workshop was compiled and validated against the lifecycle model to create the district management plans for the various land classes.
These documents have also been used to formulate an in-field Validation/Demonstration proposal.

When and how industry can benefit from the work

The development of district specific management plans will raise the awareness of producers to the costs of uncontrolled infestations and enable livestock producers to forward plan their control strategies for these two weeds – thus reducing production costs and further spread of the weed.

The district plans represent a pooled knowledge of both technical and production minded land managers, based on producers proven and local knowledge. It is likely that producers will not readily commit to the more costly or risky management options without having first hand experience of the program in their district. For this reason a proposal for a multi site/ multi State validation / demonstration proposal has been developed.

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Background

Past studies have identified individual tactics to control and manage Chilean needle grass (CNG) and Serrated Tussock (ST). This has led to the publication of national best practice management guides.

The national best practice management manuals fail to provide producers with a step by step management program specific to on-farm conditions or economic analysis of different management options.

This project aimed to deliver management calendars for specific farms that put together tactics from the best practice guide in a multi year program.

This project aimed to develop 5yr weed management programs for CNG & ST;

- Through facilitated workshops with land managers, advisors and technical specialists
- Based on tactics from the CNG and ST national best practice manuals,
- For a range of whole farm scenarios that are economically costed and tracked through benefit cost analysis

Project objectives

By July 2011:

1) Develop integrated (multi tactic) weed management programs across years to run down soil based seed and plant populations for CNG and ST that contain;

- Monthly activity schedules
- Expected seasonal economic benefit cost calculations
- Management decision support tree to allow flexibility in management decisions depending on seasonal outcomes

2) Management programs are developed and evaluated by up to 100 farm advisors, producers, technical specialists and compliance staff.

3) Develop a multi site, multi State validation / demonstration proposal.

Methodology

Three weed management programs were developed for separate commercial grazing locations for CNG in central Victoria, and Northern NSW, ST in Southern tablelands NSW. Scenarios were based on a “typical farm” within each location, comprising sub sets of land classes with different management requirements. Management plans were developed in 2 stages:

1. By technical specialists
2. Facilitated stakeholder engagement workshops. Participants included farm advisors, producers, technical specialists, compliance staff and national experts from different grazing regions across south eastern Australia.

Develop model of control tactics

- Modeller engaged to develop management model for CNG and ST
- Input for model sourced from published literature, current best practice tactics, and supplemented by technical reference group contributions.

Technical reference group

Members of the technical reference group to be national experts to:

- Validate the development of the management model.
- Partake in pre stakeholder workshop to identify:
- Three management scenarios in a whole farm context
- Management plans that cater for interaction management tactic required of different landclasses

Stakeholder engagement workshops

Up to 100 Farm advisors, producers, technical specialists and compliance staff partook in three stakeholder engagement workshop, one in each of the targeted locations.

Pre-workshop reading was sent to all participants to ensure they were informed of management contexts, plans, and current best practice tactics.

Workshops were used to:

- Address producer concerns to current control tactics
- Prioritise management actions for specific scenarios (e.g. quarantine vs production demands)
- Develop whole farm management programs from the pre- identified management plans.

Promotion and evaluation

Workshops outputs are published as a concise management plan for each management scenario, including a prescriptive month by month management calendar with critical check points and associated economic analysis.

Management plans were:

- Posted to workshop participants
- Published on national weeds websites and made available via national weeds of national significance coordinators.

Commitment to the control program was measured by surveys undertaken at the workshop.

A multi site/ multi State validation / demonstration proposal will be developed from this project.

Results

A lifecycle model was developed for CNG and ST using the program STELLA. This model consists of the plants basic lifecycle (i.e. seedbank to reproductive) with management options imposing on the natural lifecycle (i.e. slashing decreasing seed production). The lifecycle of each weed and the effects of management on the lifecycle were generally taken from published literature with district specific input from the technical reference group.

Technical reference group/ Stakeholder engagement workshops held

A technical reference group of weed experts was used to review the model and design a typical farm scenario for ST and CNG. The technical reference group comprised of:

- Brian Sindel – University of New England, Armidale
- Jeff Lowien – NSW DPI, Glen Innes
- Micheal Michelmore – NSW DPI, Goulburn
- Bronwen Wicks – National ST coordinator, Goulburn
- Aaron Simmons – NSW DPI, Orange
- Warwick Badgery – NSW DPI, Orange
- Matthew Sheehan – National CNG coordinator, Bendigo
- David McLaren – VIC DPI

The reference group reviewed the weed lifecycle as used in the model, and also verified that the lifecycle model inputs were accurately represented in the outputs of the lifecycle model for each district (see Appendix 1 - STELLA interface and model screens). The reference group also developed the typical farm scenario for discussion at the regional workshops (See appendix 2- farm scenarios). The technical reference group did not directly provide a basic control program for each farm scenario as the lifecycle model and control options catered for all scenarios. It was agreed that this process was best facilitated at the workshop for maximum diversity.

National workshops held with stakeholders

Producer workshops were held at Goulburn NSW, Glen Innes NSW and Attwood VIC. The lifecycle model of control tactics for CNG and ST was demonstrated to participants at the workshops, with comment made as to how the model could be fine tuned with respect to:

- What parts of the weed lifecycle occurred in different climatic periods and seasons
- What input parameters (i.e seed production timing) should be changed to make the model better suited to their district

The validation of benefits and costs associated with individual tactics was undertaken using a financial spreadsheet (see Appendix 3 - financial spreadsheet – Workshop paddock schedule Glen Innes,). Much discussion was had as to the costs of the tactics in the different districts, with a vast difference in the potential to pay for such management tactics across the districts. This information was captured whilst land participants worked in break-out groups and planned a weed management program for the given farm scenario.

Some of the groups that workshopped the ST farm scenario at Goulburn were unable to make the farm profitable over 5yrs, whereas the CNG example at Glen Innes and Attwood was profitable over a short period of time (See Appendix 4 - financial spreadsheet example – Workshop paddock schedule Goulburn).

Commitment to control evaluation sheets collected/Workshop evaluation:

All participants completed a written evaluation of the day (see Appendix 5 - workshop evaluation sheet), with questions about the cost and effectiveness of different techniques as well as commitment to use these management tools in the future. Generally all participants reported that they found the model and financial spreadsheet useful and would be willing to apply a more detailed analysis to their own farm (See Appendices 6 & 7 - Workshop evaluation graphs CNG & ST). Participants also commented that they would be ‘looking forward to the follow up’ from the ‘informative workshop’ with some indicating where the ‘model needs further work’ and then emailing supplementary information.

Trends from CNG workshops included:

- More costly control options (i.e. those that required the use of machinery or chemicals) were considered to be the most effective in limiting regrowth, although all options surveyed were reported to allow moderate amounts of regrowth. (see weed specific comments below).
- Although chipping surveyed as having negligible costs to production, it had one of the highest regrowth rates, presumably due to the difficulty in identifying CNG when vegetative.
- Many of the control options for CNG were already being undertaken, with a tendency for grazing, mowing and spot spraying, and a willingness to trial alternative options such as cropping (generally discussed as forage cropping).

Trends from the ST workshop included:

- Grazing (grazing management) and chipping were already being done by 40% of the group.
- Cropping and re-sowing were considered costly or not appropriate at Goulburn due to the terrain and location of infestations, although it was considered to limit regrowth where it could be done, and participants showed a willingness to consider or trial the cropping option.
- Chemical treatments were also considered costly (i.e due to spot spray labour) yet gave mixed results as far as perceived regrowth and willingness to consider or trial the options. The willingness to boom spray was split nearly evenly across the group whereas spot spraying was already being done by the majority of the group.

Management program devised for each proposed research site

Management programs for the farm scenario of each district, and each land class of the scenario, have been devised and reviewed by the respective workshop participants (sent via email or post to participants).

The management programs were devised after collating the outputs from the workshops, and aligning the various programs for the best fit in the lifecycle model (Stella)(i.e. the strategy that had the greatest effect on the weed lifecycle and longevity of the control program).

These management programs were sent to participants for review and comment prior to finalising the proposed programs (see Appendix 8 – Attwood post workshop review summary). Comments received from participants are being used to modify the plans and alter some of the terminology used.

A document that relays the revised management programs and is suitable for extension purposes has been developed for each district (See appendices 9, 10 and 11). The district management programs have been used as the basis for the in-field Validation/Demonstration proposal

A research proposal for multi state/multi site validation of the district plans has also been developed (see Appendix 12 – Unpalatable Producer Demonstration Proposal). This proposal is based on a previous proposal that led to the current project although it has been revised given the knowledge gained from the workshops. It became apparent at the workshops that a project based on producer demonstration sites would be a more appropriate means of understanding research gaps whilst building producer knowledge capacity.

Discussion / Conclusion

Certain limitations became evident or were identified during the short duration of this project. These were in relation to the lifecycle models and the financial spreadsheet. The majority of these concerns could be addressed within the workshop timeframe or in the post-workshop review although those listed below still remain;

- Lifecycle modelling gaps - unknown responses of the weeds to certain treatments (i.e. stem cleistogenes)
- Reliability of treatments – farm to farm production and variance of opinion
- Factoring climatic variation – gaining confidence in the management option
- Financial estimates – cashflow calculations, large variance of pricing and costs of certain treatments

The district example farm scenario meant that most of the limitations or variables could be dealt with or defined although given the short duration of the project it was not possible to work through all of the limitations for all scenarios.

This brief project has combined the knowledge and skills of technical experts together with producers and those working on the land. This unique blend of personalities and experience was captured through facilitated workshops to form the district weed management plans. Unlike in conventional workshops, participants had an opportunity to steer the management of their own district farm example, and push the management boundaries to achieve their aim.

The work shop evaluations indicated that producers;

- Are willing to try new control methods
- Would be willing to apply a more detailed analysis to their own farm
- Or would at least be interested to see them in a demonstration capacity.

It is recommended that the proposal for in-field Validation/Demonstration sites to test the district plans, as part of a whole farm weed management program be considered as the next step in assisting producers manage the unpalatable grasses.

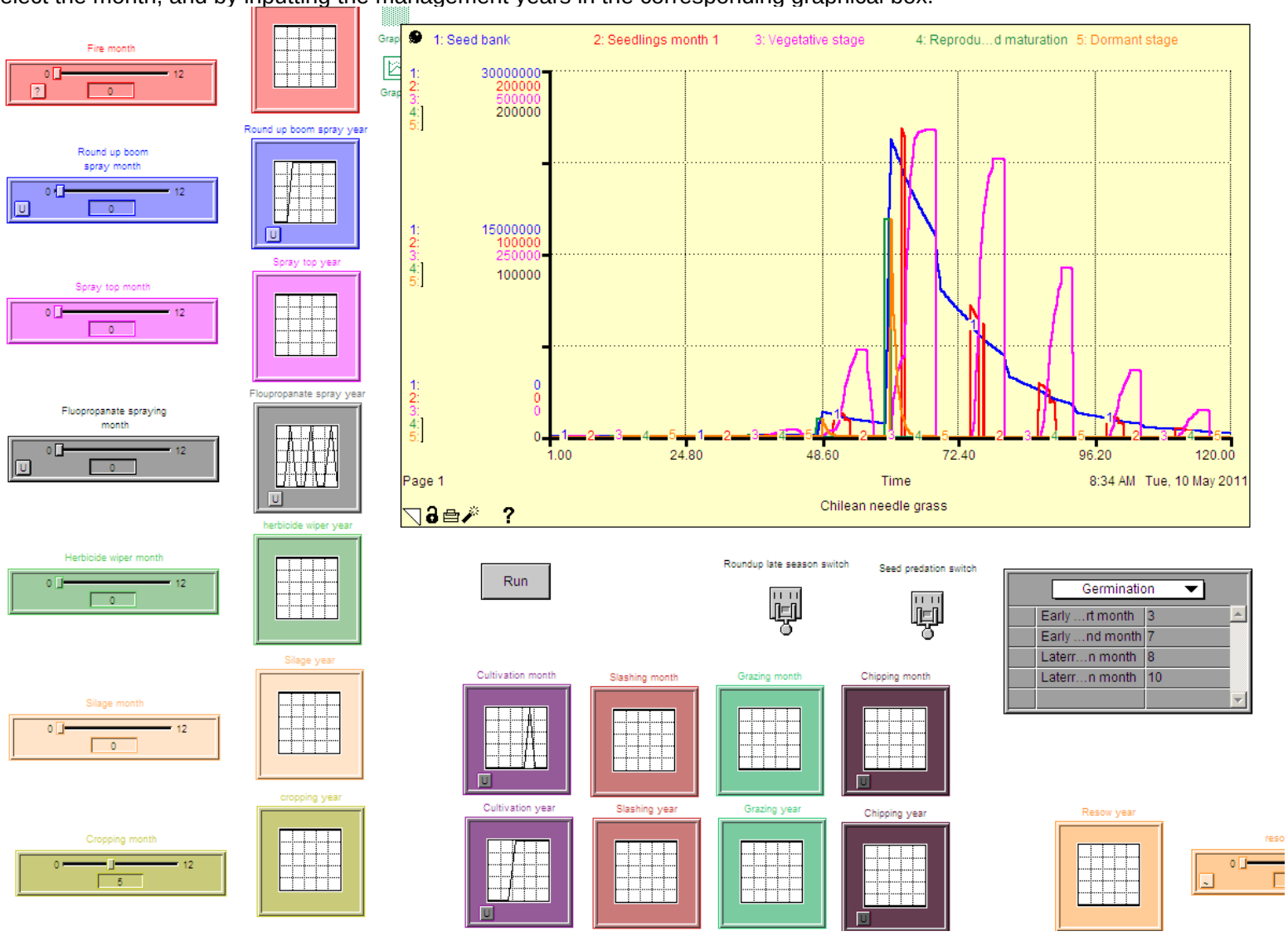
Photos/images

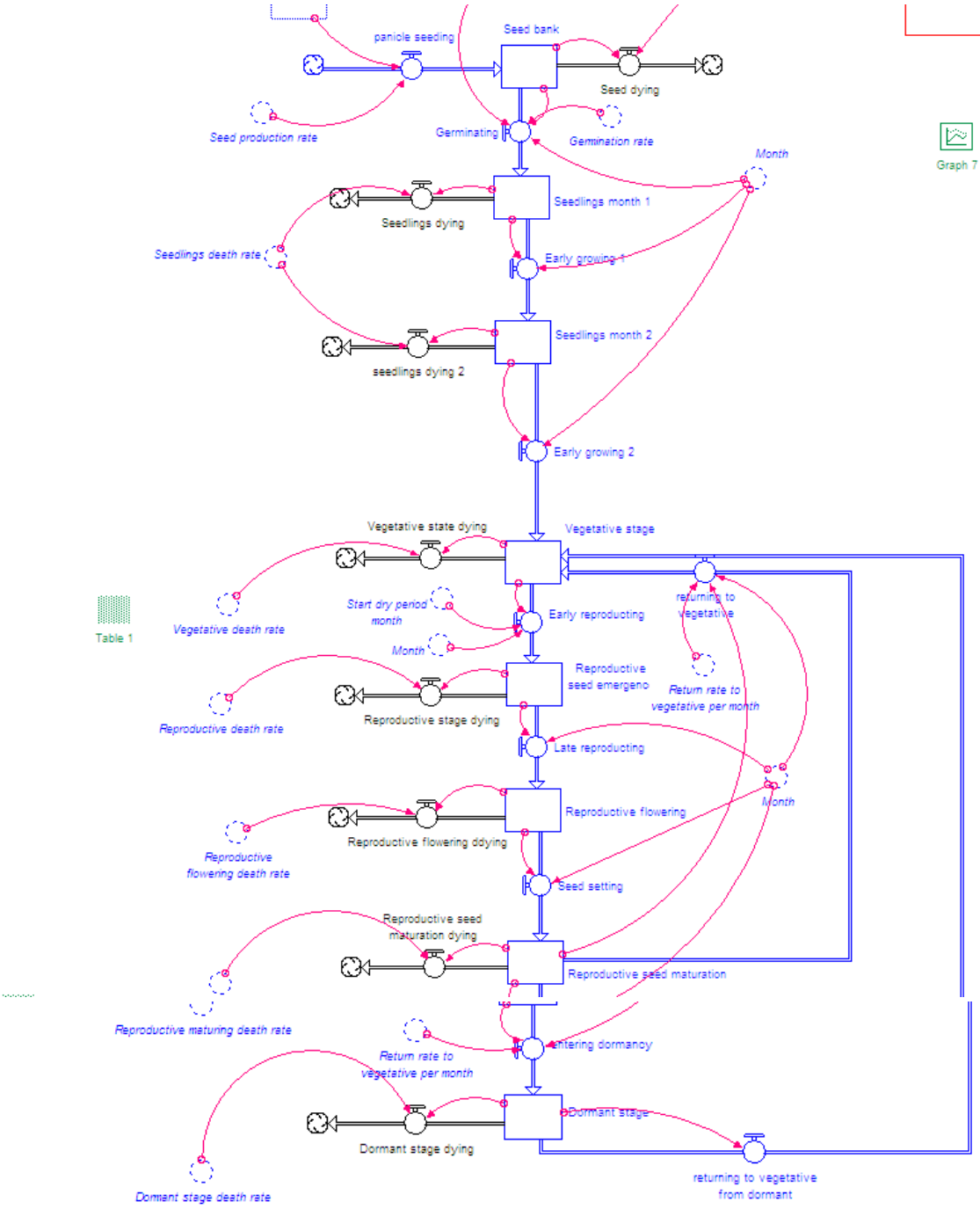
Goulburn workshop participants were able to freely contribute on all topics and have input into the model criteria through facilitated discussion sessions. Handouts were used to guide the workshop participants, with PowerPoint presentation slides used to provide additional information and demonstrate the workings of the model.

Producers worked in breakout groups at the Glen Innes workshop. Breakout groups were used to develop CNG management programs for the example farm. Each group had a laptop and were guided on how to use the financial spreadsheets.

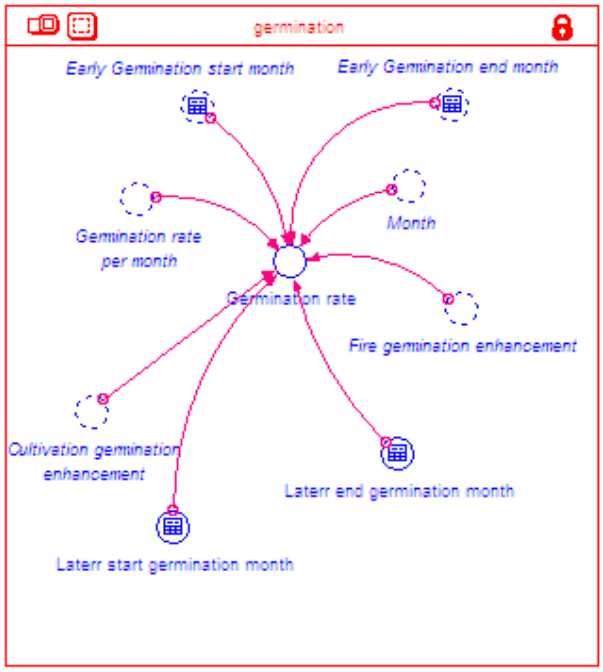
Appendix 1. STELLA interface and model screens

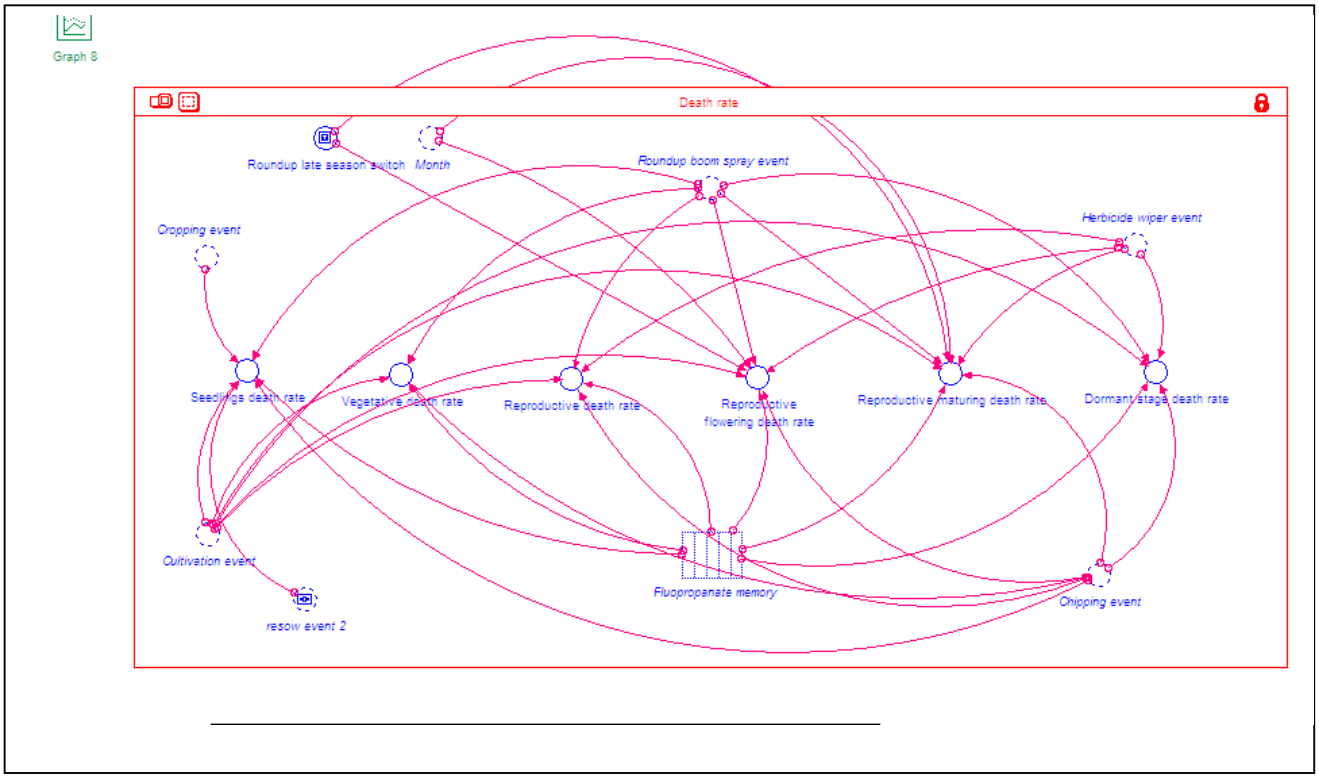
The STELLA Interface screen is used to operate the model. Participants at the workshops were able to view the effects of different management combinations on the growth and seedbank of either CNG or ST. Management options are chosen by scrolling over the slider bars to select the month, and by inputting the management years in the corresponding graphical box.





