Irrigation Protocols and Overseeding Rates and Methods For Pesticide-Free Soccer Fields

Ontario Turfgrass Research Foundation Final Report

Peter Purvis and Pam Charbonneau

Executive Summary

With the introduction of Ontario's Cosmetic Pesticides Ban, high quality, weed-free sport's fields will be a challenge to maintain. Turfgrass cultural practices, such as irrigation and overseeding, have been shown to improve sports field playing surfaces and reduce weed populations but more work is needed. Our research on soccer fields at the Guelph Turfgrass Institute included irrigation according to an evapotranspiration-based water budget used at different soil volumetric water content (VWC). Plots were also assigned one of three perennial ryegrass seeding rates (0, 3, and 6 kg/100 m^2) applied either directly to the turf by drop spreader or by a slit seeder.

Throughout the season as fields were overseeded with perennial ryegrass, the % perennial ryegrass cover increased with the final percentage being roughly double compared to the beginning of the season. The field that received more wear and traffic (South field) had more perennial ryegrass at the end of the season than the field receiving less traffic (North field). By the end of the trial, the field that received more wear and traffic (South field) had less Kentucky bluegrass and more bare sections than the field receiving less traffic (North field). Generally, the surface hardness was greatest on the field that received more wear and traffic. This study showed that over time when wear is imposed on a mixed stand of Kentucky bluegrass and perennial ryegrass, the composition of perennial ryegrass will increase at the expense of Kentucky bluegrass.

There were no significant statistical differences in the perennial ryegrass seeding rate (0, 3 or 6 kg/100m^2) or overseeding method (drop spreader or slit seeder) in this experiment, however trends indicated that the highest overseeding rate produced the greatest turf quality.

Broadleaf weeds were present in only very, small amounts (0-1 broadleaf weed per plot) in this study and the results were not significant and the numbers were too small to report any trends.

The North field (irrigated at 37% VWC) required a fewer number of irrigations, had a longer time between irrigations and less water was applied compared to the South field (50% VWC). Even though less water was applied to the North field, this field was of either similar or better quality than the South field.

Introduction

Soccer is one of the fastest growing sports in Ontario. High quality, safe, natural playing surfaces are needed to keep up with the demands of this rapidly growing sport. With the introduction of Ontario's Cosmetic Pesticides Ban, high quality, weed-free fields will be even more of a challenge to maintain. Turfgrass cultural practices, such as irrigation and overseeding, have been shown to improve sports field playing surfaces and reduce weed populations but further research is needed.

The objectives of this research were to:

- To determine the optimum overseeding rate using perennial ryegrass.
- To determine the best overseeding method for perennial ryegrass.
- To determine if water conservation can be realized using a modified water budget

Methods

Two "mini" (53.3-m x 36.6-m) soccer fields were established at the Guelph Turfgrass Institute (GTI) in 2008. In 2009, 2-m x 7-m plots was established on each field (24 plots total). Plots were randomly assigned one of three perennial ryegrass seeding rates (0, 3, and 6 kg/100 m^2). Seed was delivered to half of each plot assigned randomly either by: (a) direct application to the turf surface by drop spreader; or (b) a Ryan slit seeder. Seed was applied on 10 June, 08 July and 07 August for a total of 0, 9, and 18 kg/100 m^2 per plot.

Irrigation was applied to the South field when the volumetric water (VWC) content of the soil reached 50%, as determined by an evapotranspiration (ET) based water budget developed at the University of Guelph. Irrigation was applied to the North field when the soil VWC dropped to 37% (using the same ET model).

Guelph Soccer, the main soccer association in Guelph, scheduled regular games and practices on the fields at the GTI. Play was scheduled equally between the North and the South field. However, because the South field was located next to the parking area it tended to get more play, and therefore more traffic and wear.

