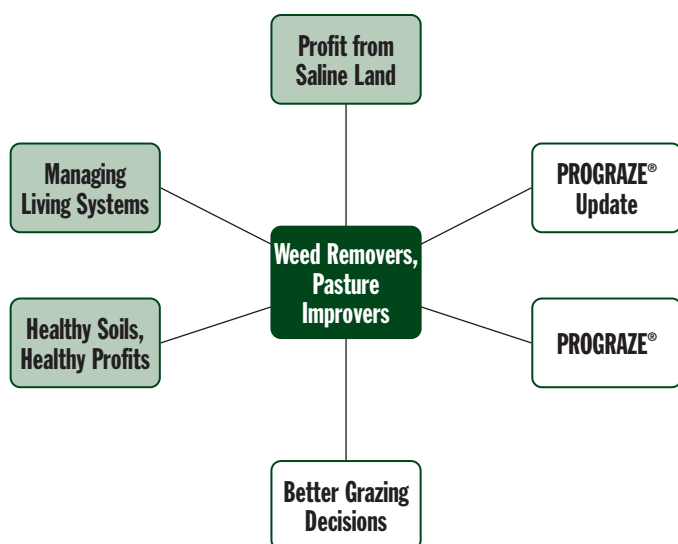


Towards Sustainable Grazing - Weeds

Weed Removers, Pasture Improvers

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- Appendix C – PROGRAZE® stick, transect and motorbike assessment sheet
- Appendix D – Pasture target recording table
- Appendix E – Species composition graph
- Appendix F – Paddock strategy sheet
- Appendix G – Glossary

Workshop
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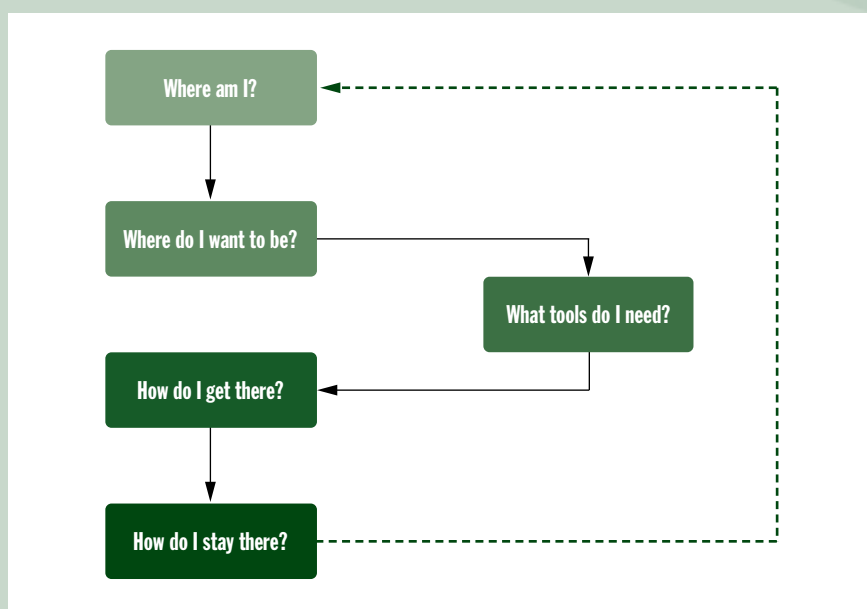
Introduction

Grazing is about turning grass into dollars. Highly nutritious pastures composed of palatable and productive species not only increase the growth rates and health of livestock but also increase and maintain the general carrying capacity of the land. Graziers who are able to keep weed numbers down and sustain high quality pastures produce more stock per hectare and receive greater returns.

Managing a sustainable and profitable enterprise relies on maintaining the quantity and quality of farm assets. The most important farm assets for grazing enterprises are the soil and the quantity of desirable plants in the pasture. When the pasture asset is degraded through weed presence, so is the ability of the pasture to efficiently produce quality livestock.

At the end of this workshop you will be able to achieve more productive pastures through effective weed management using a wide range of cost-effective tools.

Key questions



Steps

1. **Where am I?** Analyses a pasture for weed and desirable species present. This will define the 'starting point' and the specific weed problem at hand.
2. **Where do I want to be?** Develops a pasture composition target that you would like to see in the paddock. This will vary from paddock to paddock depending on a range of environmental variables such as soil type, climate etc.

3. **What tools do I need?** Looks at the wide range of cost effective tools that can be used to manage weeds in pastures.
4. **How do I get there?** Examines how to use and integrate pasture management tools to move from the current pasture to the desired composition as determined in steps 1 and 2.
5. **How do I stay there?** Once the desired composition is achieved – how do I maintain it at this level for optimum livestock production. What steps can I take to prevent or reduce pasture degradation.

About this workshop

What type of system does this workshop target?

- Temperate/cool temperate, high rainfall zones of southern Australia.
- Where perennial pasture species are sustained by climate and soil type.
- Where the main enterprise is grazing.

What weeds are covered?

- Weeds infesting pasture based grazing systems.
- Annual weeds (grasses and broadleaf weeds).
- Perennial weeds (grasses and broadleaf weeds).

What is not included in this workshop?

- Crop specific weeds.
- Aquatic weeds.
- Weeds specific to natural resource areas.
- Woody weeds.

Does the workshop lead to a national qualification?

This workshop is mapped against national competencies and contributes toward a national qualification.

Reference material

There are two main reference publications associated with this workshop. Where there is relevant technical material contained in these publications for further reading, the respective publication (abbreviated as below) and page numbers are provided.

For example:



(PWMK page 25)

refers to page 25 in the Pasture Weed Management Kit.

Abbreviation	Publication
PWMK	Pasture Weed Management Kit. By Ursula Taylor and Brian Sindel, CRC for Weed Management Systems, 2000.
PMWC	Pasture Management for Weed Control. By Jeff Burton and Peter Dowling. CRC for Australian Weed Management and NSW Agriculture, 2002.

What is a weed?

A weed is defined as a plant growing where it is not wanted.

Guiding principles

- Correct weed identification aids in effective and timely management.
- Correct weed identification leads to the appropriate selection and timing of control options.
- Weed management is an essential and integral part of the sustainable management of natural resources and the environment, and requires an integrated multi-disciplinary approach.
- Prevention and early intervention are the most cost-effective strategies that can be employed against weeds.
- The primary responsibility for weed management rests with landholders, or land managers, but collective action is necessary where the problem transcends the capacity of the individual.



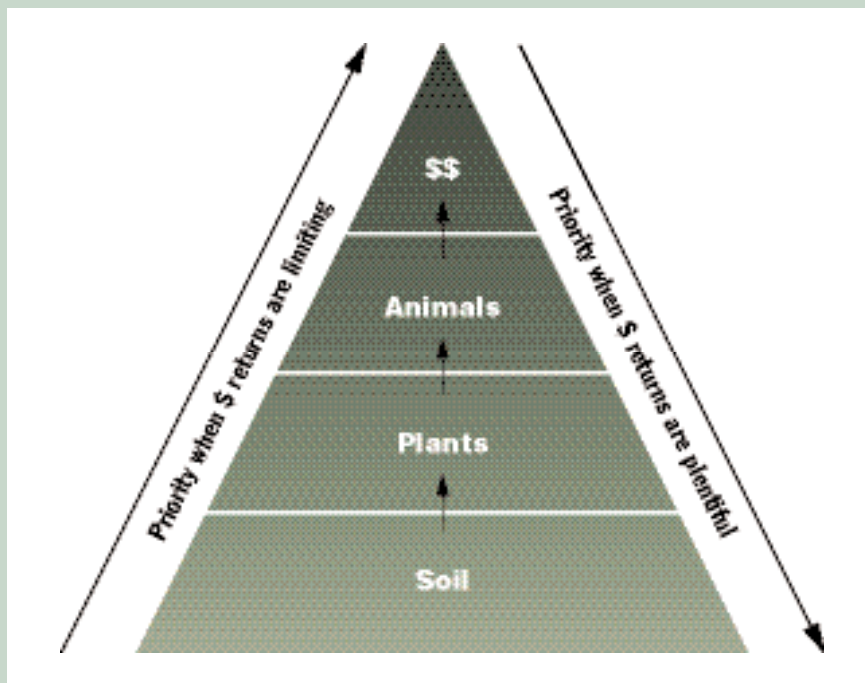
- **Weeds impact on livestock production in a number of different ways.**
- **Weeds also contribute greatly to livestock production.**
- **Determining what is a weed, depends on a range of variables (for example enterprise, location, time of the year, pasture and paddock goals and objectives).**
- **The big picture on weeds – *Weeds in pastures = less space and resources for desirable species = lower overall pasture quality = reduced animal production = lower income.***

What drives your 'on farm' decision-making – animals or pasture?

