Timing pasture cutting for weed management.

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Abstract

Silage and hay making can be strategically utilised to manage weeds in pastures. The effect of spring cutting on botanical composition was investigated in an experiment at Wagga Wagga, southern NSW. A phalaris-cocksfoot-subclover pasture invaded by annual weeds, was continuously grazed by sheep or mechanically defoliated once during spring (at either early October, late October, early November or late November). A number of pasture measurements (including botanical composition, seed production, and herbage quality) were taken over three years to determine changes over time.

The frequency of broadleaf weed species increased in the pasture after two years of cutting in early or late October. Cutting in October also significantly reduced the presence of vulpia and increased annual ryegrass. Subclover content was increased if cutting occurred in early October. Continuous grazing or cutting in late October reduced phalaris tiller density after two years. Vulpia was increased and annual ryegrass reduced after two years of continuous grazing or cutting in November. Annual grasses such as barley grass and great brome increased with continuous grazing. Early November cutting or continuous grazing reduced the occurrence of Paterson's curse after one or two seasons. Cutting in late November increased the density of annual species in the pasture, and also increased the tiller density of the phalaris.

The quality of the cut material was highest in early spring and declined with later cutting times. There was no significant difference in the total amount of dry matter produced during the spring in the mechanically defoliated pastures. The growth stage of the target weed at the time of cut will determine the impact strategic spring pasture cutting has on future pasture composition. Reducing annual weed seed production and seed entry into the soil is the key to improving pasture composition.

Introduction

The use of non-selective defoliation techniques such as those used for spring forage conservation, have the potential to provide a useful, non-herbicide method of pasture weed management. However, timing the cut is critical to prevent regrowth of the target weed (and subsequent seed production) and minimise damage to desirable pasture species. The critical time will vary for each pasture species. Understanding the effects of spring forage conservation on temperate pasture growth and development is essential to optimise weed management.

Materials and methods

Site description and preparation

The experiment was located at the Wagga Wagga Agricultural Institute, Wagga Wagga (35°5'S, 146°6'E, elevation 219 m, average annual rainfall 572 mm) in southern New South Wales. In 1995 the eight hectare paddock was sown with a mixture of perennial grasses (*Phalaris aquatica* (phalaris) cv. Sirosa and *Dactylis glomerata* (cocksfoot) cv. Porto) and *Trifolium subterranean* (subclover) cvs Goulburn and Junee. In 1996, the pasture was grazed by sheep and no herbicide or fertiliser were applied. The predominant weed species were *Echium plantagenium* (Paterson's curse), *Arctotheca calendula* (capeweed), *Lolium rigidum* (annual ryegrass) and *Vulpia* spp. (vulpia or silver grass). There were five treatments:

Treatment 1: Continuously grazed by sheep (10 dry sheep equivalents (DSE) per ha)

Treatment 2: Grazed by sheep 1 January–1 August; sheep excluded and mechanically defoliated early October
(district equivalent of a silage cut)

Treatment 3: Grazed by sheep 1 January–1 August; sheep excluded mechanically defoliated late October
(district equivalent of a late silage cut)

Treatment 4: Grazed by sheep 1 January–1 August; sheep excluded mechanically defoliated early November
(district equivalent of a hay cut)

Treatment 5: Grazed by sheep 1 January–1 August; sheep excluded mechanically defoliated late November
(district equivalent of a late hay cut)

The mechanical spring defoliation treatments were cut to a height of 10 cm and repeated over three years (1997-1999). The experimental area contained four replicates that were separated by 10 m wide buffers. Each replicate consisted of five 10 m x 20 m plots. Defoliation treatments were allocated to the plots randomly. The uniformity of grazing in the continuously grazed plots was improved by positioning them within the experimental design to allow maximum accessibility by the sheep from the surrounding paddock.

Mechanical defoliation treatments

The mechanical defoliation was achieved using a small plot forage harvester. The pasture was cut to 5 cm and the harvested material removed from the experimental area. The cutting dates were at approximately 17 day intervals each spring.

Management of livestock

The experimental area was grazed by sheep (wethers) at 10 DSE per ha from July 1997. To prevent preferential grazing, plots that were mechanically defoliated were not reopened to grazing until the herbage in the plots was visually assessed as similar in pasture height to that in the surrounding paddock.