The Lifecycle display screen is a schematic representation of the plants lifecycle and is used by STELLA to provide the forecasted response of the plant population to the management imposed. The plant population response is directly related to the effect of each individual control tactic.





These screens display how each individual control tactic affects the plant population in different ways. For example, germination is affected by fire whilst death rate can be enhanced by several management options.

Appendix 2. Farm scenarios

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Chilean needle grass Management programs workshop

Attwood 20th May 2011

Farm Scenario for consideration at workshop – please review and add or refine details for discussion at workshop.

Enterprise and past history

Sheep on basalt plains country with both native pasture (c3 e.g. *microlaena* and also summer c4 e.g. *themeda*) and introduced pasture (cocksfoot phalaris rye) with a residual legume component.
Low inherent production but decent response to super phosphate, however superphosphate has not been applied for over a decade.
Dominant soils are basalt type clays and granitic sands characterised by rocky flats and steep valleys.

Weed infestation details

Chilean needle grass has spread onto the property from a local waterway and has been carried by sheep across certain paddocks. More recently cattle and farm vehicles have been responsible for spreading CNG into clean paddocks.

Size & location - 250ha across 12 paddocks – Clarkefield Area

Name Ar	ea (ha)	character	CNG history	History	Pasture composition
PADDOCK 1	10	Creek flat	Established	Pugged and wet	Phalaris/Rye
PADDOCK 2	20	rocky	Isolated to tracks	Native pasture, limited vehicle access	Themeda/stipa/danthonia/poa
PADDOCK 3	20	rocky	Isolated to tracks	Native pasture, limited vehicle access	Themeda/stipa/danthonia/poa
PADDOCK 4	10	steep	Scattered throughout	Improved pasture	Cocksfoot and some legumes
PADDOCK 5	10	steep	Scattered throughout	Improved pasture	Cocksfoot and some legumes
PADDOCK 6	10	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 7	30	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 8	10	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 9	20	arable	Scattered throughout	Past cropping now grazing and hay	Phalaris with some natives and legumes
PADDOCK 10	30	arable	Scattered throughout	Past cropping now grazing and hay	Rye/Thistles/ limited danthonia
PADDOCK 11	40	arable	Scattered throughout	Past cropping now grazing – low fertility	Rye/Thistles/ limited danthonia
PADDOCK 12	40	arable	Scattered throughout	Past cropping now grazing – low fertility	Rye/Thistles/ limited danthonia

Treatment options for consideration – *please review $/ha costs and benefits*

	$/ha cost	$/ha benefit	Calculations for costs	Calculations for benefits
NO PRODUCTION ABILITY/WITHOLD PERIOD ETC.	48	0	e.g. Hume Council	
Grazing - little or no weed	280	700	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	7 Sheep/ha = 7 lambs/yr (Lambs @ $100/head)= $700/ha/yr
Grazing - High density weed present	280	400	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Grazing - improved/fertilised pasture	280	800	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr
Manual removal - chipping	63	560	.75ha/hr @$50/hr	80% OF 7 Sheep/ha = 7 lambs/yr (Lambs @ $100/head)= $700/ha/yr
Slashing/Mow	67	400	1.5ha/hr @ $100/hr	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Silage (cut, rake, roll, bale, wrap) - 12 rolls/ha	200	840	cut, rake, roll, bale, wrap	$70/roll @ 12 rolls/ha
Chemical application – Glyphosate boom	45	x	$20/ha +$24 glyphosate (2l/ha)	
Chemical application - Flupropanate boom	92	x	$22/ha +70 flupropanate (2l/ha)	
Chemical application - Glyphosate spot	50	400	1ha/hr @$50/hr	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Flupropanate spot	50	320	1ha/hr @$50/hr	80% OF 4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Glyphosate & Flupropanate spot	50	320	1ha/hr @$50/hr	80% OF 4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application – Wick wiper (glyphosate)	42	400	$35/ha + $7 glyphosate (0.5l/ha est)	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Spraytop Glyphosate	35	400	$20/ha +$15 glyphosate (est)	
Chemical application - Aerial Glyphosate	136	x	$100/ha fly +$36 glyphosate (3l/ha)	
Chemical application - Aerial Flupropanate	170	x	$100/ha fly +$70 flupropanate (2l/ha)	
Burning	110	x	2 crews @ $110/hr, 0.5hr/ha	
Cultivation	100	x	primary discs only	
Pasture resowing – perennial	333	x	$113 sow + $15x8kg seed +$100 fert	
Cropping – annual crops (grain/fodder)	386	500	$113 sow + $20 seed +$100 fert+ $133 harvest	$500/ha ($200/T @ 2.5t/ha i.e. Oats)
Cropping – annual crops (grazing/forage)	233	800	$113 sow + $20 seed +$100 fert	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr
Sub and super ground spread	143	800	40super+40spread+63clover	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr

Meat and Livestock Australia/DPI Victoria/NSW D I&I

Chilean needle grass Management programs workshop

Glen Innes 12th May 2011

Farm Scenario for consideration at workshop – please review and add or refine details for discussion at workshop.

Enterprise and past history
Cattle production as vegetative matter contamination has limited sheep grazing.

Weed infestation details
Chilean needle grass has spread onto the property from a local waterway and has been carried by sheep across certain paddocks. More recently cattle and farm vehicles have been responsible for spreading CNG into clean paddocks.

Size & location - 250ha across 12 paddocks – Ben Lomond Area

Name Ar	ea (ha)	character	CNG history	History
PADDOCK 1	10	Creek flat	Established	Pugged and wet
PADDOCK 2	20	rocky	Isolated to tracks	Native pasture, limited vehicle access
PADDOCK 3	20	rocky	Isolated to tracks	Native pasture, limited vehicle access
PADDOCK 4	10	steep	Scattered throughout	Improved pasture
PADDOCK 5	10	steep	Scattered throughout	Improved pasture
PADDOCK 6	10	rough	Isolated dense patches	Native pasture, limited vehicle access
PADDOCK 7	30	rough	Isolated dense patches	Native pasture, limited vehicle access
PADDOCK 8	10	rough	Isolated dense patches	Native pasture, limited vehicle access
PADDOCK 9	20	arable	Scattered throughout	Past cropping now grazing and hay
PADDOCK 10	30	arable	Scattered throughout	Past cropping now grazing and hay
PADDOCK 11	40	arable	Scattered throughout	Past cropping now grazing – low fertility
PADDOCK 12	40	arable	Scattered throughout	Past cropping now grazing – low fertility

Treatment options for consideration – *please review $/ha costs and benefits*

	$/ha cost	$/ha benefit	Calculations for costs	Calculations for benefits
NO PRODUCTION ABILITY/WITHOLD PERIOD ETC.	24	0		
Grazing - little or no weed	280	700	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	7 Sheep/ha = 7 lambs/yr (Lambs @ $100/head)= $700/ha/yr
Grazing - High density weed present	280	400	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Manual removal - chipping	63	x	.75ha/hr @$50/hr	
Slashing/Mow	67	x	1.5ha/hr @ $100/hr	
Silage (cut, rake, roll, bale, wrap) - 12 rolls/ha	200	840		$70/roll @ 12 rolls/ha
Chemical application – Glyphosate boom	45	x	$20/ha +$24 glyphosate (2l/ha)	
Chemical application - Flupropanate boom	92	x	$22/ha +70 flupropanate (2l/ha)	
Chemical application - Glyphosate spot	50	x	1ha/hr @$50/hr	
Chemical application - Flupropanate spot	50	x	1ha/hr @$50/hr	
Chemical application - Glyphosate & Flupropanate spot	50	x	1ha/hr @$50/hr	
Chemical application – Wick wiper (glyphosate)	42	x	$35/ha + $7 glyphosate (0.5l/ha est)	
Chemical application - Spraytop Glyphosate	35	x	$20/ha +$15 glyphosate (est)	
Chemical application - Aerial Glyphosate	136	x	$100/ha fly +$36 glyphosate (3l/ha)	
Chemical application - Aerial Flupropanate	170	x	$100/ha fly +$70 flupropanate (2l/ha)	
Burning	110	x	2 crews @ $110/hr, 0.5hr/ha	
Cultivation	100	x	primary discs only	
Pasture resowing – perennial	333	x	$113 sow + $15x8kg seed +$100 fert	
Cropping – annual crops (grain/fodder)	366	500	$113 sow + $20 seed +$100 fert+ $133 harvest	$500/ha ($200/T @ 2.5t/ha i.e. Oats)
Aerial fertiliser	200	x	$100/ha fly +$100fert	

Serrated tussock management programs workshop
Goulburn 10th May 2011

Farm Scenario for consideration at workshop – please review and add or refine details for discussion at workshop.

Enterprise and past history
Sheep on shale/slate country with both primarily winter (c3 e.g. *microlaena*), and also summer (c4 e.g. *themeda*) native pasture with a residual legume component. Low inherent production but decent response to super phosphate, however superphosphate has not been applied for over a decade. Dominant soils are slate/shale characterised by rocky hilltops and ridges and better soils lower down.

Weed infestation details
Serrated tussock has been dispersed across the property by winds blowing seed from adjoining properties. Seed has continued to spread across the property by wind and attached to machinery.

Size & location – 600 ha across 12 paddocks – Goulburn Area- average 5DSE/ha

Name	Area (ha) ch	aracter	ST history	History	Pasture composition
PADDOCK 1	30	Creek flat	Established (30%)	Fertile flats, cropped in the past	Volunteer native C3 species and broadleafs, some legumes
PADDOCK 2	80	Rocky	Dense in patches (30%) with some scattered (40%)	Native pasture, limited vehicle access	Redgrass and some legumes
PADDOCK 3	70	Rocky	Dense in patches (10%) with some scattered (50%)	Native pasture, limited vehicle access	Redgrass and some legumes
PADDOCK 4	40	Steep	Scattered throughout (5%)	Native pasture, limited vehicle access	C3 natives and some legumes
PADDOCK 5	40	Steep	Scattered throughout (5%)	Native pasture, limited vehicle access	C3 natives and some legumes
PADDOCK 6	60	Rocky with woody debris	Isolated dense patches (5%) with some scattered patches (25%)	Native pasture, limited vehicle access	C3 natives, redgrass and some legumes
PADDOCK 7	80	Rocky with woody debris	Isolated dense patches (5%) with some scattered patches (25%)	Native pasture, limited vehicle access	C3 natives, redgrass and some legumes
PADDOCK 8	70	Rocky with woody debris	Isolated dense patches (5%) with some scattered patches (25%)	Native pasture, limited vehicle access	C3 natives, redgrass and some legumes
PADDOCK 9	20	arable	Scattered throughout (30%)	Introduced pasture	Phalaris with some natives and legumes
PADDOCK 10	30	Moderately steep	Scattered throughout (30%) with some dense patches (10%)	Native pasture	C3 natives with a small component of phalaris and some legumes
PADDOCK 11	40	Moderately steep	Scattered throughout (30%)	Native pasture	C3 natives with a small component of phalaris and some legumes
PADDOCK 12	40	Moderately steep	Scattered throughout (30%)	Native pasture	C3 natives with a small component of phalaris and some legumes

Treatment options for consideration

– please review $/ha costs and benefits

	$/ha cost	$/ha benefit	Calculations for costs	Calculations for benefits
NO PRODUCTION ABILITY/WITHOLD PERIOD ETC.	24	0		
Grazing - little or no weed	80	200	$2.5/kgDW x 16kgDW lamb (35kgLW) x 2/ha	2 Ewes/ha = 2 lambs/yr (Lambs @ $100/head)= $200/ha/yr
Grazing - High density weed present	40	50	$2.5/kgDW x 16kgDW lamb (35kgLW) x .5/ha + minimum labour input $20	0.5 Ewes/ha = 0.5 lambs/yr (Lambs @ $100/head)= $50/ha/yr
Manual removal Low Density – chipping	50	x	1hr/ha @$50/hr	
Manual removal Medium Density – chipping	200		4hrs/ha @$50/hr	
Manual removal High Density – chipping	400		8hrs/ha @$50/hr	
Chemical application – Glyphosate boom	45	x	$20/ha +$24 glyphosate (2l/ha)	
Chemical application - Flupropanate boom	92	x	$22/ha +70 flupropanate (2l/ha)	
Chemical application - Flupropanate spot Low density	50	x	1ha/hr @$50/hr	
Chemical application - Flupropanate spot High Density	400		8hrs/ha @$50/hr	
Chemical application - Glyphosate & Flupropanate spot	50	x	1ha/hr @$50/hr	
Chemical application – Wick wiper (glyphosate)	42	x	$35/ha + $7 glyphosate (0.5l/ha est)	
Chemical application - Spraytop Glyphosate	35	x	$20/ha +$15 glyphosate (est)	
Chemical application - Aerial Glyphosate	156	x	$120/ha fly +$36 glyphosate (3l/ha)	
Chemical application - Aerial Flupropanate	190	x	$120/ha fly +$70 flupropanate (2l/ha)	
Burning	110	x	2 crews @ $110/hr, 0.5hr/ha	
Cultivation	100	x	primary discs only	
Pasture resowing – perennial	333	x	$113 sow + $15x8kg seed +$100 fert	
Cropping – annual crops (grain/fodder)	366	500	$113 sow + $20 seed +$100 fert+ $133 harvest	$500/ha ($200/T @ 2.5t/ha i.e. Oats)
Aerial fertiliser	200	x	$100/ha fly +$100fert	
Shelter belt wind break – trees (per 500m)	2088		per 500m, spray $200, fence $850, trees $410, planting $300, guards $328	

Appendix 3. Workshop paddock schedule Glen Innes

See excel spreadsheet file “APPENDICES 3 B.WEE.0127 Milestone 4 WorkshopPaddockSchedule_GLEN INNES3mods_Charles.xls”

0	NO PRODUCTION ABILITY/WITHOLD PERIOD ETC.	3.1	0	per 4 seasons
1	Grazing - little or no weed	50	162.5	per 4 seasons
2	Grazing - High density weed present	50	75	per 4 seasons
3	Grazing - improved/fertilised pasture	70	200	per 4 seasons
4	Manual removal - chipping	65	520	per event
5	Slashing/Mow	67	300	per event
6	Silage (cut, rake, roll, bale, wrap) - 12 rolls/ha	200	840	per event
7	Chemical application – Glyphosate boom	33	0	per event
8	Chemical application - Flupropanate boom	65	0	per event
9	Chemical application - Glyphosate spot	65	75	per event
10	Chemical application - Flupropanate spot	65	60	per event
11	Chemical application - Glyphosate & Flupropanate spot	65	60	per event
12	Chemical application – Wick wiper (glyphosate)	42	75	per event
13	Chemical application - Spraytop Glyphosate	35	75	per event
14	VERDICT BOOM SPRAY	30	0	per event
15	Chemical application - Aerial Flupropanate	130	0	per event
16	Burning	110	0	per event
17	Cultivation	75	0	per event
18	Pasture resowing – perennial	285	0	per event
19	Cropping – annual crops (grain)	159	250	per 2 seasons
20	Cropping – annual crops (grazing/forage)	92.5	200	per 2 seasons
21	Sub and super ground spread	143	800	per event

GI		chuck laptop	2011			
Area (ha)	character	Name	Autumn	Winter	Spring	Summer
10	Creek flat	PADDOCK1	2	0	7	0
20	rocky	PADDOCK2	1	1	1	1
20	rocky	PADDOCK3	1	1	1	1
10	steep	PADDOCK4	11	21	3	3
10	steep	PADDOCK5	11	21	3	3
10	rough	PADDOCK6	11	21	3	3
30	rough	PADDOCK7	11	21	3	3
10	rough	PADDOCK8	11	21	3	3
20	arable	PADDOCK9	21	20	14	6
30	arable	PADDOCK10	21	20	14	6
40	arable	PADDOCK11	21	19	0	0
40	arable	PADDOCK12	21	19	0	0
		Average				
250		Total				

Appendix 4. Workshop paddock schedule Goulburn

See excel spreadsheet file “APPENDICES 4 B.WEE.0127 Milestone 4 WorkshopPaddockSchedule_GOULBURN_CHARLES.xls”

		$/ha costs	$/ha benefits	
0	NO PRODUCTION ABILITY/WITHOLD PERIOD ETC.	2	0	per 4 seasons
1	Grazing - little or no weed	20	50	per 4 seasons
2	Grazing - High density weed present	10	0	per 4 seasons
3	Manual removal Low Density – chipping	200	0	per event
4	Manual removal Medium Density – chipping	600	0	per event
5	Manual removal High Density – chipping	800	0	per event
6	Chemical application – Glyphosate boom	50	0	per event
7	Chemical application - Flupropanate boom	92	0	per event
8	Chemical application - Flupropanate spot Low density	50	0	per event
9	Chemical application - Flupropanate spot High Density	400	0	per event
10	Chemical application - Glyphosate & Flupropanate spot	50	40	per event
11	Chemical application – Wick wiper (glyphosate)	42	0	per event
12	Chemical application - Flupropanate boom (low rate)	57	0	per event
13	Chemical application - Aerial Glyphosate	82	0	per event
14	SUPER ONLY	120	50	per event
15	SUB & SUPER	143	50	per event
16	Cultivation	120	0	per event
17	Pasture resowing – perennial	400	0	per event
18	Cropping – annual crops (grain/fodder)	150	400	per 2 seasons
19	Shelter belt wind break – trees (per 500m)	3000	200	per event

goulb	charles laptop		2011				ANNUAL	
Area (ha)	character	Name	Autumn	Winter	Spring	Summer	$/ha	$/paddock
30	Creek flat	PADDOCK1	18	1	1	1	340	10200
80	Rocky	PADDOCK2	9	2	2	2	-430	-34400
70	Rocky	PADDOCK3	9	2	2	2	-430	-30100
40	Steep	PADDOCK4	9	2	2	2	-430	-17200
40	Steep	PADDOCK5	9	2	2	2	-430	-17200
60	Rocky with woody debris	PADDOCK6	9	2	2	2	-430	-25800
80	Rocky with woody debris	PADDOCK7	9	2	2	2	-430	-34400
70	Rocky with woody debris	PADDOCK8	9	2	2	2	-430	-30100
20	arable	PADDOCK9	7	0	2	2	-114	-2280
30	Moderately steep	PADDOCK10	10	0	2	1	8	240
40	Moderately steep	PADDOCK11	10	0	2	1	8	320
40	Moderately steep	PADDOCK12	10	0	2	1	8	320
		Average					-230	
600		Total						-180400

Appendix 5. Workshop evaluation sheet

WHOLE FARM WEED MANAGEMENT PROGRAMS FOR UNPALATABLE GRASSES
MLA WORKSHOPS MAY 2011

WORKSHOP ☐ Goulburn serrated tussock ☐ Glen Innes Chilean needle grass
NAME; _____
LOCATION/AGENCY;_____

1. How would you describe the serrated tussock problem on your farm;

Density		**Distribution on farm**	
Light (less than 10%)	☐	Scattered throughout	☐
Medium (10%-30%)	☐	Isolated to areas	☐
Heavy (greater than 30%)	☐		

2. How would you describe the effectiveness of the methods you have tried in the last 3 years, taking into consideration both *cost of treatment* and the *effectiveness of the activity as part of your control program*. Assign a rating of 1-3 for Cost and 1-3 for effectiveness for those methods you have tried. Add any comments if required.

Cost		**Effectiveness**	
1	Negligible	1	Light regrowth
2	Significant	2	Moderate regrowth
3	Costly	3	Dense

	YES/NO	COST	EFFECTIVENESS	COMMENTS
Grazing	_____	☐	☐	
Chipping	_____	☐	☐	
Burning	_____	☐	☐	
Slashing/mowing	_____	☐	☐	
Chemical Application (spot)	_____	☐	☐	

Chemical Application (boom)____	☐	☐
Cultivation _____	☐	☐
Pasture & sowing _____	☐	☐
Cropping _____	☐	☐
Aerial fertiliser / seed _____	☐	☐

3. After having looked at the model of cost / benefit options for a variety of treatment methods, how willing would you be to trial each option to control the serrated tussock on your farm.