Making money from grazing is dependent on good soil, quality pastures and quality livestock. Paying greater attention to the 'grass roots' levels of the farming system is essential to build a solid foundation for animal production and financial return. However,

historically most graziers' priorities are dominated by cash flow, "It's hard to be green when you're in the red" is a very real issue when forced to balance short-and long-term goals.

The steps to profit



Weeds in pastures

Pasture weeds are not always easily determined as most species have some forage value for livestock at some point in their lifecycle. This complicates the management of weeds in pastures, as the weedy status of a plant will depend on the time of the year, its location, enterprise and management objectives.

In recent surveys (Reeve et al 2000) landholders identified weeds as a major management issue across all districts, in addition weeds were identified as a major 'indicator' of pasture quality decline. The annual economic impact of pasture weeds has been estimated at \$800 million.



(PMWC Chapter 1)

Know your weeds

Being able to recognise pasture species and having a working knowledge of the lifecycle of the major weeds is important, particularly the seed production and recruitment periods. These two important aspects of weed establishment and persistence are essential when timing management options to reduce weed numbers.

Exercise 2 – Top 10 weeds

List the top 10 weeds of your district.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

List several potential or emerging weeds of your district.

Weed impact

The impact of weed presence upon agricultural production will vary according to season, climate, soil type, the influence of grazing animals and most importantly the 'management of the pasture'. Weeds generally impact on grazing enterprises by:

- Reducing overall plant and livestock production by out-competing more desirable pasture species.
- Contaminating agricultural produce (for example weed seeds in grain or fodder, and vegetable fault in wool).
- Requiring control at considerable cost through herbicides, mechanical means and labour.
- Producing toxic substances or plant parts that directly affect animal health.
- Imposing external costs where weeds spread to neighbouring areas, forcing control costs and production losses on other landholders.



(PWMK page 8)

Exercise 3 – Impact of weeds

Describe how weeds impact on your business enterprises?

Exercise 4 – Cost of weeds

Estimate the total impact of weeds on your enterprise.

Cost category	\$/year	or	\$/ha
Cost of control.			
Costs in lost production.			
Costs in animal health (poisonous plants).			
Costs in discounted produce (for example vegetable fault in wool, and damaged hides).			
Weed spread.			
Total cost			

Why manage weeds

Weeds cost you money

Where weeds are maintained at low levels in the pasture, maximum resources (moisture, light, nutrients and space) are available for desirable more productive species, which in turn provide better quality forage for livestock.

While weeds make a contribution to livestock production and wool growth in Australian farming systems, there is strong evidence to suggest that pastures based on legumes and perennial grasses provide better overall nutrition for livestock.

Reduced land degradation

Agricultural land that is dominated by weeds is degraded, unable to support sustainable, profitable livestock production and is expensive to restore. Weeds also impose additional costs on surrounding land by spreading and forcing production losses and cost of control on other paddocks and neighbours.

Healthier livestock

Many weeds are toxic to livestock and their removal will improve animal health, fertility and overall production.

Weeds also impact upon financial returns by contaminating or damaging animal products. Reducing weeds that cause vegetable

fault in wool and damage hides will avoid price reduction penalties and contribute to better animal health.

Avoids huge control costs.

Preventing weed establishment and practicing early intervention is a good investment, the costs are cheap as the weed infestation is small and the seed bank is low. If weeds are allowed to establish, spread and dominate, the costs of control will be high and a large seed bank will be available for future weed establishment.

Longer life of productive pastures

Pastures that are managed for their long-term maintenance are able to last for many years thus avoiding the need to frequently re-sow them.

Review questions

What is a weed?

List four weeds on your property and give an example of their impact.

	Weed	Impact
1.		
2.		
3.		
4.		

List four benefits of being an active weed and pasture manager.

1.

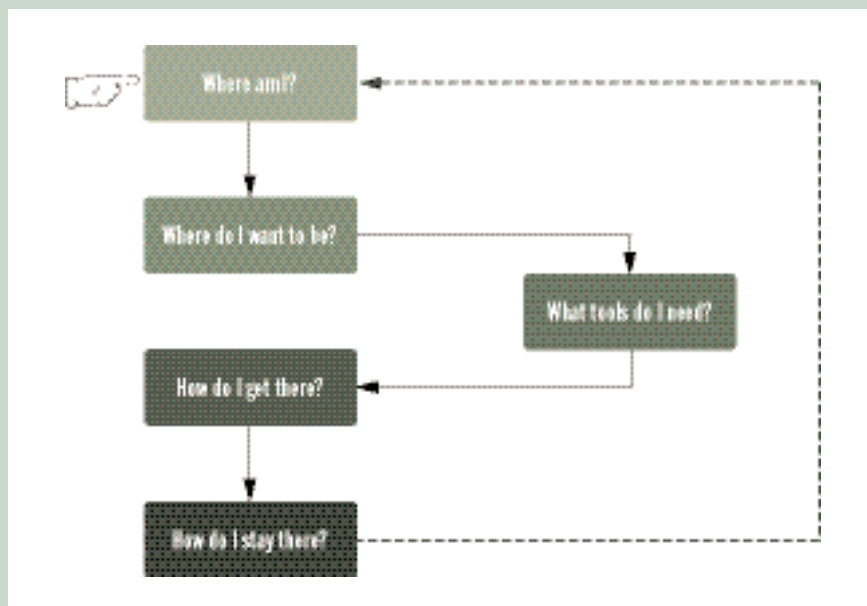
2.

3.

4.

Give an example of a plant on your property that has 'weedy' and desirable characteristics.

Where am I?



The aim of this session is to determine 'what have I got' in respect to weeds and desirable species that are present in a pasture.



- **Pasture assessment is an important part of determining the actual weed problem at hand and whether there are sufficient desirable species to 'encourage' through targeted management.**



(PWMK page 13)

- **Weed and pasture composition will vary according to factors including past management, location, slope, climate, aspect, soil type, soil fertility.**
- **Sampling needs to be undertaken annually to determine changes in pasture composition over time.**
- **Recording the information on a graph is the only means of accurately determining changes in pasture composition, otherwise assessment is just a snapshot in time.**

Determining the level of weeds will indicate:

- Whether control is warranted.



(PWMK page 13)

- Which weeds are having the greatest impact.
- Priority paddocks and locations



(PWMK page 27)

- Potential control/management tactics.

Determining the level of desirable species will indicate:

- Whether pasture restoration is possible.
- Whether re-sowing is a better option.
- The 'potential' of the paddock – what forage production levels are possible.
- Priority paddocks for weed control.



(PWMK page 27).

Many 'high profile' weeds in pastures are easily distinguished from other species in the paddock and often their level of abundance can easily be determined (such as in the case of thistles). However some weeds (particularly grass weeds) are notoriously difficult to identify and distinguish, and are often only seen as a problem when the grass has completely dominated the paddock.

Annual paddock assessment is a quick and easy way of determining whether weeds and/or desirable species are increasing or decreasing in the paddock. Where desirable species are decreasing over time – this should ring 'alarm bells' and be used as an early warning tool to take action.

A quick and simple way to assess pasture quality is to determine the percentage ground cover of various components. The ideal pasture (in high rainfall high soil fertility areas) has approximately 20-40% legume and *40-60% productive grass. Ideally, weeds should be less than 20% of the pasture composition. If weeds regularly comprise more than 20% then control measures may be required.

**This will vary greatly depending on season, location, soil type, climate, aspect and slope. For example – some areas aren't capable of supporting more than 30% perennial grass. In these areas, greater reliance will be on annual grasses to provide forage, as such they wouldn't be considered a 'production limiting' weed in these environments. The perennial grass component should be as high as the respective environment allows without exceeding about 60%.*

How to assess pastures

A number of methods are available to assess pasture composition. All of these rely on taking samples from the area and using the results to draw conclusions about the whole area or paddock. In order that the samples provide a good estimation of the real situation, the following principles should be followed:

- Make the samples truly random by not deliberately influencing the location of the sample points (don't deliberately place the quadrat or stick at a particular location).
- Take a number of samples so as to get a feel for the variation across the area. From a scientific perspective the number of samples required is determined by how the composition varies throughout the paddock. If it varies a lot then more samples are required to get an accurate measure.
- Avoid sampling areas that are obviously very different and not really a part of the paddock. These may include gateways, sheep camps, around troughs and under trees.
- If a paddock can be divided into a number of sub areas that are very different to each other with respect to pasture composition then it is better to treat each sub area as a separate sampling area. Alternatively the whole area should be sampled in a direction that crosses this variation taking care to take about the same number of sample points from each sub area.
- Do the assessments at about the same seasonal time each year and when the area has been uniformly grazed.
- Be consistent in the sampling method you use as this will ensure that changes in the pasture's composition are reasonably accurate relative to previous observations.

