# Final report

## EPDS Annual grass control strategies in a perennial pasture system

***A systems approach to reduce annual grass in perennial pasture systems to ultimately improve meat and wool quality post farm.***

Project code: E.PDS.1803

Prepared by: 1 Tess McDougall and 2 Rob Shea
1 Agriculture Victoria, 2 Perennial pasture Systems

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# Abstract

Barley grass is a prolific weed. While it provides early season feed, the animal health concerns late in the season are a continuing problem for producers. The aim of this project was to demonstrate methods to reduce the reliance on chemical control by investigating other options such as mechanical removal, increased competition and grazing management.

Perennial Pasture Systems (PPS) members already using barley grass control practices were targeted as site hosts and trials were set up on thirteen properties in the area. These trials were assessed for their effectiveness in barley grass control.

Success was demonstrated on sites where over sowing and weed control methods were used in combination, and where silage was made. The demonstration has provided useful information on the management of barley grass within the pasture system.


# Executive summary

### Background

The incursion of annual weeds into pastures and a reduced number of herbicide options for their control prompted Perennial Pasture Systems (PPS) to look for a broader range of management techniques. The main PPS group is based around Stawell and Ararat with rainfall totals of 450-500mm per annum. Members predominantly run perennial pasture-based systems with sheep; both prime lamb and wool enterprises.

This demonstration began with a focus on annual grass weeds generally, however early in the project there was a shift in focus to barley grass control. Barley grass (*Hordeum leporinum*) continues to be an issue in pastures, especially after periods of dry conditions and where perennial pasture has thinned. Barley grass can have a huge impact on the ability of growers to turn off seed-free meat and wool, with producers incurring price downgrades to various extents. In addition to the price downgrades there are significant animal health issues that arise from the sharp seeds. The invasion of annual grasses also has a deleterious effect on desirable grasses; competing for light, nutrients and moisture. The aim of the project was to reduce the reliance on chemical control by investigating other options such as mechanical removal, increased competition and grazing management. PPS aimed to demonstrate single or combined methods of reducing barley grass in perennial pasture on member farms.

The results of the demonstration have been extended to members and more broadly and show a range of different management techniques and their success or failure as a method of barley grass control.

### Objectives

To demonstrate the impact (both positive and negative) of various barley grass control strategies on total dry matter production and pasture composition in perennial pastures.

To demonstrate a combination of options to reduce barley grass seed numbers across member sites.

To increase the knowledge and skills of the producers regarding barley grass control in perennial pastures.

## Methodology

Host producers were sought from PPS membership to trial seven different strategies across four key themes: increasing competition, mechanical removal, chemical control and grazing management.

Trial sites were assessed for barley grass control by counting seedheads, pasture composition assessments and dry matter assessments. Where possible multiple trial sites were used to assess each strategy.

## Results/key findings

The seven strategies measured varying levels of success. Mechanical removal and increasing competition in combination with chemical control was the most successful at reducing barley grass during the project. Other successes were the mechanical removal with methods such as silage, which also make the ensiled seed unviable. A reduction from competition alone was difficult to achieve in demonstration and intense grazing management was problematic to manage with neither achieving a reduction in barley grass. Chemicals showed a success in reducing barley grass, however the effects were not long lived, often a second germination is possible if conditions are favourable.

The Mount Dryden Site 2 result included a cost:benefit analysis. This showed a benefit where chemical control and nitrogen plus over-sowing were trialled of $842/ha above areas where weed control and Nitrogen were used without over sowing. A reduction in barley grass numbers was also achieved, which remained in the two seasons following treatment.

The silage made at sites during the demonstration was also tested for seed viability, which returned results indicating that 0% of the ensiled barley grass seeds tested were viable. This result combined with an overall reduction in barley grass numbers after the silage are considerable for farmers in the area that can use this management technique.

The effects of COVID-19 on the demonstration resulted in a reduced number of face-to-face events being held, however written publications from the demonstration have been spread widely throughout the area. The project overview was also delivered to the 61st Grasslands Conference in 2020.

An increase in knowledge and skills was recorded from participants surveyed.

## Benefits to industry

This project has increased the overall knowledge of barley grass across core and associate members. This includes extension of practical management techniques to reduce the risk of animal welfare issues and price downgrades of sheep meat and wool due to barley grass seeds.

Results gained in this project show a reduction in barley grass seed set in one year can continue to benefit pastures for up to two years after the initial action was taken, which could reduce the reliance on chemical control for some members.

## Future research and recommendations

- Further quantification of feed quality results in a changing climate and with improved cultivars.
- Further investigation into late season barley grass management methods such as slashing and mulching to manage impacts on animals.

# PDS key data summary table

*Complete all sections of the key data summary table* ***applicable*** *to your project. Refer to the 'Engagement and Adoption Performance Metrics' section of your Agreement for key metrics that are nominated for your project.*

**Project Aim:**
The demonstration aimed to measure the impact of techniques that are currently being implemented to reduce annual grass weed invasion.

| | Comments | | Unit |
|---|---|---|---|
| **Number of core participants engaged in project** | Hosts/ key producers | 14 | |
| **Number of observer participants engaged in project** | Rest of PPS membership | 120 | |
| **Core group no. ha** | Approx. | 17,000 | |
| **Observer group no. ha** | Approx. | 173,000 | |
| **Core group no. sheep** | Approx. | 82,000 | hd sheep |
| **Observer group no. sheep** | Approx. | 600,000 | hd sheep |
| **Core group no. cattle** | Approx. | 1,100 | hd cattle |
| **Observer group no. cattle** | Approx | 32,300 | hd cattle |
| **% change in knowledge, skill & confidence – core and observers** | *The impact of barley grass control on total dry matter production and pasture composition in perennial pastures* | INCREASE<br>Knowledge 34%<br>Attitude 12%<br>Skills 25%<br>Aspirations 14% | Changes<br>5.6/10 to 7.4/10<br>8/10 to 8.9/10<br>6.1/10 to 7.7/10<br>8.0/10 to 9.2/10 |
| **% change in knowledge, skill & confidence – core and observers** | *Barley grass control in perennial pastures* | INCREASE<br>Knowledge 35%<br>Attitude 13%<br>Skills 23%<br>Aspirations 17% | Changes<br>5.6/10 to 7.6/10<br>7.6/10 to 8.6/10<br>6/10 to 7.4/10<br>7.5/10 to 8.8/10 |
| **% adoption – core and observers** | *Adoption of assessing pastures for barley grass composition* | INCREASE<br>28% | Change<br>48% to 76% |
| **% adoption – core and observers** | *Over sowing to control barley grass* | INCREASE<br>20% | Change<br>24% to 44% |

**Key impact data**

**A cost:benefit analysis was conducted on one of the barely grass control trials. The three-treatments included:**

- **Full Treatment: Over sowing, weed control and Nitrogen**
- **Partial Treatment 1: Over sowing and Nitrogen (no weed control)**
- **Partial Treatment 2: Weed control and Nitrogen (no over sowing)**

**Analysis showed a clear benefit for using both weed control and over sowing and a reduced benefit when over sowing was completed without weed control. This highlights that the minimal cost of weed control was justified by the additional benefits it gives to production. Feed value was based on an ME value equivalent to feed barley and CP was valued according to lucerne hay, a method developed by Lewis et al (2019).**

| | |
|---|---|
| **Marginal profit ($) /ha** | **$979/ha above partial treatment 2 (extra 2,657 kg DM/ha)** |

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# 1 Background

Barley grass is the dominant annual weed species in areas of rainfall above 425mm/year (Fleet and Gill, 2012) and is proving to be the most prolific and problematic annual grass issue in the region.

Barley grass came from Europe and Asia and has proven to be well adapted to Australian conditions (Agriculture Victoria, 2019).

**Figure 1: Barley grass infestation near Stawell, 2019**

While barley grass can produce large quantities of pasture feed, especially in autumn, it becomes a problem when seed is set causing animal health issues due its sharp, pointy seedheads. Large infestations of barley grass can also reduce the persistence of perennial grasses through increased competition for moisture and sunlight.

Barley grass infestations can produce a prolific number of seeds. Counts from this demonstration regularly equated to over 21 million seedheads per hectare. At an estimated 25.3 seeds/head from 27.5 spikelets/head with 92% fertility (Halloran, et.al, 1981) severe barley grass infestations (see Fig. 1) can result in prolific seed numbers to carry over to the next year (Fig 2. Equation 1).

The glumes and awns of barley grass are rough and sharp assisting it to anchor into soil to germinate and establish. The seed is a problem in pasture, hay and silage, causing eye injuries to sheep and reduced wool quality (DPIRD, 2019)

**Figure 2: Seedhead counts and potential viability of barley grass using a count from a paddock in the project**

**Seedhead counts from demonstration site measured at random in a set square;**

$$2{,}165\ \frac{seed\ heads}{m^2} \times 10{,}000 = 21{,}625{,}000 \frac{seed\ heads}{hectare}$$

**Equation 1: Seedhead counts and potential viability of barley grass using a count from a paddock in the project**

**Individual seed count and fertility estimation;**

$$\left(27.5 \times 0.92 = 25.3\ \frac{fertile\ seeds}{seed\ head}\right) \times 21{,}625{,}000 = 547{,}112{,}500\ \frac{potentially\ fertile\ seed\ heads}{hectare}$$

Understanding of the factors affecting the population dynamics of annual grass weeds can enable better selection of weed control strategies. A review of control methods found that if bare ground was minimised during autumn and early winter, a reduction in annual grasses establishment and subsequent seed production was observed. Rotational grazing reduced the estimated annual species population growth (K. Tozer et. al, 2008)

# 2 Objectives

**To demonstrate the impact (both positive and negative) of various barley grass control strategies on total dry matter production and pasture composition in perennial pastures.**

Achieved; the demonstration investigated various methods of barley grass control with varying levels of success.

**To demonstrate a combination of options to reduce barley grass seed numbers across member sites.**

Achieved; control options were used in combination, with varying levels of success.

**To increase the knowledge and skills of the producers regarding barley grass control in perennial pastures**

Achieved; PPS members (core and observers) indicated their knowledge of barley grass control in perennial pastures had increased during the project by 35% and skills increased by 23%.

# 3 Methodology

## 3.1 Paddock assessments

### 3.1.1 Pasture composition assessments

Visual assessments were made by estimating the percentage of each species present in spring. The method was calibrated using the “pasture stick” method and had proven to have sufficient accuracy for the purpose of the demonstration.
Pasture composition assessments were replicated in three quadrates at each treatment where this measurement was used.

### 3.1.2 Dry matter measurements

Pasture growth was measured using pasture cages to exclude grazing. Feed was cut and samples were dried and weighed to calculate dry matter production.
Feed tests were taken multiple times over the growing season from August to November and sent for commercial feed testing.

### 3.1.3 Seedhead counts

Barley grass seedheads were counted in spring to assess differences in demonstration treatments. Seedheads within a 40 x 40 cm square were counted on site or cut and dried then counted at a later date.
Seedhead counts were replicated three times on each treatment and control site.

## 3.2 Sowing into existing pasture

**Aim:** to increase competition by over-sowing into existing pastures using desirable species.

**Treatment:** Over-sowing was conducted with different grass and crop species (Table 1) sown as replicated strips in paddocks. Unsown 'control' areas were used as a comparison. Table 1 shows the sowing regime and Table 2 indicates measurements and timing.

**Table 1: Sowing into existing pasture methodology**

| Year | Site | Existing Pasture | | Weed control Date if known | Variety | Date sown | Seed row spacing (cm) or rate |
|---|---|---|---|---|---|---|---|
| 2019 | Tulkara | Lucerne | Treatment | Glyphosate Estercide | Moby Barley/ Oats/ Ryecorn @ 110 kg/ha | 18/5/2019 | 25 |
| | | | Control | Glyphosate Estercide | Not oversown | N/A | N/A |
| | Mt Dryden site 1 | Phalaris/ sub clover | Treatment | Nil | Ryegrass Tetila 5kg/ha & 10kg/ha | 28/4/2019 | 15 |
| | | | Control | Nil | Not over sown | N/A | N/A |
| 2020 | Ararat site 1 | Lucerne | Treatment | Clethodin 360 & Verdict 520 (barley Grass) Simazine, Diuron, Di-par (broadleaf, marshmallow) | Verdura Tetrapolid (ryegrass) | 1/6/2020 | 16kg/ha |
| | | | Control | Nil | Not over sown | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Elmhurst | Phalaris/ sub clover | Treatment | Spraytop 2019 & Gramoxone autumn 2020 | Tetila (ryegrass) | 2/5/2020 | 15kg/ha |
| | | | Control | Nil | Not over sown | N/A | |
| 2020-2022 | Mt Dryden site 2 | Phalaris/ sub clover | Full treatment | Paraquat 250 @ 1L/ha 12/5/2020 | Ryegrass Tetila 16kg/ha Balansa and Trikkala clover 4kg/ha | 14/5/2020 | 16kg/ha |
| | | | Partial treatment 1 | Nil | Ryegrass Tetila 16kg/ha Balansa and Trikkala clover 4kg/ha | 14/5/2020 | 16kg/ha |
| | | | Partial treatment 2 | Paraquat 250 @ 1L/ha 12/5/2020 | Not over sown | N/A | N/A |

**Table 2: Sowing into existing pasture- assessments conducted**

| Site | Date | Assessment |
|---|---|---|
| Tulkara | Spring 2019 | Pasture composition assessment |
| Mount Dryden site 1 | Winter/Spring 2019 | Seedhead counts<br>Dry matter measurements<br>Pasture composition assessment |
| Ararat site 1 | Spring 2020 | Seedhead counts<br>Pasture composition assessment |
| Elmhurst | Spring 2020 | Seedhead counts<br>Pasture composition assessment |
| Mount Dryden site 2 | Winter 2020 | Pasture composition assessment<br>Dry matter measurements |
| | Spring 2020 | Pasture composition assessment<br>Dry matter measurements<br>Seedhead counts |
| | Summer 2020 | Dry matter measurements |
| | Autumn 2021 | Seedling counts |
| | Spring 2021 | Seedhead counts<br>Pasture composition assessment |
| | Autumn 2022 | Seedling counts |

## 3.3 Hard seeded legumes

**Aim:** To assess if competition provided by hard seeded legumes can control annual grass weeds in multiple years. Specifically;(1) Can early sown Arrowleaf provide competition for annual grasses?

(2) Will residue of hard seed germinate in subsequent years & suppress annual grasses?

**Treatment:** Paddocks were over sown with Arrow leaf clover. Control areas were left for comparison.

Table 3 indicates establishment details and Table 4 shows assessments and timing.

**Table 3: Hard seeded legume site establishment**

| Date sown | Locality | Soil | Method | Variety and rate |
|---|---|---|---|---|
| Autumn 2019 | Nareen | Clay loam | Broadcast, rolled | Arrowleaf clover 8kg/ha |
| | Joel South site 2 | Sandy loam | Direct drilled, disc depth10mm | |
| | Addington | Clay loam | Direct drilled | |
| | Tulkara | Sandy loam | Direct drilled | |
| | Ararat site 2 | Loam | Light scarified, Broadcast, | |

**Table 4: Hard seeded legume site assessments**

| Site | Date | Assessment |
|---|---|---|
| Nareen<br>Joel South<br>Addington<br>Tulkara<br>Ararat site 2 | Spring 2019 | Pasture composition assessment |
| Ararat site 2<br>Addington | Spring 2020 | |

## 3.4 Chemical options and resistance testing

**Aim:** To assess conventional spray options for the removal of annual grass species and investigate resistance to common chemical controls. Table 5 indicates sites and treatments applied.