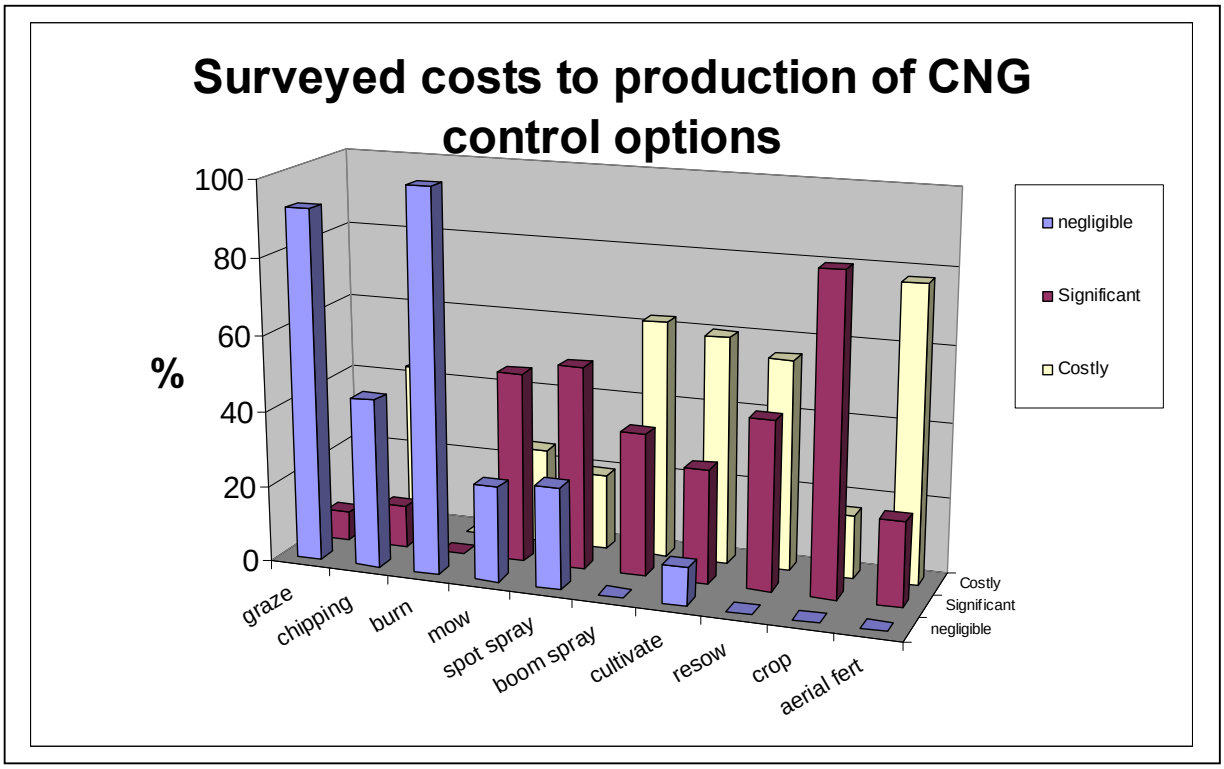
    1. Already doing this
    2. Not willing – too costly or benefits not worth the cost
    3. Would consider
    4. Very willing to trial

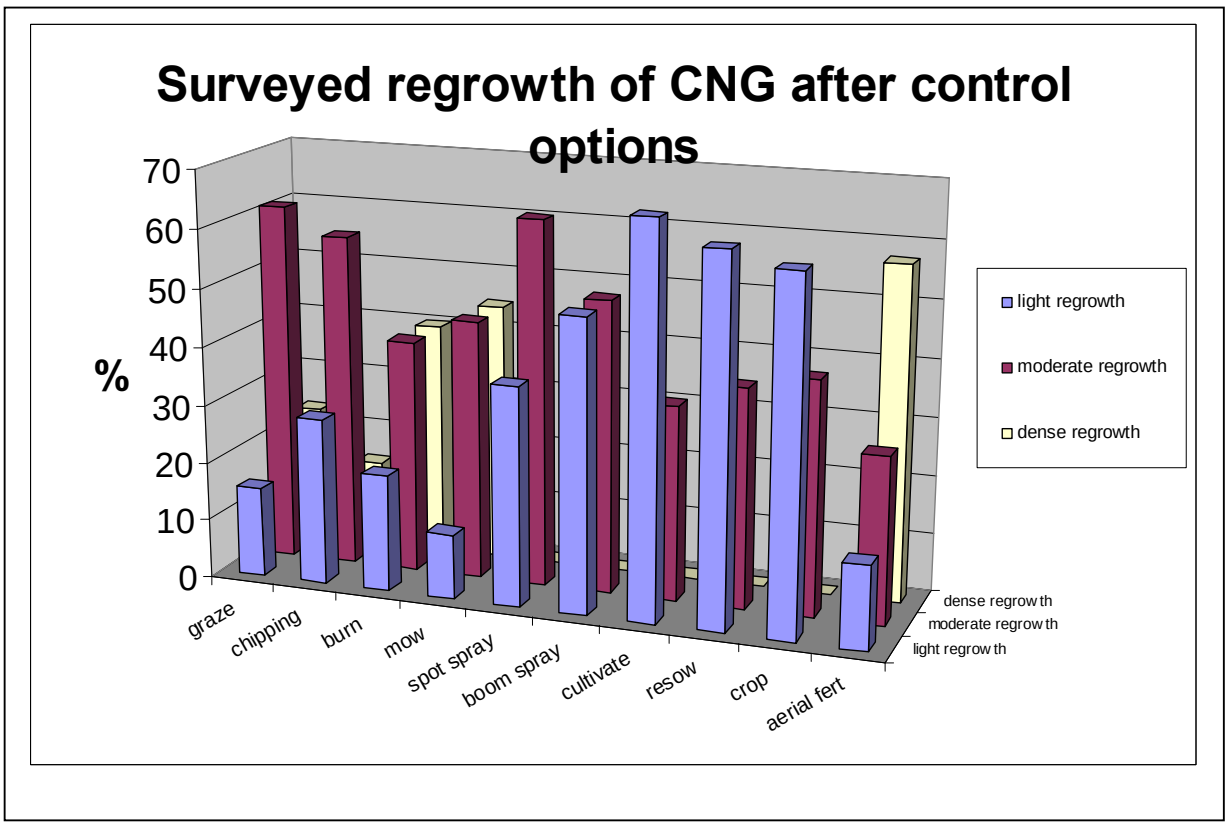
Grazing	☐	Chipping	☐
Burning	☐	Slashing/mowing	☐
Chemical Application (spot)	☐	Cultivation	☐
Chemical Application (boom)	☐	Pasture & sowing	☐
Cropping	☐	Aerial fertiliser / seed	☐

4. Would you find it useful to apply this model to your own farm for a more detailed analysis?
   YES / NO

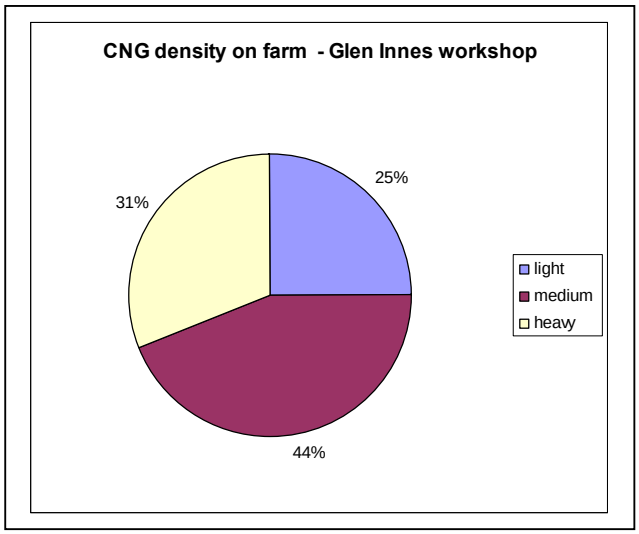
   Any other comments;

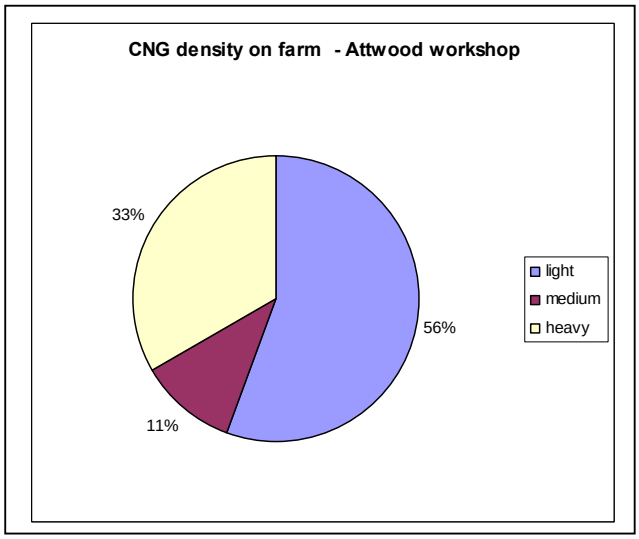
Appendix 6. Workshop evaluation graphs CNG

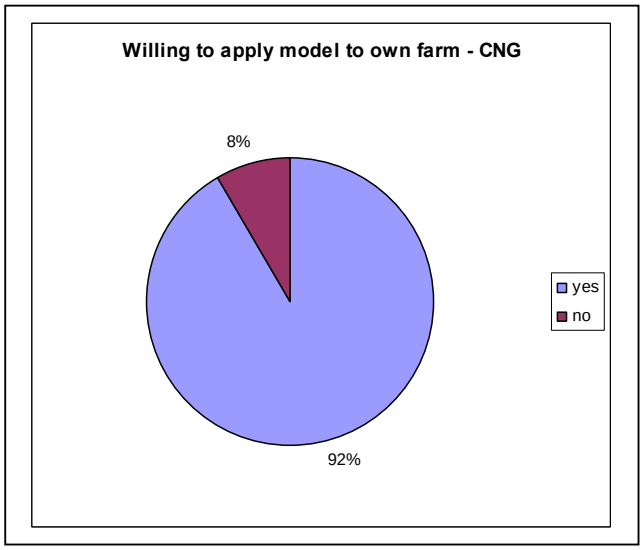




CNG managers considered the less risky management tactics (grazing, chipping and burning) to have negligible costs to production, and provided a moderate reduction in regrowth. Costly tactics (resowing, cultivation, spraying) were considered to provide the greatest reduction in regrowth.

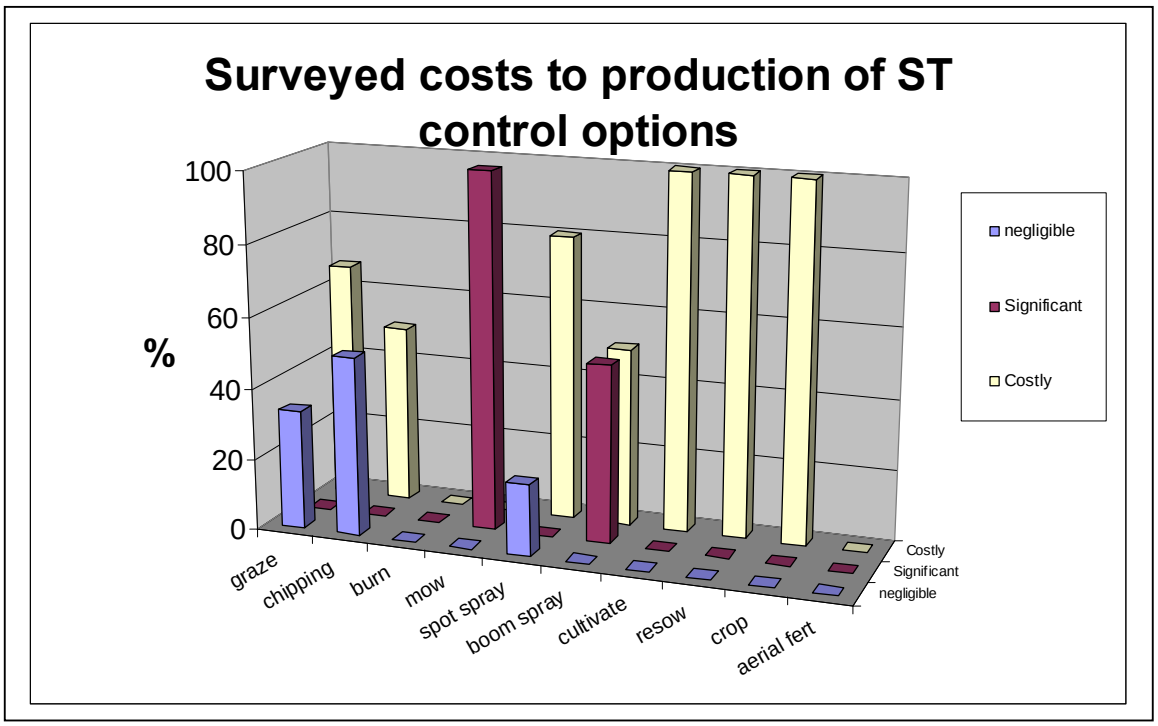


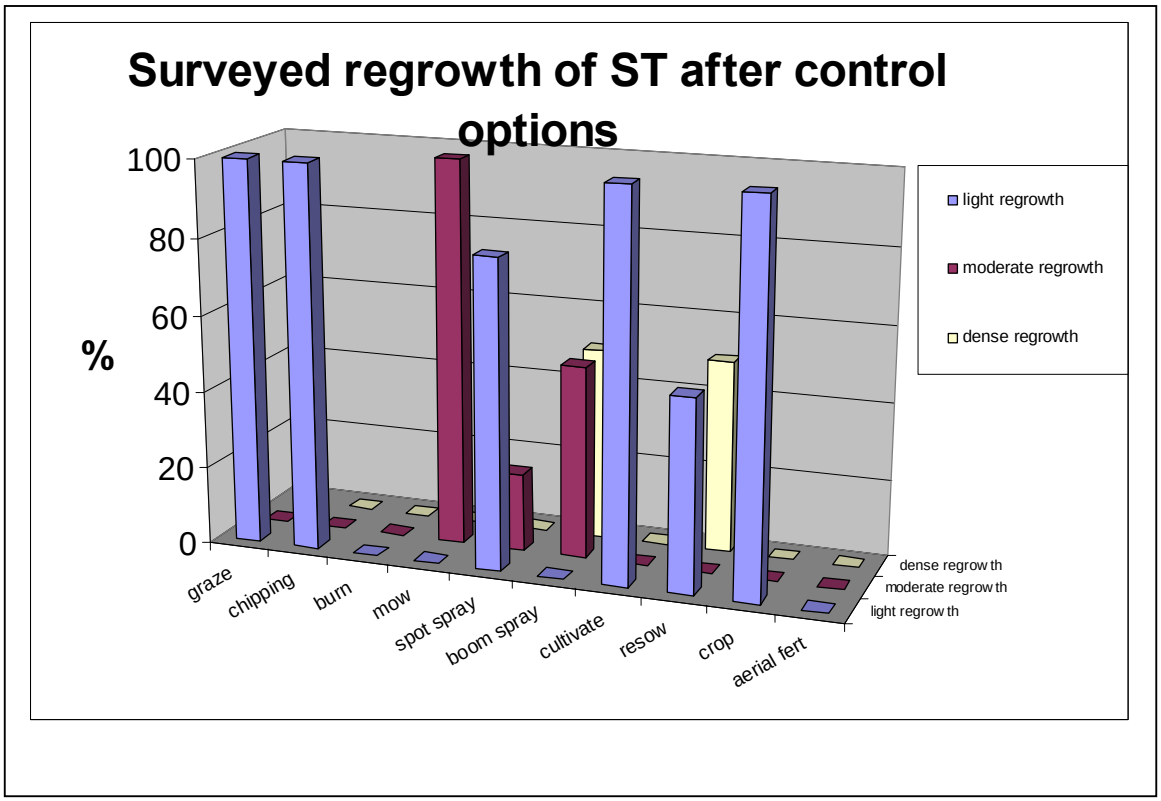




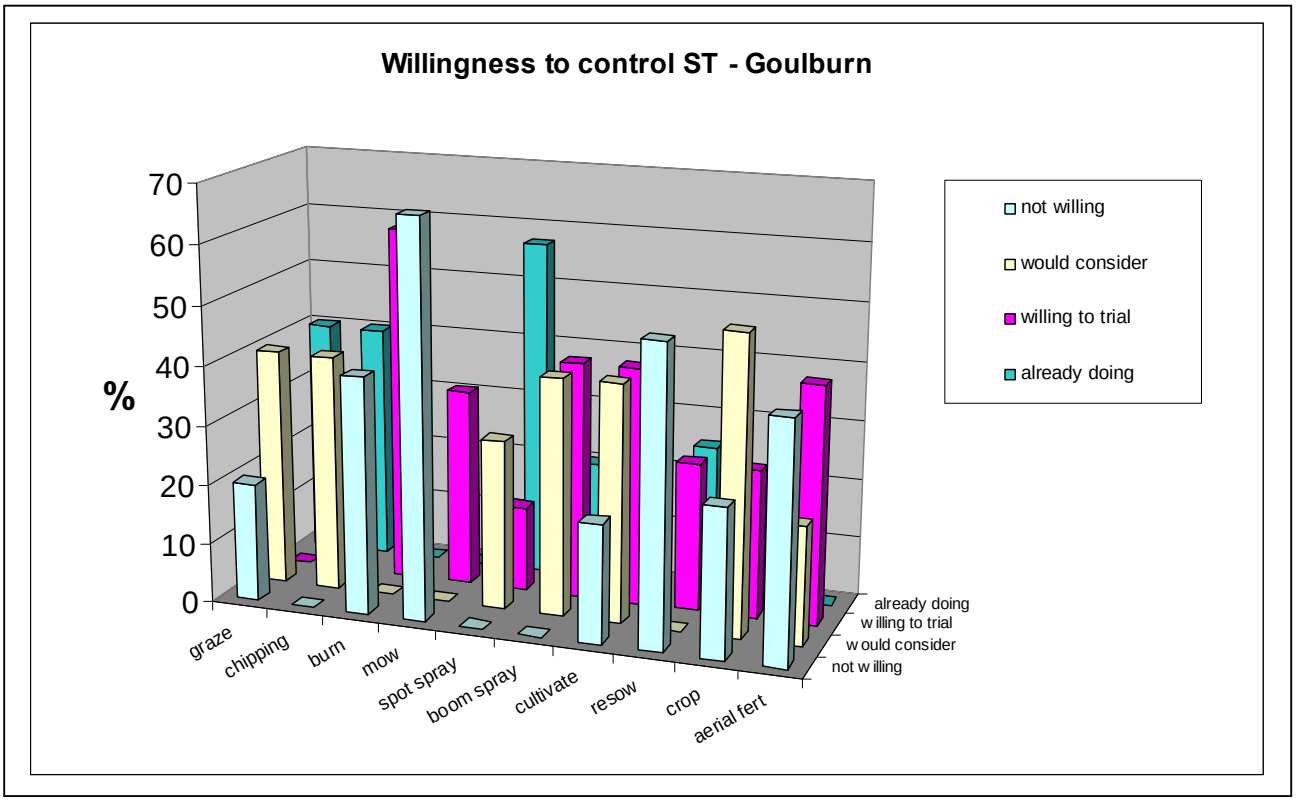
Farms of Glen Innes district generally had even distributions of CNG grass density, whereas the farms of the Attwood district were generally either lightly or heavily infested. 92% of the workshop participants were willing to apply the model to their own farm and validate the findings

Appendix 7. Workshop evaluation graphs ST

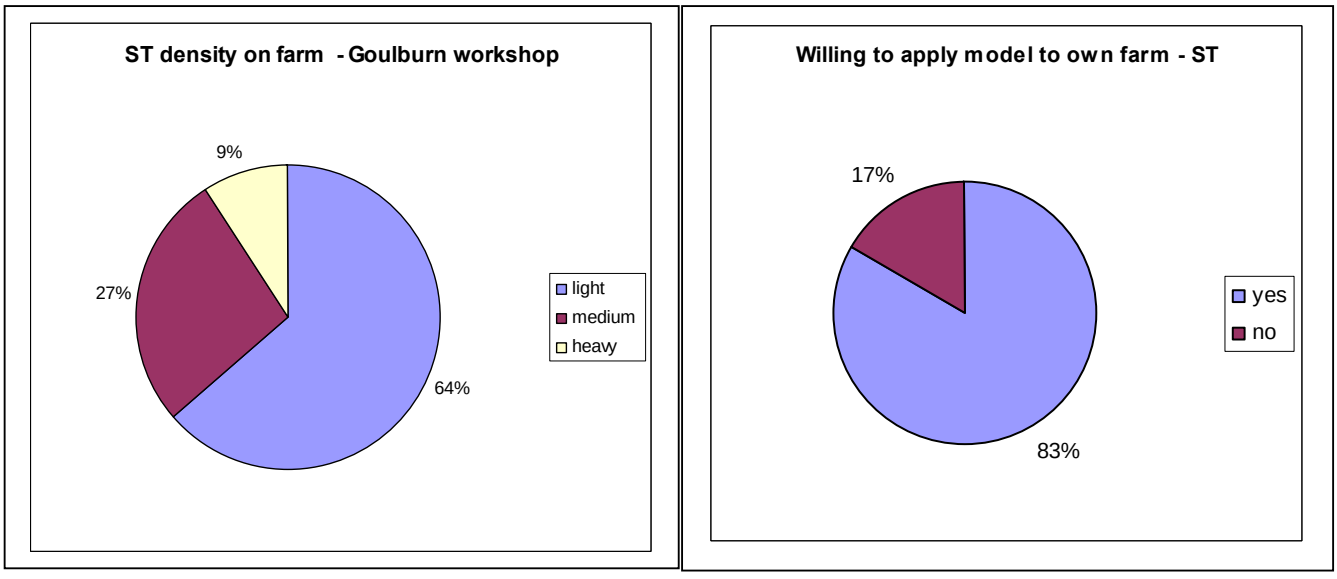




Producers affected by ST considered the less risky manual methods of removal (grazing & chipping) to be the most effective, with only light regrowth – the group was divided as to whether these tactics had a significant cost to production. The tactics that were considered to be costly (spot spray, cultivation, resowing, cropping), were those that had the least amount of ST regrowth – indicating a reluctance to invest in the tactic due to cost, not outcome.