The sampling methods described below are all valid tools for determining the botanical composition of a paddock. The one that you find easiest and most useful will be the best method for your situation, the following guidelines may be helpful in making that decision:

- Speed of doing the assessment. A quick method can allow more sampling points in a given time so accuracy of the overall estimation may be increased.
- Ease of assessment. Unambiguous interpretation of information at the sample point is important.
- Maintenance of skills. A methodology that does not require the user to undertake regular practice in order to maintain accuracy may be attractive.

PROGRAZE® stick

The PROGRAZE stick is just a piece of stick with a nail driven longitudinally in one end so anyone can make one.

Having used the above sampling principles to determine the sampling direction do the following:

1. Throw the stick.
2. Use the recording sheet to note the plant species touching the head of the nail.
3. Throw the stick again.
4. Use the recording sheet to note the plant species touching the head of the nail.
5. Repeat the above until the whole paddock has been traversed. If it is a large paddock it may be necessary to walk a set and consistent number of paces between throwing the stick, so it does not take forever to get across the paddock and you end up with heaps more samples than necessary.
6. Calculate the percentage of hits of each species and then group the species according to the broader groupings indicated on the recording sheet.

Transects

Transects are defined and semi permanent tracts or pathways across a paddock or area. Observations can be made along these transects at specific intervals. Given that these observation points are semi permanent the same area is effectively being observed at each sampling time. This reduces the variability and thus the number of samples required to obtain a reliable measure. Transects should be established to be representative of the overall area. This method can be used as follows:

1. Set and permanently mark the transect direction using a disc or paint on a fence post.
2. Walk the transect stopping every X steps. (*X is determined by the length of the transect but should be sufficient to enable up to fifty points to be sampled.*)
3. At each stop record the species touching the toe of your right boot.
4. Continue the process until sufficient observations have been made.
5. Calculate the percentage of hits of each species and then group the species according to the broader groupings indicated on the recording sheet.

Motorbike method

For experienced producers with a 'trained eye', this may be the preferred method of assessment. When you are using the motorbike method, follow the following guidelines.

1. Ride the paddock in a uniform manner eg corner to corner, around the paddock moving closer to the centre or in strips.
2. Every 100 metres (on the speedo) or count of 20-30 seconds (if the speedo is broken). Stop the bike and record the species that is at the toe of your boot (right or left). Record it on the appropriate sheet (below).
3. Continue until 50 points have been recorded.
4. Calculate your composition.

Making pasture observations from a moving motorbike or ute requires a trained eye and plenty of experience but is also a valid means of quickly assessing pastures for very experienced producers. Producers need to be aware of potential bias when using this technique such as over-estimating the more 'visual' species such as thistles and under valuing less obvious species such as vulpia. For this reason using a formal technique, at least occasionally for calibration of 'your eye' is suggested.



Assessment sheet for the PROGRAZE stick, transect and motor bike methods

Date _____ Assessor _____ Paddock Name/Number _____ Method used ☐ PROGRAZE ☐ Stick ☐ Transect ☐ Bike

Sample number	Legume	Desirable grass	Weed grass	Broadleaf weed	Litter	Bare ground
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
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30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
Totals						
% Composition*						

* If 50 points have been sampled, multiply the total by 2. If less than 50 have been sampled % composition = species total/number of samples X 100

Quadrat

A quadrat is just a means of defining a small sample area that can be assessed for species composition. The species composition assessment can be based on a number of units including contribution to total dry matter present and contribution to ground cover. The latter is probably easiest to estimate and from a practical perspective should ignore leaf overlap with the upper most species assessed as covering the ground. This method can be used as follows after selecting the direction and frequency of sampling using the above guidelines:

1. Place the quadrat on the ground.
2. Stand vertically above (helicopter view) the quadrat and estimate the proportion of the quadrat area occupied by each class of species.
3. Record the proportions on the work sheet.
4. Repeat the process until sufficient sites have been sampled.
5. Calculate the average cover for each species.

The 'Blundstone' method

(Adapted from Taylor & Sindel 2000)



(PWMK page 13)

- Step 1 Stand in the paddock with your feet about half a metre apart.
- Step 2 Visualise a square 0.5m x 0.5m in front of your toes.
- Step 3 Estimate the proportion of this square that each plant type occupies.
- Step 4 Take at least five random estimates from five different parts of the paddock for a reliable guide to your pasture's composition.
- Step 5 Record your results in the 'Blundstone' table.

Note: This method is subjective and each person will vary the estimate of ground cover. Also, estimates may change slightly as you become more familiar with the technique. To overcome these differences, take more estimates. Remember, the more consistent you are with your estimates, the more reliable the result.

'Blundstone' and Quadrat table

Paddock name/number _____ Date ____/____/____

% Cover estimate	Random sample number										Average
	1	2	3	4	5	6	7	8	9	10	
% Legume											
% Desirable grass											
% Broadleaf weed											
% Grass weed											
% Litter											
% Bare ground											
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Paddock name/number _____ Date ____/____/____

% Cover estimate	Random sample number										Average
	1	2	3	4	5	6	7	8	9	10	
% Legume											
% Desirable grass											
% Broadleaf weed											
% Grass weed											
% Litter											
% Bare ground											
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Exercise 6 – Overall assessment

Record your results from the assessment of the target paddock.

Functional group	Transects	PROGRAZE stick	Quadrat	Blundstone	Motor bike
Desirable grass					
Legume					
Grass weeds					
Broadleaf weeds					
Litter					
Bare ground					
Total	100%	100%	100%	100%	100%

Monitoring pasture composition

Undertaking an assessment of a pasture will give a ‘snapshot in time’ as to what the pasture’s composition is. In order to monitor any changes over time, assessments need to be conducted and recorded annually. A composition graph can be used to plot the annual changes in a pasture’s composition and determine any trends or changes.

How often and when should I sample?

Pasture assessment should be undertaken annually and is best made in early spring as there is little bare ground at that time and the pasture is grazed short making it easier to spot the different types of plants present.

Note:

- Use a consistent method.
- Assess at a consistent time of the year.

Sample – Monitoring a pasture over time

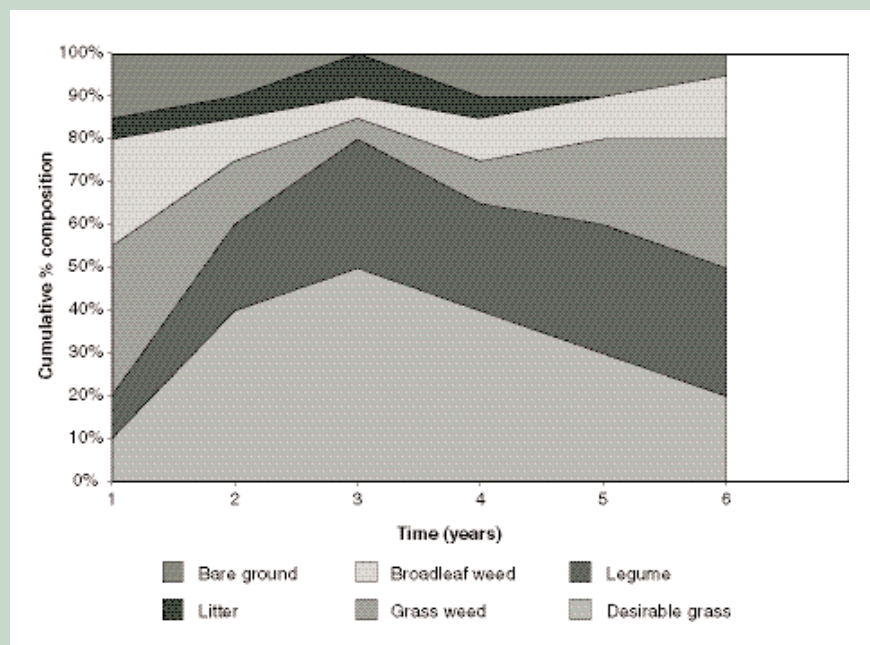


(PMWC Chapter 6)

The composition graph shows the trends in pasture composition based on each component of the pasture over time. The graph is cumulative and must total 100% at all times. Take a few minutes to interpret what has happened to this particular pasture in the following table and graph.

