Best management Practices for Soluble Pesticide Use in the ORIA

WATER SAMPLER

WEED COUNTING

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ORD LAND AND WATER

BROLGA'S ENVIRONMENT

Rangelands NRM Western Australia

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1. Introduction

Ord Land and Water (OLW) received funding under the National Action Plan for Salinity and Water Quality to implement a project to develop best management practices for soluble pesticide use in the Ord River Irrigation Area (ORIA).

This project builds on previous work to assist development and adoption of Best Management Practices to reduce the movement off site of agricultural pesticides in the ORIA. Past work developed guidelines across a broad range of chemicals; this work assisted in reducing significantly traces of insoluble chemicals found off farm. However, there has not been the same success with soluble chemicals currently in use.

By design, soluble chemicals move easily with water and therefore are prone to movement off farm with irrigation and rain events. Reasons for this include:

- The soluble nature of the chemicals,
- Their efficacy being reliant on timely water incorporation
- Management difficulties encountered by growers in the broader scale adoption of guidelines for use with soluble pesticides

In order to gain a better understanding of the characteristics of soluble chemicals in irrigation water, Ord Land and Water (OLW) devised a trial watering strategy. It was proposed to test differences in Atrazine concentrations, as an indicator soluble pesticide, over several watering time lags. Atrazine is a triazine herbicide which is reactive in the water column.

The project will:

- Test the efficacy of a soluble pesticide (atrazine) over a number of different application to irrigation time lags to determine an irrigation window that provides efficient control whilst minimising the risk of off site movement of the pesticide
- Measure and compare pesticide concentration levels moving off treatment areas over different application to irrigation time lags in the initial and a further two subsequent irrigations.

2. Aim

The aims of this project are to:

- Determine the efficacy of herbicide over different application to irrigation time lags;
- Measure and compare pesticide concentration levels moving off site with different application to irrigation time lags; and
- Trial a strategy to water-incorporate herbicide into the water furrows while reducing pesticide concentrations in tail water.

This project will assess the efficiency of Atrazine applications, the impact of post application irrigations and variations in the concentration of Atrazine in irrigation tailwater. This will be done through the assessment of three different treatments replicated on three farms.

Treatment one is aimed at determining whether the impact of immediate wetting of furrows with a small quantity of water, prior to a full irrigation 48 hours later, affects the efficiency of weed treatment and runoff concentrations. Treatment two and three determine the efficiency of Atrazine when watered 48hrs (treatment 2) and 96hrs (treatment 3) after application.

Each site would have a separate shift change, or watering application, for each treatment allowing for separate water samples to be taken at each treatment for three irrigation events.

3. Methods

Study sites were located ‘on-farm’ in the ORIA, Kununurra Western Australia. Three farmers agreed to modify their irrigation applications for participation in this trial (Figure 1). All three trial sites grew sorghum crops during the 2009 investigation. The information delivered to farmers and the agreement for the trial is contained in Appendix 1.