Goulburn participants ranged from producers on marginal steep country to those on arable country. This is evident in the willingness survey as those on arable areas were willing to trial the more costly tactics (cultivation, resowing) where as those on the steep country modelled programs were not willing due to land class limitations. Most producers were already spot spraying, grazing and chipping with a large proportion of the participants willing to trial or consider combinations of boom spraying, cultivation and cropping



The majority of farms in the Goulburn area had light infestations of ST, with only 9% having heavy infestations. 83% of the participants were willing to trial the model and validate its outputs on their own farm. Those that were not willing were either land managers with light infestations or hobby farmers.

Appendix 8. ATTWOOD POST WORKSHOP REVIEW SUMMARY

Meat and Livestock Australia/DPI Victoria/NSW D I&I

Chilean needle grass Management programs workshop

Attwood 20th May 2011

******POST WORKSHOP REVIEW***.***

Enterprise and past history

Sheep on basalt plains country with both native pasture (c3 e.g. *microlaena* and also summer c4 e.g. *themeda*) and introduced pasture (cocksfoot phalaris rye) with a residual legume component.
Low inherent production but decent response to super phosphate, however superphosphate has not been applied for over a decade.
Dominant soils are basalt type clays and granitic sands characterised by rocky flats and steep valleys.

Weed infestation details

Chilean needle grass has spread onto the property from a local waterway and has been carried by sheep across certain paddocks. More recently cattle and farm vehicles have been responsible for spreading CNG into clean paddocks.

Size & location - 250ha across 12 paddocks – Clarkefield Area

Name Ar	ea (ha)	character	CNG history	History	Pasture composition
PADDOCK 1	10	Creek flat	Established	Pugged and wet	Phalaris/Rye
PADDOCK 2	20	rocky	Isolated to tracks	Native pasture, limited vehicle access	Themeda/stipa/danthonia/poa
PADDOCK 3	20	rocky	Isolated to tracks	Native pasture, limited vehicle access	Themeda/stipa/danthonia/poa
PADDOCK 4	10	steep	Scattered throughout	Improved pasture	Cocksfoot and some legumes
PADDOCK 5	10	steep	Scattered throughout	Improved pasture	Cocksfoot and some legumes
PADDOCK 6	10	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 7	30	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 8	10	rough	Isolated dense patches	Native pasture, limited vehicle access	C3 natives, Stipa/Poa and some legumes
PADDOCK 9	20	arable	Scattered throughout	Past cropping now grazing and hay	Phalaris with some natives and legumes
PADDOCK 10	30	arable	Scattered throughout	Past cropping now grazing and hay	Rye/Thistles/ limited danthonia
PADDOCK 11	40	arable	Scattered throughout	Past cropping now grazing – low fertility	Rye/Thistles/ limited danthonia
PADDOCK 12	40	arable	Scattered throughout	Past cropping now grazing – low fertility	Rye/Thistles/ limited danthonia

Treatment options for consideration – *please review $/ha costs and benefits****POST WORKSHOP REVIEW***.

	$/ha cost	$/ha benefit	Calculations for costs	Calculations for benefits
Grazing - little or no weed	280	700	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	7 Sheep/ha = 7 lambs/yr (Lambs @ $100/head)= $700/ha/yr
Grazing - High density weed present	280	400	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Grazing - improved/fertilised pasture	280	800	$2.5/kgDW x 16kgDW lamb (35kgLW) x 7/ha	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr
Manual removal - chipping	63	560	.75ha/hr @$50/hr	80% OF 7 Sheep/ha = 7 lambs/yr (Lambs @ $100/head)= $700/ha/yr
Slashing/Mow	80	400	1.5ha/hr @ $120/hr	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Silage (cut, rake, roll, bale, wrap) - 12 rolls/ha	200	780	cut, rake, roll, bale, wrap	$65/roll @ 12 rolls/ha
Chemical application – Glyphosate boom	45	x	$20/ha +$24 glyphosate (2l/ha)	
Chemical application - Flupropanate boom	92	x	$22/ha +70 flupropanate (2l/ha)	
Chemical application - Glyphosate spot	50	400	1ha/hr @$50/hr	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Flupropanate spot	50	320	1ha/hr @$50/hr	80% OF 4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Glyphosate & Flupropanate spot	50	320	1ha/hr @$50/hr	80% OF 4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application – Wick wiper (glyphosate)	42	400	$35/ha + $7 glyphosate (0.5l/ha est)	4 Sheep/ha = 4 lambs/yr (Lambs @ $100/head)= $400/ha/yr
Chemical application - Spraytop Glyphosate	26	400	$20/ha +$6 glyphosate (est)	
Chemical application - Aerial Glyphosate	136	x	$100/ha fly +$36 glyphosate (3l/ha)	
Chemical application - Aerial Flupropanate	170	x	$100/ha fly +$70 flupropanate (2l/ha)	
Burning	200	x	2 crews @ $110/hr, 0.5hr/ha	
Cultivation	100	x	primary discs only	
Pasture resowing – perennial	318	x	$113 sow + $15x8kg seed +$85 fert	
Cropping – annual crops (grain/fodder)	371	500	$113 sow + $20 seed +$85 fert+ $133 harvest	$500/ha ($200/T @ 2.5t/ha i.e. Oats)
Cropping – annual crops (grazing/forage)	218	800	$113 sow + $20 seed +$100 fert	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr
Sub and super ground spread	143	800	40super+40spread+63clover	8 Sheep/ha = 8 lambs/yr (Lambs @ $100/head)= $800/ha/yr

Appendix 9. CNG Manage plan – Central Victoria

Chilean Needle Grass District Management Plan:

Central Victoria

State Government Victoria

mla MEAT & LIVESTOCK AUSTRALIA

DEPARTMENT OF PRIMARY INDUSTRIES

Background

Chilean needle grass (*Nassella neesiana*) is a perennial tussocky grass that can compete all year round with pastures and crops for moisture, sunlight and nutrients. It grows through winter and normally sets seed in spring. Heavy infestations can reduce pasture productivity by as much as 50%. The seed can cause physical injury to livestock and downgrade the quality of wool, hides and carcases.

Chilean needle grass can produce both normal flower/seed heads as well as hidden seeds, which are formed in the nodes and leaf sheaths at the base of plants. Forage value declines once the plant goes to seed.

How to use this management plan

Steps

1. Review the **Example production system** for your district Page 3
2. Identify **Appropriate District tactics** for your farm Page 4
3. Identify **Tactics and their timing for control** suitable for your operation Page 5
4. Match the example **Land class weed management plans** to paddocks on your property Page 6
5. Review the example **Whole farm economic analysis** and the implications on your farming system Page 10

District Infestation History

Chilean needle grass is likely to have spread onto the property from a local waterway or roadside, and has been carried by sheep across certain paddocks. More recently farm vehicles and machinery would have been responsible for spreading CNG into clean paddocks.

STEP 1 - The example production system

The example control programs were modelled on a prime lamb production system operating on the Victorian volcanic plain. The 250ha farm is comprised of both native and introduced pasture with a limited legume component, with both basalt clays and granitic sandy soil. The landform for the district is characterised by rocky plains, arable flats and steep valleys.

Name	Area (ha)	Land class	Land form	CNG History	Description and history	Pasture composition
PADDOCK 1	10	2	Creek flat	Established	Potential losses due to flooding and pugging may limit crop and pasture productivity.	Phalaris/perennial Rye grass
PADDOCK 2	20	4	Rocky	Isolated to tracks	Land suitable for grazing but not for cultivation, Soils are mostly shallow with Native pasture. Limited vehicle access	Themeda/stipa/danthonia/poa
PADDOCK 3	20					
PADDOCK 4	10	5	steep	Scattered throughout	Land is best suited only to light grazing, if any • Productivity of established aerially sown improved pastures are very low with high level s of competition from weeds. Extremes of slope can be expected.	Cocksfoot and some legumes
PADDOCK 5	10		steep	Scattered throughout		Cocksfoot and some legumes
PADDOCK 6	10	1	rough	Isolated dense patches	Land is best suited only to light grazing, if any. • Productivity of native pastures are very low. • The land is unsuitable for cultivation with limited vehicle access. Soil physical and chemical properties present an extreme limitation to the growth of pasture	C3 natives, Stipa/Poa and some legumes
PADDOCK 7	30	3	rough	Isolated dense patches		C3 natives, Stipa/Poa and some legumes
PADDOCK 8	10		rough	Isolated dense patches		C3 natives, Stipa/Poa and some legumes
PADDOCK 9	20	3	arable	Scattered throughout	Productivity is high to very high for a very wide range of field crops historically grown in the area. Cultivation is feasible as slopes are level to very gently inclined with deep well drained soil profiles.	Phalaris with some natives and legumes
PADDOCK 10	30					Rye/Thistles/ limited danthonia
PADDOCK 11	40					Rye/Thistles/ limited danthonia
PADDOCK 12	40					Rye/Thistles/ limited danthonia

STEP 2 - Appropriate District tactics

Appropriate tactics to assist in the management of serrated tussock in this district include

Mode of action	Type of control	Control name	Workshop validated result	Suitable to this district
Decrease seedbank	Cultural	**BURN**	• Seed bank germination is increased by 50%	✓
Decrease seedbank & Kill living plants	Cultural	**Cultivation**	• Kills all living growth stages • Seedbank deep buried by 10% • Seedbank germination increased by 30%	✓
Outcompete living plants	Cultural	**Forage cropping**	• Reduces seedlings by 99% • Must be terminated before CNG seed set	✓
		Winter cereal cropping	• Reduces seedlings by 99% • BUT CNG seed can mature prior to harvest	✗
		Summer grain cropping	• Reduces seedlings by 99%	✗
		Resown perennial pastures	• Reduces seedlings by 90%	✓
		Subterranean clover and superphosphate spreading	• For improved pasture, increases carrying capacity	✓
Kill living plants	Chemical	**Glyphosate boom**	• Kills all living growth stages	✓
		Glyphosate Spot spray		✓
		Flupropanate boom or aerial spray	• Kills all living growth stages after 2 month lag • Residual effect on seedlings for 2 yrs	✓
		Flupropanate Spot spray		✓
		Glyphosate wiper or spraytopping	• Stops all panicle seed production • Reduces plant density by 50%	✓
	Mechanical	**Chipping**	• Kills all living growth stages	✗ difficulties in identification of CNG when vegetative make this impractical
Decrease seedbank inputs	Mechanical	**Slashing**	• Reduces seedbank inputs proportional to timing and frequency – Early slashing (October) = 75% of panicle seed – Mid slashing (November) = 97% of panicle seed – Late slashing (December) = 0%, full viable seedload to seedbank	✓
		Silage	• Reduces 97% of panicle seed entering seedbank	✓
	Cultural	**Grazing to the point of seed emergence**	• Low weed density = 7 lambs/ha/yr	✓
			• High weed density = 4 lambs/ha/yr	
			• Improved pasture/forage crop = 8 lambs/ha/yr	

STEP 3 - Tactics and their timing for control

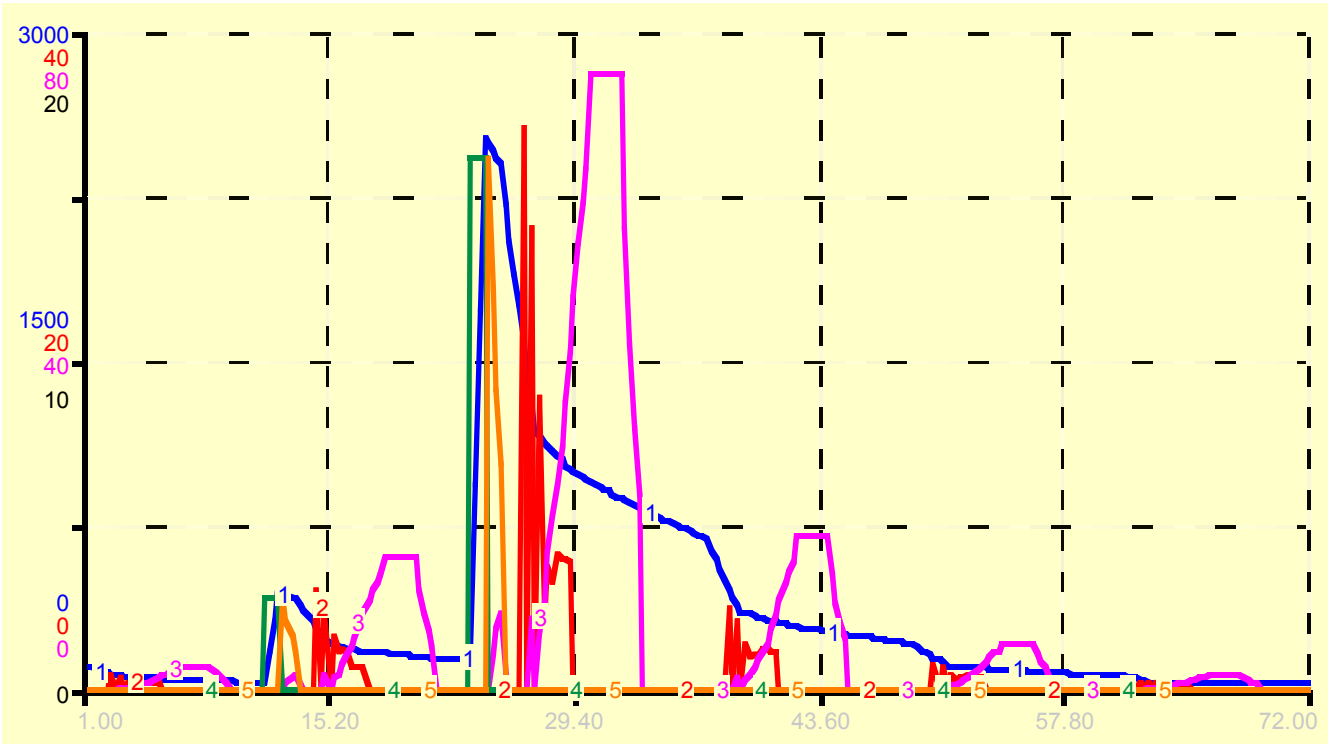
Use this chart to identify what tactics align with the seasonal aim for your farm – CROSS CHECK WITH TABLE ABOVE

	Seasonal Aim				
Biological stage	**Autumn**	**Winter**	**Spring**	**Summer**	**CHECK POINTS**
Seedbank	Encourage germination Example: • Cultivation • Burn				*Only encourage germination if seedling management can be put in place*
Seedlings	Destroy seedlings Example: • Cultivation • Chemical control	Outcompete seedlings Example: • Annual crops • Winter grain crops • Manage soil fertility	Outcompete seedlings Example: • Summer forage crops • Maintain pasture height		*Deplete the soil seedbank before resowing to perennial pastures!* *Seedlings will grow within rows of sown crops and grasses – followup management will be necessary*
Adult plants	Control vegetative growth Example: • Utilisation through strategic grazing rotations • Boom spraying • Spot spraying	Minimise reproductive growth **NO GRAZING WHEN IN SEED** Example: • Pasture topping • Spray topping • Spot sraying			*Only graze to the point of panicle seedhead emergence- remember to rotationally graze and rest paddocks* *Chilean needle grass can be very difficult to identify when spot spraying – always use marker dye and walk paddocks more than once per season.*
Seedfall			Minimise seed viability & seedbank inputs Example: • Silage • Spraytopping • Chemical wiping • Slashing		*Minimise contamination of vehicles and machinery during seeding periods* *Be vigilant of summer regrowth and secondary seed flushes - Serrated tussock has been known to seed up to 5 times per year*

STEP 4 - Land class weed management plans

The lifecycle of Chilean needle grass under each of the management programs is represented in the lifecycle graph. The coloured lines represent different growth stages of the weed, quantified on the vertical axis, whilst time is measured along the horizontal axis in months. The diagram below the lifecycle graph shows the corresponding management actions for the land class.

CLASS 3 – Creek flats



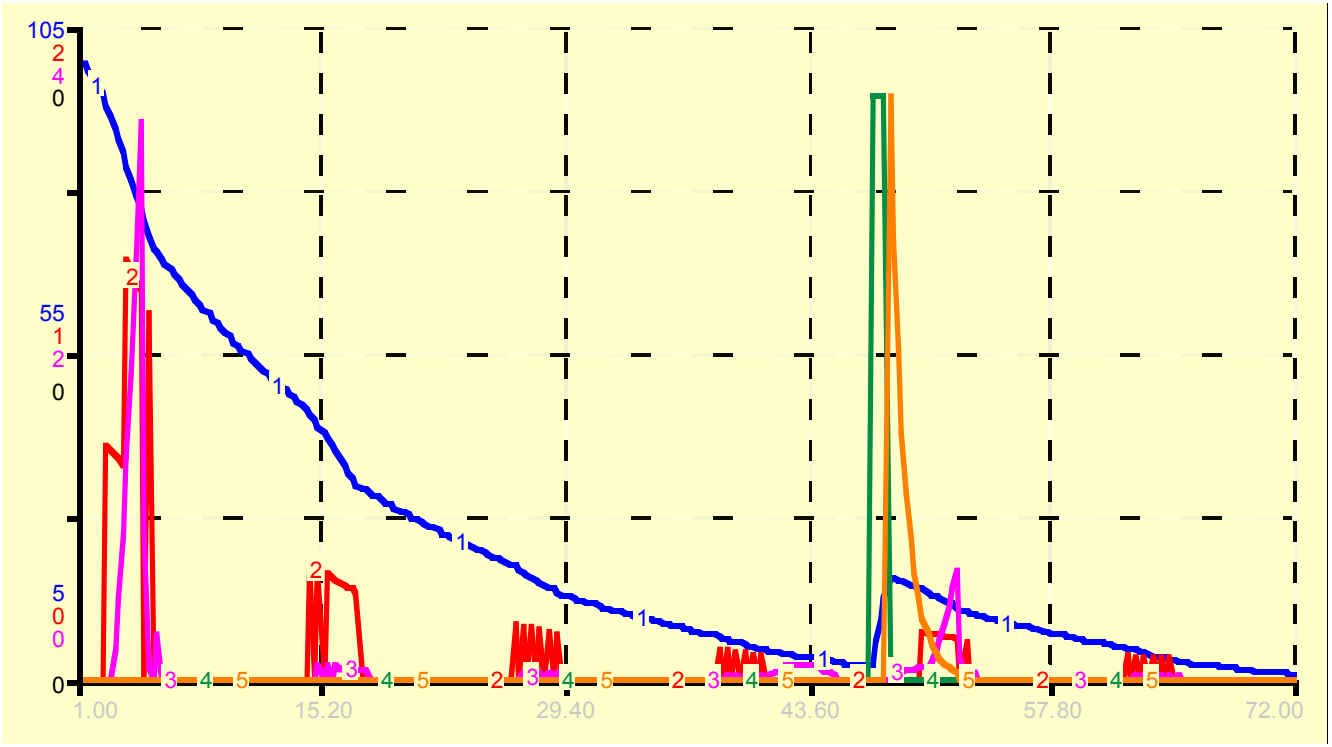
KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Burning is used to remove residual crop trash and stimulate CNG seedling germination, followed up by cultivations to destroy those seedlings. Forage crops enable rapid competition to late CNG seedlings whilst enabling winter grazing. The forage system is boom sprayed out with glyphosate prior to seed set to limit any seedbank inputs

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	BURN	CULTIVATE	CULTIVATE	SOW FORAGE	CROP GROWTH	GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	SPRAY FALLOW
2-6		CULTIVATE	CULTIVATE	SOW FORAGE	CROP GROWTH	GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	SPRAY FALLOW
9	Recovery of seedbank beyond 100 seeds per m²											