Species composition, canopy reflectance and field hardness ratings were taken regularly throughout the season. Fields were mowed three times per week at a height of 5-cm, core aerated in July, August and September, and fertilized with a total of 100 kg N per ha. No pesticide was applied to the soccer fields.

To estimate species composition, two randomized point quadrats (measuring 60-cm x 60-cm with 25 points in each quadrat; points were 10 cm apart for a total of 50 points in each plot) were used to estimate percent of Kentucky bluegrass, perennial ryegrass and bare ground at four dates: May 29 (before overseeding treatments started); June 29; July 31; and Oct. 19, 2009.

We also measured turfgrass density and quality using a device called the *Greenseeker*. This device detects reflection of light at a wavelength of 660 nm (where chlorophyll absorbs) and at 770 nm (a reference wavelength), to produce an index which is correlated with chlorophyll content, photosynthetic activity, canopy cover, and other parameters of turf health.

We measured field hardness using a devise called a *Clegg Hammer*. This device consists of a weight (0.5 kg hammer) which is dropped down the complete height of a vertical guide tube (55 cm). The drop consists of bringing the top of the weight level with the top of the tube and dropping the weight. Two drops are made per data point with only the second drop recorded (peak method). The digital readout gives an indication of the hardness or softness of the field. Clegg Hammer readings are in CIT's (Clegg Impact Test) values. The surface hardness was measured on: July 7; July 31; and Aug. 12, 2009. A greater Clegg Hammer reading equates to a firmer surface.

Results and Discussion

Objective 1 and 2: *To determine the optimum overseeding rate and overseeding method for perennial ryegrass.*

There were significant species composition differences between the two different mini-soccer fields (North and South). At the beginning of the season, Kentucky bluegrass was just under 50% for both fields (Figure 1; averaged over the seeding rates and seeding methods). By the end of the season, the % Kentucky bluegrass was just over 40% for the North field and just over 30% for the South field. Due to the close proximity to the parking area, the South field received more play and hence more traffic and wear.

By the end of the season, the wear may have been a factor contributing to the larger decrease in Kentucky bluegrass in the South field.

Comparing the North and South fields (averaged over the seeding rates and seeding methods), the % perennial ryegrass began at about 25% for both fields (Figure 2). Throughout the season, as the perennial rye was overseeded, the % perennial ryegrass gradually increased. By the end of the season, the perennial ryegrass was 47% and 53% on the North field and South fields, respectively. It is interesting that on the South field as the % Kentucky bluegrass decreased the % perennial ryegrass increased and the inverse was true on the North field (Figure 1 and 2).

As the season progressed, the % bare spots increased with most bare spots found on the more heavily trafficked South field (Figure 3).

There were no significant statistical differences in the perennial ryegrass seeding rate (0, 3 or 6 kg/100m^2) or overseeding method (drop spreader or slit seeder) in this experiment, however there were trends in the experimental data. When comparing the different rates of overseeding, the % Kentucky bluegrass tended to decrease slightly over the season for all treatments (Figure 4). Conversely, the % perennial ryegrass increased at each date throughout the summer (Figure 5). Even the plots that did not receive any overseeding had an increase in the perennial ryegrass composition. Perennial ryegrass is believed to be more wear tolerant than Kentucky bluegrass and the data would support that under traffic perennial ryegrass will out-compete Kentucky bluegrass.

Broadleaf weeds were present in only very small amounts (0-1 broadleaf weed per plot) in this study and the results were not significant and the numbers were too small to report any trends.

The surface hardness data comparing the North and South fields is shown in Figure 6 (averaged over the seeding rates and methods). The results were significant at all dates. On July 7 and July 31, the South field was harder than the North field. This was expected since the South field received more wear and traffic throughout the season. It is not clear why there is a reverse trend on August 12.

Greenseeker data, is correlated with chlorophyll content, photosynthetic activity, canopy cover, therefore giving an indication of turf health. Throughout the season, *Greenseeker* data was greatest with the high rate of perennial rye overseeding (Table 1). From July to September, the intermediate

overseeding rate was greater than when no perennial rye was applied. There was no difference in turf health in June or in October between the intermediate and no overseeding treatments.