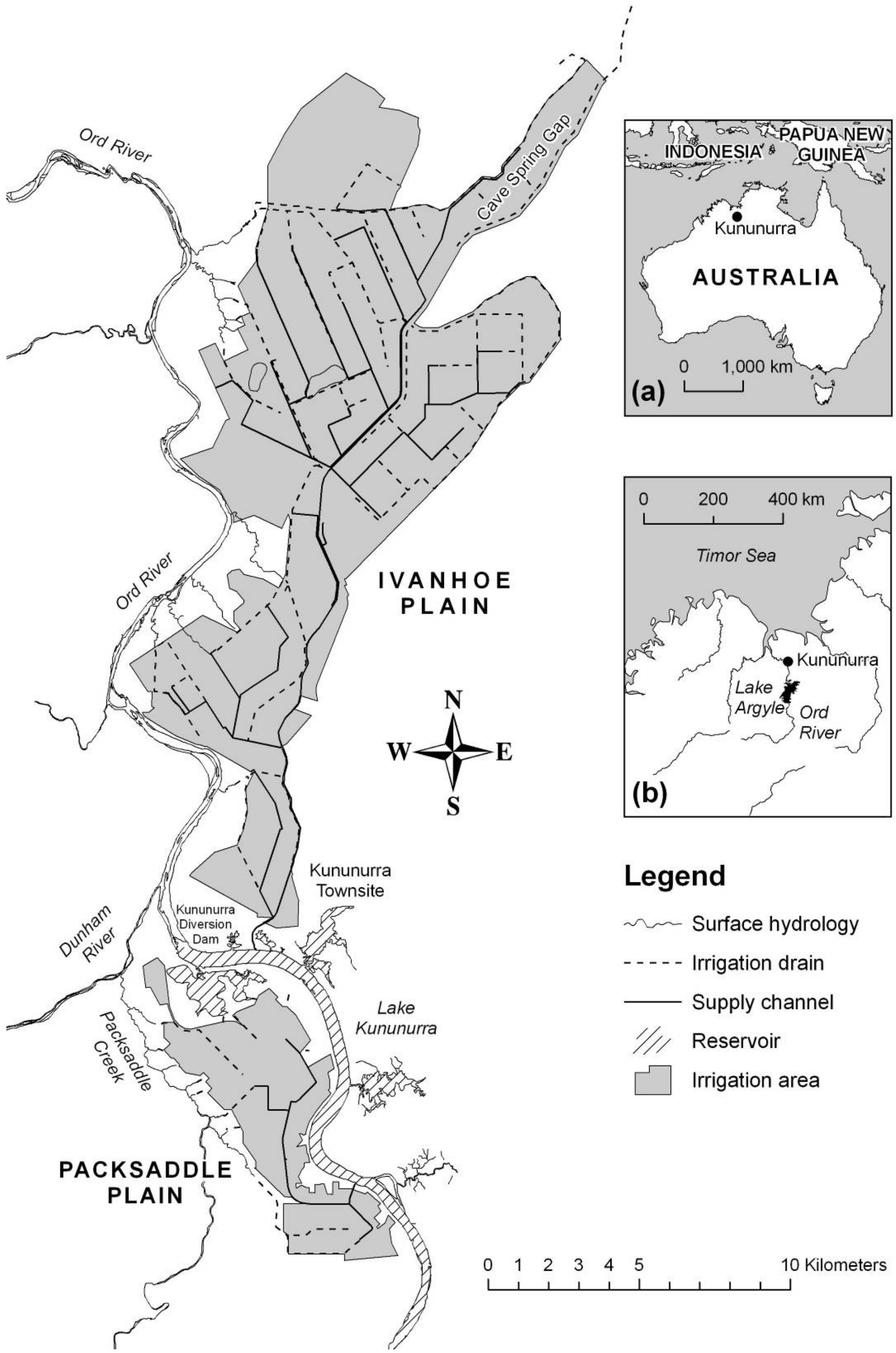


Figure 1 Location of ORIA where trial performed.

Each irrigation blocks was split into three sub-blocks in order to apply three different irrigation phases and test the eventual concentration of Atrazine in run-off (Figure 2, Figure 3 and Figure 4).

An ISCO 6712 portable sampler was used to take automatic samples every hour, of 960 ml volumes, over a ten hour period. The sampler was placed at the tail drain in the required sub-block before irrigation had reached the drain point in order to catch the first run-off. The accumulated volume was amalgamated for one sample volume of 1L. The samples were analysed for Atrazine in µg/L by the NATA accredited National Measurement Institute in Perth.

Each sub-block received irrigation at different time lags as follows:

3.1 Treatment 1 (T1)

Treatment 1 received an initial 'wet-up' of furrows only to activate Atrazine. Treatment 1 was irrigated until water reached the tail drain; water was prevented from running into receivable drains by placement of a bund in the drain and any residual water was not allowed to leave the block until 48 hrs after application as per label Instructions for Atrazine. The treatment was then fully irrigated after 72hrs and a water sample collected from the tail drain

3.2 Treatment 2 (T2)

Treatment 2 was watered 48hrs after Atrazine application with a water sample collected from the tail drain.

3.3 Treatment 3 (T3)

This irrigation was held out to 96 hours after Atrazine application. This was to test the theory that Atrazine concentrations would be reduced in tail drain run-off whilst still having adequate potency to control weed growth.

3.4 Second and Third Irrigation

The second and third irrigations followed on from the first irrigation at regular timing, as per normal irrigation. A water sample was collected from the tail drain of each treatment.