Sampling year	Desirable grass	Legume	Grass weed	Broadleaf weed	Litter	Bare ground
1	10	10	35	25	5	15
2	40	20	15	10	5	10
3	50	30	5	5	10	0
4	40	25	10	10	5	10
5	30	30	20	10	0	10
6	20	30	30	15	0	5

Pasture composition graph



Exercise 7 – Recording pasture compositions

What do you think the producer should do next to improve pasture composition?

After implementing the above actions, what do you think will be the resulting pasture composition?

Pasture composition after seven years

Pasture species group	% in pasture
Desirable grass	
Legume	
Grass weeds	
Broadleaf weeds	
Litter	
Bare ground	
Total	100%

Exercise 8 – Plotting pasture compositions

Plot the composition for the seventh year on the previous graph.

Weeds in pastures – how and why?



(PMWC Chapter 1)

Weeds have often been viewed as the cause of pasture decline but are now recognised as a symptom of broader issues. The cause of pasture decline may be inappropriate grazing pressure, drought, fertiliser imbalance, salinity, acidity or pests such as red-legged earth mite or disease. A decline in pasture quality becomes evident in a number of ways:

- The loss of perennial grasses and legumes.
- The establishment and dominance of weeds.
- Patches of bare ground.
- Reduced livestock performance.

While many causes of decline can be identified through inspection or soil tests, management based impacts such as grazing intensity and timing (in conjunction with season) are often a major contributor to pasture decline and usually the last to be identified and corrected.

The physical process of decline usually begins with conditions that stress, kill or reduce the vigour of legumes and perennial grasses. Gaps are created in the ground cover that are colonised by competitive weeds. Learning to read pastures for early indications of decline and correcting the cause of the problem will prevent further losses and may assist pasture recovery. However, determining the cause of pasture decline is not always easy and the most appropriate corrective action is not always apparent.

What does it mean for me?

- Weeds are always present in pastures but must be kept at low numbers relative to the desirable species present.
- Some plants have weedy and desirable features.
- The optimum or best pasture composition will vary from paddock to paddock according to season, location, soil type, climate, aspect and slope.
- Pasture assessment is a critical initial tool for determining weed presence in pastures.
- Pasture assessment can be undertaken using a number of easy to use sampling methods.

- In order to determine trends or changes, the pasture's composition needs to be monitored and recorded over time.
- Pasture plant identification is the first step to determining weed problems and provides information that is necessary for decision making.
- Weeds vary in their seriousness (impact and control).
- Weeds have both positive and negative characteristics, as do desirable species. A weed will vary from desirable to undesirable depending on the person, location, enterprise and season.
- Weed and pasture composition will vary according to past management, location, slope, climate, aspect, soil type, soil fertility etc.
- Sampling needs to be undertaken annually to determine changes in pasture composition over time.



Review questions

List five benefits of assessing and monitoring a pasture's composition over time.

1.

2.

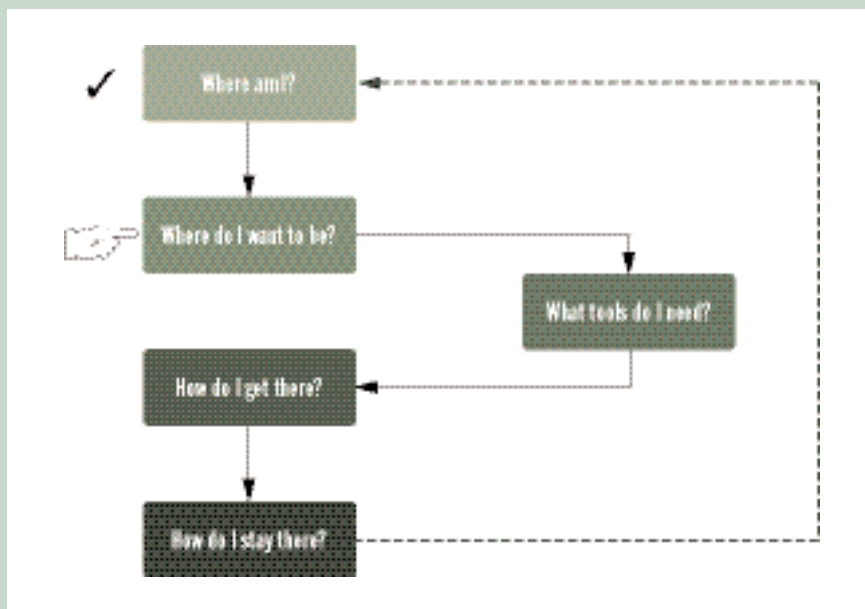
3.

4.

5.

Which method of pasture assessment are you going to use at home and why?

Where do I want to be?



The aim of this session is to answer ‘what do I want’ in respect to the kind of pasture composition that I would like to see in this paddock.



- **Weeds will always be part of the system and must be included (as maximum allowable levels) in a composition target.**
- **The ‘best possible’ pasture composition that a paddock can support and sustain depends on location, climate, soil type, soil depth, soil fertility, aspect, slope etc. This will vary from paddock to paddock and even within parts of a paddock.**

Setting paddock composition targets not only provides a goal to work towards for weed reduction and pasture improvement, it also allows us to think about the limitations of paddocks and how this will effect forage production. Other benefits include:

- Setting a paddock composition benchmark to work towards.
- Identify limitations to forage production.
- Set and adjust stocking rates and rotations.
- Target management inputs and options.

The amount of desirable species a paddock can support is highly variable and will depend on season, location, soil type, climate, aspect and slope.

Example

1. In a high rainfall, high soil fertility area of eastern Australia, a paddock may be able to support an ideal composition of 60 % desirable perennial grass and 30% legume, leaving 10% that can be occupied by other species.

2. In a different area of medium rainfall and low soil fertility, the best pastures may only be able to sustain 30% perennial grass and 40% legume, leaving 30% that can be occupied by other species. Clearly in this location, 20-30% annual grasses are not limiting production and would greatly contribute towards forage production. Whereas 20-30% annual grass in example 1 would limit legume and perennial grass production.

Exercise 9 – Limitations to the ideal pasture composition

List a range of factors that may limit the type pasture that a paddock may be able to produce/sustain.

1.

2.

3.

4.

5.

6.

7.

8.

Points to remember

- Weeds are an important and necessary part of the pasture ecosystem and will always be present to some degree.
- The amount of desirable species a paddock can support is highly variable and will depend on season, location, soil type, soil fertility, climate, aspect and slope.
- In limiting environments, aim for perennial grass content to remain close to a 'peak' level or a maximum of 60% in more favourable environments.
- Maintain the legume content within lower and upper limits. The lower limit is important to sustain nitrogen input to the pasture and provide quality forage for livestock. A legume dominant pasture can prove difficult to manage due to a degree of instability. Problems such as bloat and increased soil acidity and may destabilise some pasture types eg kangaroo and wallaby grass.

- Weeds with some value such as annual grasses and some broadleaf weeds, need to be contained below some upper limit in order to maximise the resources available to the perennial grasses and legumes.
- Weeds with little value for livestock such as serrated tussock need to be controlled to a very low or nil level.

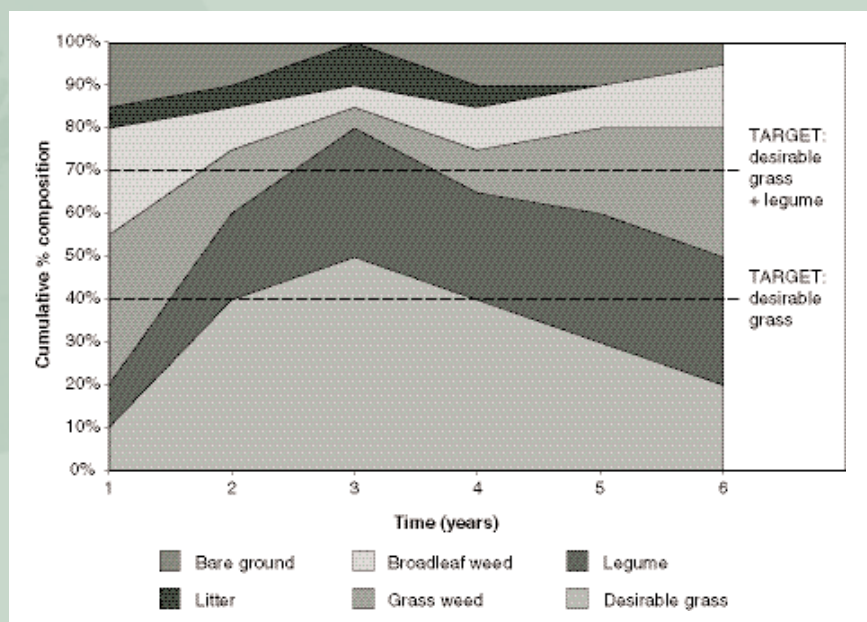
Exercise 10 – Your ideal pasture composition

Record your idea of an ideal realistic pasture species composition for a paddock or area of your farm.