When comparing overseeding methods, throughout the season (except in late October) surface broadcasting the seed produced higher *Greenseeker* readings than when the mechanical slit seeder was used (Table 1). Slit seeders slice into the turf to create a furrow in which the seed is deposited. It is likely that this slicing action damaged the turf and produced lower quality turf.

Conclusion

Throughout the season as fields were overseeded with perennial ryegrass, the % perennial ryegrass cover increased with the final percentage being roughly double compared to the beginning of the season. The field that received more wear and traffic (South field) had more perennial ryegrass and less Kentucky bluegrass and bare spots at the end of the season than the field receiving less traffic (North field). Generally, the surface hardness was greatest on the field that received more wear and traffic. This study showed that over time when wear is imposed on a mixed stand of Kentucky bluegrass and perennial ryegrass, the composition of perennial ryegrass will increase at the expense of Kentucky bluegrass.

There were no significant statistical differences in the perennial ryegrass seeding rate (0, 3 or 6 kg/100m^2) or overseeding method (drop spreader or slit seeder) in this experiment, however trends indicated that the highest overseeding rate produced the greatest turf quality.

Objective 3: *To determine if water conservation can be realized using an evapotranspiration-based modified water budget.*

Only the results from September will be reported as 388 mm (over 15 inches) of rain fell at the GTI between May and August, 2009.

The North field (irrigated when the soil reached 37% VWC; modified water budget) required a fewer number of irrigations, had a longer time between irrigations and less water was applied compared to the South field (50% VWC field; Table 2 and Figure 7). Even though less water was applied to the North field, this field was of either similar or better quality than the South field (as indicated by *Greenseeker*

readings; Table 1). Although the data is limited, it appears that good quality fields can be maintained even when the soil moisture is reduced by 75%.

Conclusion

The North field (irrigated at 37% volumetric water content [VWC]) required a fewer number of irrigations, had a longer time between irrigations and less water was applied compared to the South field (50% VWC). Even though less water was applied to the North field, this field was of either similar or better quality than the South field.

Acknowledgement

The authors gratefully acknowledge the Ontario Turfgrass Research Foundation and the Ontario Horticultural Trades Foundation for their generous support of this project.

Table 1. *Greenseeker* (NDVI) readings from the Guelph Turfgrass Institute Soccer fields between June and October, 2009.

Parameter	June 26	July 21	August 26	September 22	October 21
North	0.64 a*	0.62 a	0.54 a	0.49 a	0.50 a
South	0.64 a	0.58 b	0.55 a	0.51 b	0.56 a
0	0.62 c	0.59 b	0.59 b	0.49 b	0.51 c
3	0.63 b	0.59 b	0.59 b	0.49 b	0.52 b
6	0.66 a	0.61 a	0.61 a	0.52 a	0.55 a
Broadcast	0.65 a	0.61 a	0.55 a	0.50 a	0.53 a
Slit	0.63 b	0.59 b	0.54 b	0.49 b	0.53 a

*Means within parameter groups with the same letter are not significantly different from each other.

Table 2: A comparison between soccer fields when soil volumetric water content (VWC) reached 50 or 37% during September 2009.