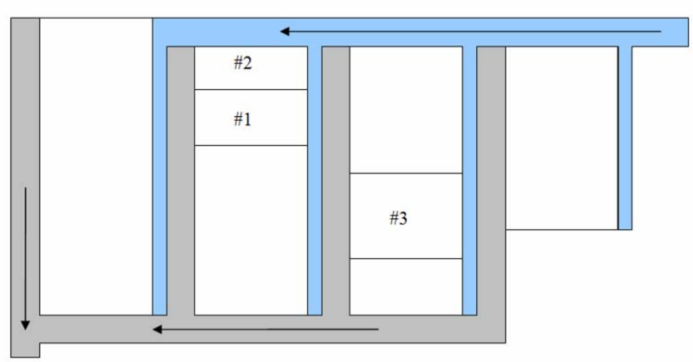


Figure 2 Treatment 1-3 applied on Site 1.

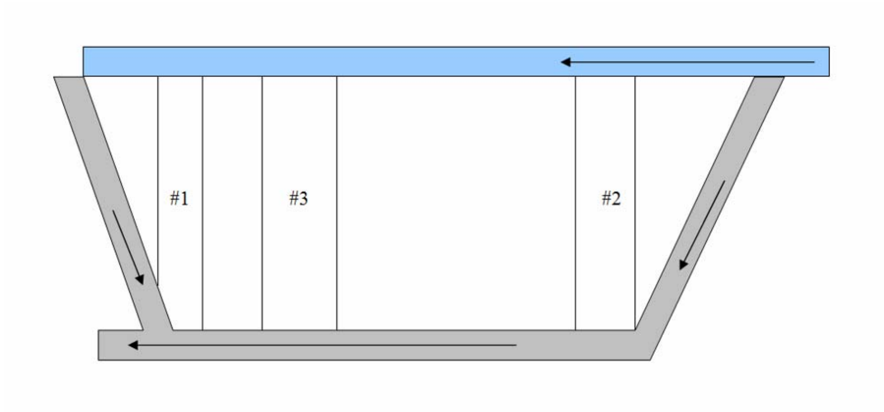


Figure 3 Treatment 1-3 applied on Site 2.

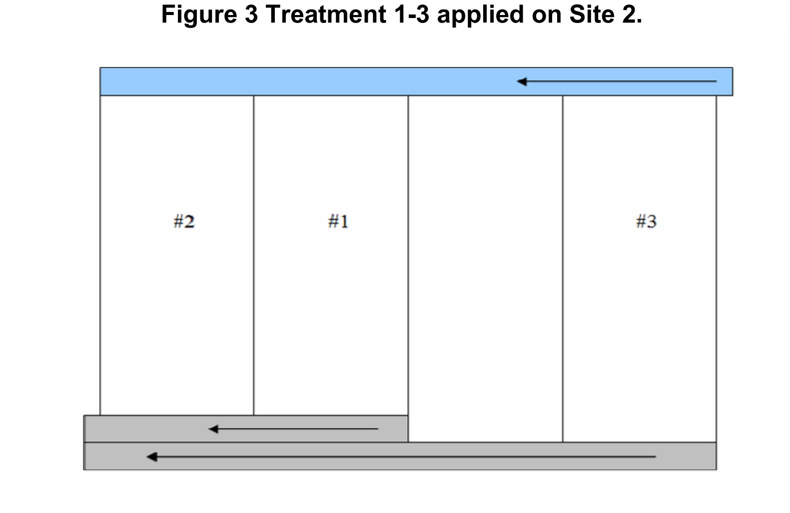


Figure 4 Treatment 1-3 applied on Site 3.

This experimental design eliminates variation in weed control and Atrazine runoff due to land preparation, farm layout and chemical application techniques. The dates and details of chemical application and water sample collection are in Appendix 2. All irrigation blocks had Atrazine applied over the entire block as a pre-emergent weed control. Each Irrigator used different concentrations and brands of Atrazine and other crop preparation additives. Details of these are contained in Table 1.

Plate 1: Watering site 1.

Plate 2: Weed counting site 1.


Plate 3: Bunded site 2 treatment 1.


Plate 4: Watering site 2.


Plate 5: Weed counting site 3.


Plate 6: Water Sampling site 3.