**Table 5: Conventional chemical options - sites and treatments 2018**

| Site | Existing pasture | Date treated | Treatment | Assessment |
|---|---|---|---|---|
| Dobie | Annual ryegrass | 2018 | 400ml/ha Paraquat | Seedhead counts |
| Elmhurst | Phalaris and sub clover | 24/10/2018 | 1L/ha Grammoxone | Seedhead counts Spring 2019 |

### 3.4.1 Chemical options trial conducted by Tyler's Rural

**Treatment:** Randomised trial conducted by agronomist at Tyler's Rural, Stawell. To assess the effectiveness of Propaquizafop (Shogun®) and Haloxyfop (Verdict™) at different rates. Assessments were conducted to assess the health of Phalaris after removal of barley grass.

The image in Appendix 7.3 shows how the plots were set up along with the chemical rates applied. The sites were sprayed on the 8/5/2019 and assessed for barley grass death and phalaris damage 28 days post spray. Assessments recorded using the key in Table 7. No further results were observed from this trial.

**Table 6: Chemical rates applied**

| Treatment |
|---|
| Control |
| AMS 0.8% + Verdict 25ml/ha + 0.5% Uptake |
| AMS 0.8% + Verdict 50ml/ha + 0.5% Uptake |
| AMS 0.8% + Verdict 75ml/ha + 0.5% Uptake |
| AMS 0.8% + Shogun 200ml/ha + 0.5% Hasten |
| AMS 0.8% + Shogun 250ml/ha + 0.5% Hasten |

**(AMS; Ammonium Sulphate)**

**Table 7: Plant assessment key to determine effect of chemical on phalaris and barley grass**

| | |
|---|---|
| **0** | No Effect |
| **1** | Slight Effect |
| **2** | Moderate Effect |
| **3** | High Effect |
| **4** | Severe Effect |
| **5** | Plant Death |

### 3.4.2 Chemical resistance testing

PLANT SCIENCE CONSULTING
by Dr. Peter Boutsalis

22 Samples of barley grass were taken from 16 properties and were reported anonymously. All samples were dried and sent to Plant Science Consulting for analysis. 9 samples were taken from Phalaris pastures, 3 from Ryegrass and 7 from Lucerne pastures.

**Treatment:** Seedings were germinated and planted in 0.55L pots (2 replicates) 10 seedlings per pot (1000 seedlings/$m^2$). Herbicide was applied at the correct growth stage with T-jet fan nozzels at a speed of $1ms^{-1}$. Output of the sprayer was 100L $ha^{-1}$ at a pressure of 250kPa. Plants were assessed for survival at 4 weeks post spray.

Two chemicals were tested on each sample at post emergent timings. Samples were tested for Quizalofop resistance (group A herbicide), Paraquat resistance (group L), Diuron resistance (group C herbicide) and for Glyphosate resistance (Group M). Susceptible standard barley grass populations and quizalofop/paraquat resistant barley grass populations were included.

## 3.5 Mechanical removal of seedheads

**Aim:** To assess whether the mechanical removal of seedheads is a viable option for barley grass. control.

### 3.5.1 Hay simulation

**Treatments:** Hay making simulation and control

Ararat site 1 was used for this assessment, beginning in 2018. Seedheads were removed using a hand mower and catcher. This procedure was replicated in spring each year of the project. The plot adjacent plot was set up as a control.

Seedhead counts were taken randomly at nine intervals across the 4m[2] treatment area and control areas.

### 3.5.2 Silage making

**Treatments:** Silage and control areas.

Silage was cut at two barley grass infested sites in spring 2019 and one site in spring 2020. Table 8 shows the monitoring and timing of pasture assessments.

**Table 8: Assessments conducted on silage sites**

| Site | Date | Assessment |
|---|---|---|
| Tulkara site 2<br>Ryegrass pasture | Spring 2019 | Pasture composition assessment<br>Seedhead count |
| | Summer 2019 | Seed viability samples taken |
| | Spring 2020 | Seedhead count<br>Pasture composition assessment |
| Glenlofty site 1<br>Phalaris pasture | Spring 2019 | Pasture composition assessment |
| | Summer 2019 | Seed viability samples taken |
| | Spring 2020 | Pasture composition assessment |
| Crowlands site 1<br>Cocksfoot pasture | Spring 2020 | Pasture composition assessment<br>Seedhead count |
| | Summer 2020 | Seedhead count<br>Seed viability samples taken |
| | Spring 2021 | Seedhead count |

#### *3.5.2.1 Seed viability post ensiling*

Samples were taken from Tulkara site 2, Glenlofty site 1 and Crowlands site 1 to be assessed by Plant Science Consulting for seedhead viability. Samples were grown under laboratory conditions and assessed for their germination as a percentage of healthy seeds. A healthy seed was defined as the appearance of a monocotyledon leaves and first true leaves.

## 3.6 Grazing management

Objective: To assess if the removal of hard seeds by crash grazing of stock can reduce seed set of barley grass with or without the late winter application of Gibberellic Acid.

**2019 treatments**

1. Nil (under cage)
2. Giberellic Acid no grazing (under cage)
3. Giberellic acid plus grazing
4. No Giberellic acid plus grazing

*Note: GA was only used in 2019.*

Table 9 and 10 show details of treatments and assessments.

**Table 9: Grazing demonstration information Ararat Site 1.**

| Year | Site | Stock removed | GA Application | Stocked (DSE, Date) | Stock removed |
|---|---|---|---|---|---|
| 2019 | Ararat site 1 | 01/08/2019 | GA applied 12/08/2019 | 41.5DSE/ha 27/08/2019 | 23/09/2019 |

**Table 10: Ararat site 1 assessment methodologies**

| Site | Date | Assessment |
|---|---|---|
| Ararat site 1 | Spring 2019 | Pasture composition assessments<br>Seedhead count |

**2020 treatments**

Two small holding paddocks at Ararat Site 1 were used to simulate set stocking and hard grazing. The hard grazed paddock was kept to 800kgDM/ha (approximately 2cm) by transient stock. While the set stocked paddock was kept stocked at 8DSE/ha for the duration of the trial period. Multiple cages were used as a control.

**Figure 3: Seedheads collected on the same day, Mooney's Gap, November 2019**

## 3.7 Economic analysis

Economic analysis was conducted on the Mount Dryden 2 over sowing and weed control site (see Appendix 1 communication and extension for link). A market value was put on dry matter, based on nutritive values obtained in the demonstration, to show value of extra feed grown where over-sowing and weed control was conducted.

No further sites were used for an economic analysis primarily due to the lack of success of many of the demonstrations at controlling barley grass for an extended period of time (i.e. >4months).

## 3.8 Extension and communication

Planned communication and extension activities included the following:

- 1 group field day or major engagement event per year
- 1 media article based on annual outcomes per year
- 2 social media posts/ year (on AgVic Facebook and/or Twitter)
- 1 case studies or fact sheet

## 3.9 Monitoring and evaluation

Monitoring and evaluation included:

Surveys to benchmark KASA (knowledge, attitude, skills and aspirations) undertaken by the group prior to commencing the demonstration and after its completion.
Evaluation of group activities using a typical feedback form.
Annual group review of the demonstration to discuss how the project is performing, results and levels of adoption by the group and demonstration methods implemented by the group.
Estimates of the costs and benefits of the practice demonstrated.

# 4 Results

## 4.1 Sowing into existing pasture

### Tulkara Site 1 2019:

Oats and barley were established but seedling counts were low. Ryecorn seedling counts were so low it was classified as a germination failure. When the pasture composition was assessed in spring, the results showed no useful suppression of barley grass (Figs. 4 and 7).

**Figure 4: Tulkara Site 1- spring pasture composition 2019**

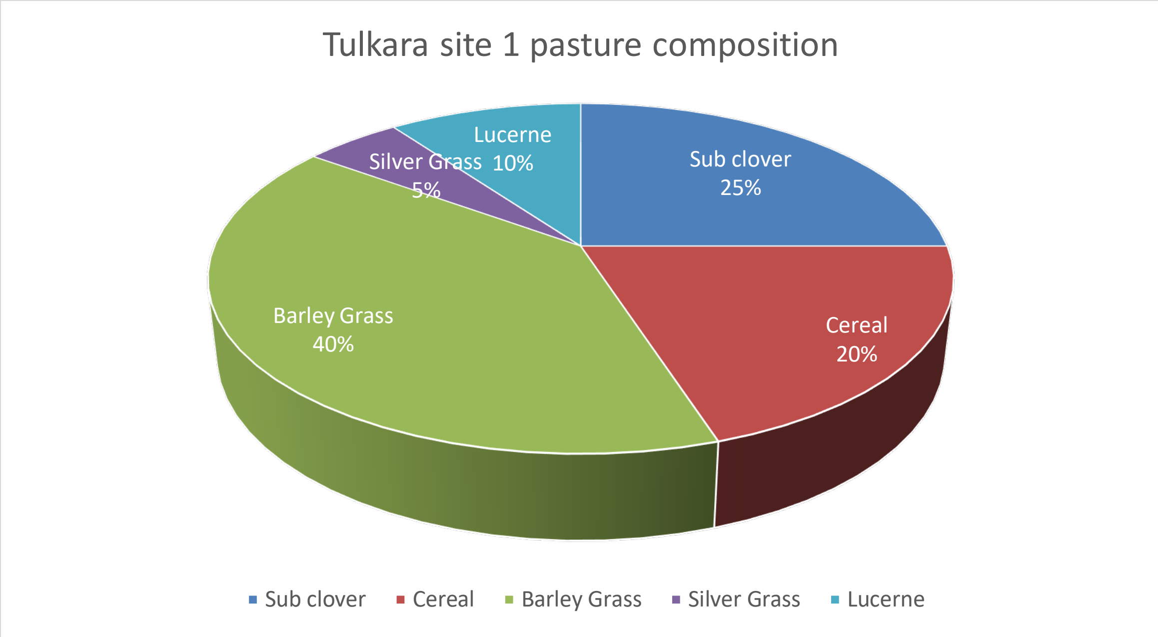



**Figure 5: Tulkara Site 1 -spring 2019**

### 4.1.2 Mount Dryden Site 1 2019 results:

Tetilla is a fast-growing tetraploid ryegrass and was sown into the existing phalaris/sub clover pasture. The dry matter production results (Figure 6) show an increase of 949 kg/DM/ha in the 10 kg/ha ryegrass sowing rate treatment when compared to the control. The control area produced 256 kg/DM/ha more than the 5 kg/ha ryegrass treatment. These results reflect the large amount of biomass that barley grass can produce in favourable seasons which were measured in the control.

