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FarmLink Research Report 2017

Optimising summer weed control – preserve soil moisture and reduce impact of variability in growing season rainfall

Trial Site Location

Temora Agricultural Innovation Centre, Temora NSW

Report Authors

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Introduction

Research focusing on crop water use efficiency (WUE) has demonstrated the importance of summer weed control in conserving soil moisture for subsequent crops. The value of conserving soil moisture over summer in achieving improved crop establishment and final yield under dry growing conditions has been demonstrated over the last decade as farmers have experience drought along with more variable rainfall patterns and an apparent 'shortening' of spring.

Growers are keen to maximize the yield potential of crops in an increasingly variable environment and have embraced the philosophy of summer weed control. This farm practice brings with it questions related to the cost/benefit associated with the timing and frequency of summer spraying along with the trade-off between weed control for moisture & nitrogen conservation, reduction in weed burdens and summer feed for live-stock on mixed farms. Optimising the summer weed control practice will help farmers to better respond to climate variability.

Project Partners

FarmLink change • adapt • prosper

Project Code - RV01210

Funding Partners

NSW Government | Local Land Services Riverina

Aim

This project is focused on one area that may assist farmers to mitigate or adapt to the impacts of climate variability. Specifically, the project aims to investigate the costs and benefits of four different, commonly used summer weed control strategies – single spray, regular & frequent spraying over summer, grazing and a no management strategy as a control. Benefit will be described in terms of the differences in moisture retention over summer and final soil nitrogen. While cost will be described in terms of the differential in input and management costs of each strategy.

Method

- The field trial located at the Temora Innovation Centre, was replicated 3 times and commenced following harvest 2016. The trial was established in a Spitfire wheat stubble and was sown to Suntop wheat in 2017.
- The four treatments are listed in Table 1:

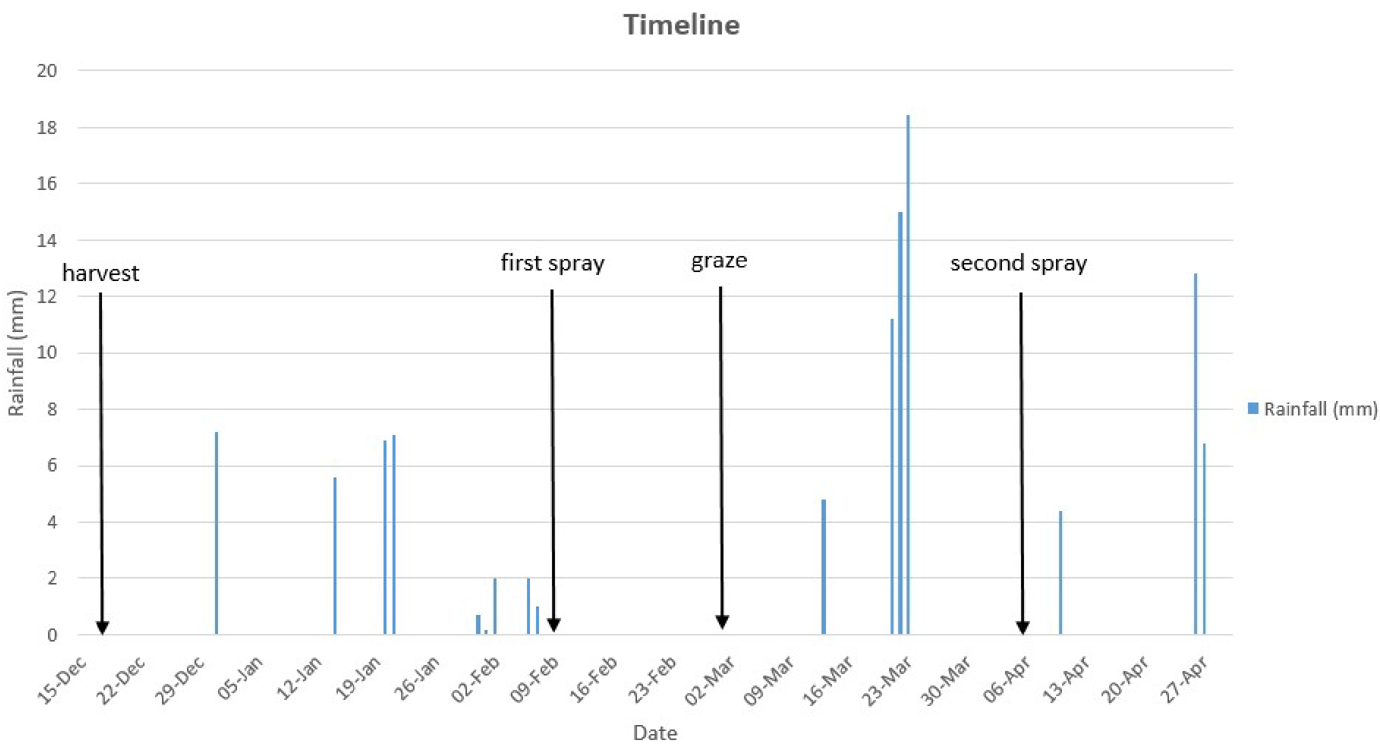
Table 1. list and description of the four treatments applied in this trial.