Pasture species group	% in pasture
Desirable grass	
Legume	
Grass weeds	
Broadleaf weeds	
Litter	
Bare ground	
Total	100%

Marking targets on composition graphs

Desirable ‘target’ levels have been suggested for perennial grass and for perennial grass plus legume. Where perennial grasses and legumes are dominant within the pasture, there simply isn’t enough room and resources for weeds. Importantly, adequate levels of legume are essential for livestock production and to complement the perennial grass.



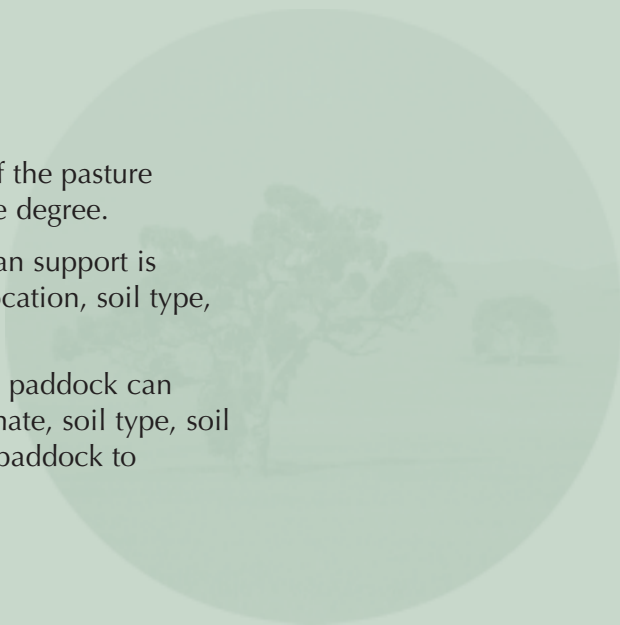
Exercise 11 – Pasture composition targets

Refer back to Exercise 7 and mark your composition targets for:

- Desirable grasses.
- Desirable grasses plus legumes.

What does it mean for me?

- Weeds are an important and necessary part of the pasture ecosystem and will always be present to some degree.
- The amount of desirable species a paddock can support is highly variable and will depend on season, location, soil type, soil fertility, climate, aspect and slope.
- The 'best possible' pasture composition that a paddock can support and sustain depends on location, climate, soil type, soil fertility, aspect, slope etc. This will vary from paddock to paddock and even within parts of a paddock.



Review questions

List four reasons for setting pasture composition targets.

1.

--

2.

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3.

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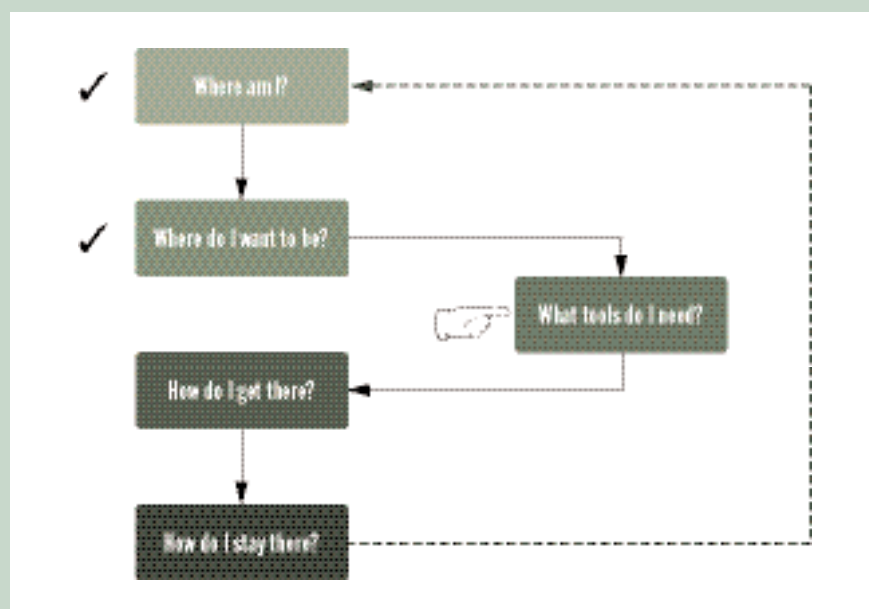
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Thinking of a paddock at home that is under-performing due to weeds – write down the kind of composition you would like it to have.

Pasture species group	% in pasture
Desirable grass	
Legume	
Grass weeds	
Broadleaf weeds	
Litter	
Bare ground	
Total	100%

What tools do I need?



- A wide range of cost effective tools are available
- That there are three key objectives for weed management in pastures:
 1. Remove the weed or reduce weed seed set.
 2. Reduce weed germination.
 3. Encourage competition from desirable species.

The aim of this session is to determine 'what tools do I need' to manage weeds and encourage desirable species in the pasture. There are a wide range of cost effective tools that can be combined to reduce weeds without heavily relying on herbicides. Similarly re-sowing is not the only method to increase the proportion of desirable species in the pasture.

There are many pasture and weed management options available to landholders, which are described in detail in the publication 'Pasture Management for Weed Control'. When looking at what options are best for your situation, many landholders turn to herbicides as the primary option for weed control in pastures, but in most cases, unless other management inputs are integrated any initial control is rapidly lost and the weeds usually return.

Integrated weed management means using a range of management options to disadvantage the weed and eventually replace weeds with desirable, productive, competitive species. **This weed replacement approach is the only long-term solution to weeds and has the added benefit of providing a valuable forage resource.**

When looking at weed replacement in pastures there are three key objectives that the range of management options implemented must satisfy:

1. Remove the weed or reduce weed seed set.
2. Reduce weed germination.
3. Provide competition from desirable species.

Pasture and weed management options

Remove weeds or reduce weed seed set	Reduce weed germination	Increase competition from desirable plants
Herbicides – Grasses • Spray top • Winter clean Broadleaf • Lethal spray • Spray graze • Spray top	Strong plant competition at time of germination.	Grazing rest.
	Grazing rest.	Fertiliser.
	Litter retention.	Soil conditioning (such as lime).
	Minimal bare ground.	Appropriate competitive species.
		Pest management (eg red-legged earth mite).
Biological control.		Re-sowing, over-sowing.
Silage or hay cuts.		
Slashing.		
Targeted grazing.		
Cultivation.		

Management tools



(PWMK pages 14-20)
(PMWC Chapters 4 and 5)

Encourage desirable species

Fertiliser

Implementing a well-planned fertiliser program increases soil fertility to encourage 'fertiliser responsive' perennial species to dominate the pasture. Often this occurs after legumes respond to increased fertility which in turn drives perennial grasses. Soil tests should be used to determine fertiliser rates, specific nutrient requirements and frequency of application.

Soil pH

Maintaining soils at the appropriate pH or level of acidity will provide ideal conditions for pasture growth.

Grazing management and rest

Grazing management is a very important tool in maintaining and encouraging desirable species to dominate the pasture. In the absence of appropriate grazing management it is difficult to maintain a quality perennial pasture and nearly impossible to restore a degraded pasture without re-sowing.

By applying suitable stocking rates that do not over or under-utilise desirable species and introducing tactical rests, perennial species should remain vigorous and competitive within the pasture. Periods of grazing rest allows the perennial species to set seed, increase basal cover and root development; essentially allowing the perennial grasses to recover from, and prepare for grazing.

Pasture establishment

Pasture re-establishment is sometimes the best option for restoring a severely degraded pasture. Pasture establishment is usually an expensive option with associated risk, therefore planning should commence at least 12 months in advance to ensure that pasture establishment is given the best possible chance of success in the first instance. Importantly, where a pasture has been degraded through inappropriate management, if the same management is applied to a re-sown pasture, it too will decline.

Pest management

The management of vertebrate and insect pests is important to maintain the health of perennial grasses and legumes in the pasture.

Remove the weed or reduce seed set

Herbicides

Herbicides are often the first management tool considered when weeds are present in pastures and are thought to provide a 'quick fix – one hit' solution to the problem. However, in the absence of any other management inputs, initial control is rapidly lost.

The aim of chemical control is to selectively control the undesirable weeds but to leave the desirable pasture plants relatively unharmed and sufficiently competitive. Care should be taken to avoid damage to non-target species within the pasture and on neighbouring areas. Always read the label, follow the directions and seek additional information from the supplier if unsure.