**Figure 6: Mount Dryden Site 1 spring 2019 dry matter production**

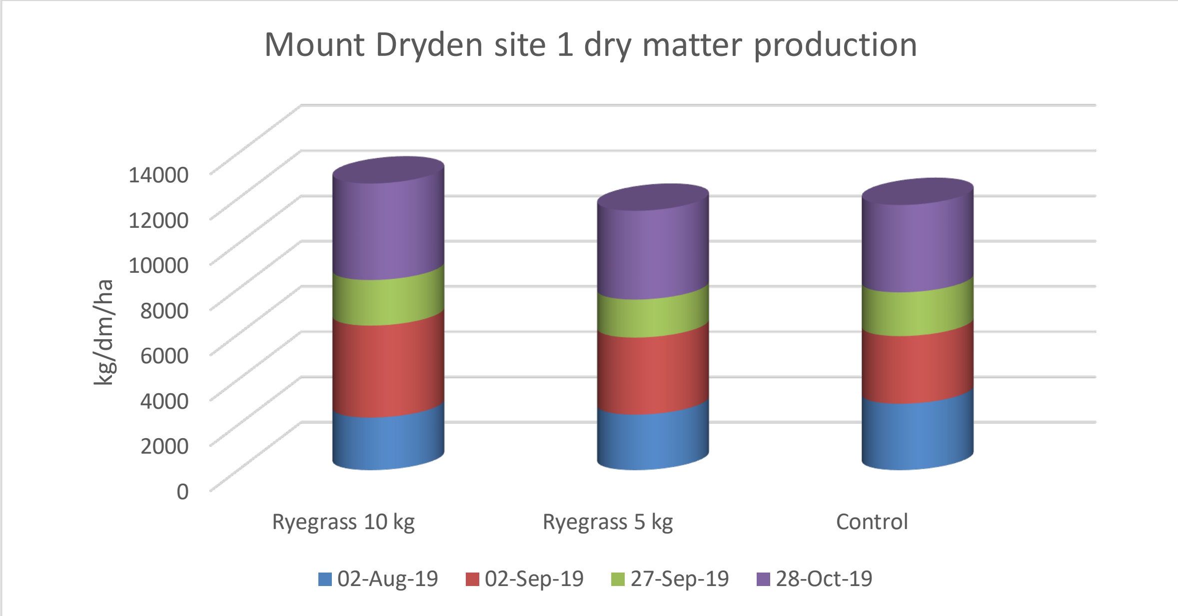



**Figure 7: Mount Dryden Site 1 spring 2019 pasture composition**

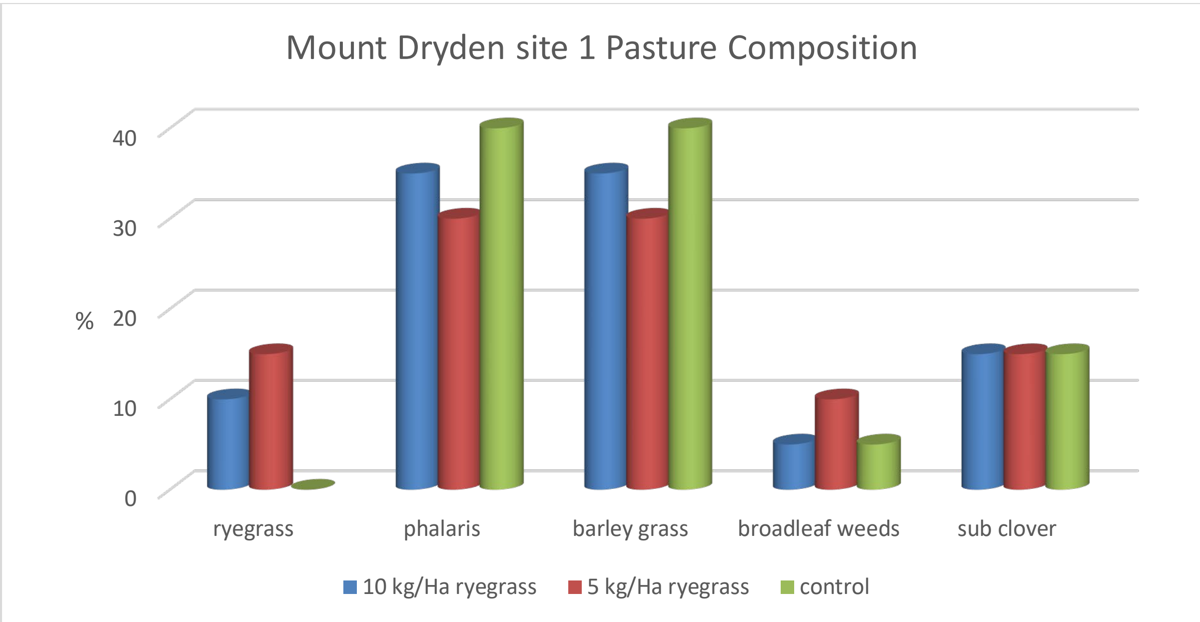
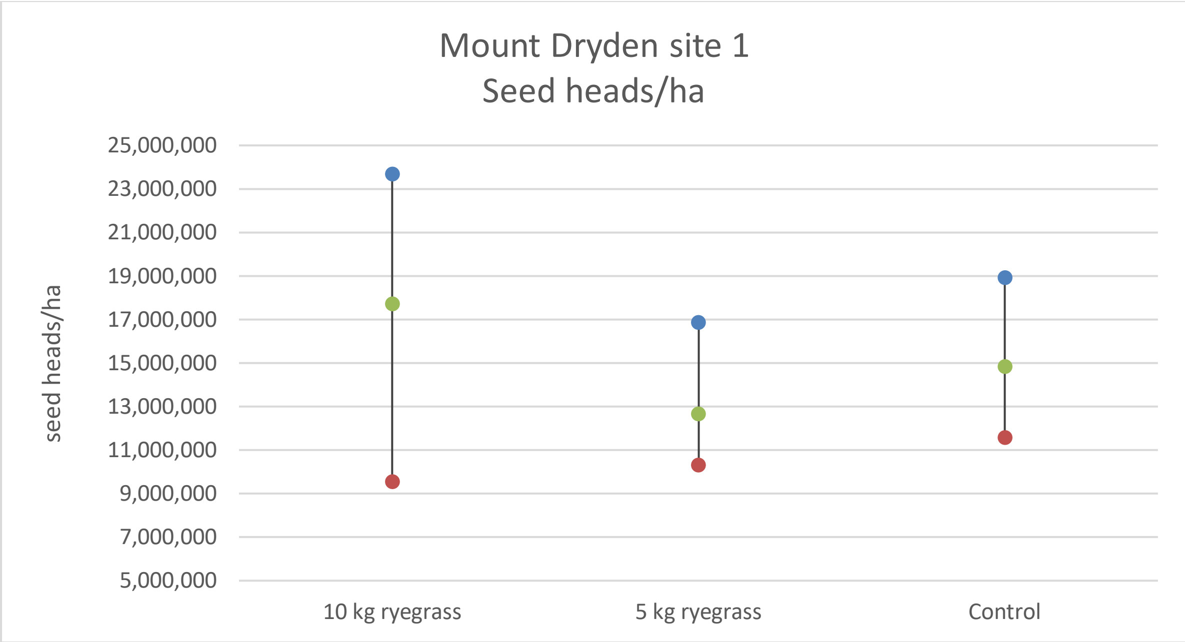



Figure 7 shows that there was very little difference between the compositions of the treatment sites with a slight reduction in barley grass observed compared to the control. Interestingly the 5kg/ha sowing treatment had less barely grass than the higher sowing rate, however it had more broadleaf weeds.

**Figure 8: Mount Dryden site 1 spring 2019 seedhead counts**




The barley grass seedhead counts showed a slight decrease in the 5 kg/ha ryegrass treatment, however results indicate that over sowing in isolation failed to outcompete the barley grass (Figure 8).

### 4.1.3 Ararat Site 1 2020 results

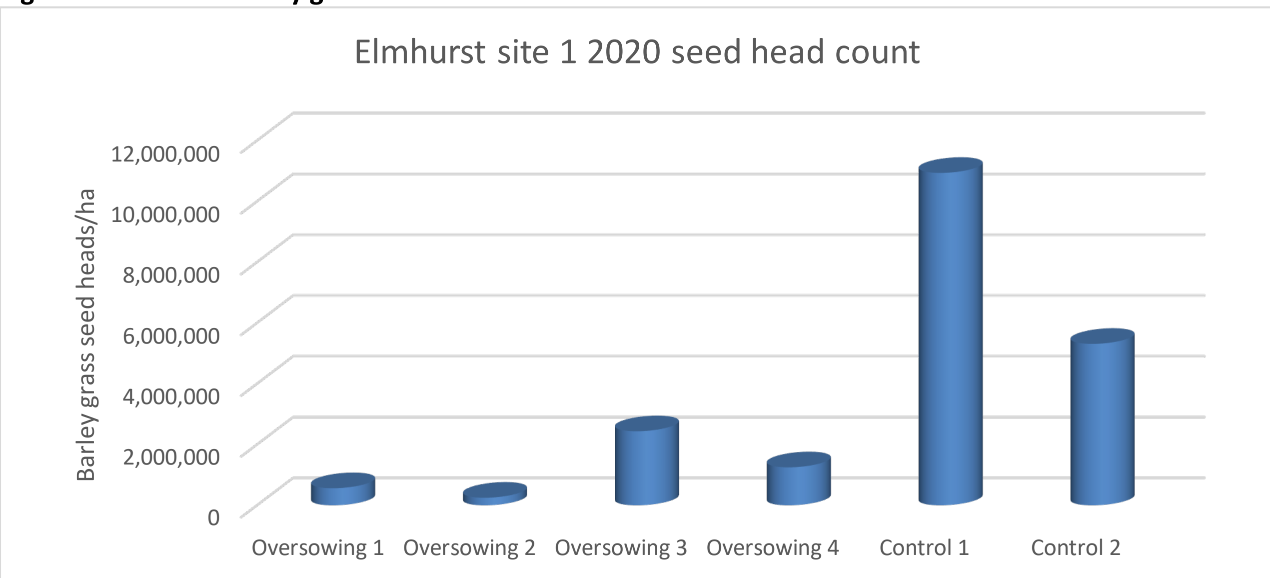
No observable difference was noted between the number of seedheads in the treatment and control sites. Figure 9 shows pasture composition.

**Figure 9: Ararat site 1 ryegrass over sowing in lucerne stand**

#### 4.1.4 Elmhurst site 1 2020 results

The site at Elmhurst showed a reduction in barley grass seedheads in spring 2020(Figure 10).

**Figure 2: Elmhurst barley grass seedhead counts October 2020**




### 4.1.5 Mount Dryden Site 2 2020-2022

The demonstration was set up in May 2020 with the intention of controlling barley grass and at the same time, bulking up feed and extending the productive life of the paddock. The three-treatment trial (detailed in Table 1) included:

Full Treatment- Over sowing, weed control and Nitrogen
Partial Treatment 1: Over sowing and Nitrogen (no weed control)

Partial Treatment 2: Weed control and Nitrogen (no over sowing)

*4.1.5.1 Dry matter*

Dry matter production across the paddock was highest under the Full Treatment (Figure 11), followed by Partial Treatment 1 (over sowing and Nitrogen). Total dry matter production figures are shown in Table 11, where the full treatment resulted in an increase in dry matter production of 2,657 kg DM/ha above Partial Treatment 2 where no over sowing was undertaken.

**Figure 3: Mount Dryden 2 pasture production spring 2020 measured in kgDM/ha under pasture cages, cut in August, September, October, November, and December:**

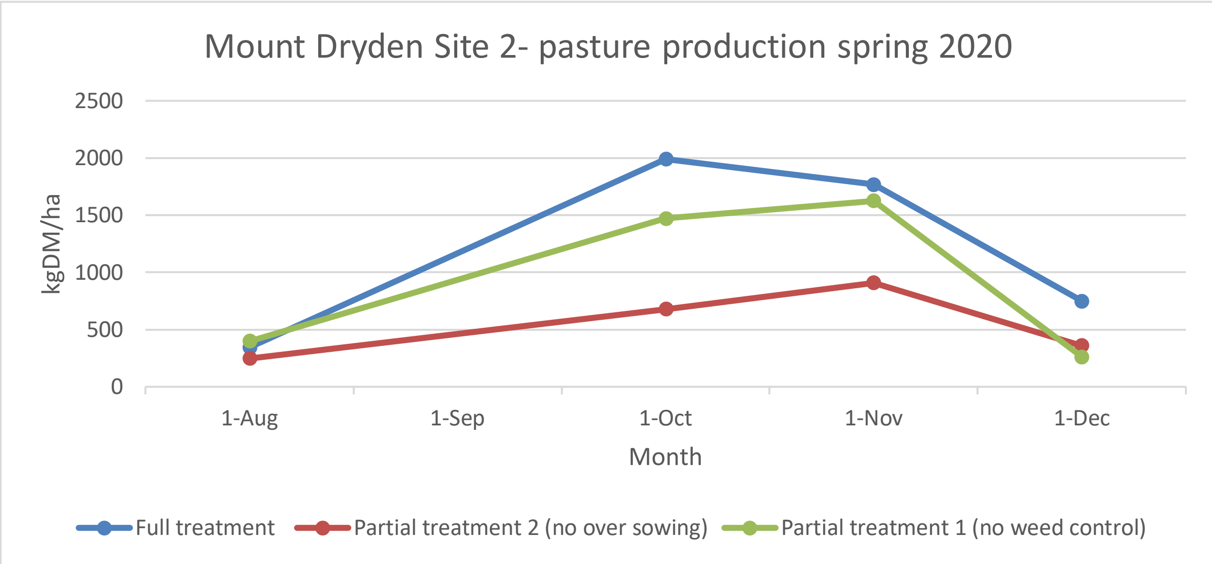



**Table 11: Total dry matter production Mount Dryden site 2 (1 August - 1 December 2020) for each treatment.**

| | | **Total Dry Matter Production / ha** |
|---|---|---|
| **Full Treatment** | Over sown, weed control and Nitrogen | 4851kgDM/ha |
| **Partial Treatment 1 (no weed control)** | Over sown and Nitrogen | 3754 kgDM/ha |
| **Partial Treatment 2 (no over sowing)** | Weed control and Nitrogen | 2194 kgDM/ha |

*4.1.5.2 Pasture quality*

Feed test results are reported in Table 12. Full Treatment plots had a higher metabolisable Energy (ME) and Crude Protein (CP) in September which reduced as the season finished but remained higher, this is due to the large amount of ryegrass that germinated.

**Table 12: Feed test results Mount Dryden Site 2- from each treatment in September and October 2020.**

| | | September | | | November | | |
|---|---|---|---|---|---|---|---|
| | | **DODM** | **ME (MJ/kgDM)** | **CP %** | **DODM** | **ME (MJ/kgDM)** | **CP %** |
| **Full Treatment** | Over sown, weed control and Nitrogen | 82.9 | 12.6 | 33.8 | 73.2 | 11.0 | 14.5 |
| **Partial Treatment 1 (no weed control)** | Over sown and Nitrogen | 70.6 | 11.3 | 27.9 | 59.1 | 9.0 | 17.1 |
| **Partial Treatment 2 (no over sowing)** | Weed control and Nitrogen | 69.4 | 11.1 | 26.9 | 59.4 | 9.1 | 20.7 |

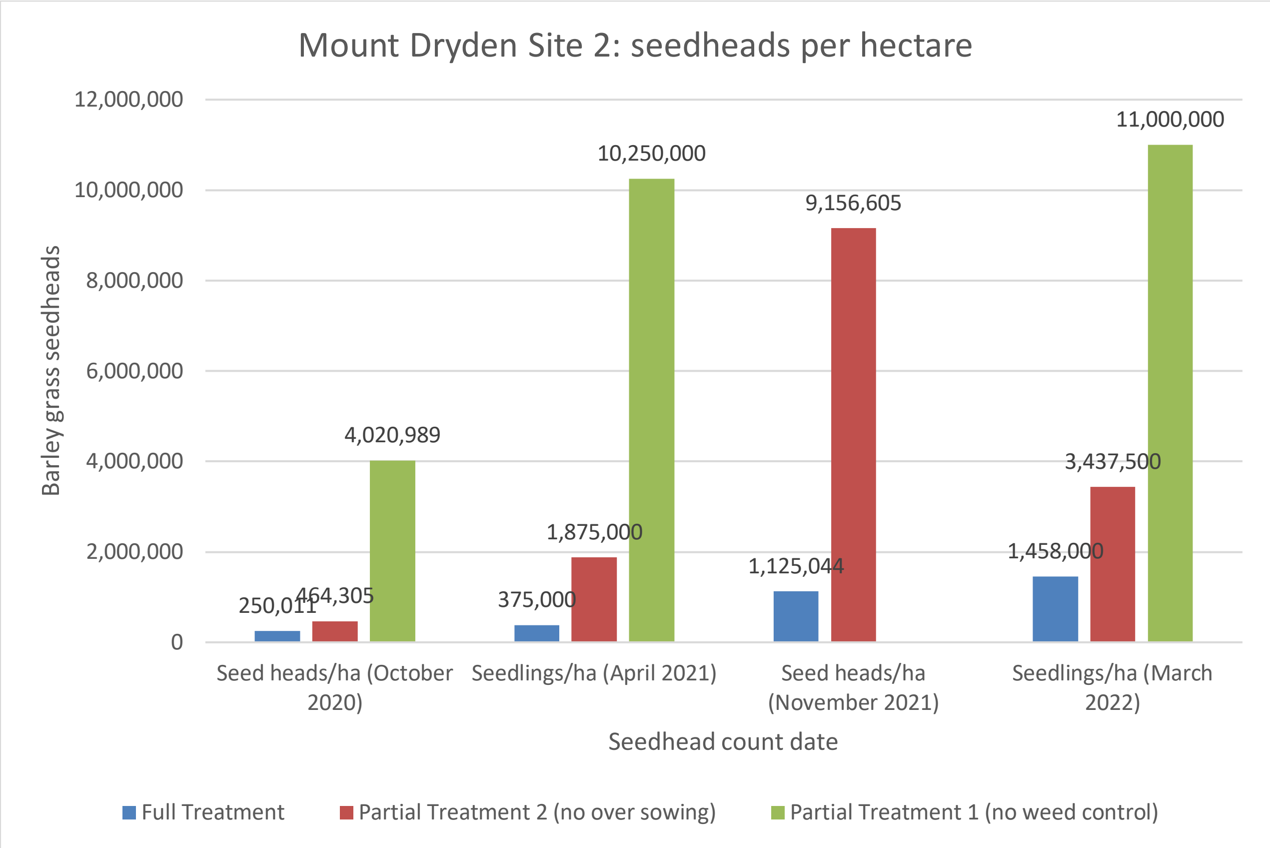
#### *4.1.5.3 Barley grass seedhead count*

Seedhead count results (Figure 12: **Barley grass seedhead counts Mount Dryden Site 2 for the three treatments in October 2020, April 2021, November 2021 and March 2022.**) showed that weed control was very effective on this site with both the Full Treatment and Partial Treatment 1, however seed counts were high in Partial Treatment 2 (no weed control). Over-sowing without weed control did little to reduce the amount of barley grass present. The results have continued in this trend as the site was assessed until March 2022. A significant reduction in barley grass was measured for the full treatment for two years without further treatment applied.

The effectiveness of barley grass control was measured five months after the treatments in May 2020 through seedhead counts for the three treatments. The results showed that weed control was very effective on this site with both the Full Treatment and Partial Treatment 1, however seed counts were high in Partial Treatment 2 (no weed control). Over-sowing without weed control did little to reduce the amount of barley grass present.