	South Field 50 % VWC	North Field 37% VWC
# of Irrigations	3	2
Days between Irrigation	7	10
Vol. of water applied (mm)	77	70
Vol. of water applied per irrigation (mm)	26	35

Figure 1: The percent Kentucky bluegrass composition on the North vs. South field

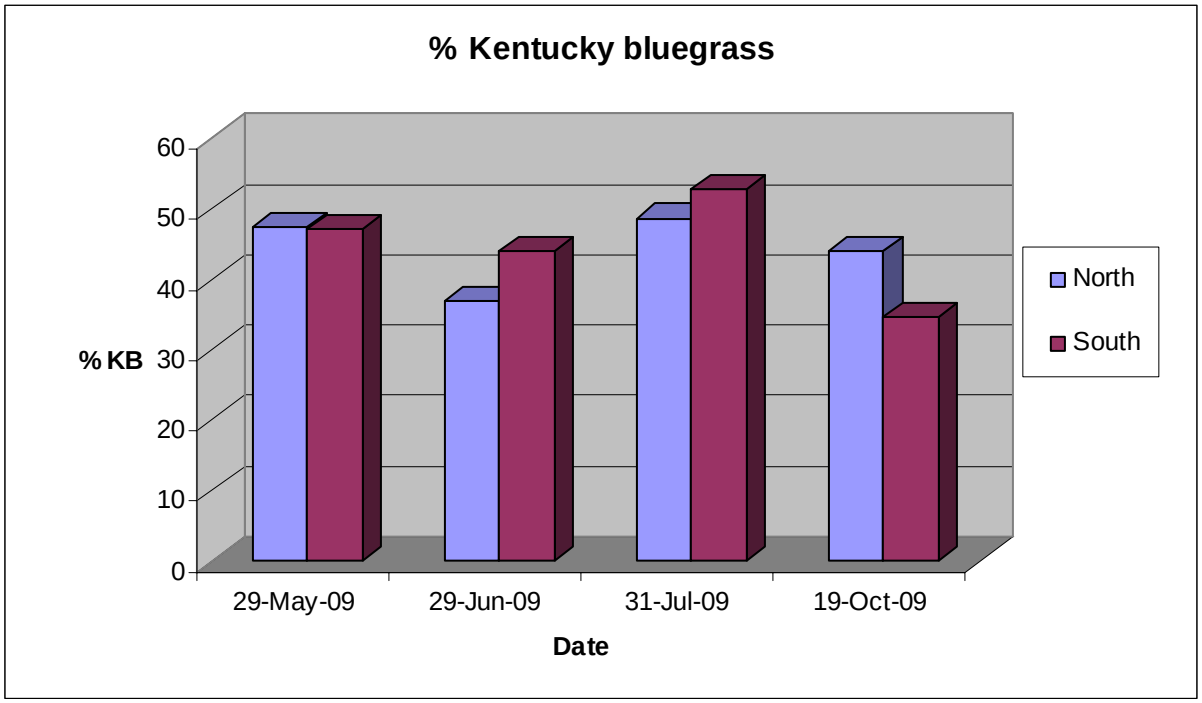

Figure 2: The percent perennial ryegrass composition on the North vs. South field

