



EMPIRE Turf Mowing Research

- Objective:
 - Determine the relative mowing requirements of the following turfgrasses:
 - Zoysiagrass - EMPIRE Turf
 - St. Augustinegrass – Palmetto, Sir Walter
 - Bermudagrass - Greenlees Park
 - Kikuku – common variety
- Procedure:
 - Study took place over the course of three years in Australia using 12 replicated plots.
 - Evaluated frequency and height of mowing needed to keep turf varieties at acceptable quality.
- Results:
 - EMPIRE Turf needed the least amount of mowing to keep an acceptable appearance.
 - St. Augustine needed over 31% more mowing than EMPIRE Turf. Bermudagrass needed 100% more mowing than EMPIRE. Kikuyu needed 172% more mowing than EMPIRE.
 - A taller mowing height in summer helped EMPIRE perform better in drought.

Mowing frequency evaluation and general observations of popular turf varieties.

- First and Second Evaluation

By, Ian Paananen, and Henry Locock, Nathan Dutschke.

Biographical Information

Ian Paananen (BSc Agr)

Ian Paananen is a horticultural scientist who consults to various organisations in Australia. He has an Agricultural Science Degree, providing scientific services to many organisations in Australia, Europe and the USA for over twenty years in variety testing, PBR, IPM, plant tissue culture, and nursery production.

Ian Paananen helped with the data collection and reviewed the data analysis for this paper. He also reviewed and edited the final version of this paper.

Henry Locock

Henry Locock is an experienced lawn mowing contractor, having worked in the industry for 12 years, with various clients ranging from private houses to businesses. Henry conducted all mowing, measuring, fertilizing, general maintenance, data collection, and helped with observations.

Nathan Dutschke

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Nathan began his horticultural career in the nursery industry in Adelaide back in 1998, specializing in native plant production. Since then Nathan has completed his horticultural trade and Diploma of Horticulture. After working in both Adelaide and country Victoria Nathan now currently works for Ozbreed Pty Ltd in Sydney. Ozbreed specialize in the breeding and marketing of improved plant and turf varieties for the domestic and commercial markets.

Nathan Dutschke coordinated the mowing trials, and helped with lawn frequency data correlation based on Henry Lococks and other data, helped with observations, and generally coordinated the writing of the paper.

Abstract

The cost of mowing turf in Australia is considerable, both in dollar terms and in the amount of pollution lawn mowers make. Research from the USA shows that mowing contributes significantly to green house gasses. For these reasons it is important to quantify which lawns need less mowing than others. Little research has focused on this in Australia.

The purpose of this investigation is to quantify the minimum amount of mowing various lawn types need to keep an acceptable appearance. This will be particularly useful to government bodies, golf courses, sporting venues, parks, real estate developments, home owners, or anyone interested in saving mowing costs, or reducing green house gases.

This research was conducted over 2 sites near Windsor, which is North West of Sydney, for two years, using a total of 12 replicated plots, showing different maintenance techniques. The first part of the trial showed that Buffalo turf types and Empire Zoysia could tolerate taller less frequent mowing to look good, whilst Kikuyu and Couch needed more frequent lower mowing to keep acceptable quality. The second part of the investigation showed that the minimum mowing required to keep Kikuyu looking good, was 3 times that of Empire Turf, and 2.58 times that of Buffalo. Compared to Empire turf, the turf variety that needed the least amount of mowing in the investigation, Kikuyu required 173% more mowing, whilst Couch (also known as Bermuda Grass) needed 100% more mowing than Empire, and Buffalo (also known as St Augustine) needed 32% more mowing than Empire to keep the lawns at an acceptable quality. If turf users all over the country reduced their mowing frequencies to those outlined in this investigation, and if they switched to varieties that need less mowing like Empire Zoysia, or to a lesser extent the Buffalo varieties then the savings in green house gases based on USA Mower pollution data could be millions of tonnes, and the savings in dollars could be immense.