Class 4 – Rocky



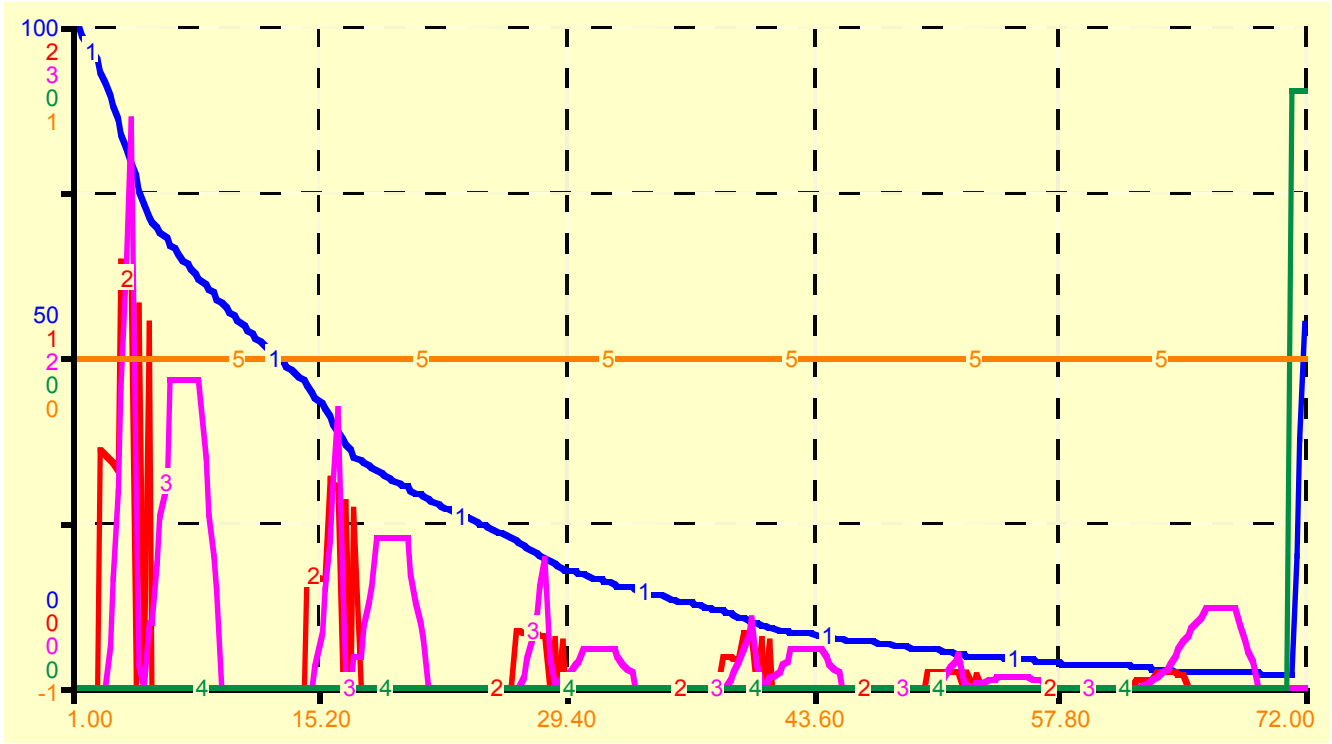
KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Class 4 land has limited options for CNG control. Flupropanate boom or boomless spraying is used where possible to control infestations along tracks. Good machinery hygiene and stock management is essential to minimise any further spread of the infestations

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE		GRAZE	BURN		GRAZE	FLUPROPANATE BOOM	WITHOLD GRAZING	WITHOLD GRAZING			GRAZE
2	GRAZE		GRAZE			GRAZE			GRAZE			GRAZE
3	GRAZE		GRAZE			GRAZE			GRAZE			GRAZE
4	GRAZE		GRAZE	BURN		GRAZE			GRAZE			GRAZE
5	GRAZE		GRAZE			GRAZE	FLUPROPANATE BOOM	WITHOLD GRAZING	WITHOLD GRAZING			GRAZE
6	GRAZE		GRAZE			GRAZE			GRAZE			GRAZE
8	Recovery of seedbank beyond 100 seeds per m²											

CLASS 5 - Steep & Rough land classes



Quantity of Plant or seed/m²

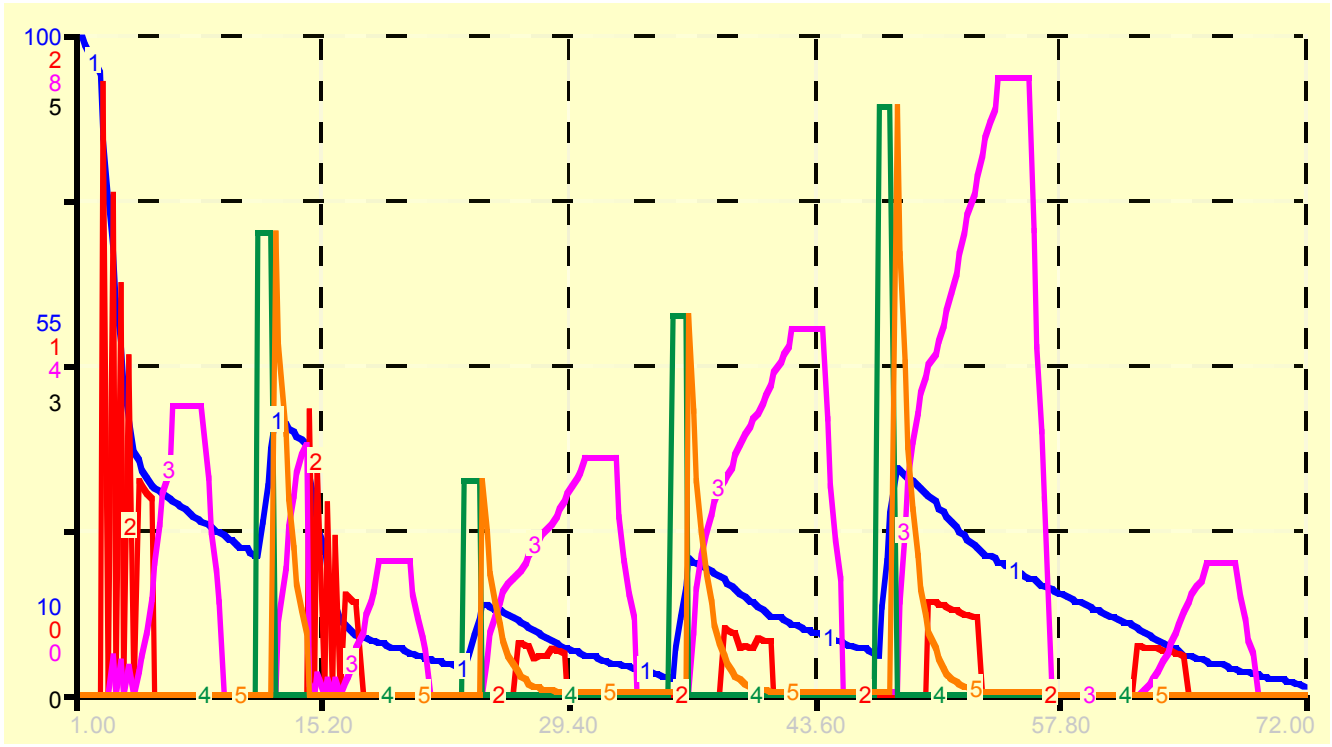
KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Burning is used to stimulate germination of the seedbank, and is followed up prior to seed set with spot spraying. Flupropanate spot spraying is undertaken twice over the growing season to provide selective and residual control of individual patches. This needs to be ongoing to capture late CNG germinants and avoid seedbank recovery.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE		BURN		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
2	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
3	GRAZE		BURN		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
4	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
5	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
6	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE			GRAZE	SPOT SPRAY FLUPROPANATE	GRAZE	GRAZE
7	Recovery of seedbank beyond 100 seeds per m²											

CLASS 1 Arable



KEY

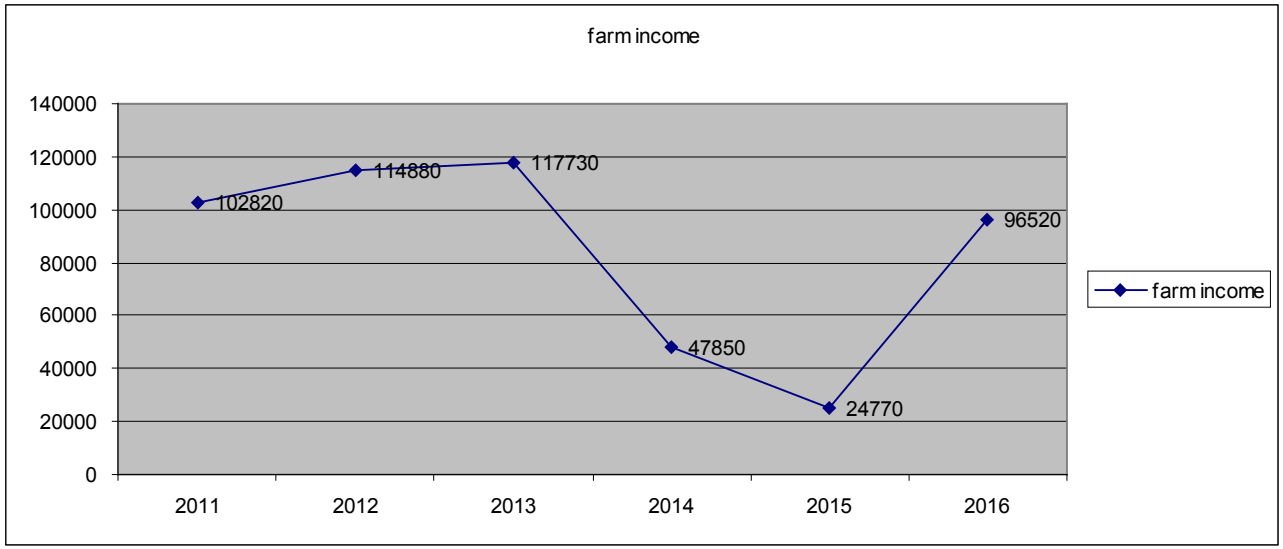
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Grazing forage crops are used to provide competition to CNG seedlings, whilst also allowing stock carrying capacity while other paddocks are sprayed or renovated. Silage is used to capture any outlier CNG plants and seed for 3 yrs prior to resowing to perennial pasture.

Resown perennial pastures are spot sprayed on an ongoing basis to capture late CNG germinants and avoid seedbank recovery.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1		CULTIVATE	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		Cut for SILAGE	
2		CULTIVATE	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		Cut for SILAGE	
3		CULTIVATE	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		Cut for SILAGE BOOM SPRAY GLYPHOSATE	FALLOW
4	FALLOW		FALLOW	BOOM SPRAY GLYPHOSATE & RESOW to PERENNIAL PASTURE		WITHOLD GRAZING			WITHOLD GRAZING	SPOT SPRAY flupropanate and glyphosate		WITHOLD GRAZING
5	GRAZE		GRAZE			GRAZE			GRAZE	SPOT SPRAY flupropanate and glyphosate		GRAZE
6	GRAZE		GRAZE			GRAZE			GRAZE	SPOT SPRAY flupropanate and glyphosate		GRAZE
7	Recovery of seedbank beyond 100 seeds per m²											

STEP 5 - Whole farm economic analysis



The example farm had a positive cash flow throughout the first 6 years of management, although certain paddocks were in deficit at times during the management program (see farm income graph and profit tables below).

The largest costs to the production system were. Forage cropping, for not only grazing, but also silage was most profitable with the added value of removing outlier CNG panicle seeds.

Recovery of the Chilean needle grass is the pasture system is generally likely within 2 years after active management ceases, as such costs of control are likely to be re occurring.

Flupropanate boom spray and withhold period

Burning and regeneration period

Land form	Name	TOTAL PROFIT	$/HA PROFIT PER YEAR					
			YR1	YR2	YR3	YR4	YR5	YR6
Creek flat	PADDOCK 1	5,820	97	97	97	97	97	97
rocky	PADDOCK 2	25,800	-195	420	115	420	110	420
rocky	PADDOCK 3	25,800	-195	420	115	420	110	420
steep	PADDOCK 4	16,520	-73	345	345	345	345	345
steep	PADDOCK 5	16,520	-73	345	345	345	345	345
rough	PADDOCK 6	12,340	345	-73	345	345	-73	345
rough	PADDOCK 7	37,020	345	-73	345	345	-73	345
rough	PADDOCK 8	12,340	345	-73	345	345	-73	345
arable	PADDOCK 9	57,380	722	722	677	677	-349	420
arable	PADDOCK 10	86,070	722	722	677	677	-349	420
arable	PADDOCK 11	104,480	722	722	677	-349	420	420
arable	PADDOCK 12	104,480	722	722	677	-349	420	420
Average			290	358	397	277	78	362
Total		504,570						

Resowing perennial pasture

Forage crop for grazing and silage

When planning a control program for your farm, consider:

- What treatment options are available to use in your location?
  - Is control feasible for your district, is utilisation more appropriate?
  - What control options can be used on your landclasses?
- What fits in with your seasonal constraints?
  - Can the treatments be timed to be economical and work effectively?
- Are the land class plans suitable?
  - What needs to be tailored to suit your own farm?
- Is it financially viable?
  - The example farm proved to be productive although there are several assumptions including

    CASH FLOW - The farm business needs sufficient cash flow to outlay for treatments whilst also taking paddocks out of production

    MANAGEMENT FLEXIBILITY AND SKILLS – labour on the farm will be able to accommodate the extra workload and have the know how to make time critical decisions e.g. Stock movements, timing of operations

    EQUIPMENT AND SERVICES AVAILABLE – equipment is available on farm or can be contracted within the district. It also assumes that the contractor is ready, able and willing to work at optimum times for weed control – this will require weed hygiene practices for all equipment used in the program.

For further information or detailed costings and modelling information from the producer workshop, call Dr Charles Grech, Weed Sciences, DPI Victoria (03) 9217 4120 or charles.grech@dpi.vic.gov.au

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Appendix 10. ST Manage plan – Southern tablelands

Serrated Tussock District Management Plan:

Southern Tablelands, New South Wales

State Government Victoria

mla MEAT & LIVESTOCK AUSTRALIA

DEPARTMENT OF PRIMARY INDUSTRIES

Background

Serrated tussock (*Nassella trichotoma*) is a perennial tussock grass that was inadvertently introduced into Australia from South America during the 1930's. It is now widely dispersed in NSW, Victoria, Tasmania and the ACT with an estimated potential distribution of more than 32 million ha. It has a very high fibre content and a very low protein content meaning that stock can ingest it but have great difficulty digesting it. Due to its unpalatability, it has been described as as potentially causing greater reductions in stock carrying capacity than any other plant in Australia with heavy infestations reducing pasture productivity by more than 90%. A single serrated tussock plant can produce as many as 100,000 seeds. Serrated tussock flowering tillers containing the small seeds readily detach from the plant and get blown across the landscape large distances. Seeds are also spread by livestock, vehicles and machinery. Serrated tussock is Weed of National Significance in Australia due to its massive agricultural and environmental impacts.

This weed management plan was compiled at a producer workshop using known best practice techniques to validate a weed modelling tool and to calculate the associated benefits and costs of the program. The management programs were developed for a typical farm of the district, to assist producers decide on an appropriate weed management plan for their own farm.

How to use this management plan

Steps

1. Review the **Example production system** for your district Page 3
2. Identify **Appropriate District tactics** for your farm Page 4
3. Identify **Tactics and their timing for control** suitable for your operation Page 5
4. Match the example **Land class weed management plans** to paddocks on your property Page 6
5. Review the example **Whole farm economic analysis** and the implications on your farming system Page 10

District Infestation History

Serrated tussock is likely to have been dispersed across the property by wind blowing seed from adjoining properties. Seed has also spread within the property by wind, and attachment to livestock and machinery.

STEP 1 - The example production system

The example control programs were modelled on a Sheep production system. The 600ha farm is on both shale/slate (60-75%) and granite (40- 25%). Sown pastures establish well on the granite soils, although perennial persistence is poor on the hotter & drier slopes – now dominated by annual grasses. On the slate/shale, both winter (C3 e.g. *microlaena, austrodanthonia*), and summer (C4 e.g. *themeda, bothriochloa*) native pasture persist with a residual legume component. Naturalised winter growing annual grasses are a significant component that allows serrated to invade during summer.

The farm has low inherent production but responds well to super phosphate, especially on the granite. However superphosphate has not been applied for over a decade. While the slate/shale soils have shallow rocky hilltops and ridges, deeper, more productive soils occur lower in the landscape. Larger paddocks will contain flowlines, lower slopes and different aspects with more productive species including Themeda.

Name	Area (ha)	Land class	Land form	ST history	History	Description and history	Pasture composition
PADDOCK 1	10	2	Creek flat	Established (30%)	Fertile flats, cropped in the past	Potential losses due to flooding and pugging may limit crop and pasture productivity.	Annual grasses and broadleaf weeds with volunteer native C3 species;, some legumes
PADDOCK 2	20	4	Rocky	Dense in patches (30%) with some scattered (40%)	Native pasture, trafficable	Land suitable for grazing but not for cultivation, Soils are mostly shallow with Native pasture. Limited vehicle access	Redgrass and some legumes
PADDOCK 3	20						
PADDOCK 4	10	5	Steep	Scattered throughout (5%)	Native pasture, limited vehicle access	Land is best suited only to light grazing, if any. • Productivity of native pastures are very low. • The land is unsuitable for cultivation with limited vehicle access. Soil physical and chemical properties present an extreme limitation to the growth of pasture	C3 natives and some legumes
PADDOCK 5	10						
PADDOCK 6	20	1	Arable	Scattered throughout (30%)	Introduced pasture	Productivity is high to very high for a very wide range of field crops historically grown in the area. Cultivation is feasible as slopes are level to very gently inclined with deep well drained soil profiles.	Annual grass dominant with a small component of sown perennial and some legumes
PADDOCK 7	30	3	Rocky with woody debris	Isolated dense patches (5%) with some scattered patches (25%)	Native pasture, limited vehicle access	Productivity is high for locally adapted pastures and moderate for crops well suited to the area. Slopes are level to moderately inclined with moderate to shallow soil profiles. Soil physical and chemical properties may limit crop and pasture productivity.	C3 natives and some legumes
PADDOCK 8	10	3					
PADDOCK 9	10	3	Rocky granite	Isolated dense patches (5%) with scattered patches (25%)	Degraded sown pasture	Productivity is high for locally adapted pastures and moderate for crops well suited to the area. Slopes are level to moderately inclined with moderate to shallow soil profiles. Soil physical and chemical properties may limit crop and pasture productivity.	Annual grass dominant with a small component of sown perennial and some legumes
PADDOCK 10	30		Moderately steep granit				
PADDOCK 11	40						
PADDOCK 12	40						

STEP 2 - Appropriate District tactics

Appropriate tactics to assist in the management of serrated tussock in this district include

Mode of action	Type of control	Control name	Workshop validated result	Suitable to this district
Decrease seedbank	Cultural	**BURN**	• Seed bank germination is increased by 50%	✓
Decrease seedbank & Kill living plants	Cultural	**Cultivation**	• Kills all living growth stages • Seedbank deep buried by 10% • Seedbank germination increased by 30%	✓
Outcompete living plants	Cultural	**Forage cropping**	• Reduces seedlings by 99%	✓
		Winter Grain cropping		✓
		Summer Grain cropping	• Reduces seedlings by 99%	✗
		Resown perennial pastures	• Reduces seedlings by 90%	✓
		Subterranean clover and superphosphate spreading	• For improved pasture, increases carrying capacity	✓
Kill living plants	Chemical	**Glyphosate boom**	• Kills all living growth stages	✓
		Glyphosate Spot spray		✓
		Flupropanate boom or aerial spray	• Kills all living growth stages after 2 month lag • Residual effect on seedlings for 2 yrs	✓
		Flupropanate Spot spray		✓
		Glyphosate wiper or spraytopping	• Stops all panicle seed production • Reduces plant density by 50%	✓
	Mechanical	**Chipping**	• Kills all living growth stages	✓
Decrease seedbank inputs	Mechanical	**Slashing**	• Reduces seedbank inputs proportional to timing and frequency – Early slashing (October) = 75% of panicle seed – Mid slashing (November) = 97% of panicle seed – Late slashing (December) = 0%, full viable seedload to seedbank	✓
		Silage	• Reduces 97% of panicle seed entering seedbank	✓
	Cultural	**Grazing to the point of seed emergence**	• Low weed density = 7 lambs/ha/yr	✓
			• High weed density = 4 lambs/ha/yr	
			• Improved pasture/forage crop = 8 lambs/ha/yr	

STEP 3 - Tactics and their timing for control

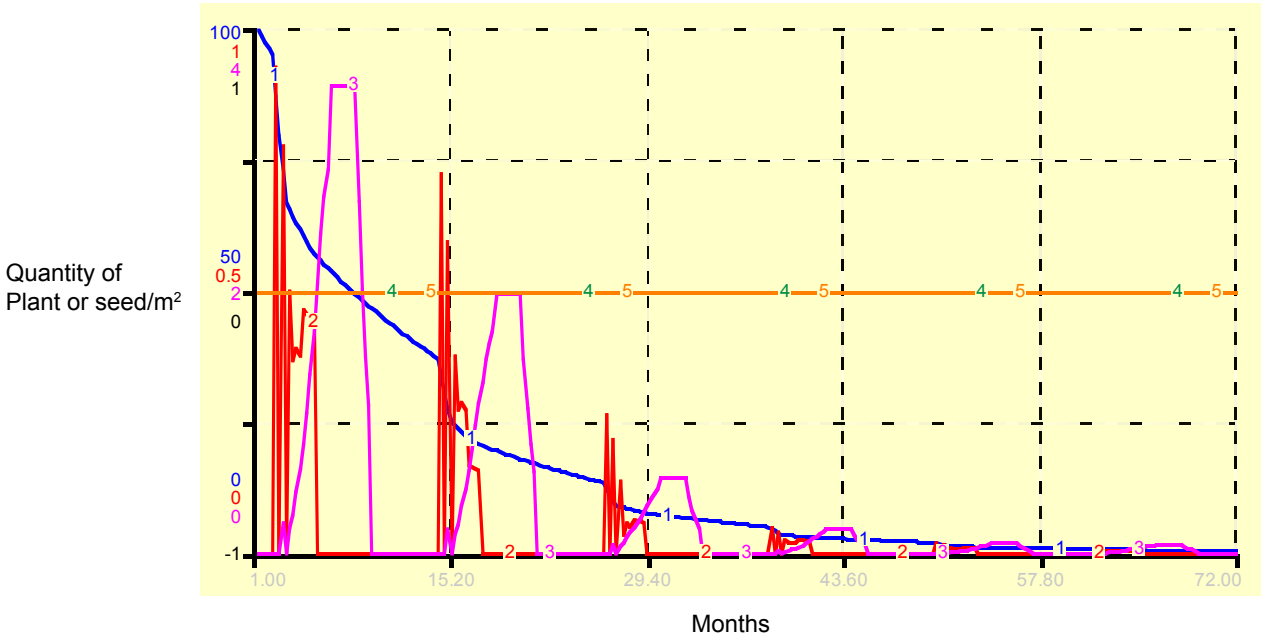
Use this chart to identify what tactics align with the seasonal aim for your farm – CROSS CHECK WITH TABLE ABOVE

	Seasonal Aim				
Biological stage	**Autumn**	**Winter**	**Spring**	**Summer**	**CHECK POINTS**
Seedbank	Encourage germination Example: • Cultivation • Burn				*Only encourage germination if seedling management can be put in place*
Seedlings	Destroy seedlings Example: • Cultivation • Chipping • Chemical control	Outcompete seedlings Example: • Annual crops • Perennial pastures • Winter grain crops • Manage soil fertility	Outcompete seedlings Example: • Summer forage crops • Maintain pasture height		*Deplete the soil seedbank before resowing to perennial pastures!* *Seedlings will grow within rows of sown crops and grasses – followup management will be necessary*
Adult plants	Control vegetative growth Example: • Utilisation through strategic grazing rotations • Chipping • Chemical control		Minimise reproductive growth Example: • Pasture topping		*Remember the feedvalue is very low – don't starve stock by trying to graze out mature tussocks*
Seedfall				Minimise seed viability & seedbank inputs Example: • Silage • Spraytopping • Chemical wiping • Slashing • Chipping	*Minimise contamination of vehicles and machinery during seeding periods* *Be vigilant of summer regrowth and secondary seed flushes - Serrated tussock has been known to seed up to 5 times per year*

STEP 4 - Land class weed management plans

The lifecycle of serrated tussock under each of the management programs is represented in the lifecycle graph. The coloured lines represent different growth stages of the weed, quantified on the vertical axis, whilst time is measured along the horizontal axis in months. The diagram below the lifecycle graph shows the corresponding management actions for the land class.