Site assessment continued in 2021 and March 2022, with no further treatments undertaken. Figure **12** shows that the seedhead numbers at the full treatment site had a threefold increase. This highlights the adaptability and vigour of barley grass. Results indicate a reduction in barley grass where the full treatment occurred 24 months post demonstration. The key outcome from the demonstration is the need to assess your pasture composition regularly to make timely management decisions.

**Figure 4: Barley grass seedhead counts Mount Dryden Site 2 for the three treatments in October 2020, April 2021, November 2021 and March 2022.**




*4.1.5.4 Pasture composition assessments*

Pasture composition results (Table 13) reflect the lower seedhead counts (Fig. 12) where there was a reduction in the amount of barley grass present in the Full Treatment, followed by Partial Treatment 2.

**Table 13: Mount Dryden Site 2 pasture composition assessments November 2021**

| | Full Treatment | Partial Treatment 1 (no weed control) | Partial Treatment 2 (no over sowing) |
|---|---|---|---|
| Sub Clover | 30 | 30 | 35 |
| Phalaris | 15 | 15 | 15 |
| Ryegrass | 30 | 5 | 0 |
| Barley Grass | 10 | 35 | 15 |
| Brome Grass | 10 | 10 | 25 |
| Capeweed | 5 | 5 | 10 |

Over-sowing with annual species was a highly valuable tool and extends the life of perennial pastures while continuing to produce highly valuable feed throughout the growing season. The decrease in seedhead counts at the sites minimised the potential for seedhead damage. This has broadened the class of animals that could benefit from the nutrient dense feed on offer.

### 4.1.6 Hard seeded legumes

Only three of the sites were successful in establishing Arrowleaf Clover; Ararat site 2 (two paddocks) and Addington. This was despite all sites having a large amount of annual grasses in 2018 prior to the trial beginning.

Soil type, a large weed seed bank and sowing depth may have caused the failure to establish hard seeded legumes at other sites.

**Figure 5: Arrowleaf shown as a percentage of paddock composition, all sites, spring 2019**

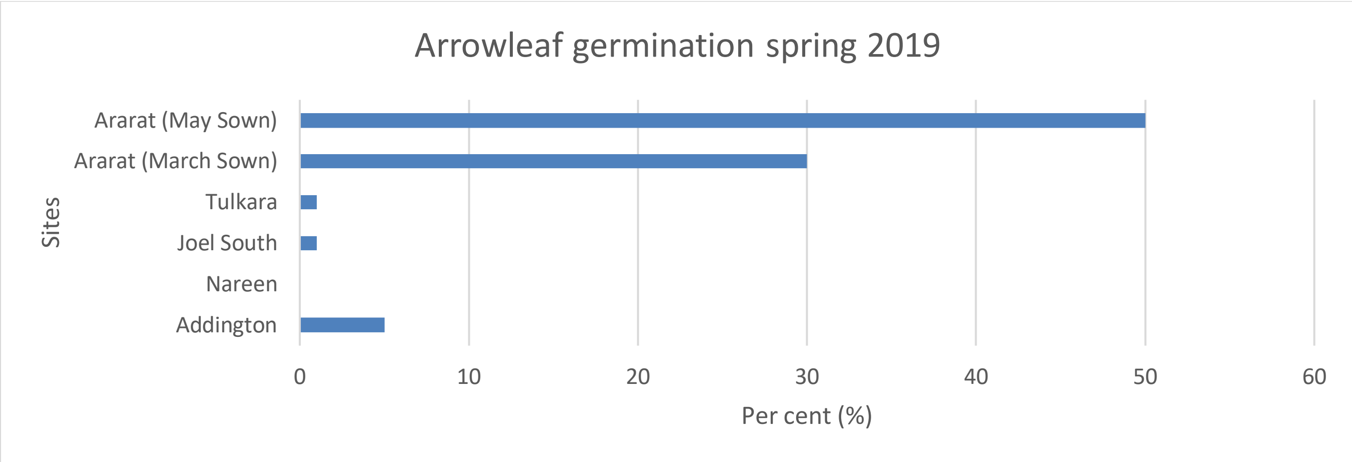
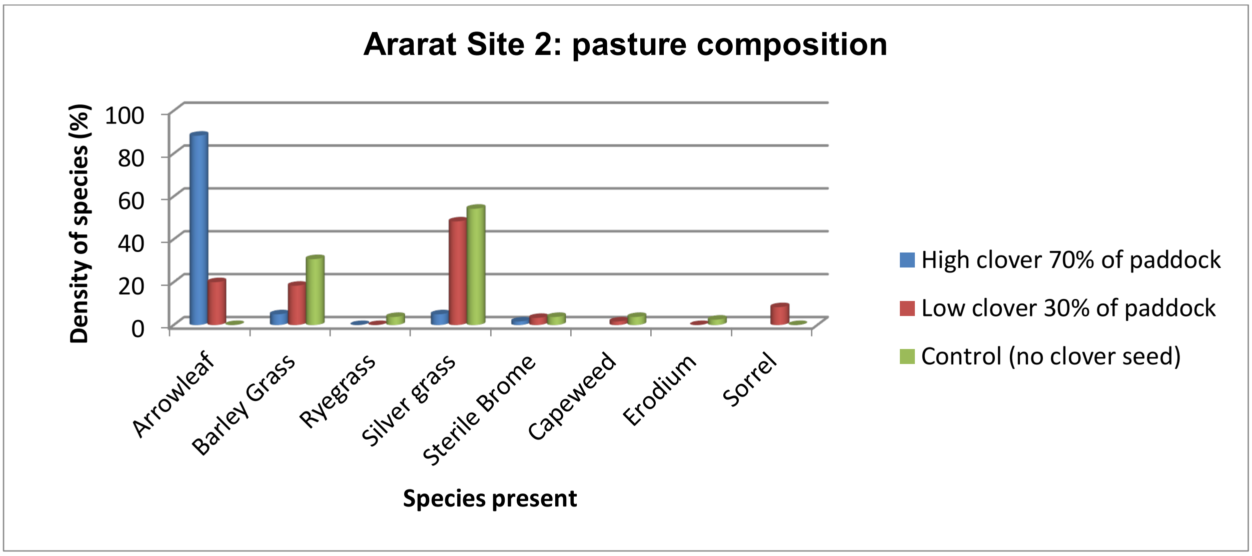



Figure 13 shows the most successful site, although on inspection there were areas of the paddock where Arrowleaf was highly successful and areas where it was less successful. Barley grass was still present and there was a marked reduction in silver grass.

**Figure 64: Clover at Ararat  Site 2, spring 2019**

The paddocks that established successfully in 2019 were revisited in 2020. Counts from Ararat Site 2 showed some reduction in barley grass in areas where clover establishment was greatest.

**Figure 7: Ararat Site 2 pasture composition October 2020**




The result suggests that even when the barley grass growth is suppressed by good clover establishment; it can set sufficient seed to remain a problem in subsequent years.

**Figure 86: Tess McDougall and PPS President Matt Kindred discussing the project.**

**Figure 9: Ararat site 2 arrowleaf clover November 2020**


*4.1.6.1 Feed quality*

The arrowleaf at Ararat 2 was tested for feed quality throughout the spring and summer. The results are reported in Appendix 3. Feed values reflect its high quality in spring, and fast drop in quality at the end of season.

## 4.2 Chemical options and resistance testing

### 4.2.1 Dobie Site 1

Visual assessments showed an almost complete elimination of barley grass in the sprayed paddock in 2019 compared to the adjacent unsprayed areas near the fence line.

**Figure 10: Treated and control areas at Dobie site 1.**


While the result allowed new pasture establishment in 2019, there was a late flush of barley grass in November as a result of late rain, plants sent up small seedheads. Whilst spray topping was useful to initially knock down the populations of barley grass, results did not extend through a single growing season.

**Figure 19: Barley grass seedheads at Dobie, mid December 2019**

## 4.2.2 Elmhurst site 1

Seedhead counts were undertaken in spring 2019 to measure the effectiveness of the 2018 treatment and showed a large reduction in the areas spray topped.
However, later in the season (December 12, 2019) a further assessment showed a late barley grass seedhead emergence on the higher parts of the paddock. This was unexpected and meant that the paddock still had a barley grass infestation in 2020. While the initial chemical treatments were successful, rainfall events late in the season resulted in a secondary germination at both sites.

**Figure 20: barley grass regrowth Elmhurst site 1, December 2019**

### 4.2.3 Chemical options trial conducted by Tyler's Rural Mount Dryden site 1

Demonstration advisory group member Ash de Clifford, agronomist at Tyler's Rural, Stawell, carried out a demonstration at Mt Dryden Site 1. Plant assessments were recorded using the key in Table 7 (methodology). Results from the chemical treatments on barley grass are shown in Table 14 and the effects on phalaris are reported in Table 15.

Treatments with Verdict® (haloxyfop) resulted in barley grass plant death, however the phalaris injury due to the herbicide was severe but plants recovered.
Treatments with Shogun® (propaquizafop) resulted in barley grass plant death. Only the highest rate of application caused an 'unacceptable' amount of injury to the phalaris plants.

The effect of the successful treatments did not carry over into 2019 as there must have been enough residual seed to allow for barley grass infestation at the site when inspected in winter.

**Table 14: Effectiveness of applied chemicals on barley grass**

| Treatment | Barley grass plant death rating | Effectiveness |
|---|---|---|
| Control | 0 | No Effect |
| Verdict® 25ml/ha | 4 | Severe Effect |
| Verdict® 50ml/ha | 5 | Plant Death |
| Verdict® 75ml/ha | 5 | Plant Death |
| Shogun® 200ml/ha | 5 | Plant Death |
| Shogun® 250ml/ha | 5 | Plant Death |

**Table 15: Effect of treatments on phalaris plants**

| Treatment | 28 day Phalaris plant health rating | Effectiveness |
|---|---|---|
| Control | 0 | No Effect |
| Verdict® 25ml/ha | 1 | Slight Effect |

| | | |
|---|---|---|
| Verdict® 50ml/ha | 1 | Slight Effect |
| Verdict® 75ml/ha | 3 | High Effect |
| Shogun® 200ml/ha | 1 | Slight Effect |
| Shogun® 250ml/ha | 2 | Moderate Effect |

**Figure 11: Barley grass control summary Mount Dryden Site 1.**

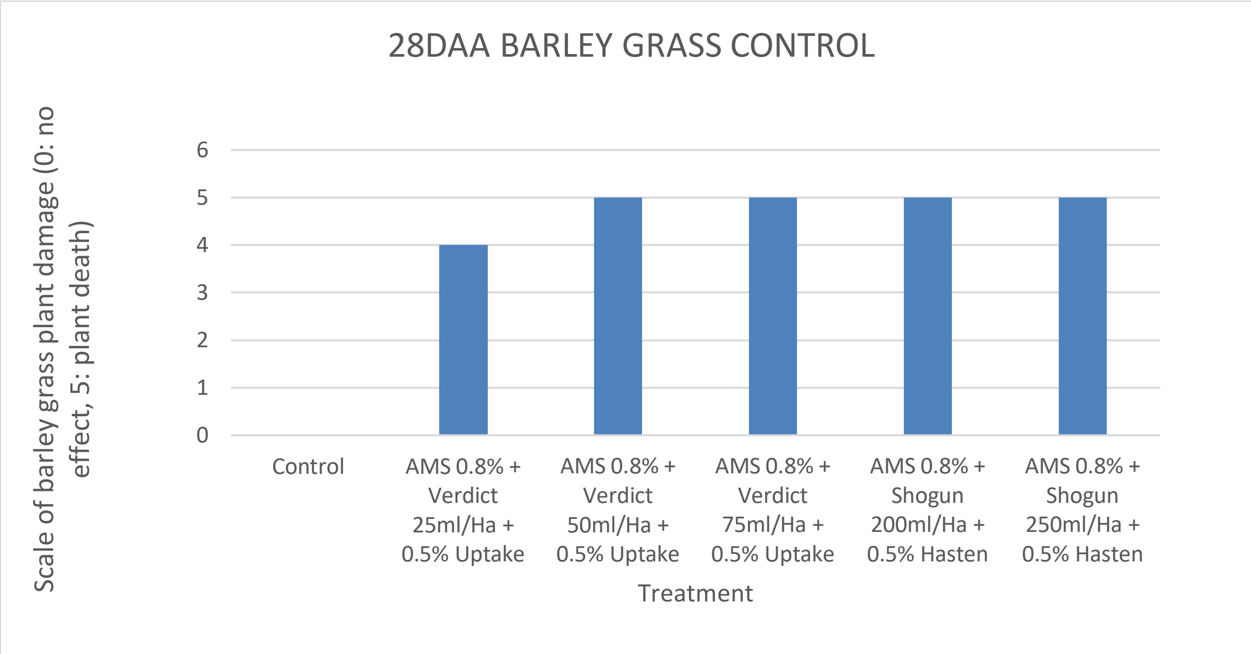



**Figure 12: Spray demonstration site in late October 2019, showing reinfestation of barley grass at Mount Dryden Site 1.**

### 4.2.4 Chemical resistance

Twenty-two barely grass samples from 16 properties were tested for chemical resistance to the following groups of chemicals A,C,L and M.  In 2020, one site exhibited resistance to paraquat. This resistance gene was first identified in the 1980's and could be attributed to past herbicide use or contamination. No other resistance was observed. See Appendix 3 for full results.

## 4.3 Mechanical removal of hard seeds

### 4.3.1 Ararat Site 1: hay making simulation

It is important to note that this was a very small trial site and results may not be transferrable to larger scale applications.

The removal of barley grass heads in the hay simulation showed a reduction in the estimated seedhead per hectare. While this appeared to be a useful strategy on a single paddock basis, hay quality was marginal and the seedheads in the hay were still viable and could create further barley grass infestations where it is fed out. Consideration could be made to feeding out the hay in containment, minimising the area that the hay is fed out on and therefore minimising the weed spread.

Seedhead counts were undertaken in early November and the results showed a reduction in the number of seedheads; see Figure 23.

**Figure 13: Ararat Site 1 seedheads per hectare assessment, October 2020**

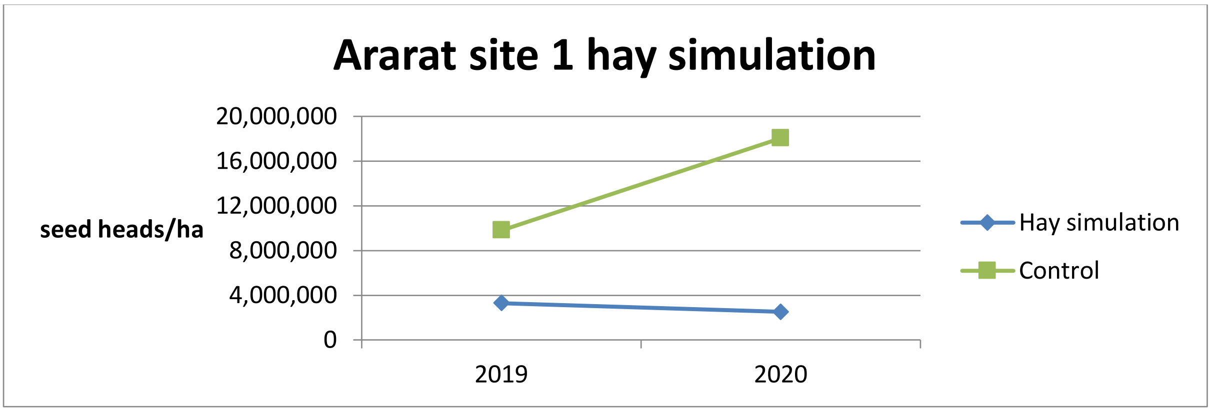



**Figure 14: Hay simulation Ararat Site 1 2018, photo taken November 2019**

**Figure 15: Hay simulation site, Ararat Site 1, October 2019**

### 4.3.2 Tulkara Site 2 silage

Feed tests showed that the silage cut at the Tulkara site was good quality, measuring 12.9 MJ Metabolizable Energy (ME) and 17.3 % Crude Protein (CP) and classified in the A2 quality range (Australian Fodder Industry Association).