Other issues for consideration included:

- Contamination of sampler between samplings and therefore carry over of atrazine- the sampler was washed between tail water sampling with Spiroklen and then rinsed with clean water;
- Assistance with irrigation as the first irrigation scheduling will be very intense for the farmer. All farmers were happy to be involved in the project and did not require assistance; and
- Compensation for weediness of treatment sites (ie. Aerial application of atrazine on block after trial finished). The only block that was resprayed on trial completion was required to due to re-emergence of a previous crop

Table 1 Details on atrazine applications, crop preparation and block characteristics.

Manager	Site 1	Site 2	Site 3
Area (ha)	T1/T2 14ha T3 8ha	50	53
Drains to	D4C	D8	D4
Soil Cultivation	Heavy disked, power ripped and re shaped	Go-deviled and bedshaped	
Crop type	Sorghum	Forage Sorghum	Sorghum
History Crop	T1/T2: Sorghum T3: Coriander/Sunflowers	Sorghum	Chickpeas
Slope	2500-3000		3000
Chemical	Atrazine 900	Atrazine 900	Atrazine 900
Application rate (L/ha)	2	2	1.8
Application method	Spray boom	Cover Spray	Boom Spray
Other chemicals	Metolachor 2L/ha Crop oil 0.25 L/ha Water 100L/ha	Metolachor 2.5kg/ha Sprayseed 2.5kg/ha Wetter 0.2L/ha	Metolachor 1L/ha Powermax 1L/ha Sygnertrol Hortioil 0.5L/ha

Weed Counts

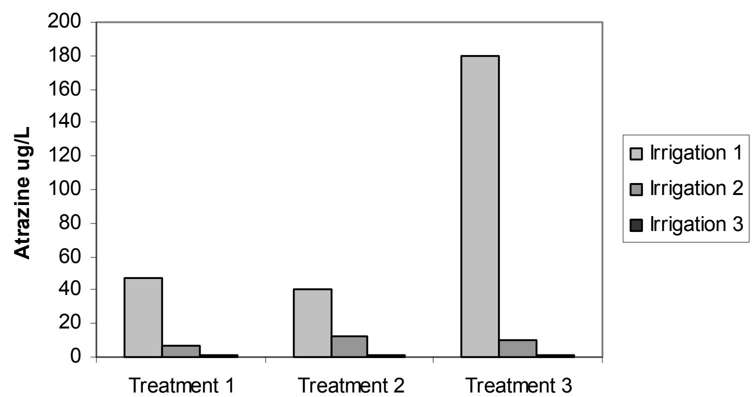
Broad Leaf and Grasses were counted at each block between 21-28 days after first irrigation wet up. Transects of 20m X 1.8m were counted along every second row of each treatment block until reaching the end of the block.

4. Results

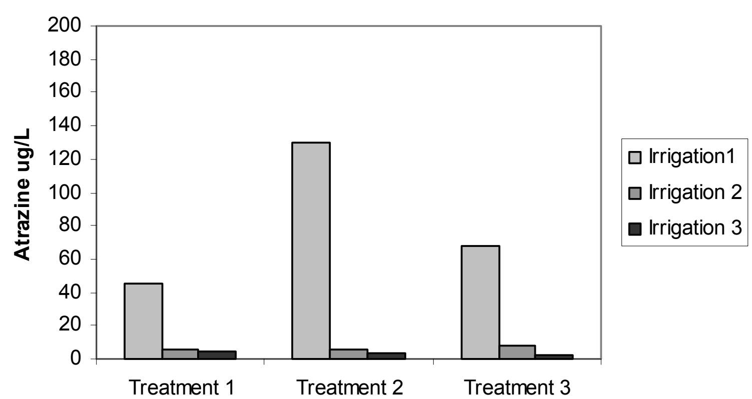
Water Quality

The results of the Atrazine concentrations in each irrigation event from each treatment on the three separate blocks are shown in Figure 5.