No.	Treatment	Description
1	Single spray	one spray application of herbicide 10-12 days after first major rain event (>15mm)
2	Multiple spray	Spray application 10-12 days after each major rain event (<15mm)
3	Graze	Graze by sheep 10-12 days after first major rain event (<15mm). Six sheep per plot for 5 days (600 DSE grazing days)
4	Control	No weed control

- Soil samples were collected at the commencement and completion of the trial and analyzed for soil moisture and nitrogen comparison.
- Photos and weed counts were undertaken on all the plots 10-12 days after the first major rain event of the summer and again at the end of the trial.
- The gravimetric moisture content was measured using a dry-weight basis equation:

$$\text{Gravimetric moisture content} = \frac{\text{(grams of wet soil} - \text{dry soil)}}{\text{grams of dry soil}}$$

- then calculated into millimetres using the standard bulk density of 1.3 for 0-10cm and 1.5 for 10-20cm. Kilograms of nitrogen per hectare were also calculated using the above bulk density figures.



Graph 1. Timeline of treatment application, sampling and rainfall events during 2016.

Results

Table 2. Final average weed plants per square metre. Including and not including volunteer wheat in the count.

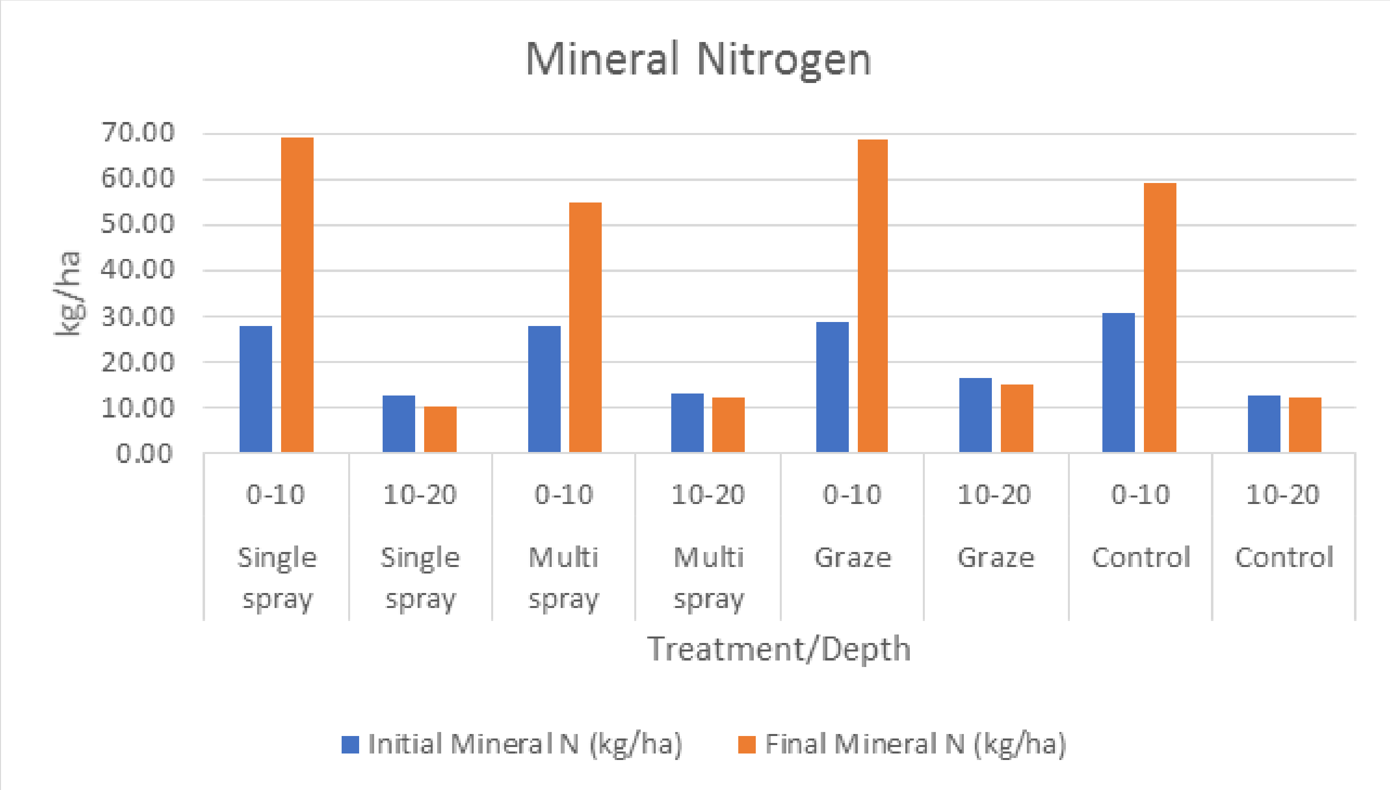
	*including volunteer wheat	*not including volunteer wheat
Treatment	**Final Avg plant/m²**	**Final Avg plant/m²**
Single Spray	79b	18a
Multi Spray	4c	2b
Graze	159a	31a
Control	122ab	22a
LSD (P = 0.05)	44.3	14.6

Table 2 shows there was significantly less weed plant numbers in the multiple spray treatment when comparing to the other three treatments, when volunteer wheat is and isn't included in the data. There was no treatment effect in terms of weed plant numbers on the single spray, graze and