Broadleaf weed options

Broadleaf weeds can be treated within pastures using a wide range of selective herbicides. When applying selective herbicides to pastures for the control of broadleaf weeds there are three main options:

- i. Using a *lethal dose* of herbicide to directly kill the weeds. This involves spraying at an optimal time and removing stock for the specified withholding period.
- ii. *Spray grazing*. This involves using a sub-lethal rate of herbicide at an optimal time, and applying high density grazing after the withholding period to utilise the weed. The herbicide modifies the metabolism of the target weed, making it more attractive to livestock. In addition, the normally prostrate rosette of the target species becomes more erect and accessible to grazing. This is best suited to arable areas in smaller paddocks (less than 20ha) on non-erodible soils.
- iii. *Spray topping*. The strategic use of 'spray topping' can be used to reduce the seed set of some broadleaf weeds. Herbicide is applied in spring and should be timed according to the target weed. However, spray topping may cause a reduction in the seed set of desirable grasses and legumes and lead to poor pasture regeneration and can cause non-target damage.

Annual grass options

Spray topping

The strategic use of 'spray topping' (paraquat or glyphosate applied early post flowering to reduce seed set) is a valuable tool to reduce the seed set of weeds.

Winter cleaning

Winter cleaning involves an application of herbicide (such as simazine for vulpia and other herbicide combinations for annual grasses) to target annual grass plants prior to seeding. This technique can remove the majority of annual grasses from the pasture with a net effect of reducing seed set in spring.

Perennial grass weed options

Controlling perennial grass weeds within a perennial grass pasture remains an extremely challenging aspect of pasture management. Herbicide options are few and there is usually a higher risk of non-target damage.

Biological control

Biological control involves the introduction of a weed's natural enemies. The process involves identifying pests and diseases of the target weed species in its region of origin. After rigorous testing to ensure they are safe for the Australian environment, they are imported and released into areas where the weed is a problem.

Biological control aims to create an ecological balance between a weed and its natural enemies to reduce the weed population to a level where it is no longer of economic or environmental significance. Complete eradication of the weed is neither achievable nor desirable as this would result in the extinction of the imported agent, then the weed would re-establish through germination from the seed bank, re-sprouting from underground structures or re-introduction.

Biological control will not provide instant control, but is a long-term strategy that aims to reduce the population of the target weed to lower levels over many years. Biological control is increasingly seen as part of an overall management strategy that complements other management techniques such as grazing, competitive vegetation and herbicide use, rather than a replacement for them. Importantly their introduction should not be regarded as an opportunity to relax other management practices.

Biological control agents currently released or under investigation.

Weed	Agent		Status
	Common name	Scientific name	
Paterson's Curse <i>Echium plantagineum</i>	Root weevil	<i>Mogulones geographicus</i>	E*
	Crown weevil	<i>Mogulones larvatus</i>	E*
	Stem-boring beetle	<i>Phytoecia coerulescens</i>	NE
	Flea beetle	<i>Longitarsus echii</i>	E*
	Pollen beetle	<i>Meligethes planiusculus</i>	E*
	Leaf-mining moth	<i>Dialectica scalarisella</i>	W
Nodding thistle <i>Carduus nutans</i>	Crown weevil	<i>Trichosirocalus mortadello</i>	W
	Seed fly	<i>Urophora solstitialis</i>	W
	Thistle head weevil	<i>Rhinocyllus conicus</i>	W
Scotch thistle <i>Onopordum</i> spp.	Seed weevil	<i>Larinus latus</i>	W
	Stem boring weevil	<i>Lixus cardui</i>	W
	Crown weevil	<i>Trichosirocalus briesei</i>	E*
	Petiole Moth	<i>Eublemma amoena</i>	E*
	Rosette fly	<i>Botanophila spinosa</i>	NE
	Seed fly	<i>Tephritis postica</i>	NE
	Seed fly	<i>Urophora terebrans</i>	NE
Bathurst burr <i>Xanthium spinosum</i>	Rust	<i>Colletotrichum orbiculare</i>	I
St John's wort <i>Hypericum perforatum</i>	Leaf beetle	<i>Chrysolina quadrigemina</i>	W
	Mite	<i>Aculus hyperici</i>	W
	Aphid	<i>Aphis chloris</i>	W
	Root-boring beetle	<i>Agrilus hyperici</i>	R
Serrated Tussock <i>Nassella trichotoma</i>	Rust fungus	<i>Puccinia nassellae</i>	I
	Smut fungus	<i>Ustilago</i> sp.	I
Chilean needle grass <i>Nassella neesiana</i>			
Ragwort <i>Senecio jacobaea</i>	Cinnabar moth	<i>Tyria jacobaeae</i>	NE
	Crown boring Moth	<i>Cochylis atricapitana</i>	R
	Ragwort plume moth	<i>Platyptilla isodactyla</i>	I
	Flea beetle	<i>Longitarsus flavicornis</i>	R
	Flea beetle	<i>Longitarsus jacobaeae</i>	R
Common heliotrope <i>Heliotropium europaeum</i>	Flea beetle	<i>Longitarsus albineus</i>	R
	Rust fungus	<i>Uromyces heliotropii</i>	R

NE = Not established.

E = Established.

E* = Established and currently being redistributed.

R = Restricted distribution.

W = Widespread.

I = Under investigation.

Tactical grazing pressure

Grazing management can be used to manipulate pasture composition by applying targeted grazing pressure and rest periods (timed according to the life-cycle of the weeds and desirable species).

Tactical grazing is mainly used to reduce the seed set of weeds in spring or in a spray graze context (usually in autumn). High density grazing (100 to 200 DSE/ha) for short periods (such as five days) forces stock to graze the weeds prior to seeding.

Silage and hay

Cutting pasture in spring before flowering will reduce the seed production of weeds. Any regrowth resulting from wet springs must be controlled using heavy grazing, cutting or spray topping.

Silage is preferable to hay, as all material (including seed) is removed from the paddock immediately after cutting. A quality silage process will also kill up to 98% of any viable seed. If hay cutting is to be used, then the cut should be timed so that the target weed is prevented from setting seed. Timing of the cut is critical, as immature seeds may become viable while 'haying off' in the paddock.

Cultivation

Cultivation is mainly used when sowing or re-establishing a pasture. Cultivation and pasture re-establishment is an expensive alternative but is necessary to quickly replace an extremely degraded pasture. During the pasture establishment process, a cultivation fallow can be used to reduce the soil seed bank and the level of weed in the newly established pasture.

Slashing

Slashing can be a useful technique to prevent the seeding of certain weeds.

Reduce weed germination

Groundcover retention

Maintaining greater than 1500kg/ha of dry matter (DM) (including litter) and at least 80% ground cover at the autumn break can reduce the germination and establishment of weed species in 'pasture gaps'.

Maintaining a vigorous pasture at the autumn break is particularly effective in reducing autumn germinating weed seedlings, which are most susceptible to competition early in their lifecycle.

Maintaining groundcover not only reduces weeds but also:

- Reduces raindrop impact and run-off, soil erosion and nutrient movement.
- Can reduce evaporation by 50% (Francis 2001).
- Provides a food source for soil fauna.
- Insulates the soil against temperature extremes.

Note: Maintaining groundcover in autumn will also decrease clover germination. Once weeds have been reduced to an acceptable level and perennial grasses increased, legumes can be encouraged by higher utilisation of the pasture.

What does it mean for me?

A wide range of cost effective tools are available.

When developing a weed management strategy – make sure that you have options in place that:

- Remove the weed or reduce weed seed set.
- Reduce weed seed germination.
- Provide or increase competition from desirable species.

Do not rely too heavily on herbicides. While they are important in reducing initial weed numbers, other options must be integrated to achieve weed replacement. Herbicides can be expensive, the use of other management options can reduce weed management costs.



Review questions

List the three key management objectives for a weed strategy:

1.

2.

3.

List three weed management actions you are going to adopt that you haven't used before.

1.

2.

3.