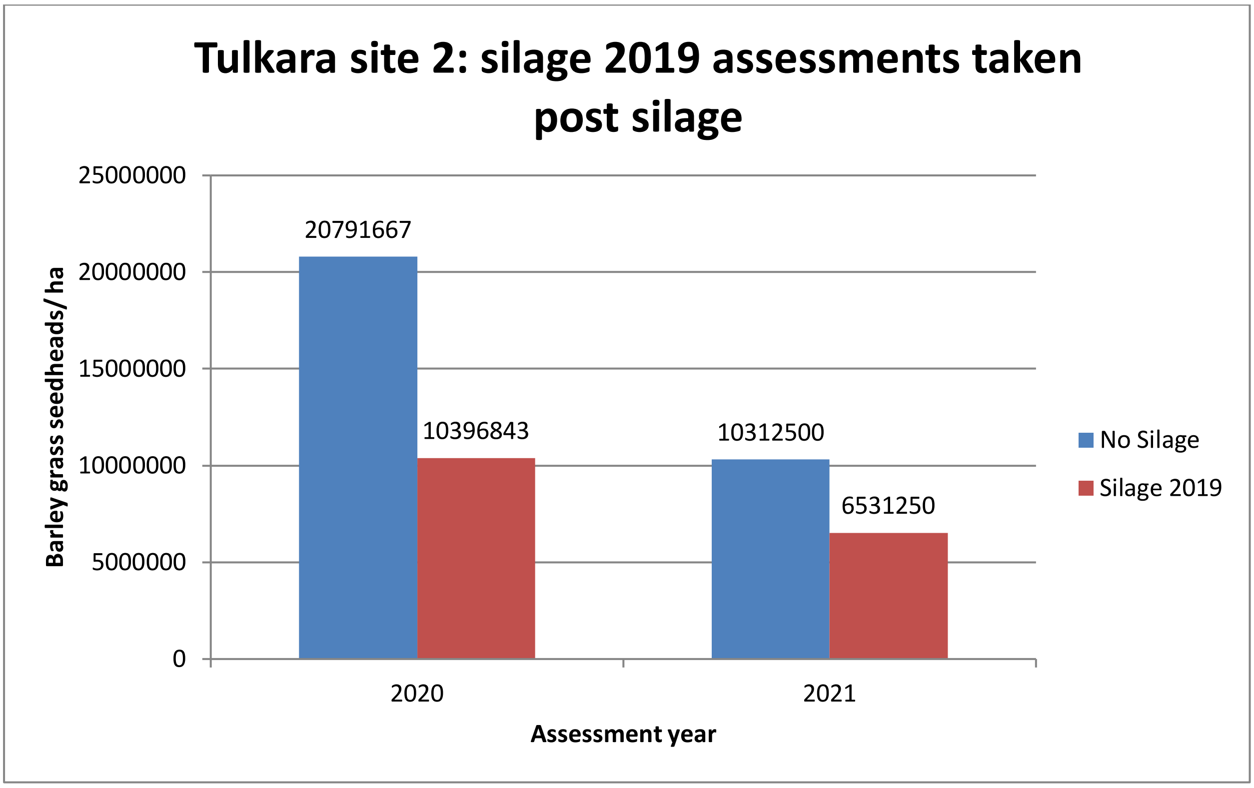
A clear reduction in barley grass was observed in the 2019 silage site (treatment) compared to the uncut (control) site in both May (Figure 26) and October 2020 (Figure 27).

**Figure 16: Tulkara Site 2: silage demonstration site May 2020**

**Figure 17: Tulkara Site 2: silage site October 2020**


Pasture assessments in October 2020 involved counting barley grass seedheads in the silage (treatment) and uncut (control) areas. The results indicated a large reduction in seedheads where silage was made in 2019, with approximately 2000 seedheads/m$^2$ in the control site and 200 seedheads/m$^2$ in the treatment sites (Figure 28).

**Figure 18: Tulkara Site 2 barley grass seedhead counts assessed in October 2020 and October 2021**



Site assessment continued in 2020 and 2021 (silage was cut in 2019). Figure 28 shows that there was a small increase in seedheads in the years post silage. Interestingly the control infestation halved, which could be due to the season and growing conditions.

The demonstration host was also pleased with the pasture quality in 2020 following silage production. He observed that, "After harvesting silage in 2019 there was a lot more ryegrass than expected, which led to great palatability and utilisation in 2020. I would certainly do it again."

The demonstration host described silage production as a 'useful tool'. "It didn't get rid of all the weeds, but it got rid of a lot," he said.

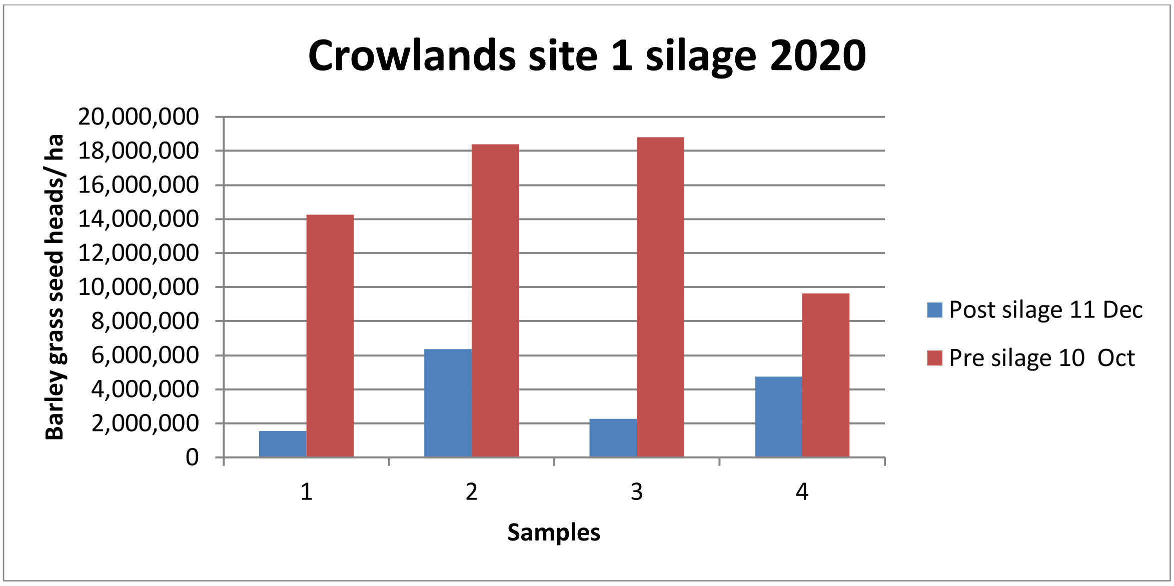
### 4.3.3 Glenlofty Site 1 silage

A second pasture at Glenlofty with high quality perennial grass and sub clover pasture and almost no barley grass was also included in the demonstration to assess seedhead viability, testing showed no viable seed after ensiling.

### 4.3.4 Crowlands site 1 silage

**Figure 29: 2020 silage Crowlands site 1 prior to cutting for silage October 2020**

**Figure 19: Barley grass germination comparison pre and post silage at Crowlands site 1 October-November 2020**




In October 2021 the site was visited again and seedheads were counted where the silage was cut. Seedhead numbers remained consistent with post silage (December 2020) ranging from 3-10 million seedheads/ ha.

###### 4.3.4.1.1 Silage site feed test comparison

The feed test results from 2019 and 2020 are shown in Table 18. The digestibility of the 2020 silage is very low compared to the 2019 site due to the higher fibre content of the feed.

**Table 16: Feed test comparison 2019 and 2020 silage**

| | Joel South Site 2 2019 | Crowlands Site 1 2020 |
|---|---|---|
| Dry Matter (%) | 60.4 | 58.6 |
| Crude Protein (%DM) | 17.3 | 11.4 |
| Neutral detergent fibre (%DM) | 48.2 | 61.9 |
| Dry Matter digestibility (%DM) | 75.3 | 65.2 |
| Metabolisable energy (MJ/kgDM) | 11.3 | 9.9 |

The 2019 silage was made from a predominantly ryegrass pasture (with a significant barley grass incursion) while the 2020 silage site was predominantly uplands cocksfoot, also with a significant barley grass incursion, causing some species related differences in results. Additionally, the 2019 silage site was ensiled with an inoculant, which was not the case for the 2020 silage. This could also explain some of the difference in results. The large difference in crude protein, metabolizable energy and digestibility between samples highlights the value of feed testing to ensure you know what you are feeding out. Despite its poorer quality, the 2020 silage was cut earlier than the 2019 silage and during an arguably in a better growing season.

The quality of the 2019 silage was adequate be eaten by a 60kg ewe in condition score three at 100 days pregnancy (with twins). In later stages of pregnancy or lactation the silage would need to be supplemented. The 2020 silage was not of a quality to be able to be fed to any class of growing stock without supplementation.

Making silage from barley grass infested pasture showed promise in some areas, however there are limitations to its use given the region's steep topography.

Testing of the silage made from barley grass measured zero viable seeds. This means that although the seedhead is still present, the seeds won't germinate and the infestation can't be spread to another area.

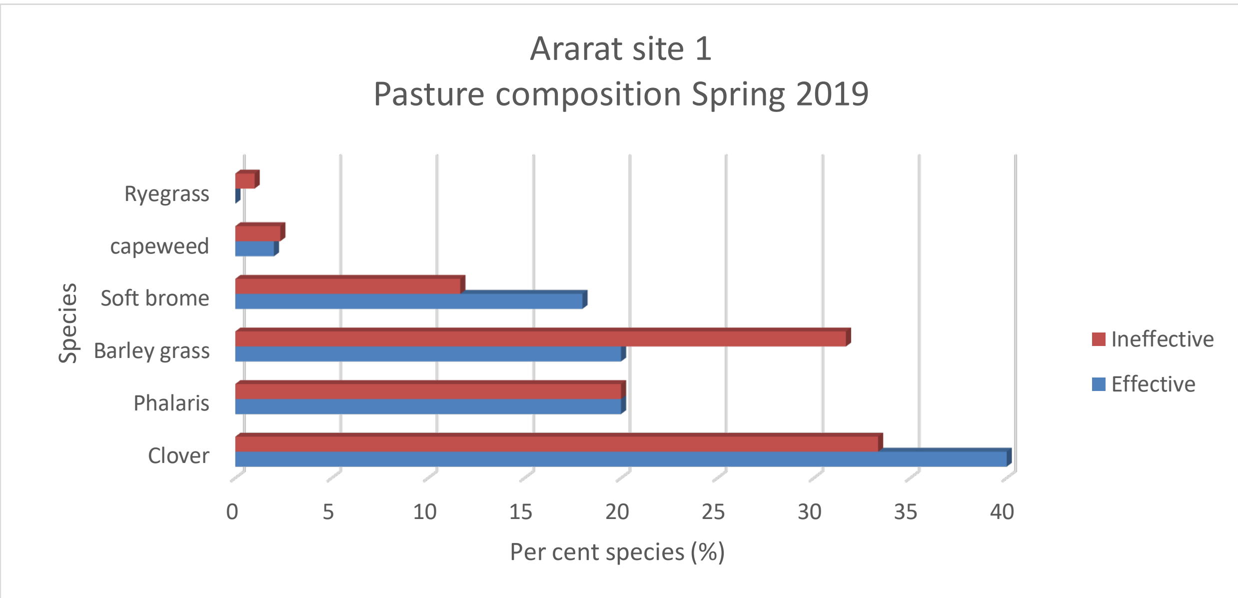
The overall reduction in barley grass seedheads, combined with the zero viability of the seedheads within the silage was a positive result for the group.

## 4.4 Grazing management

### 4.4.1 Ararat Site 1 2019

While the stocking rate at the grazing management site was reasonably high, the pasture was vigorous in late winter and the sheep grazed it unevenly. The grazing was ineffective over much of the paddock, but sections were repeatedly eaten by sheep providing an effective grazing. The pasture composition post grazing in both the effectively (blue bars) and ineffectively (red bars) grazed areas is shown in Figure 31. Cages were used to compare ungrazed pasture on areas with and without GA.

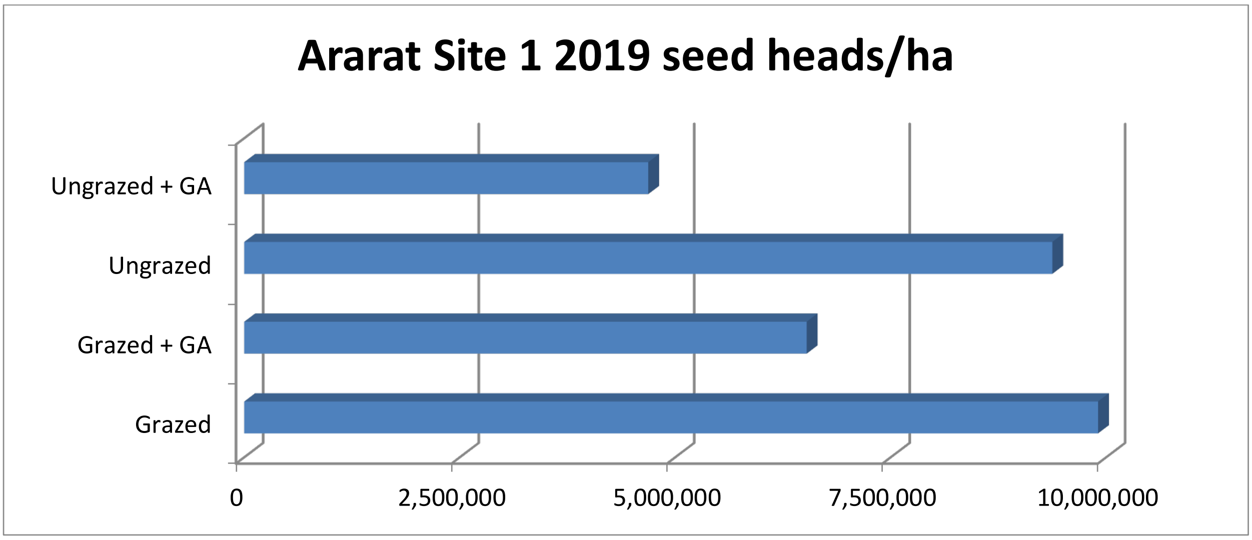
**Figure 20: Ararat Site 1 pasture composition, post grazing spring 2019**




Barley grass seedheads were counted in November and the results are shown in Figure 32

The application of gibberellic acid has had no effect on barley grass seedhead numbers as shown in Figure 32. Grazing management has also shown no effect on barley grass seedhead numbers.