control treatment when volunteer wheat was not included. However, when volunteer wheat was included in the collection of data, there was a larger spread in results. The multi-spray treatment was most effective, followed by the single spray treatment, the control had was not significantly better than the graze treatment, or worse that the single spray treatment.

Table 3. Initial and final volumetric moisture content average at a depth of 0-10cm and 10-20cm.

Treatment	Initial Moisture 0-10cm (mm)	Initial Moisture 10-20cm (mm)	Final Moisture 0-10cm (mm)	Final Moisture 10-20cm (mm)
Single spray	4.1	7.4	19	14.3
Multi spray	4.0	7.7	19.5	16.9
Graze	3.7	7.8	18.5	13.6
Control	4.5t	9.5	19.1	13.8
LSD (P = 0.05)	No significant difference	No significant difference	No significant difference	No significant difference

Table 3 shows that the trial began with uniform moisture over all the plots down to 20 centimetres, except for the control treatment which had a higher level of 9.5mm of moisture stored at 10 – 20 centimetres. However, this high figure did not carry through to the end of summer. The final moisture analysis shows there was no effect on moisture retention between treatments at the depth 0 – 10 and 10-20 centimetres. The multiple spray treatment proved to be superior at moisture conservation over the other treatments, but it was of no significant difference.



Graph 2. Initial and final mineral nitrogen (ammonium + nitrate) at a depth of 0-10cm and 10-20cm.

The statistics in graph 2 show that there was no difference between treatments when comparing Initial and final mineral nitrogen. The mineral nitrogen increased over the summer period at the depth of 0-10cm, while at 10-20cm levels remained constant.

Table 4. Cost analysis per treatment, displayed as dollars per hectare.