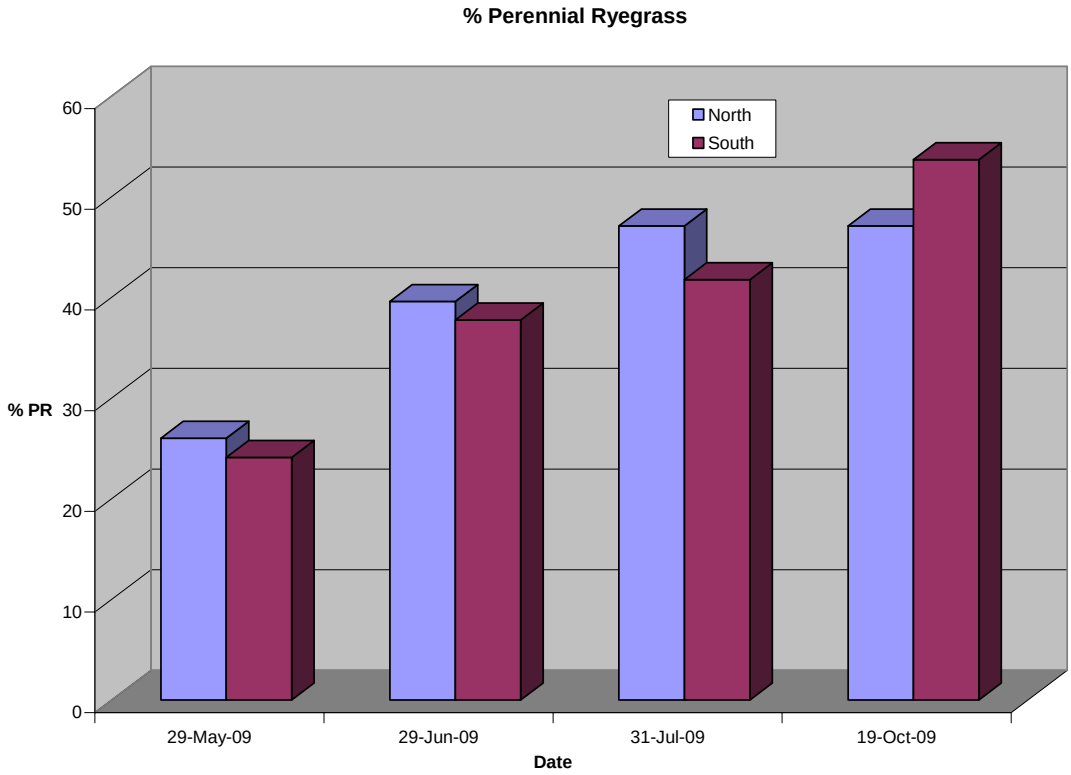

Figure 3: The percent bare spots on the North vs. South field

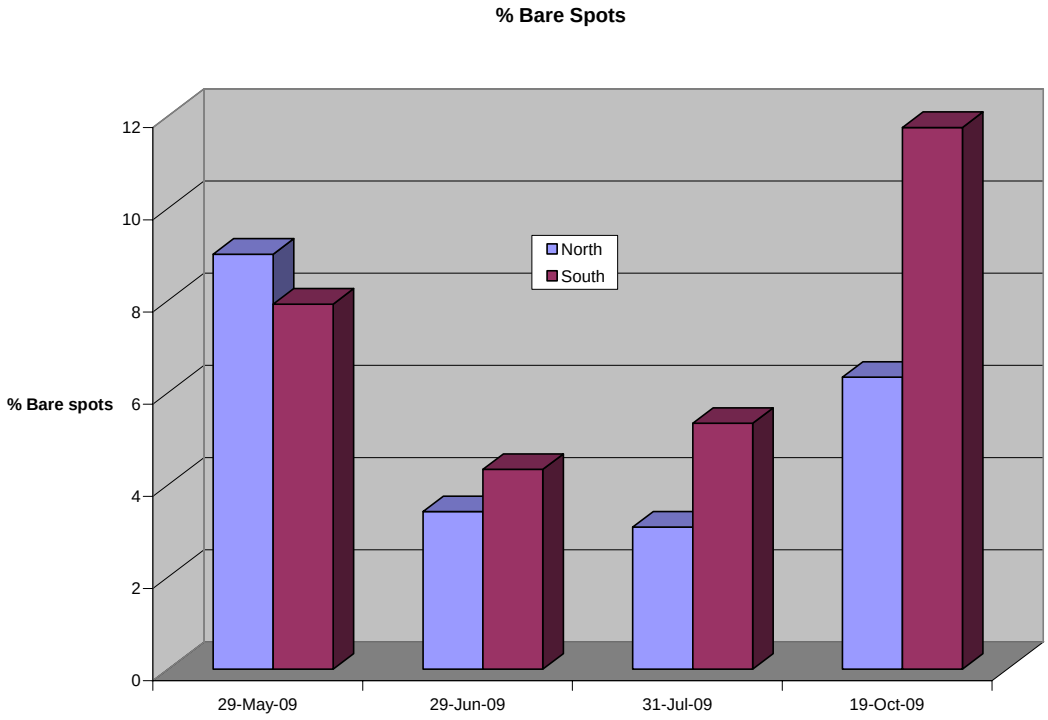

Figure 4: The percent Kentucky bluegrass compositions at different overseeding rates