**Figure 21: Ararat site 1 seedheads/ha results show no effect from grazing management in 2019.**




### 4.4.2 Ararat site 1 2020

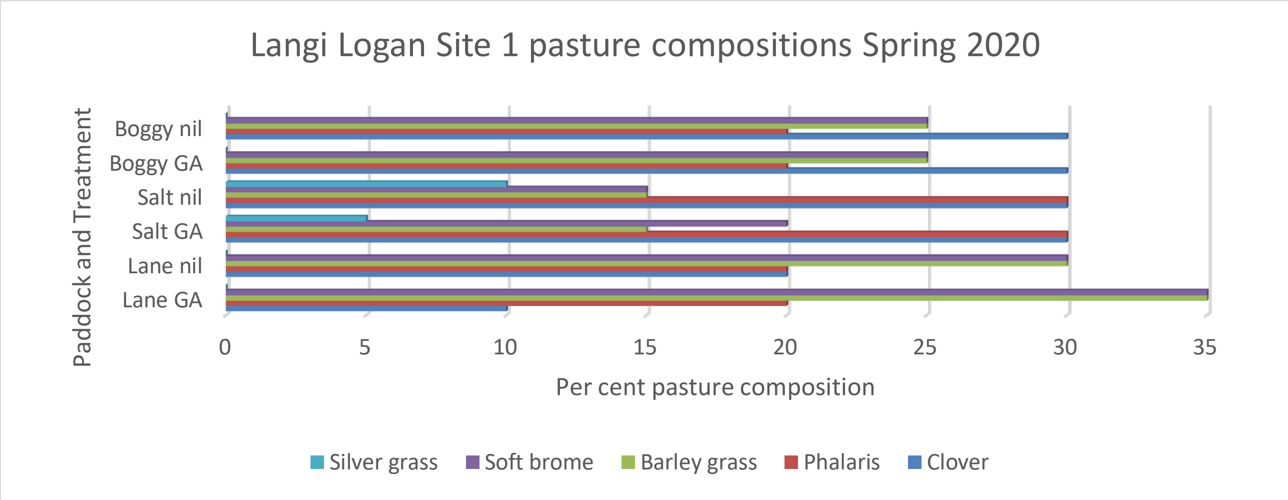
**Figure 223: Sample being cut at Ararat Site 1 October 2020**

No meaningful differences were measured between grazed and ungrazed treatments with or without gibberellic acid (GA) application at Ararat Site 1 in October 2020.

Three sites at Langi Logan Site 1 had GA strips applied to ascertain if it had any effect on barley grass. No differences were observed in spring at any of the three sites where GA was applied.

### 4.4.3 Langi Logan Site 1 2020

**Figure 23: Langi Logan Site 1 pasture composition assessments taken from 3 sites (Boggy, Salt and Lane paddocks) October 2020**




There was no reduction in barley grass observed as a result of gibberellic acid applications .

### 4.4.4 Ararat site 3 2020

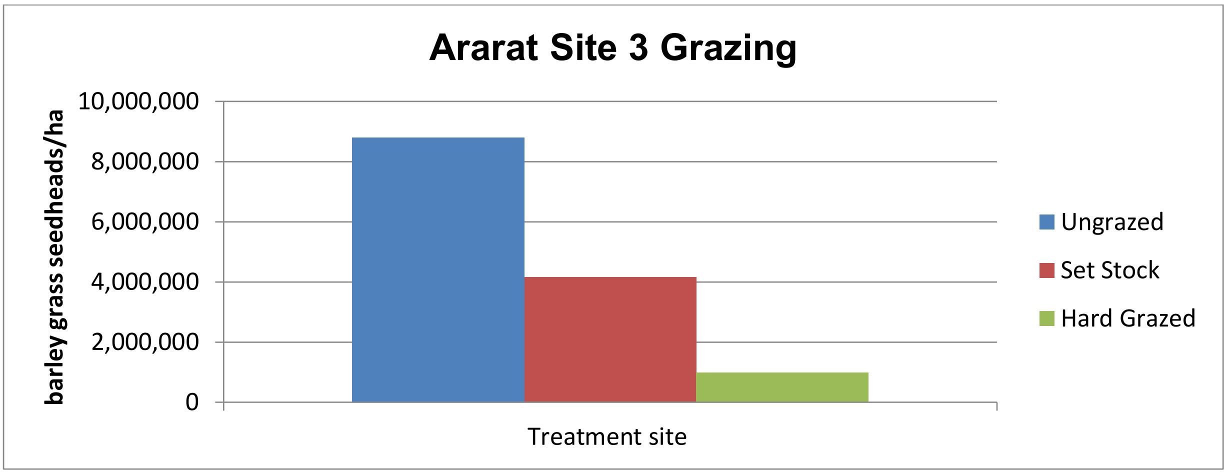
After the failure of controlling barley grass through grazing at Ararat Site 1 in 2019 a smaller 14 ha paddock was chosen on the same property to enable better grazing control. With close monitoring, hard grazing (4cm residual) was imposed on the holding paddock with a lot of stock movement, enabling very high stocking rates for very short periods without any stress on the sheep. The early results showed a reduction in barley grass heads on the hard grazed area, but late seedhead emergence after above average October rainfall produced enough seed to cause a reinfestation.

An adjoining paddock was set stocked at approximately 8 sheep/ha (Figure 35) and pasture cages were used to replicate an ungrazed area.

The practice of hard grazing was impractical on a large area as very large numbers of sheep were required for short periods with close monitoring of the animals.

**Figure 24: Ararat Site 3 hard grazed paddock in foreground and set stocked paddock behind fence October 2020**

**Figure 256: Ararat Site 3 Barley grass counts taken in October 2020**




Barley grass had a subsequent germination after above average October rainfall, which reduced difference between the grazed and ungrazed portions of the paddock.

## 4.5 Economic analysis

### 4.5.1 Mount Dryden site 2

A cost:benefit analysis was undertaken to compare the three treatments (Table 17). The analysis included an estimate of the operational cost of treatments, inputs (including chemical and seed), hours of labour and the relative cost of the equipment. The cost of barley grass seedhead contamination was beyond the scope of the project and was not included in the cost:benefit analysis.

Feed test values were used to calculate a market value of the feed based on Metabolisable Energy.

Partial Treatment 2 (no over sowing) was used as the basis of comparison for the cost:benefit. The cost of weed control was $27/ha which is shown as an 'avoided cost' for Partial Treatment 1 and not included as an additional cost in the Full Treatment as Partial Treatment 2 also had an application of herbicide.

The analysis shows a clear benefit for using both weed control and over sowing and a reduced benefit when over sowing was completed without weed control. This highlights that the minimal cost of weed control was justified by the additional benefits it gives to production.

**Table 17: Cost: benefit analysis of the full treatment and partial treatment. Costs and benefits measured above partial treatment 2.**

| | **Full Treatment**<br>Over sown, weed control and Nitrogen | **Partial Treatment 1 (no weed control)**<br>Over sown and Nitrogen |
|---|---|---|
| **Extra Benefits (above Partial Treatment 2- no over sowing)** | | |
| Value of extra DM ($/ha) | $979 | $455 |

| | | |
|---|---|---|
| Avoided costs (spraying) ($/ha) | | $27 |
| Total benefits ($/ha) | $979 | $481 |
| **Extra investment costs (above Partial Treatment 2 no over sowing)** | | |
| Over sowing ($/ha) | $137 | $137 |
| Total costs ($/ha) | $137 | $137 |
| **Total benefits (above Partial Treatment 2 no over sowing) $/ha** | $842 | $345 |

The Full Treatment increased dry matter production throughout the season leading to the highest return per hectare. It also incurred the lowest seed numbers, reducing the likelihood of barley grass seeds impacting animal health and germinating in the following year.

## 4.6 Extension and communication

**Table 18: Extension and communication during project**

| Date | Event description | No. producers | No. service providers |
|---|---|---|---|
| December 2019 | Presentation at field day Stuart Mill and publication of article in PPS newsletter (200+ members) and Beef sheep Networks Newsflash (audience approx. 3500) | 20 | 2 |
| March 2020 | 2019 results report sent to members & posted on PPS website | 200+ | 30 |
| March 2020 | Update & case study on barley grass control methods included as appendix to PPS newsletter | 193 | 332 |
| June 2020 | Report on chemical resistance delivered to the members via the PPS Newsletter in June. | 193 | 332 |
| June 2020 | Silage webinar, guest speaker Michele Jolliffe. Topic: making quality silage in our region. Link to recording | 16 | 8 |
| July 2020 | Grassland Society of Southern Australia's 60th Annual Conference; guest Speaker Tess McDougall. Topic Project overview and results from year 1 and year 2.<br>This event composed of three distinct extension products.<br>1. Development of a paper for publication within the conference proceedings,<br>2. Presentation to 140 live participants of the conference, link to recording<br>3. The development of an article for the Grasslands Newsletter which was | 140 | N/A |

| Date | Event description | No. producers | No. service providers |
|---|---|---|---|
| | distributed in September 2020 Link (Page 14 & 15)<br>Delivery of project overview to PPS AGM 14/10/2020. | 25<br><br>14 | 4<br><br>N/A |
| December 2020 | Results from 2019 silage treatment included in PPS newsletter and Beef Sheep Newsflash | 193<br><br>>3500 subscribers | 332<br><br>N/A |
| March 2021 | Report on sites PPS Newsletter | 193 | 340 |
| June 2021 | Cost:benefit analysis included in PPS newsletter and Beef Sheep Networks Newsflash | 193<br><br>>3500 | 332<br><br>N/A |
| September 2021 | Reports from Plant Science Consulting results shared in PPS Newsletter | 193 | 332 |
| March 2022 | Results presentation & KASA survey collection | 27 | 3 |
| March 2022 | Results presentation to BestWool/BestLamb and BetterBeef Coordinators conference | 0 | 32 |
| March 2021 | SheepNotes update of over sowing and weed control cost: benefit case study (page 14) | 15000 | |
| 2022 | Final report produced & approved | 193 | 332 |

## 4.7 Monitoring and evaluation

A pre and post evaluation survey was completed with PPS members. The evaluation measured changes in knowledge, attitude, skills, aspiration and adoption (KASAA). Two objectives were measured with members who attended the last field day and final presentation (n=30). The survey involved producers rating their knowledge, attitude and skills from 1-10 and indicating practices they'd adopted.

Objective 1: Understand the impact of barley grass control on total dry matter production and pasture composition in perennial pastures.

Objective 2: Understand barley grass control options for perennial pastures.

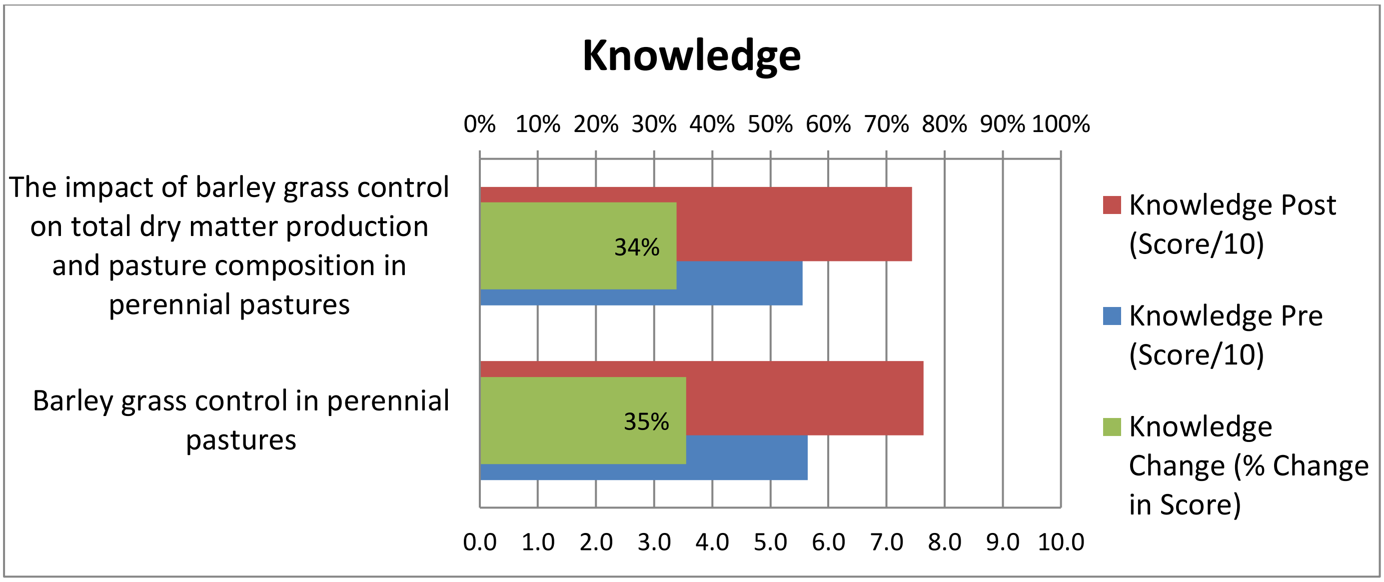
The group's knowledge, attitude, skills and aspirations increased on both objectives during the project as reported below. It is noted that pre demonstration knowledge, skills and aspirations of the project group was already high.

Of note also is the increased awareness of the importance to regularly assess pasture composition, which will enable early decisions to enable best possible outcomes.

### 4.7.1 Knowledge

Producers indicated their knowledge of barley grass and its control had grown substantially (35%) over the demonstration period (Figure 37).

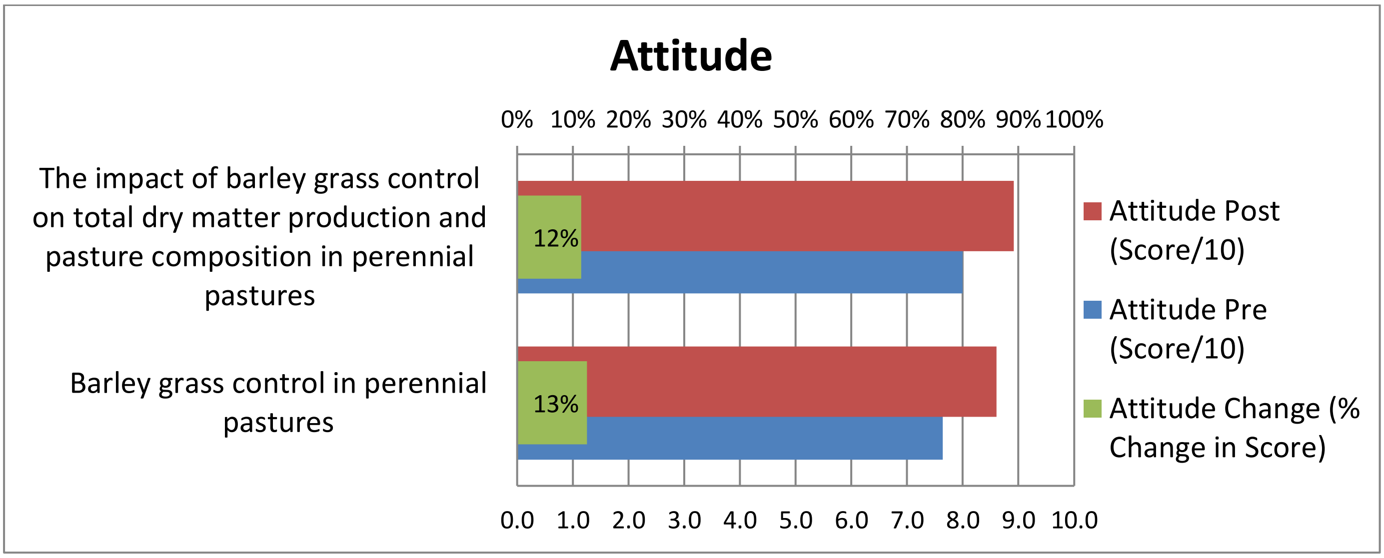
**Figure 26: Change in knowledge reported by group members during the project.**




### 4.7.2 Attitude

Attitude to barley grass control increased slightly during the demonstration period averaging 7.8/10 pre demonstration and 8.8 /10 post demonstration (Figure 38).