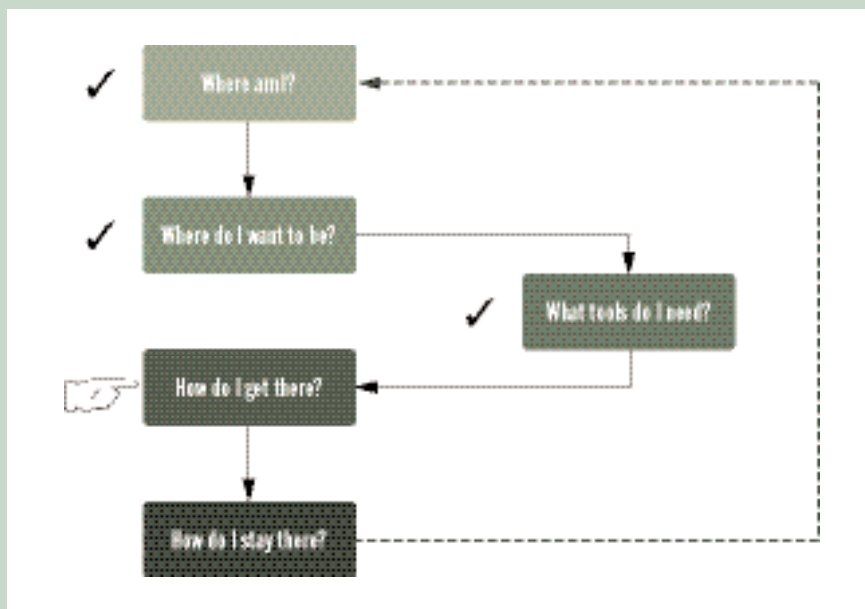
Write down three pasture management actions that you are going to adopt to help reduce the presence and impact of weeds.

1.

2.

3.

How do I get there?



- Use and integrate a range of weed and pasture management options that:
 1. Remove the weed or reduce weed seed set.
 2. Reduce weed germination.
 3. Encourage competition from desirable species.
- Strategies must be timed to the weed and desirable species lifecycles.

The aim of this session is to answer the question ‘how to get there?’ That is, how do I reach my paddock composition targets from my current situation?

Developing and implementing a plan of attack for weeds in pastures is an important process that requires planning, coordination and integration into whole farm planning. A weed strategy can be as simple as releasing biological control agents or it can be a more complex process involving the use of insects, livestock, herbicides and mechanical control means. A series of MLA Tips and Tools information sheets has been developed for five common weeds that demonstrate how management tactics can be combined to target weeds and simultaneously improve the desirable components of the pasture.

An effective weed strategy generally has the following features:

Flexibility

To adjust to seasonal conditions, pasture and weed responses and other farm priorities.

Practicality

Easy to implement and incorporate into the whole farming system.

Cost effective

The cost of implementing a weed strategy must be affordable. Any costs must be able to be repaid through better forage and livestock production.

Sustainable

The end result must be a more sustainable system.

Long-term focus

Leads to long-term reductions in weed presence, impact and better forage production.

Three key objectives

Has a range of management tools that satisfy the three key management objectives.

1. Remove the weed or reduce weed seed set.
2. Reduce weed germination.
3. Provide competition from desirable species.

Note: Depending on the initial status of the pasture, location and seasons, it may take several years of targeted management to achieve pasture composition goals.

Exercise 12 – Target weed actions

Based on the paddock sampled earlier in the day. Record a couple of actions for the target weed.

Try and integrate tactics that satisfy:

1. Remove the weed or reduce weed seed set.
2. Reduce weed germination.
3. Provides competition from desirable species.

Paddock strategy	
Paddock name or number:	
Target weed:	
When does it mainly germinate:	
When does it mainly seed:	
Season	Tactic
Autumn	
Winter	
Spring	
Summer	

What does it mean for me?

The following steps can be used when implementing Weed Removers, Pasture Improvers principles at home:

1. Choose a priority paddock(s) to which you can apply targeted pasture weed management.
2. Assess pasture composition for the degree of weed and desirable perennial grasses.
3. Based on the pasture's composition, decide whether the pasture will respond to targeted management treatments.
4. Select a range of management options that satisfy the three key objectives and achieve progress towards your pasture composition targets.
5. Implement your choice of options.
6. Monitor the pasture's composition for signs of species composition shift, (decline or increased weed invasion) and take action early.
7. Be flexible. Adjust weed and pasture management as required.
8. Seek advice from weed agronomists and pasture management advisers.

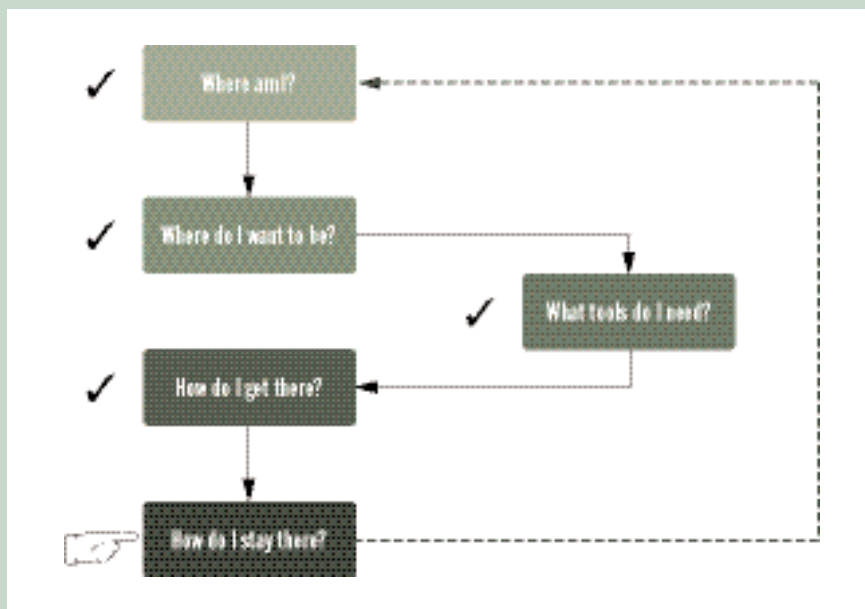
Note:

- *Where desirable species are at very low numbers the best option may be to re-sow.*
- *Strategies must be timed to the weed and desirable species lifecycles.*

Review questions

List six features of a weed strategy:

How do I stay there?



Better weed and pasture management means:

- Better grazing forage for livestock.
- Better financial returns (\$ income).
- Weeds maintained at low levels – pasture resilient to pending weed invasion.
- Reduced need for expensive pasture re-establishment.
- Sustainability issues from PMWC.

A secondary question that is addressed as part of the workshop is, 'once my paddock has achieved a good composition, how do I keep it there?'.

The answer lies in ongoing monitoring of the paddock to determine early signs of pasture decline. Early signs of pasture decline include:

- Loss of desirable species.
- Increased incidence of weeds.
- Gaps or too much bare ground in the pasture cover.
- Poor livestock performance.

The cause of pasture decline may be inappropriate species selection, grazing strategies, drought, soil fertility, salinity, acidity or pests such as red-legged earth mite or disease. While many causes of pasture decline can be identified through inspection or soil tests, management based impacts such as grazing intensity and timing are often a major contributor to pasture decline and may be the last to be identified and corrected.

Determining the cause of pasture decline and the most appropriate corrective action is not always apparent and can often be a complex combination of factors. Importantly, corrective action often commences too late, making the restoration process more difficult and costly.

What can I do about it?

If noticed early, halting and correcting pasture decline may be as simple as checking soil fertility and reducing grazing pressure (or perhaps short, well-timed grazing rests) to allow desirable species to increase their competitiveness within the pasture. If action is taken early, there will be a good (high) proportion of desirable species in the pasture to rapidly respond and regain dominance of the paddock.

If the pasture decline process is let go too long, desirable species will be a lower proportion of the pasture composition, hence more complex treatments will be required (see – how do I get there?) and the response will be slower. This means that the paddock will be operating at a lower production level for longer, impacting upon livestock production, sustainability and income.

Exercise 13 – Planned actions

List four things that you are going to do at home to maintain and improve the pasture's composition.

1.

2.

3.

4.

What does it mean for me?

- Weeds are a symptom of pasture decline – not the cause.
- Monitoring a paddock is the only means of determining pasture decline early.
- Commence corrective action early. The sooner you start, the quicker the recovery of the pasture and the lower the costs.
- Look for other signs and causes of decline.
- Grazing intensity and timing can have a large effect on pasture composition and is often the major contributor to pasture quality decline.

- Better weed and pasture management:
 - Better grazing forage for livestock.
 - Better financial returns (\$ income).
 - Weeds maintained at low levels – pasture resilient to pending weed invasion.
 - Reduced need for expensive pasture re-establishment.
 - Sustainability issues from PMWC.
 - Reduced need for chemical use.

Review questions

List four possible causes of pasture decline:

1.

2.

3.

4.

If you notice some signs of pasture decline in your paddock – list four things you will do:

1.

2.

3.

4.

List five benefits of better pasture and weed management:

1.

2.

3.

4.

5.