Site 1



Site 2



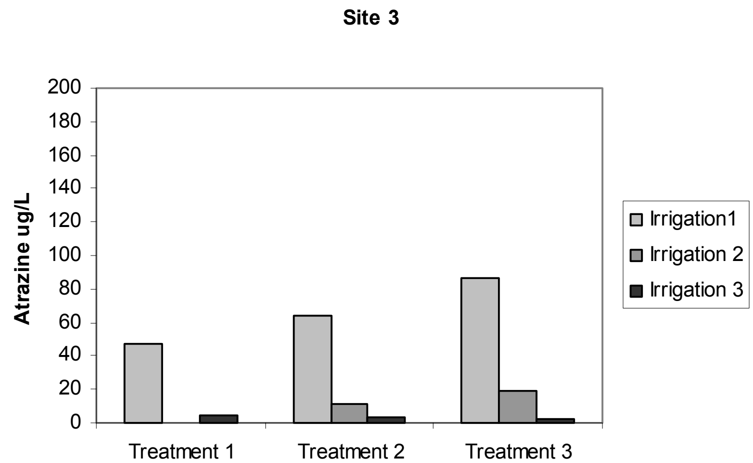


Figure 5 Atrazine concentration in water samples collected off the three different blocks.

Across all three treatments the concentration of Atrazine decreases with successive irrigations (Figure 5). It is not possible to compare the concentration of Atrazine in on each block for each irrigation event as the management techniques differ. As such the variability in Atrazine concentration between the treatments (1-3) for each irrigation event at each site is used to be able to compare the results of each irrigation event at each site. This has been calculated as follows:

Variability for irrigation 1 at site 1 = standard deviation (Atrazine concentration for 1st irrigation for treatment 1-3 at site 1) / average (Atrazine concentration for 1st irrigation for treatment 1-3 at site 1)

The variability in results for each treatment within an irrigation event is reduced in the 2nd and 3rd irrigation although it still remains between 25-40% of the average in that irrigation event (Figure 6). The variability is much greater in the first irrigation event except on Site 3 where the variability is greatest in the second irrigation event. This demonstrates that the greatest impact on Atrazine concentration in tailwater from changed irrigation management can be achieved in the first irrigation event. The variation in Atrazine concentrations diminishes with successive irrigations and so the opportunity to impact on Atrazine concentration in tailwater also diminishes.

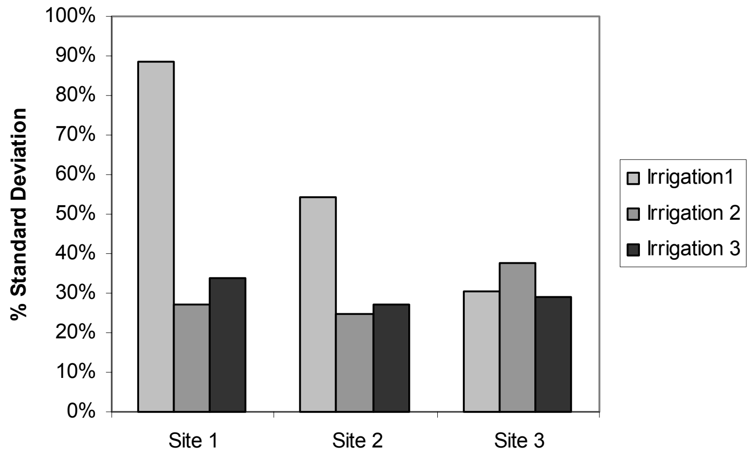


Figure 6 the standard deviation as an average of all samples collected off all treatments for that irrigation event from each site.

During the first irrigation event the Atrazine concentration is greater in the 3rd treatment than in the 1st treatment (re-watering after initial wetting up). This is unexpected as at all sites the 1st treatment was re-watered in between the 2nd and 3rd treatment samplings. It would be expected that the longer the Atrazine is exposed, without watering would result in greater volatilisation and therefore less available to runoff. This suggests that the wetting up on the 1st treatment fixed a greater amount of Atrazine in the soil. At two of the sites the 1st treatment had the lowest concentration of Atrazine of all the treatments. Site 1 was different with treatment 2 being the lowest Atrazine concentration for the first irrigation.

The Atrazine concentrations for the third full irrigation were the lowest of all irrigations for all sites.

Weed Counts

The density of broadleaf weeds versus grasses is much greater on Site 1 treatment 1 and 2, while the reverse was the case on his treatment 3, possibly due to the proliferation of regrowth from residual seed from the previous year and could possibly have outcompeted the grasses (Appendix 3). Broadleaf weeds were in greater density than grasses at Site 2 for all treatments while the broadleaf was greater than that of grasses for treatment 2 and 3 at Site 1 while treatment 1 had a lower density of broadleaf weeds.