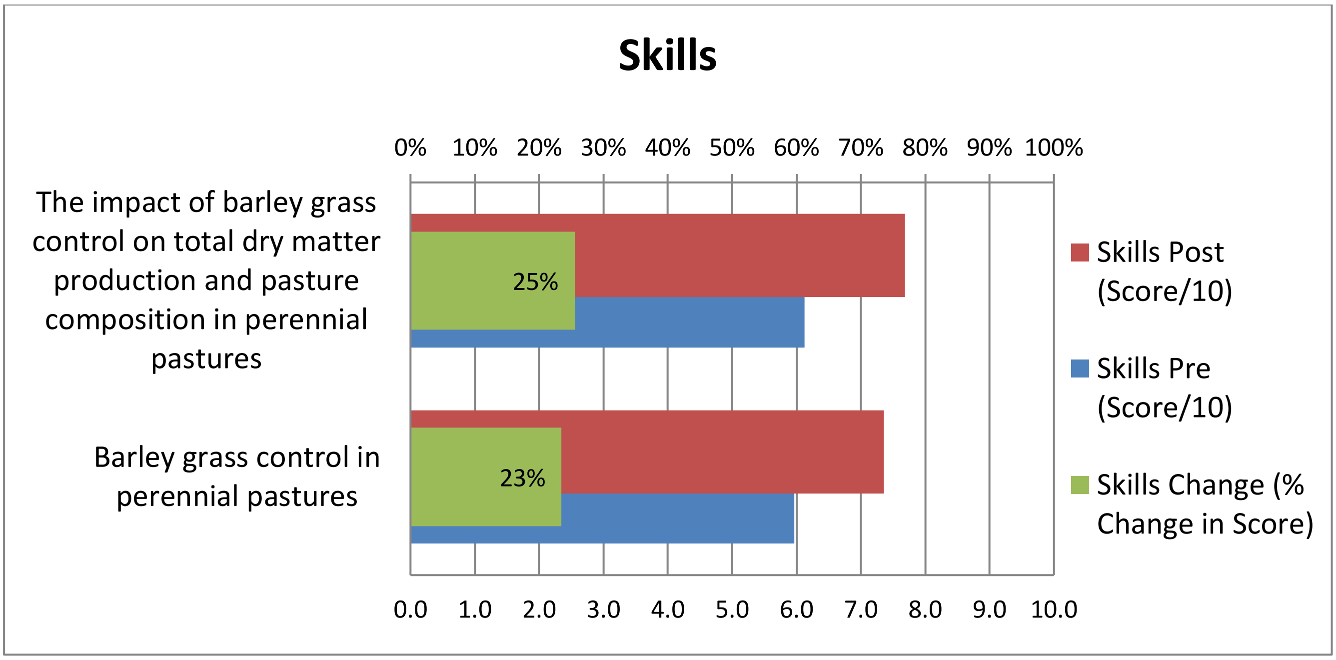
**Figure 27: Change in attitude reported by group members during the project.**



#### 4.7.3 Skills

Producers indicated an average of 24% increase in their skills around barley grass identification and control related to the demonstration period (Figure 39).

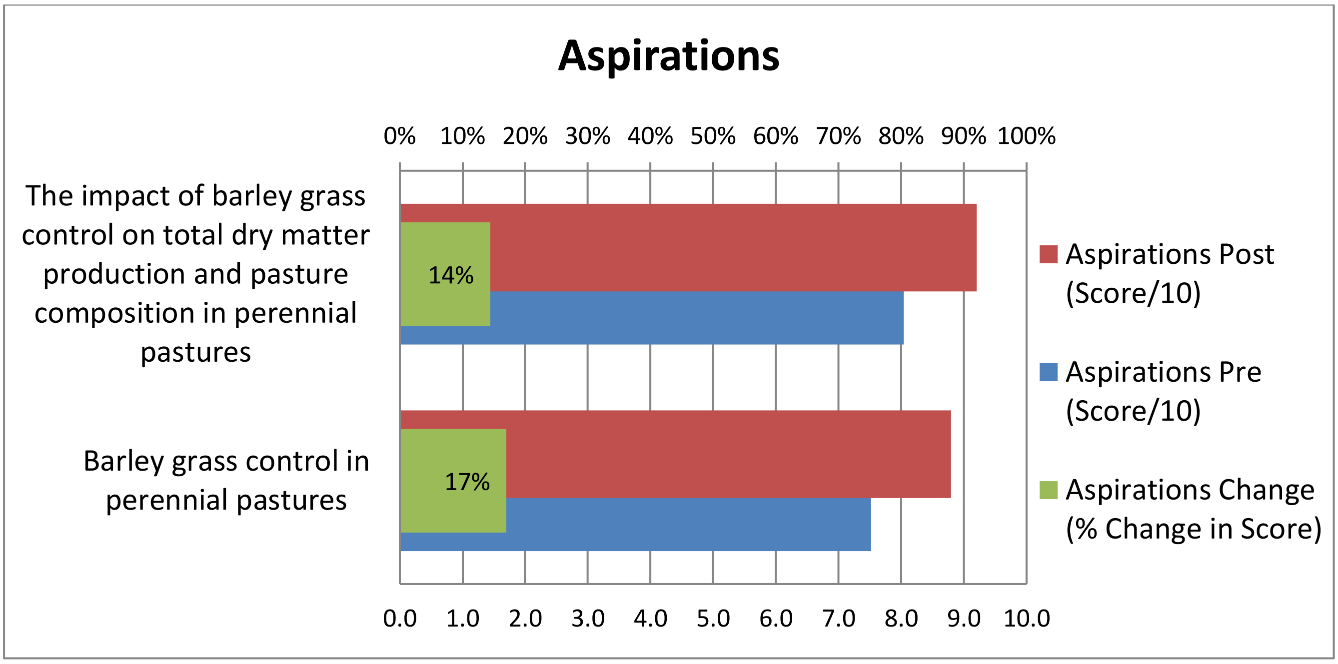
**Figure 39: Change is skills reported by members during the project.**




#### 4.7.4 Aspirations

Aspirations around the control of barley grass have shown little movement given the high aspirations recorded in the pre demonstration period, barley grass remains one of the most prolific annual weeds in the area.

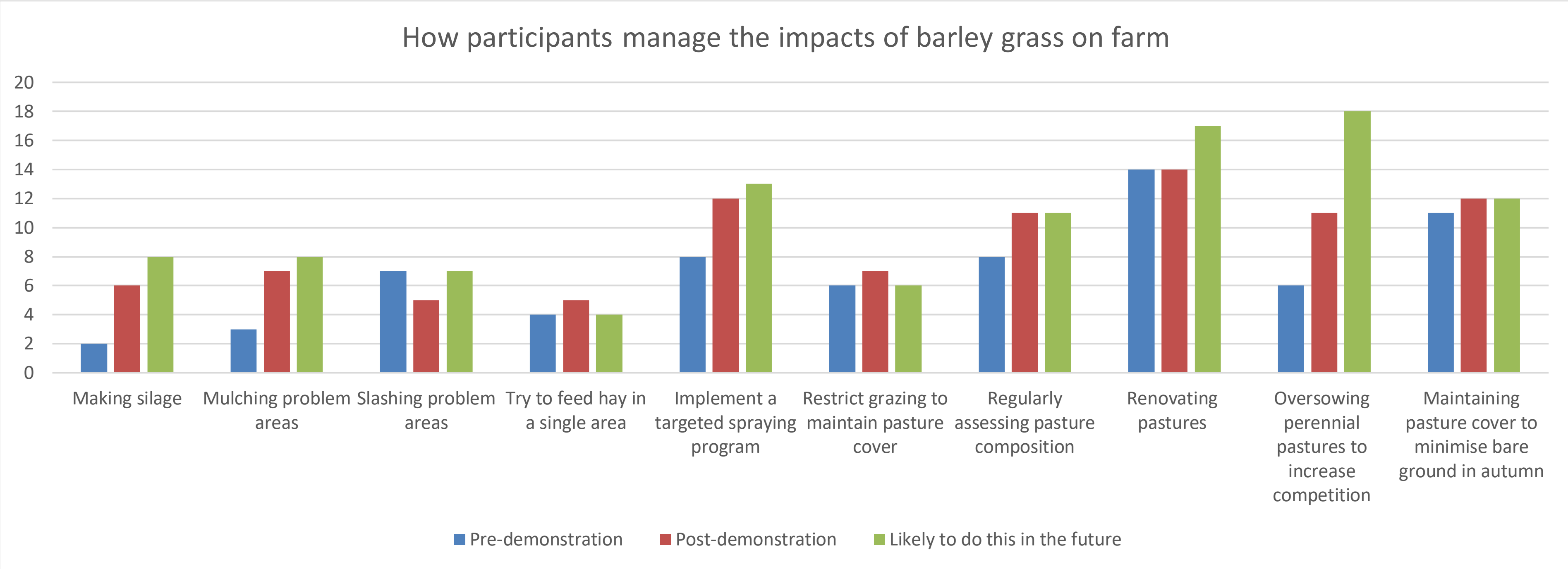
**Figure 28: Change in aspirations reported by group members during the project.**



### 4.7.5 Adoption

Also reported are the management techniques for barley grass control and their implementation pre and post demonstration and into the future. These results indicate that the demonstration has increased the adoption and intention to adopt the use of silage, late season slashing, mulching, chemical control and oversowing as methods to control barley grass, which is reflected by the successful results from these trials on farm. Oversowing showed an increase in adoption of 20% (24% pre to 44% post demonstration). The survey also revealed an increase in pasture assessments for barley grass by 28% (48% pre to 76% post demonstration).

**Figure 41: Change in the implementation of barley grass control methods pre and post demonstration.**



# 5 Conclusion

The demonstration was able to investigate a range of different management techniques in isolation and also in conjunction with each other. There were a range of results, with the biggest reduction coming from the use of silage and oversowing when used in conjunction with weed control.

**Sowing into existing pasture**

In isolation sowing into existing pasture failed to provide enough competition for barley grass to show a reduction in plant numbers. When used at Mount Dryden Site 2 in conjunction with successful chemical weed control, the project successfully demonstrated control which continued for subsequent years. Mount Dryden Site 2 represented a significant success for the control of barley grass in practice.

**Hard seeded legumes**

Where the Arrowleaf was successfully germinated it provided excellent feed, however it failed to germinate at the majority of sites. Therefore, its ability to provide useful competition for barley grass was unsuccessful.

**Chemical options and resistance testing**

Chemical options for the control of barley grass are effective, however late season rainfall will cause germination which allows seed set. Treatments with haloxyfop and propaquizafop successfully controlled barley grass and lower rates showed only slight effect to phalaris plants. No chemical resistance observed in samples can be attributed to past chemical use.

**Mechanical removal of hard seeds**

The hay making simulation reduced barley grass seedhead counts but was a small trial site, not paddock scale. The removal of barley grass did prevented seedling recruitment of phalaris resulting in more bare ground. Hay making has no effect on the viability of seedheads. Consideration must be given when feeding out hay contaminated with barley grass.

Silage was a successful management tool. All sites surveyed showed a reduction in barley grass after silage was removed. Seed viability post ensiling was also nil making it a useful control tool where topography and availability of equipment make silage possible.

**Grazing management**

On a paddock scale, successful hard grazing during spring is hard to achieve due to the number of animals required. When smaller paddocks were used with transient mobs of sheep the results were more successful however a late season rainfall event reduced the margin of difference between areas that were hard grazed and the un-grazed control.

## 5.1 Key Findings

Barley grass is a prolific and adaptable plant (seedhead counts of up to 21 million/ ha were found during the project).

For competition to be successful weed control must be considered in conjunction with oversowing.

Mechanical removal of seedheads (silage and hay) can reduce populations in pasture in subsequent years.

Ensiling makes barley grass seeds non-viable
Grazing management to control barley grass seed set is difficult to manage due to the high numbers of stock and the intense grazing required in a normal farm situation.
Late season rainfall will cause secondary germination which can reverse early season intervention.

### 5.2 Benefits to industry

While the project has not found any new methods for controlling barley grass it has increased the knowledge and skills of a large farm group in methods of dealing with barley grass.

The demonstration has raised the awareness of the usefulness of early season barley grass, providing it is managed correctly when seedheads emerge.

The increased awareness of the barley grass lifecycle and control methods will assist producers in reducing the meat and wool contamination better.

The project has successfully increased the awareness of making silage in the area, which has been successful at reducing barley grass. There is a barrier to the adoption of this technique due to the cost of purchasing specialist equipment, availability of contractors and local topography.

## 6 Acknowledgements

Thank you to those that hosted and provided information to this demonstrations including PPS host farms, Tylers Rural, Plant Science Consulting and the project advisory board Wayne Burton, Hayden Price, Richard de Fegely and Ash de Clifford.