CLASS 1 & 2 – Arable and creek



KEY

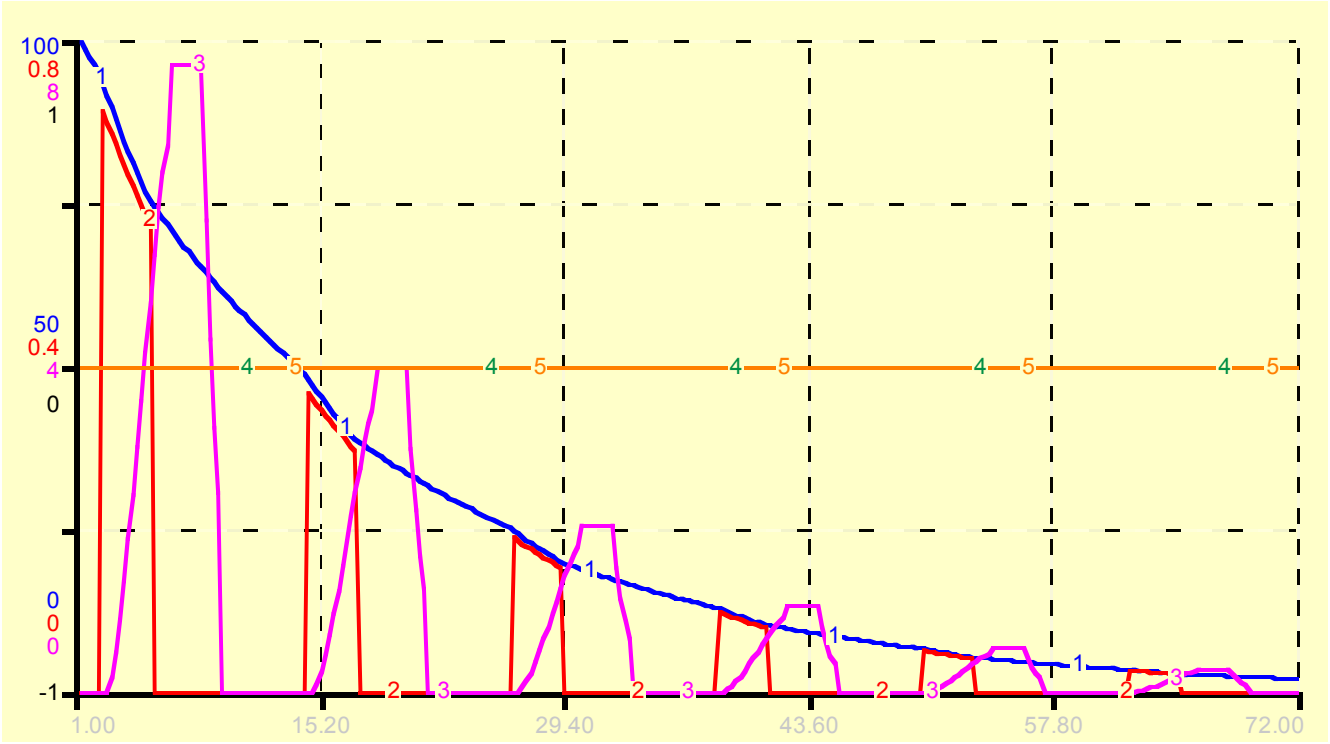
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Forage crops are used to provide grazing fodder whilst outcompeting ST seedlings. The crop is boom sprayed prior to seed set to kill any outlier ST plants growing in the crop.

After adequate soil seedbank depletion, perennial pastures can be resown and monitored as part of an annual spot spray or chipping program.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	FALLOW	FALLOW	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	FALLOW
2	FALLOW	FALLOW	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	FALLOW
3	FALLOW	FALLOW	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	FALLOW
4	FALLOW	FALLOW	CULTIVATE	SOW FORAGE		GRAZE			GRAZE		BOOM SPRAY GLYPHOSATE	FALLOW
5	FALLOW	FALLOW	CULTIVATE	SOW PERENNIAL PASTURE	WITHOLD GRAZING	WITHOLD GRAZING				SPOT SPRAY GLYPHOSATE WITHOLD GRAZING		WITHOLD GRAZING
6	GRAZE		GRAZE			GRAZE				SPOT SPRAY GLYPHOSATE GRAZE		GRAZE
9	Recovery of seedbank beyond 100 seeds per m²											

CLASS 3 - Rocky with woody debris



KEY

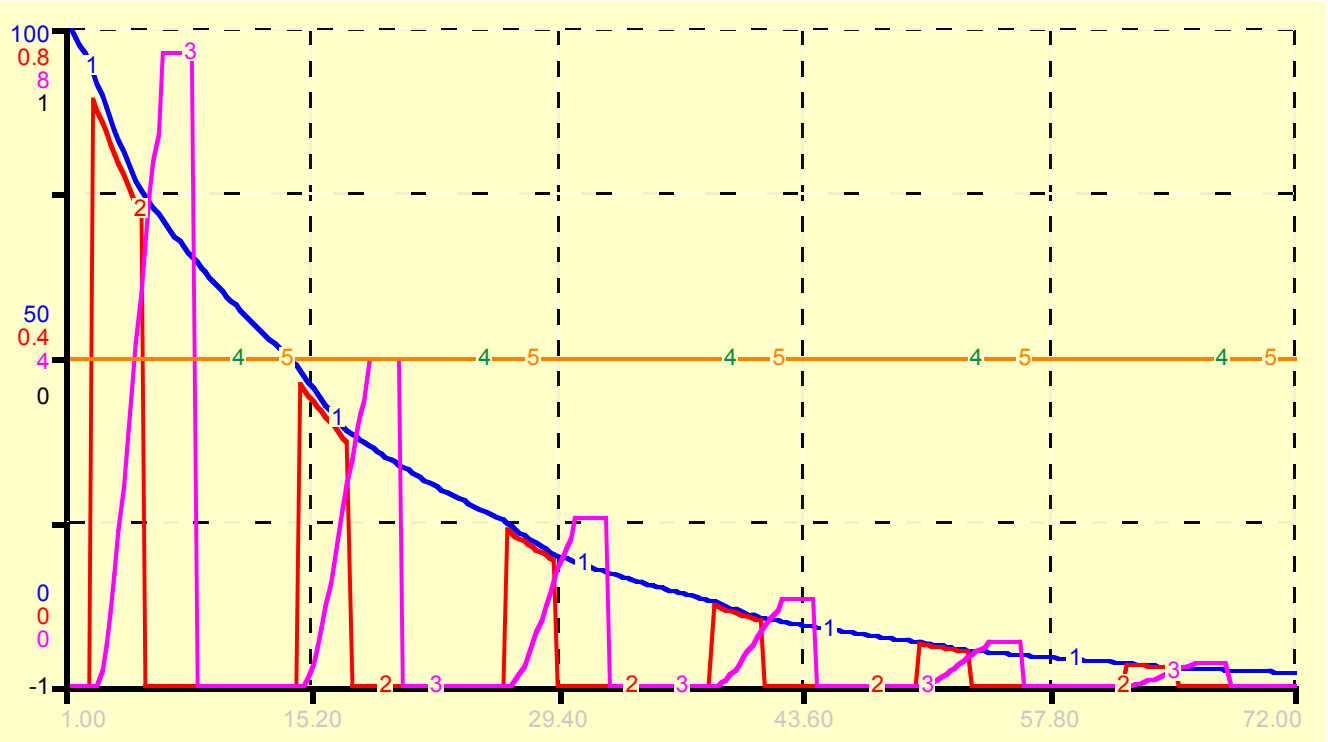
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

High density spot spraying spot spraying is necessary in areas that are inaccessible to vehicles or machinery.

The spot spraying task after year 3 could revert to chipping or low density spot spraying once the seedbank has depleted.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE		GRAZE			GRAZE				HIGH DENSITY SPOT SPRAY		GRAZE
									GRAZE			
2	GRAZE		GRAZE			GRAZE				HIGH DENSITY SPOT SPRAY		GRAZE
									GRAZE			
3	GRAZE		GRAZE			GRAZE				HIGH DENSITY SPOT SPRAY		GRAZE
									GRAZE			
4	GRAZE		GRAZE			GRAZE				SPOT SPRAY GLYPHOSATE		GRAZE
									GRAZE			
5	GRAZE		GRAZE			GRAZE				SPOT SPRAY GLYPHOSATE		GRAZE
									GRAZE			
6	GRAZE		GRAZE			GRAZE				SPOT SPRAY GLYPHOSATE		GRAZE
									GRAZE			
7	Recovery of seedbank beyond 100 seeds per m²											

CLASS 3 - Moderately steep granite &/or rocky granite



Quantity of Plant or seed/m²

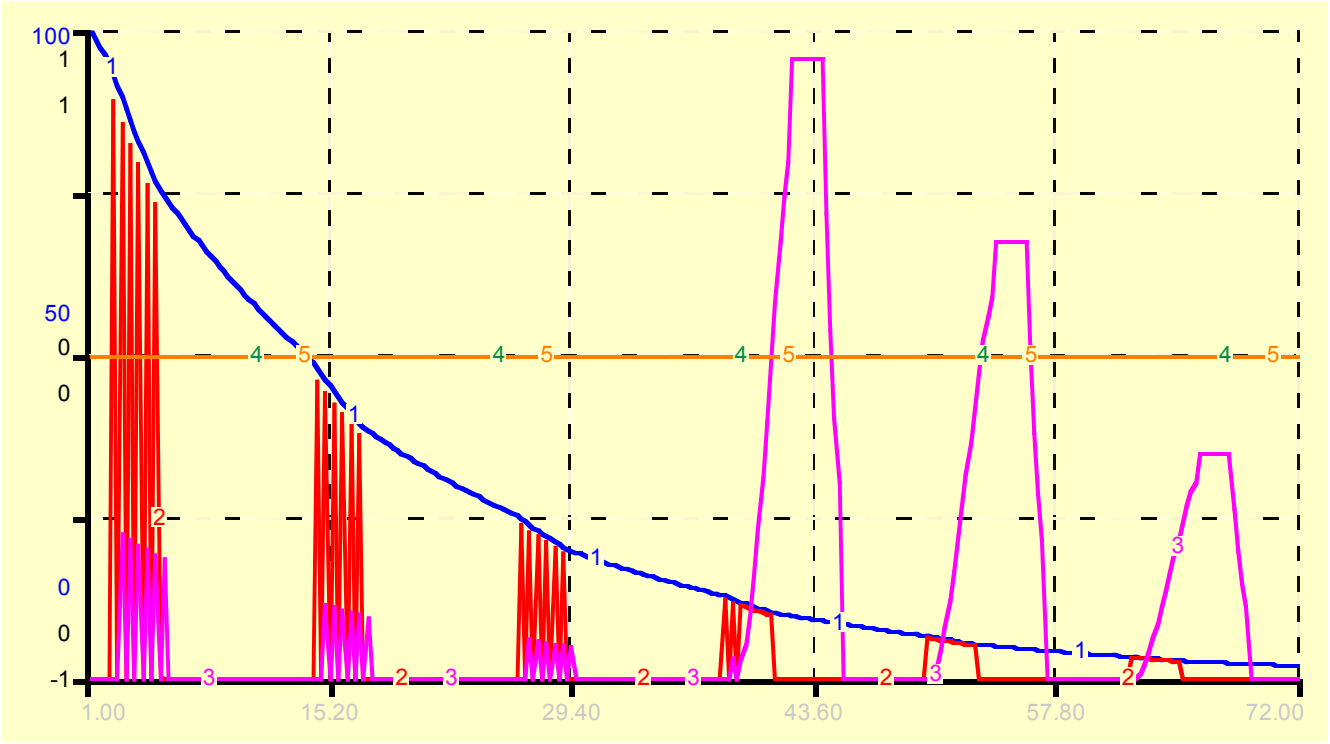
KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Fertiliser and subterranean clover is used to boost pasture growth, together with spot spraying or chipping to remove adult ST plants.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE		FERTILISER			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
			GRAZE						GRAZE			
2	GRAZE		FERTILISER			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
			GRAZE						GRAZE			
3	GRAZE		GRAZE			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
									GRAZE			
4	GRAZE		GRAZE			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
									GRAZE			
5	GRAZE		GRAZE			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
									GRAZE			
6	GRAZE		GRAZE			GRAZE			SPOT SPRAY GLYPHOSATE			GRAZE
									GRAZE			
7	Recovery of seedbank beyond 100 seeds per m²											

CLASS 4 & 5 – Rocky &/OR steep



KEY

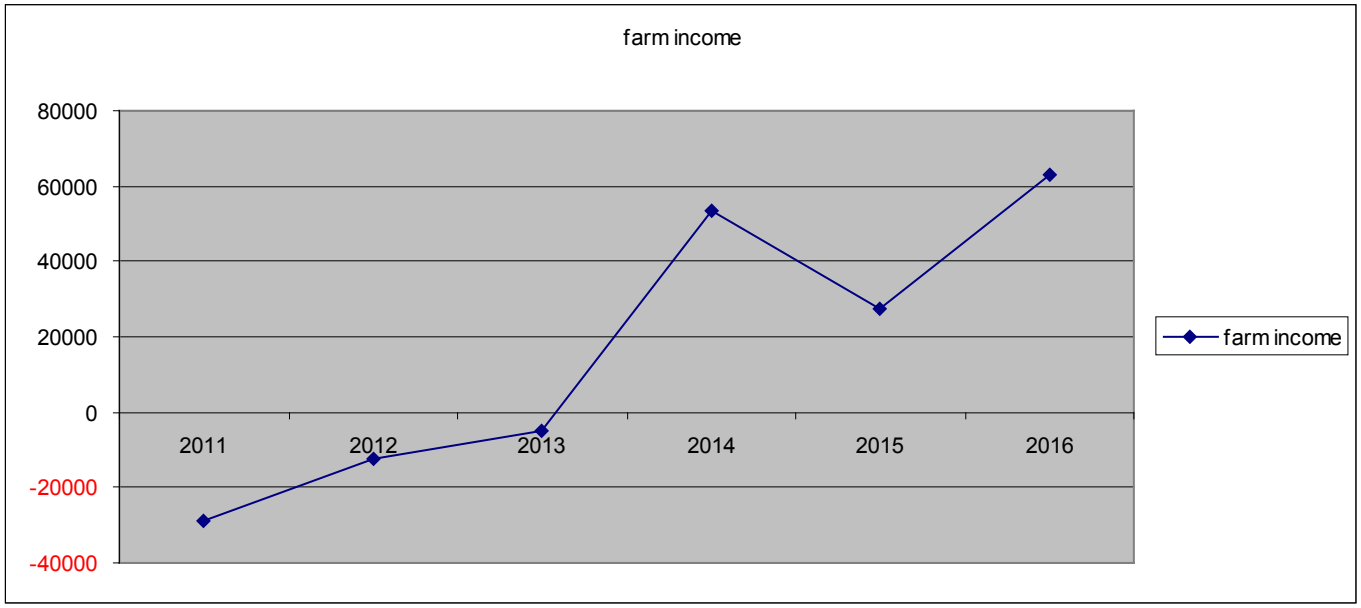
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Flupropanate boom spraying is used to kill mature ST plants followed by spot spraying of Seedlings or plants in areas that could not be boom sprayed.

The use of flupropanate in this example is dependant on the tolerance of the native pasture to flupropanate.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE		GRAZE		BOOM SPRAY FLUPROPANATE	WITHOLD GRAZING			GRAZE			GRAZE
2	GRAZE		GRAZE			GRAZE					SPOT SPRAY GLYPHOSATE	GRAZE
									GRAZE			
3	GRAZE		GRAZE			GRAZE					SPOT SPRAY GLYPHOSATE	GRAZE
									GRAZE			
4	GRAZE		GRAZE			GRAZE					SPOT SPRAY GLYPHOSATE	GRAZE
									GRAZE			
5	GRAZE		GRAZE			GRAZE					SPOT SPRAY GLYPHOSATE	GRAZE
									GRAZE			
6	GRAZE		GRAZE			GRAZE					SPOT SPRAY GLYPHOSATE	GRAZE
									GRAZE			
7	Recovery of seedbank beyond 100 seeds per m²											

STEP 5 - Whole farm economic analysis



The example farm did not produce a profit for the first 3 years. The total profit over the 6 year period was also very low.

The largest costs to the production system were:

- Managing the dense ST infestations in country with limited vehicle access or native pastures.
- Resowing to perennial pastures

Greatest returns were made on arable land where crops could be grown for forage grazing

Recovery of the serrated tussock seedbank is the pasture system is generally likely within 2 years after active management ceases. For this reason, control costs for serrated tussock are likely to be re-occurring.

Land form	Name	TOTAL PROFIT	$/HA PROFIT PER YEAR					
			YR1	YR2	YR3	YR4	YR5	YR6
Creek flat	PADDOCK 1	24240	190	190	190	190	-332	380
rocky	PADDOCK 2	29520	-31	80	80	80	80	80
rocky	PADDOCK 3	25830	-31	80	80	80	80	80
steep	PADDOCK 4	19200	80	80	80	80	80	80
steep	PADDOCK 5	19200	80	80	80	80	80	80
arable	PADDOCK 6	16160	190	190	190	190	-332	380
Rocky woody debris	PADDOCK 7	-68000	-390	-390	-310	80	80	80
Rocky woody debris	PADDOCK 8	-59500	-390	-390	-310	80	80	80
Rocky granite	PADDOCK 9	32040	107	107	80	80	80	80
Moderately steep granite	PADDOCK 10	16020	107	107	80	80	80	80
Moderately steep granite	PADDOCK 11	21360	107	107	80	80	80	80
Moderately steep granite	PADDOCK 12	21360	107	107	80	80	80	80
Average			11	29	33	98	11	130
Total		97430						

Forage crops provided a high return

Resowing costs

Spot spraying of high density infestations

When planning a control program for your farm, consider:

- What treatment options are available to use in your location?
  - Is control feasible for your district, is utilisation more appropriate?
  - What control options can be used on your landclasses?
- What fits in with your seasonal constraints?
  - Can the treatments be timed to be economical and work effectively?
- Are the land class plans suitable?
  - What needs to be tailored to suit your own farm?
- Is it financially viable?
  - The example farm proved to be productive although there are several assumptions including

    CASH FLOW - The farm business needs sufficient cash flow to outlay for treatments whilst also taking paddocks out of production

    MANAGEMENT FLEXIBILITY AND SKILLS – labour on the farm will be able to accommodate the extra workload and have the know how to make time critical decisions e.g. Stock movements, timing of operations

    EQUIPMENT AND SERVICES AVAILABLE – equipment is available on farm or can be contracted within the district. It also assumes that the contractor is ready, able and willing to work at optimum times for weed control – this will require weed hygiene practices for all equipment used in the program.

For further information or detailed costings and modelling information from the producer workshop, call Dr Charles Grech, Weed Sciences, DPI Victoria (03) 9217 4120 or charles.grech@dpi.vic.gov.au

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Appendix 11. CNG Manage plan – Northern tablelands

Chilean Needle Grass District Management Plan:

Northern Tablelands, New South Wales

State Government Victoria

mla MEAT & LIVESTOCK AUSTRALIA

DEPARTMENT OF PRIMARY INDUSTRIES

Background

Chilean needle grass (*Nassella neesiana*) is a perennial tussocky grass that can compete all year round with pastures and crops for moisture, sunlight and nutrients. It grows through winter and normally sets seed in spring. Heavy infestations can reduce pasture productivity by as much as 50%. The seed can cause physical injury to livestock and downgrade the quality of wool, hides and carcases.