Treatment 3 exhibited the lowest density of broadleaf weeds at all sites (Figure 7). While at Site 2 the highest density of broadleaf weeds occurred in treatment one but at Site 3 it was in treatment 2.

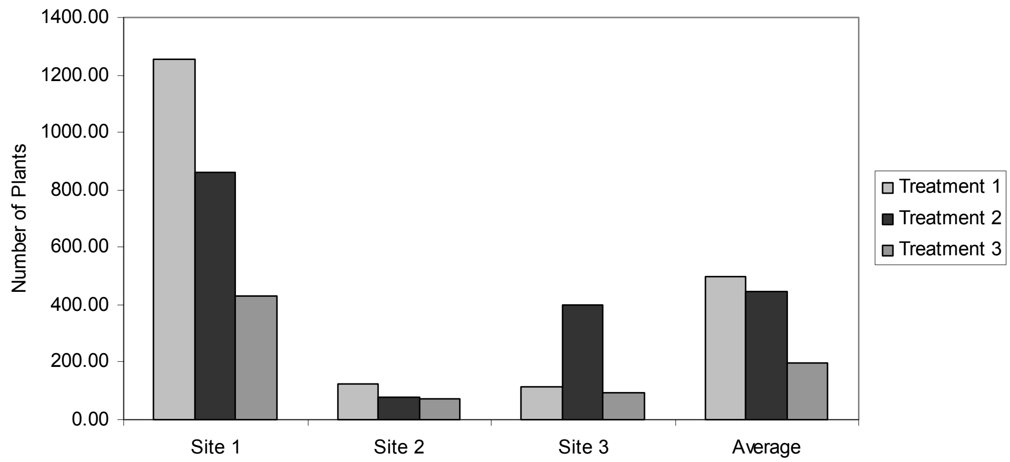


Figure 7 Broadleaf weed density per hectare at the three sites and the average across all sites.

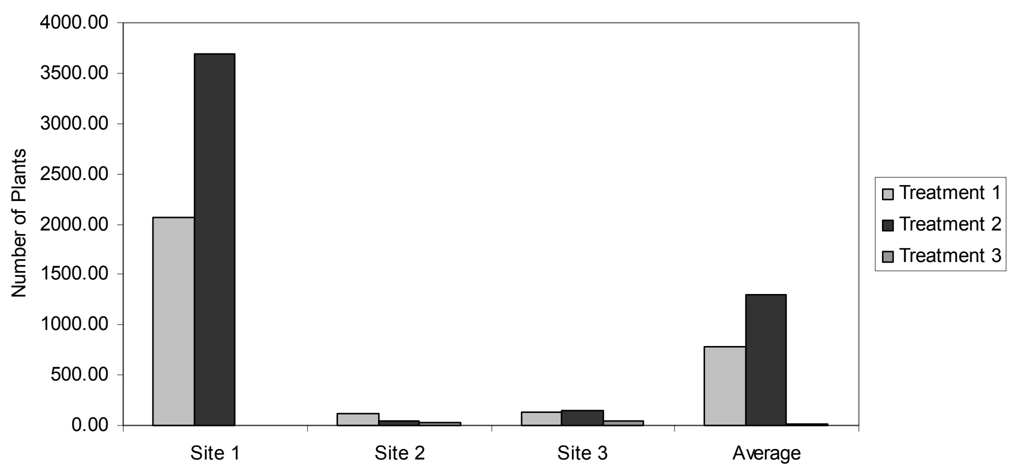


Figure 8 Grass density per hectare at the three sites and the average across all sites.

5. Conclusion

This trial indicates that the concentration of Atrazine in tail water can vary significantly with different watering techniques. It also demonstrates that there is an opportunity to manage the concentration of Atrazine in tailwater in the first irrigation event following application.

From the work done, the first treatment reduced on average the concentrations of atrazine moving off the paddock in the initial and the two subsequent irrigations.

The effectiveness of Atrazine as a broadleaf weed control does not seem to be impacted by delaying watering as all three sites demonstrated greater broadleaf weed control on those sites where the watering was delayed the greatest. In addition at two of the three sites the greatest concentration in Atrazine was lost in the 1st irrigation after the longest delay in watering (3rd treatment).