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Appendix B: 'Blundstone' and Quadrat table

'Blundstone' and Quadrat table

Paddock name/number _____ Date ____/____/____

% Cover estimate	Random sample number										Average
	1	2	3	4	5	6	7	8	9	10	
% Legume											
% Desirable grass											
% Broadleaf weed											
% Grass weed											
% Litter											
% Bare ground											
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Paddock name/number _____ Date ____/____/____

% Cover estimate	Random sample number										Average
	1	2	3	4	5	6	7	8	9	10	
% Legume											
% Desirable grass											
% Broadleaf weed											
% Grass weed											
% Litter											
% Bare ground											
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix C: PROGRAZE stick, transect and motor bike method assessment sheet

Assessment sheet for the PROGRAZE stick, transect and motor bike methods

Date _____ Assessor _____ Paddock Name/Number _____ Method used ☐ PROGRAZE ☐ Stick ☐ Transect ☐ Bike

Sample number	Legume	Desirable grass	Weed grass	Broadleaf weed	Litter	Bare ground	Sample number	Legume	Desirable grass	Weed grass	Broadleaf weed	Litter	Bare ground
1							27						
2							28						
3							29						
4							30						
5							31						
6							32						
7							33						
8							34						
9							35						
10							36						
11							37						
12							38						
13							39						
14							40						
15							41						
16							42						
17							43						
18							44						
19							45						
20							46						
21							47						
22							48						
23							49						
24							50						
25							Totals						
26							% Composition*						

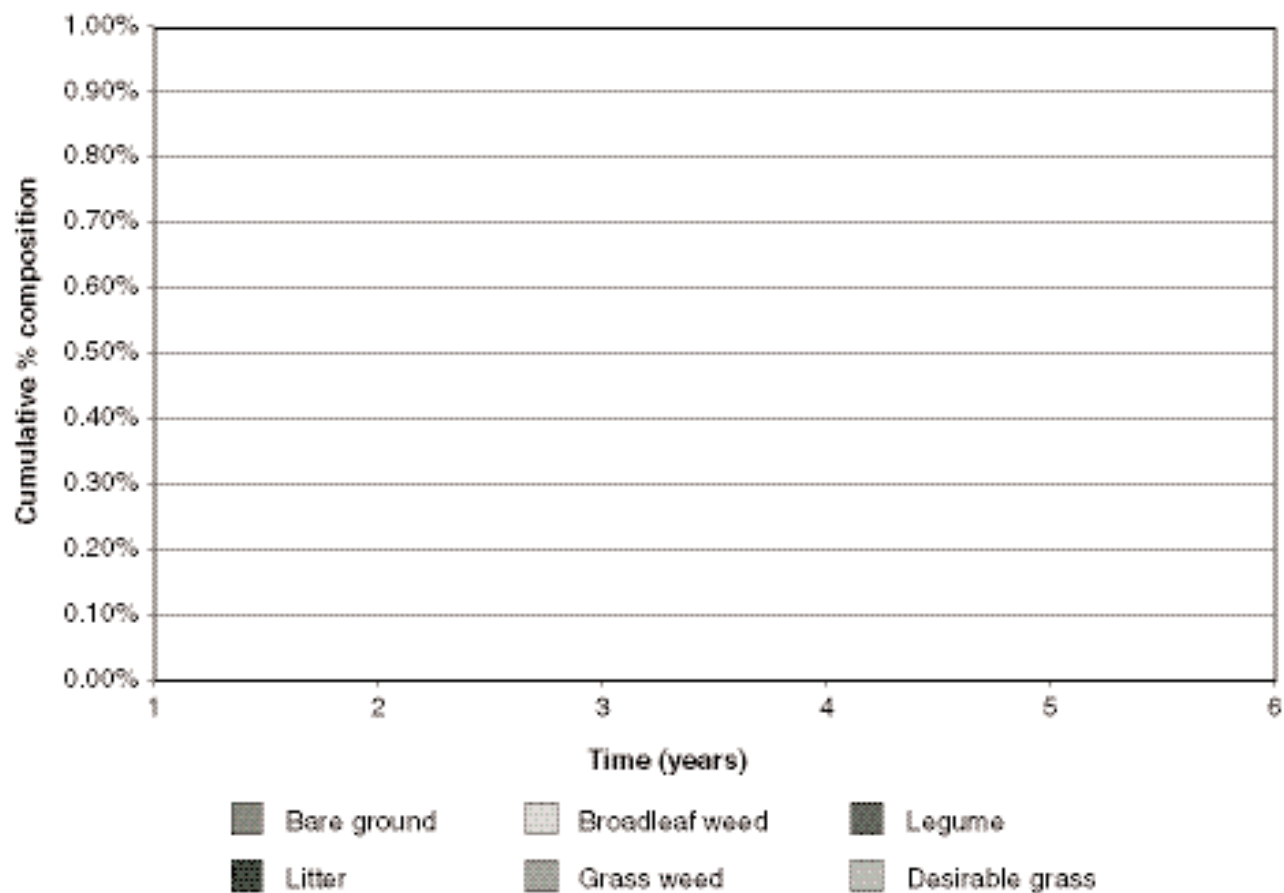
* If 50 points have been sampled, multiply the total by 2. If less than 50 have been sampled % composition = species total/number of samples X 100

Appendix D: Pasture target recording table

Pasture species group	% in pasture
Desirable grass	
Legume	
Grass weeds	
Broadleaf weeds	
Litter	
Bare ground	
Total	100%

Appendix E: Species composition graph

Pasture composition



Appendix F: Paddock strategy sheet

Paddock strategy	
Paddock name or number:	
Target weed:	
When does it mainly germinate:	
When does it mainly seed:	
Season	Tactic
Autumn	
Winter	
Spring	
Summer	

Appendix G: Glossary

Arable	Land suitable for cultivation.
Annual	A plant that completes its lifecycle within one year.
Biennial	A plant that flowers and bears fruit only in the second year, then dies.
Colonisers	Are the first species to occupy disturbed land.
Digestibility	A measure of the proportion of pasture or feed which, once consumed, can be used by the animal.
DSE	Dry sheep equivalent – is represented by the amount of available pasture required to maintain an adult sheep at 45kg live weight.
Ecosystem	The variety of plants, animals and soils, and their interactions with each other and the environment.
Functional group	A group of plants linked by similar broad features and lifecycles, for example perennial grasses, annual legumes, and annual grasses.
Gross margin	The income from an enterprise less the variable costs for the enterprise.
Heading	Refers to grasses that are about to produce flowers or ‘come into head’.
Heavy grazing pressure	50-150DSE/ha for short periods (5-10 days).
High density grazing	50-150DSE/ha for short periods (5-10 days).
Integrated weed management (IWM)	Using or integrating a range of weed management and ‘vegetation’ management tactics to achieve a long-term reduction in weed populations. Well planned IWM programs achieve a greater level of control than the use of individual methods alone.
Monoculture	Pasture or crop growth based on a single species.
Net present value (NPV)	The discounted present-day value of the total annual net returns over the life of the pasture.
Non-arable	Land that cannot be safely cultivated.
Opportunity cost	The value of livestock production foregone, for example from having a weedy pasture - relative to a weed-free pasture system.
Palatable	Relates to the preference (or priority) that grazing animals show when a range of species is offered.
Pasture assessment	Determining the species present within the pasture and the amount of forage material present.
Pasture composition	The proportional mixture of plant species or groups within the pasture.

Pasture decline	The loss of desirable species and their replacement with weeds, resulting in lower forage quality and quantity.
Perennial	A plant which continues to grow from year to year. Production of new growth by perennial grasses each year is from tillers and buds located on a persistent crown.
pH	A measure of a soils acidity or alkalinity expressed as a scale of 0-14. pH 7 is neutral, less than 7 is acid, more than 7 is alkaline.
Recruitment	Germination from seed.
Rotational grazing	Livestock are rotated (using fixed grazing periods) around a series of fenced paddocks.
Seed bank	Seeds in the soil that germinate when conditions are favourable.
Set stocking	Paddocks are grazed year round at a stocking rate that largely does not change over the year.
Sustainability	A variety of definitions exist, but here the most useful might be.... The use of farming systems and practices which maintain or enhance: • The economic viability of agricultural production. • The natural resource base. • The social capital of rural communities. (Referred to as the 'triple bottom line').
Tactical grazing	Paddocks are subjected to periods of grazing and rest, determined by basal cover, stage of development/lifecycle and biomass.
Tiller	A side shoot from the base of a plant near the ground, for example from the bottom of the stalk or stem of cereals and grasses.
Weed	A plant environmentally suited to its place in the landscape, but from an agricultural productivity, ecological or aesthetic perspective is a plant out of place.



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