Treatment	Chemical ($/ha)	Contractor/agistment rate ($8/ha)	Total ($/ha)
Single Spray	$15.70	$8.00	$23.70
Multi Spray	$31.40	$16.00	$47.40
Graze	-	30 cents/DSE/week	-$25.71
Control	-	-	$0.00

The cost analysis (table 4) shows the multiple spray treatment is double the cost of the single spray treatment, while the grazing treatment gained $25.71 per hectare when an agistment rate of 30 cents per DSE (dry sheep equivalent) per week was used. The control treatment strategy was no weed control, therefore the cost was $0.00/ha.

Discussion

The multiple spray treatment had an average of only four weed plants per square metre including volunteer cereal and only 2 plants per square metre not including self-sown cereal. This is by far the best treatment when aiming to reduce weed plant numbers. The graze treatment had significantly more weeds than the single and multiple herbicide treatments, but had no effect when compared to the control treatment when controlling both weeds and volunteer wheat (image 1).

Image 1. Each treatment post final weed counts at the end of the trial. Photo taken April 24th, 2017.

There are many advantages for controlling weed numbers, by reducing the number of weeds, the seed set is reduced too. Weed seedbank numbers can increase significantly and very quickly if no management in undertaken, this can contribute to future weed burdens. Ultimately, the aim would be to run down the weed seed bank numbers by using effective management strategies until a second herbicide spray is not required. Other problems that arise from large weed populations are certain weeds can cause trouble when sowing, such as wire weeds tough long stems getting caught around tines of a seeder and cause blockages.

Grazing did not occur 10-12 days after the first rain event as stated in the original plan due to

Image 1. Each treatment post final weed counts at the end of the trial. Photo taken April 24th, 2017.

insufficient biomass, grazing occurred once there was sufficient biomass for the sheep to consume. However, it is important that the weeds were not left long enough to set seed, otherwise this would defeat the purpose of controlling weeds for the benefit of reducing weed seed bank numbers. Grazing should be monitored as some weeds such as loose strife and caltrop can be toxic to sheep in large quantities. It is likely that more weeds germinated following the second rainfall event that occurred post grazing, a second graze would have been beneficial.

Moisture is removed from the soil profile over summer through transpiration and evaporation, evaporation can have an effect down to 20cm. At the conclusion of the trial, there was very little difference in moisture content between treatments at 0-10cm in the soil profile. While there was a small difference noticeable at 10-20 centimetre's, it was of no significant difference. The lack of difference in the 0-10cm layer is most likely due the rainfall received prior to the soil samples being taken. The 10-20cm layer would have also been somewhat affected by the rainfall event. The multiple spray treatment conserved the most moisture at 10-20cm, followed by the single spray treatment. There was no difference in moisture conservation in the graze and control treatment. It is noted that the total volume and frequency of rain that fell over this summer period was low compared to the long-term averages, and this will have had the effect of reducing the biomass of weeds produced and reducing the difference in impact between treatments.

Effective management of weeds over a summer fallow can conserve moisture for the crop in the following year. This can be very advantageous if there is a dry start to the season, emerging crops may gain a head start. Extra moisture isn't the only advantage for emerging crops, some weeds may affect subsequent emerging crops due to their allelopathic abilities. Some common summer weeds found in our area with this ability is crumb weed and caltrop.

There was no treatment effect on the final mineral nitrogen levels across all the treatments. The slight increase of nitrogen in the 0-10cm segment over summer was due to mineralization of organic matter.

The multiple spray treatment is by far the most expensive summer weed control strategy, but it is also the most effective. Although the grazing treatment made an income of $25.71 per hectare, it had no control of weed numbers and no impact on nitrogen or moisture retention. The cost of these strategies need to be weighed up against the advantages, both short and long term. Situations may vary from farm to farm, some control strategies may suit better than others. Some of these variables include; weed numbers and type, whether livestock are available or if they must be brought in, if spray equipment is available or a contractor is to be used, the list goes on. The climate over summer can have a massive impact on selecting a control strategy too.

It's important to keep in mind that this was a short-term project, results drawn from this trial only reflect the 2016/17 summer season. Accumulating this data over 3 or more summer seasons would produce more accurate results by considering seasonal variability.