Botanical composition

Botanical frequency was assessed at various times during the spring using a non-destructive modified rod-point quadrat technique. Species frequency was calculated and percentage contribution of each species to botanical composition was estimated.

Pasture digestibility

Digestibility subsamples were taken from the bulk harvested material at the time of each spring defoliation.

Results and discussion

Botanical composition and seed production

After two years , large changes in pasture composition occurred as a result of the various defoliation methods and their timing (Table 1). Compared to grazing, defoliating in early October (equivalent to an early silage cut in this region), significantly improved subclover and annual ryegrass content, and reduced vulpia. Cutting at this time may favour an increase in the content of Paterson's curse if the regrowth is not managed as the regrowth can successfully produce viable seed.

Continuously grazing the pastures during spring had a large impact on Paterson's curse seed production (Table 2) and subsequent autumn seedling germination but favoured annual grass species such as vulpia, bromes and barley grass. Although in this experiment the pasture regrowth was not grazed until mid-summer, a strategic grazing and/or use of herbicide on the spring regrowth may have further minimised seed production for some species (eg Paterson's curse).

Cutting in early November would equate to the timing of a traditional hay cut for Wagga Wagga and surrounding districts. Defoliating at this time reduced annual ryegrass and subclover content in the pasture in following years. However the vulpia content significantly increased as large amounts of viable seed was produced and shed prior to the November cuts.

The stage of growth of a species at the time of defoliation determines its response to the cutting eg subsequent re-growth and seed production. For weed

Table 1 Effect of grazing by wethers (10 DSE per ha) and cutting times on species composition of a mixed annual grass/subclover/perennial grass pasture the third spring after cutting or grazing in each of the two previous springs.

Species	Initial pasture composition (%)	Grazing only	Grazed then cut in spring (no control of regrowth)			
			Early Oct (silage)	Late Oct (late silage or early hay)	Early Nov (traditional hay – district practice)	Late Nov (late hay)
		Species in pasture in year 3 (%)				
Phalaris + cocksfoot	15.9	15.4	18.4	14.2	14.1	16.6
Subclover	31.4	18.1	36.6	11.6	15.6	19.9
Naturalised clovers	3.9	0.5	4.5	0.3	4.0	6.6
Annual ryegrass	25.1	17.7	28.3	52.8	9.8	9.2
Vulpia (silvergrass)	~~25.1~~ 16.4	~~17.7~~ 26.3	~~28.3~~ 2.0	~~52.8~~ 10.3	~~9.8~~ 53.2	9.2 41.3
Great brome	↑ 16.4 1.0	26.3 14.1	2.0 2.1	~~10.5~~ 0.2	~~53.2~~ 1.3	~~41.3~~ 3.9
Barley grass	↑ ~~1.0~~ 0.3	~~14.1~~ 4.8	~~2.1~~ 0.2	~~9.2~~ 0	~~1.5~~ 0.4	3.9 0.1
Paterson's curse	3.5	0.3	6.9	4.4	1.4	1.5
Other broadleaf weeds	2.3	2.7	1.2	6.0	0.8	0.2

Table 2 Impact of one or two years of grazing or cutting on the seed production of annual ryegrass, vulpia, and Paterson's curse.

Defoliation method	Annual species seed production (seeds/m²)					
	Annual ryegrass		Vulpia		Paterson's curse	
	1 year	2 year	1 year	2 year	1 year	2 year
Grazing	1 481	1 669	6 824	18 469	20	22
Cut early October	981	834	1 004	56	973	877
Cut late October	95	7	208	29	303	86
Cut early November	237	2 896	2 248	13 650	7	223
Cut late November	990	6 879	11 985	29 895	208	2 153

management in this experiment, the optimum stage for cutting annual grasses is when the majority (eg 75%) of the most advanced seed heads is between post-flowering and very early seed fill. For Paterson's curse, the optimum cutting time appears to be when the earliest (lowest) flowers are starting to form green seeds on the most advanced flowering head.

Further research is required to provide clear guidelines on the critical growth stages for other pasture species, so that farmers can identify the optimum cutting time. This approach will be much more reliable with respect to weed management than setting defoliation dates by a calendar as species development will vary with region and year.