## 7 References

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# 8 Appendix

## 8.1 Arrowleaf clover feed test results

**Figure 292: Crude protein measurements Arrowleaf clover, spring/summer 2020**

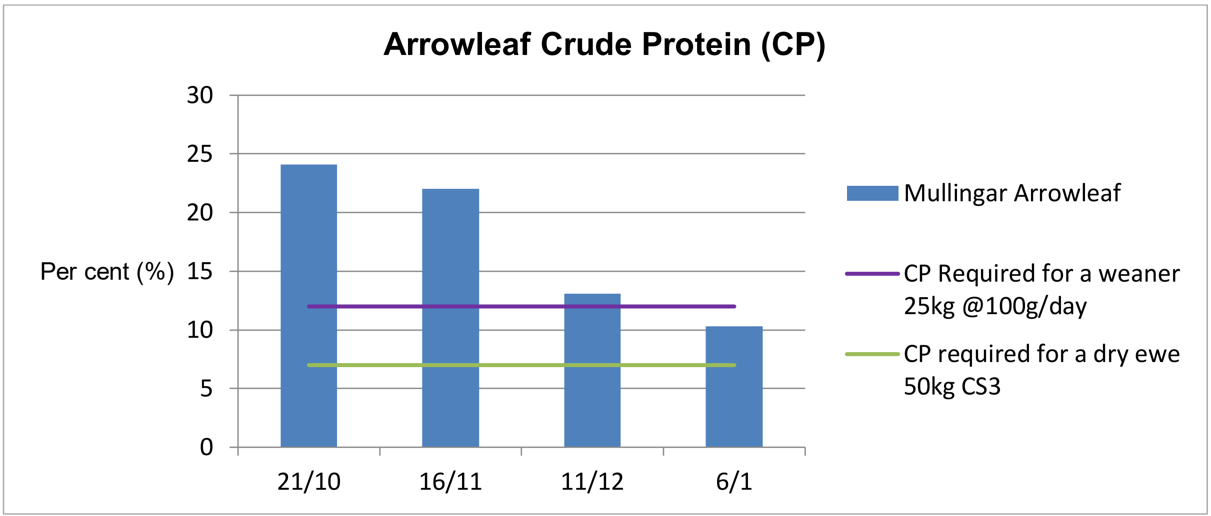



**Figure 303: Metabolisable energy measurements Arrowleaf clover, spring/summer 2020**

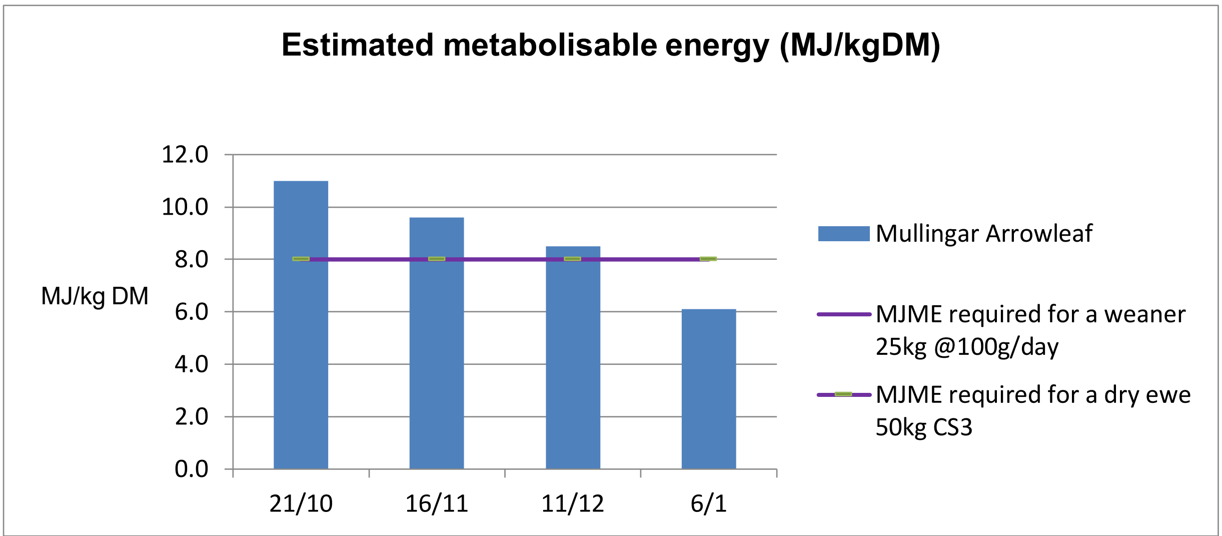
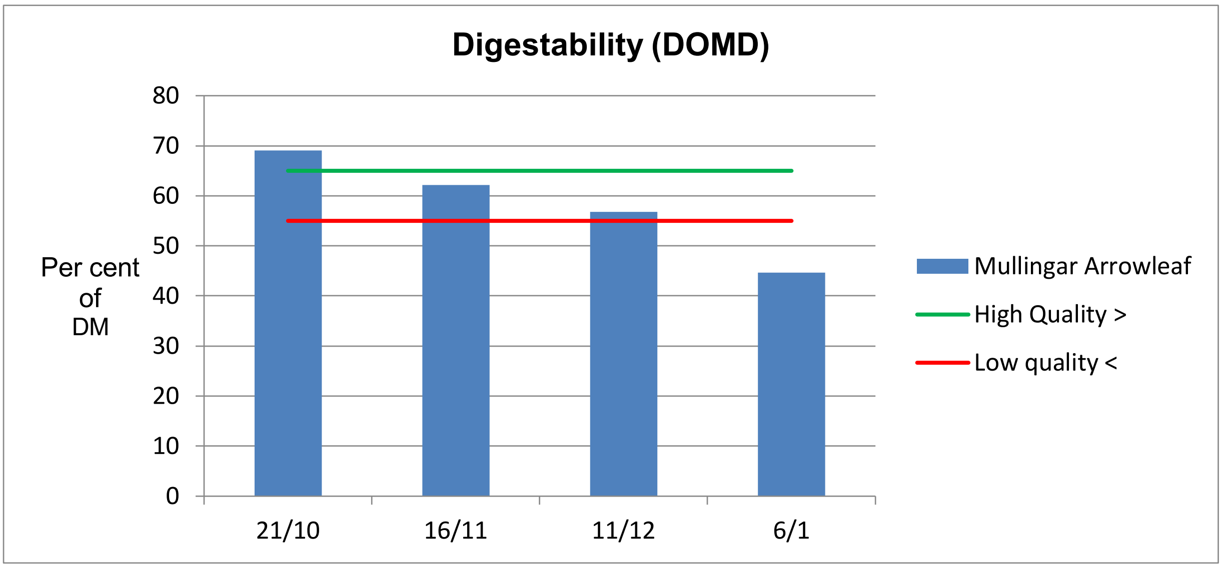


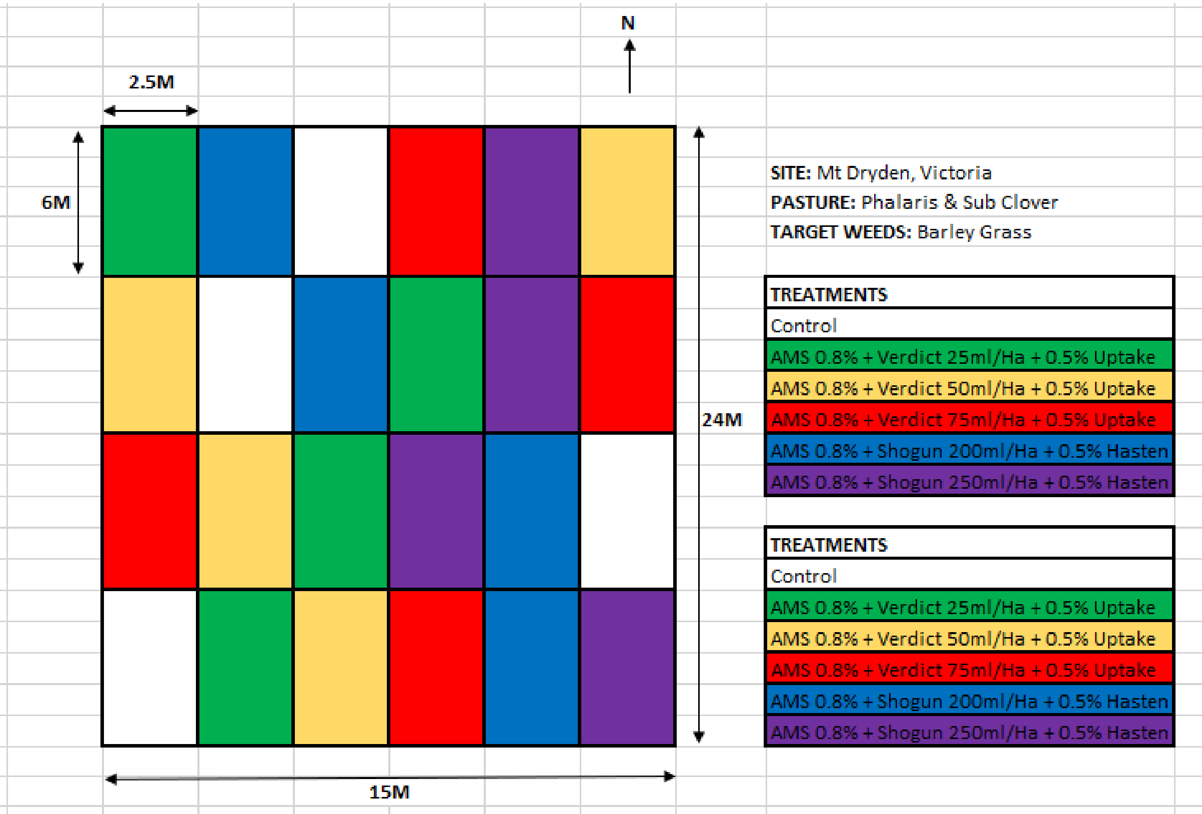
**Figure 31: Digestibility Arrowleaf clover, spring 2020**




## 8.2 Tyler's Rural Chemical Trial results Mount Dryden Site 1

**Methodology**

**Figure 32: Mount Dryden Site 1 site replication diagram**



**Results**

**Figure 33: Phalaris injury rating 28 days post treatment**

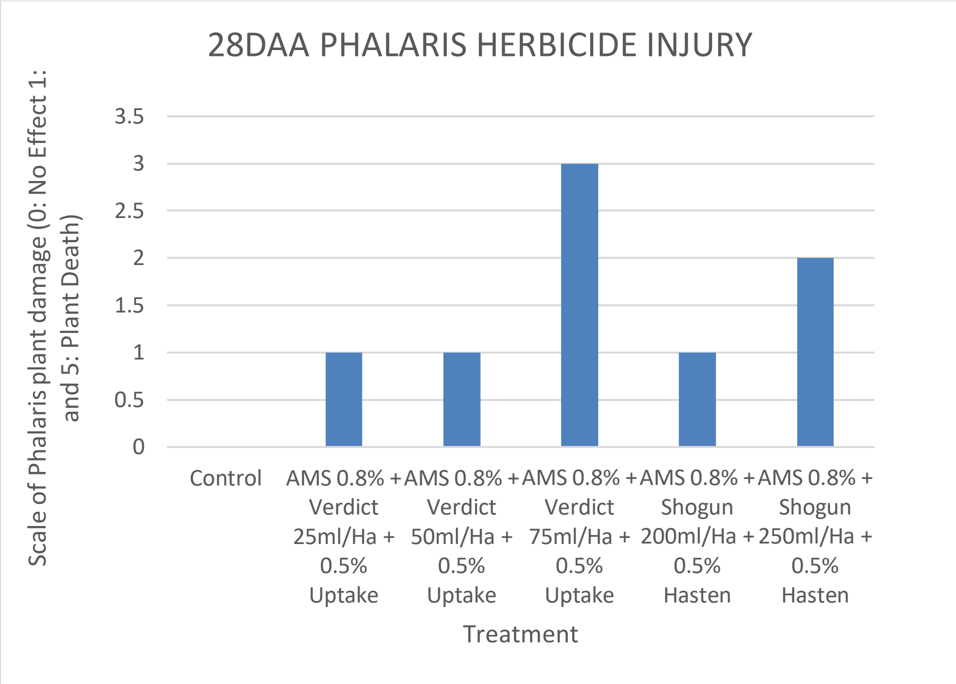
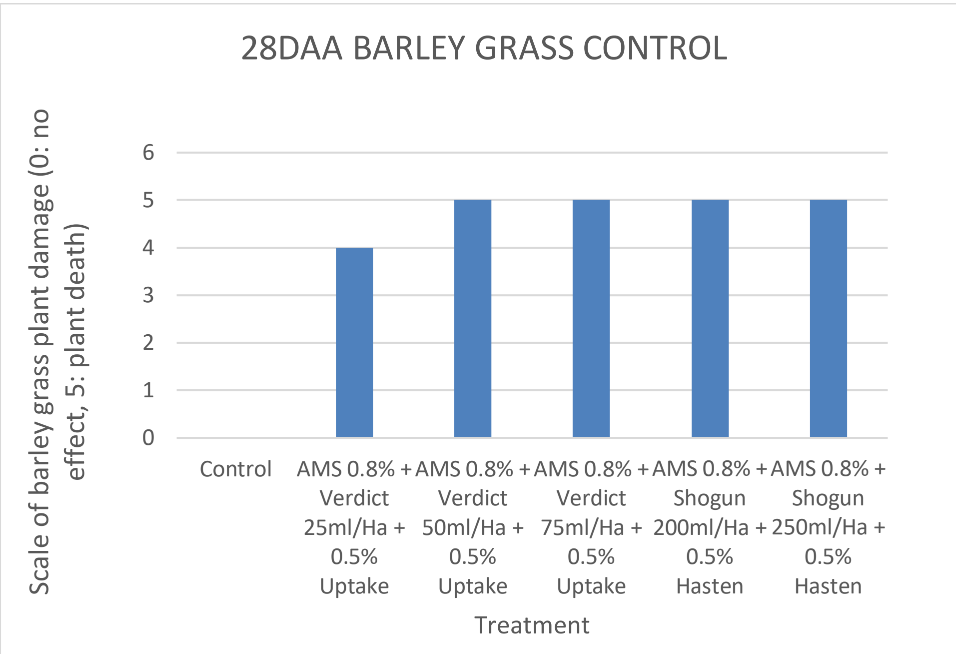



**Figure 34: Barley grass control rating 28 days post treatment**



## 8.3 Chemical resistance trial results

**Table 19: 2018 chemical resistance results**

PPS samples for resistance testing 2018 2 groups

| **Property** | **Location** | **A** | **C** | **L** | **M** | **Pasture Type** | **Notes** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | Y | Y | Lucerne | | Gramoxone | Sprayseed | L |
| 2 | | Y | | Y | | Lucerne | | | Roundup | M |
| 3 | | | Y | Y | | Lucerne | | | Select | A |
| 4 | | Y | | Y | | Mixed | | | Diuron | C |
| 5 | | | | Y | Y | Ryegrass | | | | |
| 6 | | | | Y | Y | Phalaris | | | | |
| 7 | | | Y | | Y | Phalaris | | | | |
| 8 | | | Y | | Y | Phalaris | | | | |
| **Spraytop** | | | | | | | | | | |
| 9 | | | | Y | | | | | | |
| 10 | | | | Y | | | | | | |

**Table 20: 2019 chemical resistance testing results**

2019
results
and RRR= 0-40% biomass reduction.

**PPS samples for resistance testing** **2 groups**

| | Property | Location | A | C | L | M | Pasture Type | | |
|---|---|---|---|---|---|---|---|---|---|
| 2005.1 | 1 | | | | 0 S | 0 S | **Lucerne** | Gramoxone | Sprayseed |
| 2005.2 | 2 | | 0 S | | 0 S | | **Lucerne** | | Roundup |
| 2005.3 | 3 | | | 90 RRR | 60 R | | **Lucerne** | | Select |
| 2005.4 | 4 | | 0 S | | 0 S | | **Mixed** | | Diuron |
| 2005.5 | 5 | | | | 0 S | 0 S | **Ryegrass** | | |
| 2005.6 | 6 | | | | 0 S | 0 S | **Phalaris** | | |
| 2005.7 | 7 | | | 60 RR | | 0 S | **Phalaris** | | |
| 2005.8 | 8 | | | 55 RR | | 0 S | **Phalaris** | | |
| | 9 | | | | | | | | |
| | Spraytop | | 1 Group | | L | | | | |
| 2005.9 | 10 | | | | 0 S | | | | |
| 2005.10 | 11 | | | | 0 S | | | | |

**Herbicides sprayed**

Glyphosate 540 @ 1.5L/ha

Targa 150ml/ha + 0.2% BS1000

Diuron 500g/ha

**Comments**

2 samples tested with Targa and no resistance detected

3 samples tested with diuron and all three exhibited resistance.

8 samples tested with paraquat, with paraquat resistance detected in 1 sample

5 samples tested with Glyphosate with no sample exhibiting resistance