Chilean needle grass can produce both normal flower/seed heads as well as hidden seeds (cleistogenes), which are formed in the nodes and leaf sheaths at the base of plants. As with all plants, forage quality declines with maturity as generally does palatability.

This weed management plan was compiled at a producer workshop using known best practice techniques to validate a weed modelling tool and to calculate the associated benefits and costs of the program. The management programs were developed for a typical farm of the district, to assist producers decide on an appropriate weed management plan for their own farm.

How to use this management plan

Steps

1. Review the **Example production system** for your district Page 3
2. Identify **Appropriate District tactics** for your farm Page 4
3. Identify **Tactics and their timing for control** suitable for your operation Page 5
4. Match the example **Land class weed management plans** to paddocks on your property Page 6
5. Review the example **Whole farm economic analysis** and the implications on your farming system Page 10

District Infestation History

Chilean needle grass is likely to have spread onto the property from a local waterway or roadside, and has been carried across properties by animals. More recently farm vehicles and machinery in addition to animals would have been responsible for spreading CNG into clean paddocks.

STEP 1 - The example production system

The example control programs were modelled on a cattle production system operating on the (Northern Tableland, NSW. Historically a sheep grazing farm, the 500ha farm is comprised of both native and introduced pasture with a limited legume component. The landform for the district is characterised by fertile creek/river flats & moderate to steep hillside country.

Name	Area (ha)	Land class	Land form	CNG History	Description and history	Pasture composition
PADDOCK 1	20	3	Creek flat	Established	Potential losses due to flooding and pugging Crop and pasture productivity maybe limited by excessive soil moisture.	Semi improved, puggy & wet
PADDOCK 2	40	4	Frequent Rocky outcrops	Isolated to tracks	Land suitable for grazing but not for cultivation, Soils are mostly shallow with Native pasture. Limited vehicle access	Native pasture, limited vehicle access
PADDOCK 3	40					
PADDOCK 4	20	5	Light – moderate timber steep	Scattered throughout	Land is best suited only to light grazing, if any • Productivity of established aerially sown improved pastures are moderate with some competitive weed species. Extremes of slope occasionally occur.	Improved pasture
PADDOCK 5	20		Light – moderate timber steep	Scattered throughout		Improved pasture
PADDOCK 6	20	5	Moderate – heavy timber Mod – steep slope	Isolated dense patches	Land is best suited only to light grazing, if any. • Productivity of native pastures are very low. • The land is unsuitable for cultivation with limited vehicle access. Soil physical and chemical properties present an extreme limitation to the growth of pasture.	Native pasture, limited vehicle access
PADDOCK 7	60		Moderate – heavy timber Mod – steep slope	Isolated dense patches		Native pasture, limited vehicle access
PADDOCK 8	20		Moderate – heavy timber Moderate – steep slope	Isolated dense patches		Native pasture, limited vehicle access
PADDOCK 9	40	1	arable	Scattered throughout	Productivity is high to very high for a wide range of field crops historically grown in the area. Cultivation is feasible as slopes are level to very gently inclined with deep well drained soil profiles.	Past cropping now grazing and hay
PADDOCK 10	60					Past cropping now grazing and hay
PADDOCK 11	80					Past cropping now grazing – low fertility
PADDOCK 12	80					Past cropping now grazing – low fertility

STEP 2 - Appropriate District tactics

Appropriate tactics to assist in the management of Chilean needle grass in this district include

Mode of action	Type of control	Control name	Workshop validated result	Suitable to this district
Decrease seedbank	Cultural	**BURN**	• Seed bank germination is increased by 50%	✓
Decrease seedbank & Kill living plants	Cultural	**Cultivation**	• Kills all living growth stages • Seedbank increased by 10% by deep burial • Seedbank germination increased by 30%	✓
Outcompete living plants	Cultural	**Forage (winter, summer) cropping**	• Reduces seedlings by 99% • Must be terminated before CNG seed set	✓
		Winter cereal cropping	• Reduces seedlings by 99% • BUT CNG seed can mature prior to harvest	✗
		Summer Grain cropping	• Reduces seedlings by 99% • Must be terminated before CNG seed set	✗
		Resown perennial pastures	• Reduces seedlings by 90%	✓
		White clover and Sub and superphosphate spreading	• Increases carrying capacity • Reduces seedling recruitment by < 20%	✓
Kill living plants	Chemical	**Glyphosate boom**	• Kills all living growth stages when applied late summer – autumn • (Spot spray) effective most times of year when applied correctly	✓
		Glyphosate Spot spray		✓
		Flupropanate boom or aerial spray	• Kills all living growth stages applied any time of year but complete kill of plant can vary from 2 months to <18 months depending on soil moisture • Residual effect on seedlings for up to 2 yrs	✓
		Flupropanate Spot spray		✓
		Glyphosate wiper or spraytopping	• Stops all panicle seed production • Reduces plant density by 50%	✓
	Mechanical	**Chipping**	• Kills plants • No effect on seedbank – bare areas left may encourage further germinations	✗ difficulties in identification of CNG when vegetative make this impractical
Decrease seedbank inputs	Mechanical	**Slashing**	• Reduces seedbank inputs proportional to timing and frequency – Early slashing (October) = 75% of panicle seed – Mid slashing (November) = 97% of panicle seed – Late slashing (December) = 0%, full viable seedload to seedbank	✓
		Silage	• Reduces 97% of panicle seed entering seedbank	✓
	Cultural	**Grazing to the point of seed emergence**	• Low weed density = 7 lambs/ha/yr • High weed density = 4 lambs/ha/yr • Improved pasture/forage crop = 8 lambs/ha/yr	✓
		Spraytopping	• Reduces panicle seed entering seedbank by > 80%	

STEP 3 - Tactics and their timing for control

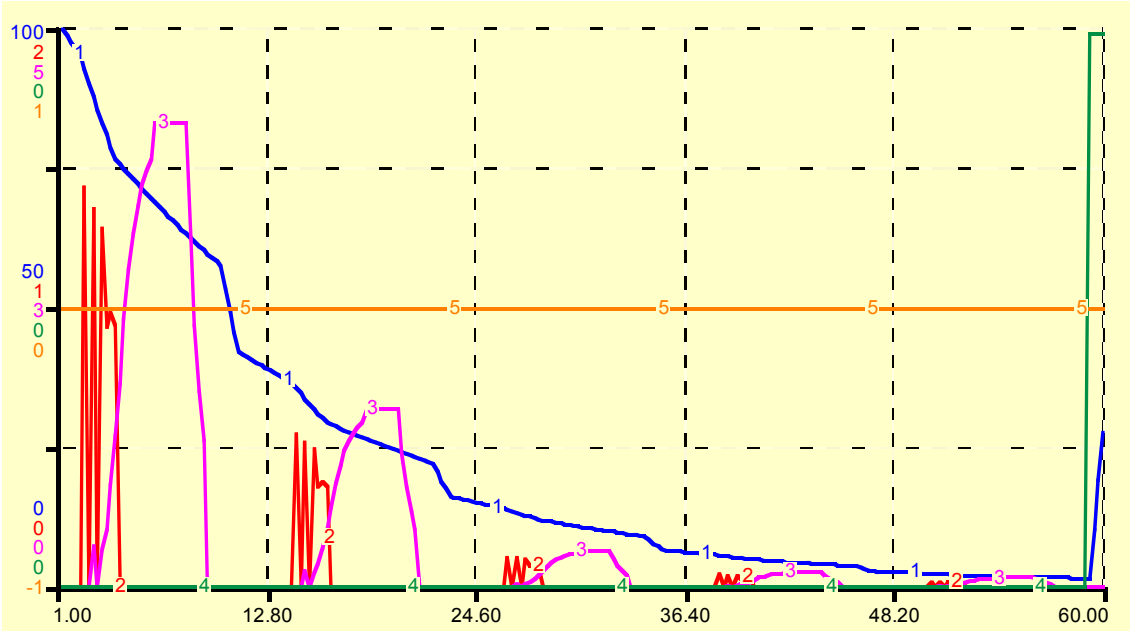
Use this chart to identify what tactics align with the seasonal aim for your farm – CROSS CHECK WITH TABLE ABOVE

	Seasonal Aim				
Biological stage	**Autumn**	**Winter**	**Spring**	**Summer**	**CHECK POINTS**
Seedbank	Encourage germination Example: • Cultivation • Burn				*Only encourage germination if seedling management can be put in place*
Seedlings	Destroy seedlings Example: • Cultivation • Chemical control	Outcompete seedlings Example: • Winter forage crops (terminate before CNG flowering) • Winter legume grain crops • Manage soil fertility	Outcompete seedlings Example: • Summer forage crops • Maintain pasture height		*Deplete the soil seedbank before resowing to perennial pastures!* *Seedlings will grow within rows of sown crops and grasses – followup management will be necessary*
Adult plants	Control vegetative growth Example: • Utilisation through strategic grazing rotations • Boom spray • Spot spray	Minimise reproductive growth **NO GRAZING WHEN IN SEED** Example: • Pasture topping • Slashing • Wiping • Spot spraying			*Only graze to the point of panicle seedhead emergence* *Chilean needle grass can be very difficult to identify when spot spraying – always use marker dye and walk paddocks more than once per season.*
Seedfall			Minimise seed viability & seedbank inputs Example: • Silage • Spraytopping • Chemical wiping • Slashing • Spot spraying		*Minimise contamination of vehicles and machinery during seeding periods* *Glyphosate will not be fully effective during later stages of growth (Paraquat can extend spray window in States where registered)* *Be vigilant of summer regrowth and secondary seed flushes*

STEP 4 - Land class weed management plans

The lifecycle of Chilean needle grass under each of the management programs is represented in the lifecycle graph. The coloured lines represent different growth stages of the weed, quantified on the vertical axis, whilst time is measured along the horizontal axis in months. The diagram below the lifecycle graph shows the corresponding management actions for the land class.

CLASS 3 – Creek flats



KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

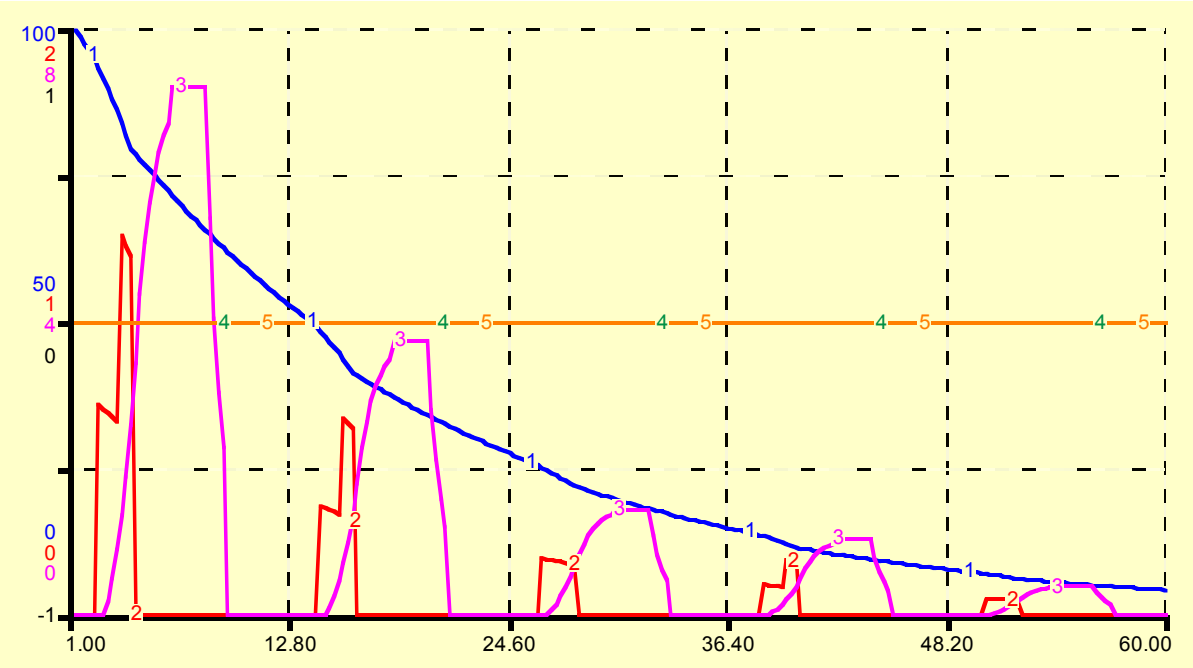
Prior to starting a 3 yrs forage cropping cycle, paddocks are burnt to remove residual crop trash and stimulate CNG seedling germination. This is followed up by a boom spray application of glyphosate to kill seedlings before direct drilling a forage crop for winter feed. Any residual CNG plants in the legume/brassica crop are SPRAYED WITH GRASS SELECTIVE HERBICIDES in the grazing phase OR cultivated prior to or at flowering of CNG.

Newly sown perennial pastures are rested during the first season with grazing, maintenance fertiliser and spot spraying commencing in the years to follow.

Grazing should always be strategic or rotational – do not use continuous (set stocking) grazing techniques

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	FALLOW	BURN	BOOM SPRAY GLYPHOSATE	SOW LEGUME/ BRASSICA FORAGE		BOOM SPRAY HALOXYFOP	GRAZE		GRAZE		CULTIVATE	FALLOW
2	FALLOW	FALLOW	BOOM SPRAY GLYPHOSATE	SOW LEGUME/ BRASSICA FORAGE		BOOM SPRAY HALOXYFOP	GRAZE		GRAZE		CULTIVATE	FALLOW
3	FALLOW	FALLOW	BOOM SPRAY GLYPHOSATE	SOW LEGUME/ BRASSICA FORAGE		BOOM SPRAY HALOXYFOP	GRAZE		GRAZE		CULTIVATE	FALLOW
4	GRAZE		BOOM SPRAY GLYPHOSATE	SOW PERENNIAL FORAGE		WITHOLD GRAZING			WITHOLD GRAZING			GRAZE
5	GRAZE		GRAZE			GRAZE			GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
6	GRAZE			SPREAD FERTILISER		GRAZE			GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
			GRAZE									
7	Recovery of seedbank beyond 100 seeds per m²											

Class 4 – Rocky



KEY

Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Class 4 land has limited options for CNG control. Flupropanate spot spraying is used where possible to control infestations along tracks. Good machinery hygiene and stock management is essential to minimise any further spread of the infestations

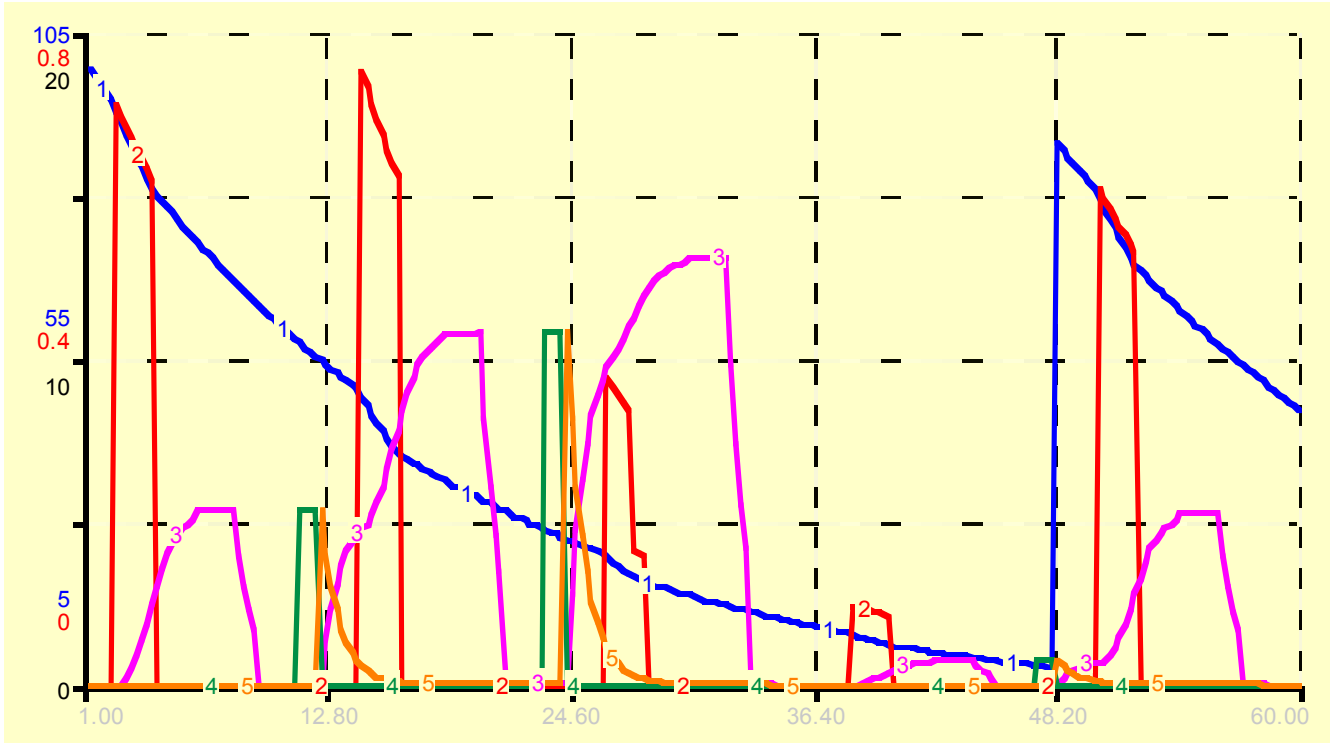
Burning can be used to stimulate the CNG seedbank and encourage competition from native pasture species. (never burn on a regular basis as it will destroy competitive advantage of the better native species)

Spot spraying should be undertaken more than once per year to ensure success.

Grazing should always be strategic or rotational – do not use continuous (set stocking) grazing techniques

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	GRAZE			BURN		SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
2	GRAZE		GRAZE			SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
3	GRAZE			BURN		SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
4	GRAZE		GRAZE			SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
5	GRAZE		GRAZE			SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
6	GRAZE		GRAZE			SPOT SPRAY FLUPROPANATE	GRAZE		GRAZE		SPOT SPRAY FLUPROPANATE	GRAZE
8	Recovery of seedbank beyond 100 seeds per m²											

CLASS 5 - Steep & Rough land classes



KEY

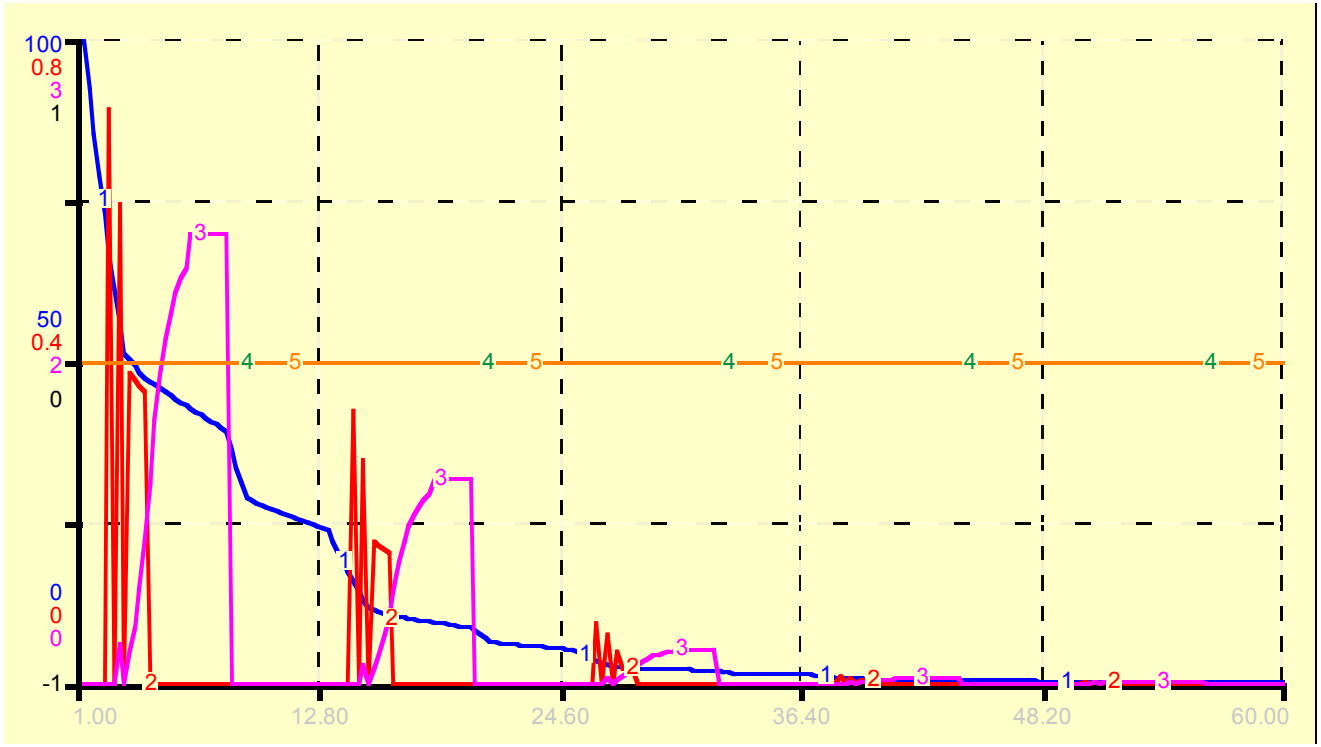
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Burning is used to stimulate germination of the seedbank, Flupropanate spot spraying is undertaken to provide residual control of individual patches but is usually non selective. This needs to be ongoing to capture late CNG germinants and avoid seedbank recovery.