Digestibility

The forage quality of the removed herbage was reduced as spring progressed (Table 3) and as the composition changed during the three seasons of cutting (Table 1). After two years of cutting (1999), the quality of the pasture cut in early October was higher than all the other fodder conservation times. The forage removed at this time was dominated by subclover and annual ryegrass. The poor digestibility of the pastures cut in November (less than the 55% required for maintenance) is due predominantly to the increase in their vulpia content. The vulpia was also at a very advanced stage of development ie at or post-seed production. The quantity and quality of pasture biomass produced was partially influenced by the rainfall received during the spring growing season. The rainfall during August and September was similar during the three years presented. The rainfall received in October and November 1997 was substantially lower than the two subsequent years and reduced the capacity for pasture re-growth after each forage cut.

Incorporating spring cutting into an IWM plan

Use of Tactic Groups

The key goal of managing weeds in any farming system is to stop the target weed from reproducing and spreading. Just as herbicides can be grouped by mode of action (MOA), weed control measures can be grouped according to their main aim (Table 4). Splitting tactics into these five 'Tactic Groups' will assist in planning a more successful weed management program for your pasture and farming enterprise. The aim is to have control measures from one Tactic Group backing up control measures used previously, from a different Tactic Group. Any survivors of a control measure used from one Tactic Group can be targeted at another opportunity by

Table 3 Effect of time of cut in spring (1999) on the yield at cutting and from the regrowth for a mixed annual grass, subclover and perennial grass pasture dry matter after two years of cutting in spring.

Defoliation method	Cutting time and harvest strategy			
	Early October (early silage)	Late October (late silage or early hay)	Early November (traditional hay district practice)	Late November (late hay)
Dry matter removed at time of cut (t DM/ha)	1.67	1.97	2.98	2.43
Organic matter digestibility (%)	68.0^{c}	57.4^{b}	54.3^{b}	51.0^{a}
Total spring dry matter* (t DM/ha)	5.34	4.67	5.05	4.48

*Total spring dry matter = dry matter removed at time of cut + residual dry matter + regrowth after cut.
Values followed by the same letter are not significantly different, $P < 0.05$

Table 4 Tactic Groups for weed management.

Tactic Group number	Aim of Tactic Group
Tactic Group 1	Deplete weed propagules (eg seeds) in target area.
Tactic Group 2	Kill and remove weed from target area.
Tactic Group 3	Stop weed forming viable propagules (eg seeds).
Tactic Group 4	Prevent weed propagules (eg seeds) from existing weeds entering the target area.
Tactic Group 5	Prevent viable weed propagules (eg seeds) from external sources entering the target area

using one from the next Tactic Group. The more opportunities taken to control the weed, the fewer survivors there will be.

Spring cutting as a weed management tactic

Silage production, and to a lesser extent hay making, can be successfully incorporated into an IWM plan. These forage conservation techniques can assist to manage weeds by:

i) reducing the viable seed-set of target weeds (Tactic Group 3); and

ii) removing viable weed seeds so that they are not added to the soil seedbank (Tactic Group 4).

The opportunity to use strategic spring cutting to make silage or hay, may arise when excessive numbers of weeds have escaped a previous tactic in a crop or pasture phase. In the Wagga Wagga pasture experiment described in this paper, the viability of weed seeds contained in the dry matter removed from the pasture plots was not determined. However, the growth stages of the weeds were assessed at the time of cutting. As pastures cut late in spring (hay cut) had a high proportion of weed seed that had filled or had been shed, much of this seed would be viable. Greater weed seed viability in pasture cut for hay has implications for the sale or feeding out of conserved forage and consequently weed spread.

The Wagga Wagga experiment did not ensile any of the cut material to measure seed viability after silage production. A Canadian study by Blackshaw and Rode (1991) identified that ensiled broad leaf weeds can still have low levels of viability however this has yet to be proved for common Australian weeds.

Key messages

Introduced hay or silage has the potential to bring weed seeds with it. It is advisable to feed out in dedicated areas that can be monitored so that any introduced weed seeds can be controlled. Hay, in particular has the potential to contain high proportions of viable weed seed if it has been cut when weeds have already set seed.

If mechanical defoliation is to be used as a weed management tactic in pastures, the optimum time to manage the target weed may not correspond with the optimum time for obtaining maximum forage quality. Farmers wishing to incorporate strategic spring defoliation into their pasture weed management plans need to determine a balance between forage quality and desirable changes to pasture composition.

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