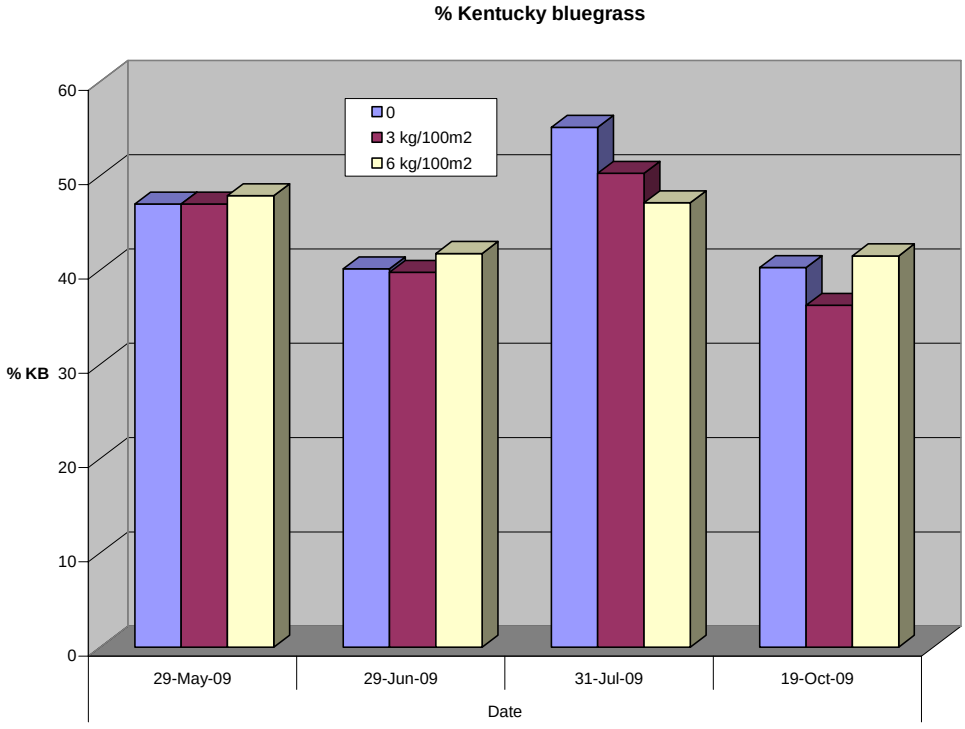

Figure 5: The percent perennial ryegrass compositions at different overseeding rates