Grazing should always be strategic or rotational – do not use continuous (set stocking) grazing techniques

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	BURN		GRAZE			GRAZE			GRAZE			SPRAY TOP
2	GRAZE		GRAZE			GRAZE			GRAZE		SPOT SPRAY FLUPROPANATE	SPRAY TOP
3	GRAZE		GRAZE			GRAZE			GRAZE			SPRAY TOP
4	GRAZE		GRAZE			GRAZE			GRAZE		SPOT SPRAY FLUPROPANATE	SPRAY TOP
5	GRAZE		GRAZE			GRAZE			GRAZE			SPRAY TOP
6	GRAZE		GRAZE			GRAZE			GRAZE			SPRAY TOP
7	Recovery of seedbank beyond 100 seeds per m²											

CLASS 1 Arable



KEY

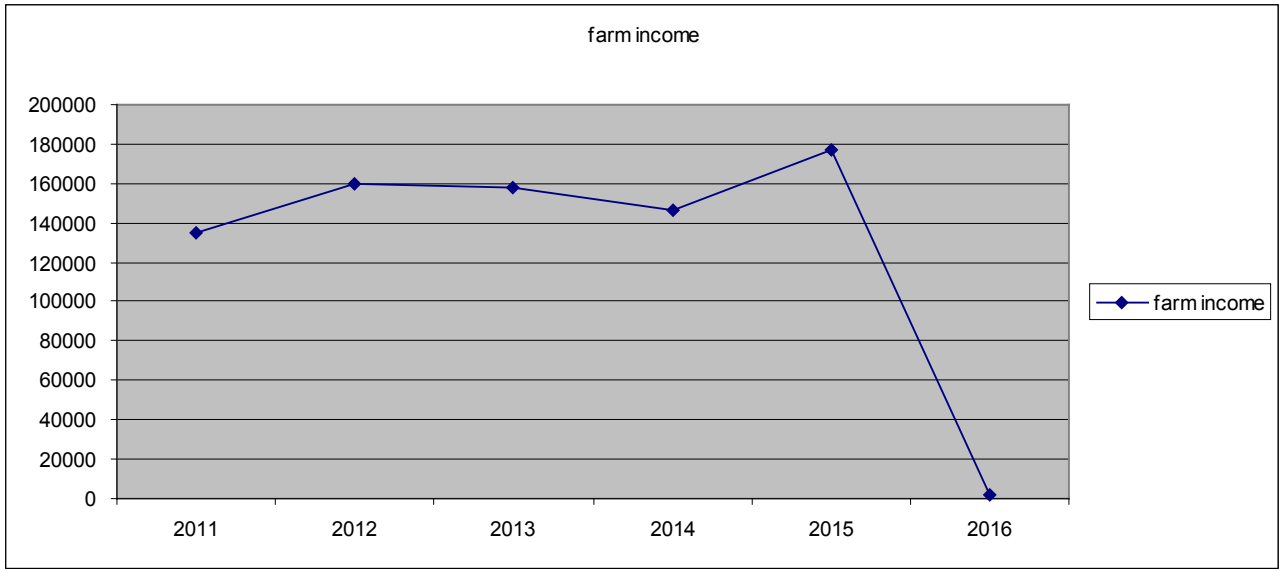
Blue line = seedbank
Red line = seedlings
Pink line = vegetative plant growth
Green line = reproductive plants = growing to seed
Orange line = dormant plants (i.e. browned off over dry summer)

Grazing forage crops are used to provide competition to CNG seedlings, whilst also allowing stock carrying capacity while other paddocks are sprayed or renovated. Silage is used to capture any outlier CNG plants and seed for 3 yrs prior to resowing to perennial pasture.

Resown perennial pastures are spot sprayed on an ongoing basis to capture late CNG germinants and avoid seedbank recovery.

	Summer		Autumn			Winter			Spring			Summer
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
1	WITHOLD GRAZING		CULTIVATE SOW FORAGE			BOOM SPRAY HALOXYFOP	GRAZE		CULTIVATE	SOW BEANS		WITHOLD GRAZING
2	WITHOLD GRAZING		CULTIVATE SOW FORAGE			BOOM SPRAY HALOXYFOP	GRAZE		CULTIVATE	SOW BEANS		WITHOLD GRAZING
3	WITHOLD GRAZING		CULTIVATE SOW FORAGE			BOOM SPRAY HALOXYFOP	GRAZE		CULTIVATE	SOW BEANS		WITHOLD GRAZING
4	WITHOLD GRAZING		CULTIVATE SOW FORAGE			BOOM SPRAY HALOXYFOP	GRAZE		CULTIVATE	SOW BEANS		WITHOLD GRAZING
5	WITHOLD GRAZING		CULTIVATE SOW FORAGE			BOOM SPRAY HALOXYFOP	GRAZE		CULTIVATE	SOW BEANS		WITHOLD GRAZING
6	WITHOLD GRAZING		BOOM SPRAY GLYPHOSATE SOW PERENNIAL PASTURE			WITHOLD GRAZING			WITHOLD GRAZING			WITHOLD GRAZING
9	Recovery of seedbank beyond 100 seeds per m²											

STEP 5 - Whole farm economic analysis



The example farm had a positive cash flow throughout the first 6 years of management. (see farm income graph and profit tables below).

The largest costs to the production system was pasture resowing.

Forage cropping for grazing and silage was most profitable with the added value of removing outlier CNG panicle seeds.

Recovery of the Chilean needle grass in the pasture system is generally likely within 2 years after active management ceases, as such costs of control are likely to be re occurring.

Land form	Name	TOTAL PROFIT	$/HA PROFIT PER YEAR					
			YR1	YR2	YR3	YR4	YR5	YR6
Creek flat	PADDOCK 1	35,207	709	337	337	-324	385	312
rocky	PADDOCK 2	62,000	110	333	110	333	333	333
rocky	PADDOCK 3	62,000	110	333	110	333	333	333
steep	PADDOCK 4	36,150	155	260	378	260	378	378
steep	PADDOCK 5	36,150	155	260	378	260	378	378
rough	PADDOCK 6	36,150	155	260	378	260	378	378
rough	PADDOCK 7	108,450	155	260	378	260	378	378
rough	PADDOCK 8	36,150	155	260	378	260	378	378
arable	PADDOCK 9	56,246	344	344	344	344	344	-324
arable	PADDOCK 10	84,369	344	344	344	344	344	-324
arable	PADDOCK 11	112,492	344	344	344	344	344	-324
arable	PADDOCK 12	112,492	344	344	344	344	344	-324
Total		777,856	3,080	3,678	3,820	3,016	4,313	1,568

The greatest profit may not always be failsafe – *ensure that the task can be undertaken with success.*

Pasture resowing can be expensive – make sure the seedbank has been depleted before going to pasture

When planning a control program for your farm, consider:

- What treatment options are available to use in your location?
  - Is control feasible for your district, is utilisation more appropriate?
  - What control options can be used on your landclasses?
- What fits in with your seasonal constraints?
  - Can the treatments be timed to be economical and work effectively?
- Are the land class plans suitable?
  - What needs to be tailored to suit your own farm?
- Is it financially viable?
  - The example farm proved to be productive although there are several assumptions including

    CASH FLOW - The farm business needs sufficient cash flow to outlay for treatments whilst also taking paddocks out of production

    MANAGEMENT FLEXIBILITY AND SKILLS – labour on the farm will be able to accommodate the extra workload and have the know how to make time critical decisions e.g. Stock movements, timing of operations

    EQUIPMENT AND SERVICES AVAILABLE – equipment is available on farm or can be contracted within the district. It also assumes that the contractor is ready, able and willing to work at optimum times for weed control – this will require weed hygiene practices for all equipment used in the program.

For further information or detailed costings and modelling information from the producer workshop, call Dr Charles Grech, Weed Sciences, DPI Victoria (03) 9217 4120 or charles.grech@dpi.vic.gov.au

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Appendix 12. Unpalatable grasses producer demonstration proposal

PART 2: FULL APPLICATION FORM

PARTIES

Research Organisation

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Senior Investigator

Title/First Name/Surname	Dr Charles Grech
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Facsimile Number	03 9217 4299
Email Address	Charles.grech@dpi.vic.gov.au

PROJECT

Project Title (Maximum of Ten Words)

Producer demonstration of unpalatable grass management programs – validation of district plans

Background of Research Work

- National best practice manuals for Chilean needle grass (CNG) and Serrated tussock (ST) contain management tactics tested in a non commercial environment (small plot trials, in isolation from one another, over short time frames). These manuals fail to provide producers with a step by step management program specific for on-farm conditions or provide economic analysis of different management options

- Previous MLA investment (*B.WEE.0127 Developing whole farm Integrated Management programs for Unpalatable grasses)* has led to the development of district weed management plans for ST and CNG. These are commercially costed whole farm scenarios for a typical farm of the district. Producer workshops were used to validate a computer based lifecycle model that was then used to formulate specific management plans for each district.

- The district plans were formulated from both known and new management tactics as well as successful systems of management that may not be common place in the district – it is these lesser known or used tactics that need to be demonstrated and validated in conjunction with the whole farm system.

- Key producers from the workshops have been identified as suitable candidates to host demonstration sites. These producers are undertaking novel or untested techniques of weed management that were widely accepted by producers at the workshop.

- The projects aligns with the MLA R&D plan with respect to improving animal welfare, productivity and building knowledge and capacity leading to profitable and sustainable producers.

- This project aims to increase producer uptake of management strategies for Chilean needle grass and serrated tussock to increase carrying capacity and production per hectare

Project Description

Field based producer demonstration sites will be established and monitored on commercial grazing farms in Victoria and New South Wales to validate each of the district management plans developed as part of the MLA project, B.WEE.0127 *(Developing whole farm Integrated Management programs for Unpalatable grasses).* This is anticipated to improve producer skills in managing Chilean needle grass and serrated tussock to raise production per hectare.

Objectives and Outcomes of Project

High Level Outcome

Ninety percent reduction in CNG/ST seed entering the soil seedbank whilst increasing carrying capacity by up to 50% over 5yrs.

Intermediate Outcome

Producers have the confidence and knowledge to manage CNG and ST within their production system.

Objectives

Establishment of 3 producer demonstration sites (PDS) across Victoria and New South Wales

1. To validate integrated (multi tactic) district weed management programs across years to run down soil based seed and plant populations for Chilean Needle Grass (CNG) and Serrated tussock (ST)
    - **a.** To increase the knowledge base of producers to enable 90% reduction in CNG/ST seed entering the soil seedbank whilst increasing carrying capacity by up to 50% over 5yrs.
    - **b.** To enable producers to determine the cost:benefit of managing unpalatable weeds in pastures, or renovating pastures compared to unimproved, or unmanaged controls.

Linkage to MLA R&D strategic plan 2006-2011.

1. The project concept will build to knowledge in the management of healthy environments as well as improving animal welfare (2 of 5 key areas) for the southern beef and goat meat industries (2 of 5 industry sectors)
2. Healthy environments key area - knowledge gain will focus on managing weeds to maintain biodiversity (program 3 environments) and monitor pasture production and weed vigour in seasons of variable climate (program 4 Healthy environments).
3. Improved animal welfare – public perception (program 6 improved animal welfare) will be a major outcome of grazing CNG in a responsible way to ensure acceptable animal welfare standards. Given the impact of past animal welfare concerns about grazing industries, this issue need sot be resolved prior to the development of any negative perceptions.
4. Improved productivity – CNG already covers many different production zones within southern Australia, and has the potential to continue its spread, decreasing production, if appropriate management strategies are not tested and relayed to producers (program 1 improved productivity). This is aligned with MLA action plan section 1.1.4 reducing the cost of production through increasing pasture utilisation for the Southern Beef area. The project has the ability to build the productivity of the goat industry as a means of controlling this weed and relaying the message to producers as an alternative control (program 4 improved productivity).
5. Build knowledge and capacity – communication of findings and demonstrations of the results will lead to a greater capacity to manage CNG. This will be delivered through the production of agricultural notes, hosting seasonal producer field days, as well as seminar presentations, delivered both in the field and via statewide meat and wool extension networks (program 1 build knowledge and capacity. This is also inline with the federal governments national research priorities (defeating the weed menace – Weeds of National Significance) as per MLA action plan1.7.
6. Profitable and sustainable producers – CNG represents a major environmental risk that is generally only noticed once significant invasion has occurred. Producers need to be more aware of how to stop CNG entering their production system and infesting their entire pasture area (program 6 Profitable and sustainable producers).
7. The proposed project builds on current pasture/weed management tools (i.e. More beef from pastures, seeds in sheep, CNG national best practice manual, CNG AgNote series) and can provide a medium term (3-5yrs) demonstration site to fit the need for different timeframes in the MLA R&D portfolio (section 4.1).
8. Overall, this project addresses the MLA identified target area: Increase environmental sustainability of whole farm system. This project provides an opportunity for MLA to support R&D related to *understanding the footprint of the red meat industry* through *weed control and pasture management.*

Method

Planning phase (Sept 2011)

In conjunction with up to 30 selected key producers from the district workshops (project *B.WEE.0127)*,

- Locate 3 suitable producer demonstration sites and sign off of farm use agreements
    - PDS sites and land managers need to able to meet the following criteria
        - Participation in other producer based research programs
        - Existing engagement with local agribusiness organisations
        - Time and commitment to the proposed trial (including DPI farm use agreement)

- Establish which programs of tactics are best suited to the chosen demonstration sites
- Run the STELLA model and financial spreadsheets for the three PDS to formulate the weed management program
- Develop whole farm monitoring protocols with paddock level detail including
    - Pasture composition changes
    - Available pasture mass (kgDM/ha) and relative feed value (i.e. ME, protein, NDF)
    - Weed Soil seedbank changes
    - Weed seed production
    - Animal live weights, welfare and DSE equivalents
    - Economic analysis of tactics undertaken
- Establish criteria for an annual review of the management program and define the treatment failure thresholds for mid season reviews. For example, "*if grazing is unable to suppress seed production by 90% then herbicide wiping or spraytopping will be added to the management plan for that year to limit seedbank inputs."*

Setup and monitoring phase (Oct 2011 – June 2015)

For each of the three PDS (as scoped during project *B.WEE.0127*)

- Setup sites to accommodate planned weed management program and appropriate statistical analysis (replication). Paddocks to be sized to suit commercial grazing mobs, works may include addition of:
    - Fencing (i.e. laneways/strip grazing/landclasses)
    - Tanks & troughs

- Establish baseline pasture, soil fertility and weed seed bank data prior to any treatments
    - 100 point pasture comb assessments on fixed transects per paddock
    - Full soil tests for each paddock – 100mm depth on fixed transects
    - Weed seedbank data taken from soil cores - 50mm depth in grid pattern

- Initiate planned management programs on paddocks, using tactics from below;
    - Burning
    - Cultivation
    - Boom spraying
    - Direct drilling/resowing
        - Annual grains/ forage crops, perennial pastures
    - Spot spraying/chipping if applicable
    - Strategic grazing
    - Capital and maintenance fertiliser
    - Mowing/slashing/mulching
    - In crop herbicide sprays
    - Spray topping/spray grazing
    - Herbicide wiping
    - silage

- Undertake seasonal data collection as listed below. Timing as per the management protocol with findings compiled in national database.
    - Flora
        - Pasture composition change under treatment –

- Pasture composition growth rates of pasture species – i.e. Botanal
- Damage scores from chemical – if applicable – 0-9 scale - Target and non target
- Pasture mass – ERPPM (kgDM/ha, using pasture cages where applicable)

o Animal/Livestock
- Liveweight change under treatment
- Condition score
- Welfare – infections, eye damage ETHICS

Annual review process (annually April)

- Statistical analysis of national database and compilation of research updates.
- Undertake annual reviews of the management program with up to 30 producers, using the predefined treatment failure thresholds as a cause for mid season reviews.

Annual field days (annually November)

For all 3 PDS

- In field presentation of research updates to up to 100 producers.
- Guided stakeholder tours through each paddock under management, with facilitated discussion for producer feedback.
- Distribution of up to 300 research updates via the national CNG and ST coordinator networks

Interest (IP proportions)

MLA	100%
Research Organisation	%

Milestones

Milestone Number	Achievement criteria	Due date
	1. Signing – August 2011	
	2. Planning phase completed – Sept 2011 Management program devised for 3 PDS	
	3. Research sites established – December 2011 Producer demonstration Sites established at Goulburn NSW, Glen Innes NSW Clarkefield VIC – (All TBC) (Landholder agreements, Baseline data collected, treatments commenced)	
	4. Field days held & National data base analysed – April 2012 Field days held, inc producer feedback report Report on: Biometric analysis of national interim database completed	
	5. Research sites – ongoing treatments applied – October 2012 Treatments ongoing, data collected	
	6. Field days held & National data base analysed – April 2013 Field days held, inc producer feedback report Report on: Biometric analysis of national interim database completed	
	7. Research sites – ongoing treatments applied – October 2013 Treatments ongoing, data collected	
	8. Field days held & National data base analysed – April 2014 Field days held, inc producer feedback report Report on: Biometric analysis of national interim database completed	

9. Research sites – ongoing treatments applied – October 2014 **Treatments ongoing, data collected**
10. National data base analysed – April 2015 **Report on: Biometric analysis of national database completed**
11. Final Report – June 2015

Nominated Person(s)

Title/First Name/Surname	Dr Charles Grech
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Phone Number	03 9217 4120
Facsimile Number	03 9217 4299
Email Address	Charles.grech@dpi.vic.gov.au

Project Budget and Funding – Indicative Budget OR Cash Flow Budget (complete only one)

Indicative Budget – (PCM CG284)

Overall Preliminary Budget (All budgets are recorded exclusive of GST, however, MLA will pay GST in addition to this budget.)

	Previous expenditure	2011-12 (YEAR 1 – SETUP)	2012-13 (YEAR 2)	2013-14 (YEAR 3)	2014-15 (YEAR 4)	TOTAL 2011-15
Salaries and on costs – Vic, NSW Staff		184,056	177,445	184,988	192,969	**739,458**
Travel, vehicle , airfares		25,000	25,000	25,000	25,000	**100,000**
Operating,- printing, contractors,		57,545	27,516	27,561	27,610	**140,232**
Capital (equipment) – fencing, troughs, tanks		100,000	8,000	8,000	8,000	**124,000**
TOTAL BUDGET (excl. GST)		**366,601**	**237,961**	**245,549**	**253,579**	**1,103,690**

Funding Breakdown – UNCONFIRMED PROPOSAL.

MLA	366,601	187,961	195,549	203,579	**953,690**
Other Contributors (please list)					
DPI VIC		50,000	50,000	50,000	**150,000**
					0
					0
Total	366,601	237,961	245,549	253,579	**1,103,690**
Research & Other Organisations (in kind)					**0**
					0
Govt Departments Qld/NSW/Vic	30000	30000	30000	30000	**120,000**
FARMER/LANDHOLDER	10000	10000	10000	10000	**40,000**
SUPPLIERS	5000	5000	5000	5000	**20,000**
UNIVERSITY	2000	2000	2000	2000	**8,000**
Total	47,000	47,000	47,000	47,000	**188,000**

OR
Cash Flow Budget

Total Funds = **$ (GST exclusive)**

Date	Payment Dependent on Milestone	Fees/Operating Costs	Expenses	Capital	Total

* on acceptance and approval of corresponding milestone report, with tax invoice for payment and copy of receipts attached
** on receipt and acceptance of final report, with tax invoice attached
Note: any money uncommitted at the end of the Project must be returned to MLA

Contributors/Other Funds

Funding Breakdown (only if applicable) - AS ABOVE

Party	Amount of Contribution	Type of Contribution	Amount of Interest in Intellectual Property
MLA			
Other Contributors (please list)			
Research & Other Organisations (in kind)			

Agent(s)/Subcontractor(s)

Name of Company	
ABN	
Contact Person Title/First Name/Surname	
Mailing Address	
Phone Number	
Facsimile Number	
Email Address	

Communications and Delivery

Target groups

Group	Total Potential Number of People
Farm advisors	100
Weed Compliance staff	50
Producers	350

77	4

Awareness/Participation/Adoption Objectives

Year following launch:	Awareness Partic	ipation	Adoption
Year 1	%	%	%
Year 2	%	%	%
Year 3	%	%	%
Year 4	%	%	%
Year 5	%	%	%

Communication Products/Tools/Services

Stakeholder adoption field days and publicity

Adoption pathways include several methods of uptake to cater for different learning styles. Results and findings of best practice program disseminated to up to 300 Farm advisors, producers, compliance staff via district specific Agnote publication and annual events such as:

- Annual review workshop – with linkages to existing agronomy networks (i.e. Elders/Landmark)
- Annual Field day at each research site (Total of 3 annually)
- Annual Research updates launched (Total of 3 annually)

The annual cycle of continuous improvement through producer feedback will guide the frequency and direction of workshops whilst also provide feedback as to the direction of the demonstrations sites – providing producers with ownership of the demonstration and the outcomes, leading to greater uptake and acceptance of the results.

Cost estimate included in budget? *** Yes [ ] No

Communication/Delivery Channels

As above

Cost estimate included in budget? ** Yes [ ] No

Other Capacity Building

As above

Cost estimate included in budget? ** Yes [ ] No

Timelines

Annual cycle of:

- Annual review workshop – with linkages to existing agronomy networks (i.e. Elders/Landmark)
- Annual Field day at each research site (Total of 3 annually)
- Annual Research updates launched (Total of 3 annually)