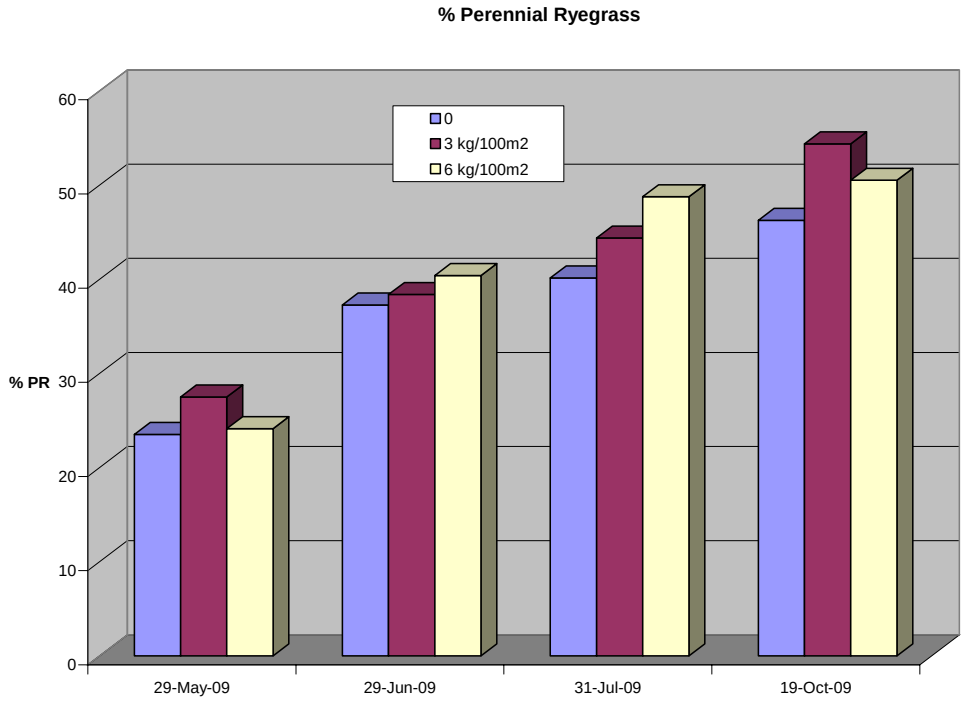

Figure 6: The surface hardness of the North vs. South field

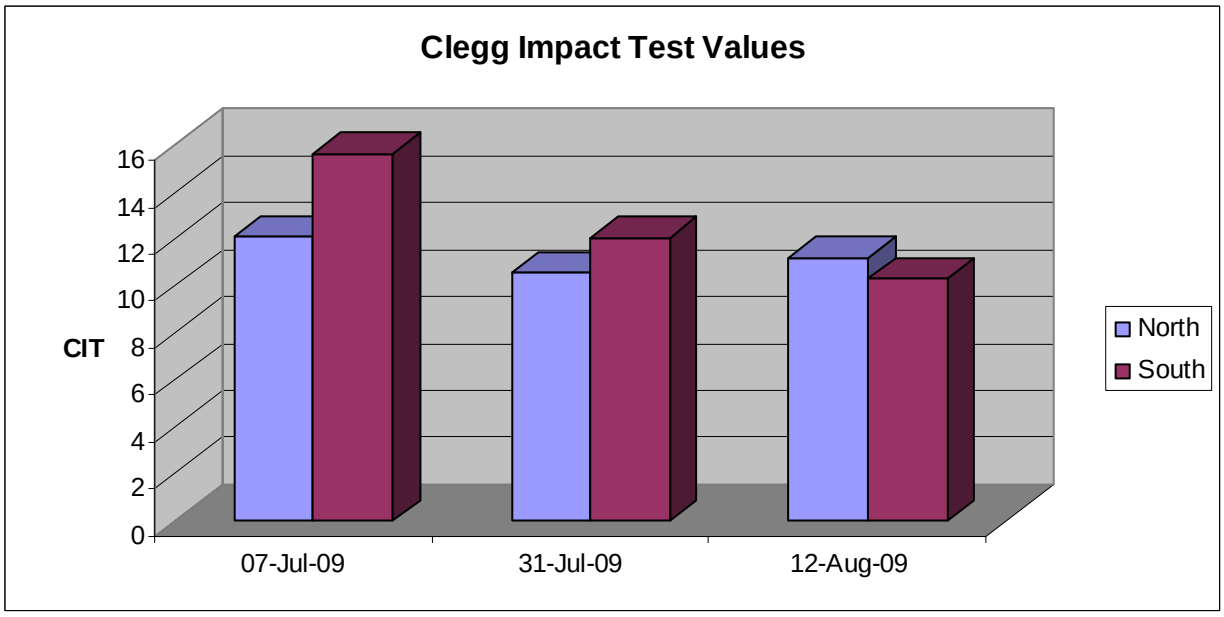

Figure 7: The volumetric water content (VWC) of soccer fields irrigated at 50 or 37% VWC.