In the course of this investigation, other evaluation studies were conducted, and data was collected from organised observations. Both Autumn and Winter colour were rated on each variety, with Kikuyu and Palmetto Buffalo having the best winter colour ratings. Thatch ratings were also taken, with Palmetto having the least thatch development of the Buffalos. Seed head under stress was also observed, as too was drought stress in relation to mowing heights. All the Buffalos and Empire turf were less drought stressed when mown higher in summer, compared to the shorter mown plots of the same varieties.

First Trial Stage

Introduction

The mowing trials were established on two separate sites on 29th and 30th August 2005. Each individual plot was established by rolls of instant turf. Both mowing trial sites have deep alluvial soils and are located on the Hawkesbury-Nepean flood plain near Windsor,

NSW. We trialed 6 different varieties of grasses including common Kikuyu (*Pennisetum clandestinum*), Empire Turf (*Zoysia japonica*), Greenlees Park Couch/Bermuda Grass (*Cynodon dactylon*) and three varieties of Buffalo/St Augustine (*Stenotaphrum secundatum*), Palmetto, Sir Walter and Shademaster. Each turf variety had 3 plots alternated at each trial site, this gave a total of 18 plots at each site. Irrigation was used to keep the trial growing and performing evenly. Records were kept weekly on quality of each variety and the frequency of mowing. All mowing, maintenance, weeding and fertilising and statistical recording was conducted by Henry Locock, an experienced independent lawn maintenance contractor. Henry used the one lawn mower on the entire trial, a 5hp 18inch Masport conventional lawn mower, with a catcher. Clippings were removed at each mow.

The aim of this trial was to establish the minimal mowing regime for a variety to keep adequate quality and to quantify which varieties required less mowing than others. The aim is also to observe which varieties have the best winter colour, lowest levels of thatch and the least amount of seed head produced.

General Information and Results

Both sites were visited each week by an independent mowing contractor to measure heights of each variety. Once a height of 80mm was reached all plots of that same variety were mown back down to a height of 50mm. The first mow at this height was conducted on the 27th September 2005 approximately 1 month after the trials were installed, this time gave all varieties a chance to establish their root systems and put on some foliage growth. The only variety to be mown at this time was the kikuyu, it was definitely the fastest to establish and get growing at both sites. During this date all plots were fertilized with a slow release fertilizer at the recommended rate. At the first trial site (Richmond) - Kikuyu was the first to establish and reach the mowing height of 80mm followed by Empire 25th Oct, Sir Walter 1st Nov, Palmetto and Greenlees Park 8th Nov and Shademaster 22nd Nov. The second trial site (Pitt Town) Kikuyu as mentioned was first followed by Palmetto 18th Oct, Sir Walter 25th Oct, Empire and Greenlees Park 8th Nov and Shademaster 15th Nov.

On the 6th December 2005 it was decided to mow each plot once a height of 90mm was reached not the original 80mm. Some wet weather for this time of year had encouraged the turf to grow a lot faster than normal, so the height was raised 10mm to give us a more accurate reading on minimal mowing requirements. It was already obvious however, that the Couch and Kikuyu were struggling with the 80cm height, and were of poor quality.

Over the two trial sites we observed that on Site A Richmond the trial plots received infrequent to moderate irrigation. This represented how the turf would typically be treated in a commercial situation. Site B Pitt Town received typically more adequate irrigation which represented how the turf would be treated in a home garden situation. We completed the mowing trial on 3rd October 2006 and we used the results from both sites to calculate the total mowing requirements for each variety and the overall quality of the turf varieties at this mowing regime. The results showed that couch and kikuyu could

not be adequately maintained at this mowing height due to the bad quality and appearance of the turf. Kikuyu and Couch would need to be mown more frequently at a shorter mowing height. However Empire Zoysia and the Buffalo varieties proved in this investigation that they could tolerate a taller mowing height and keep acceptable quality. Over the two trial sites the results indicated that Empire would require less mowing to look good compared to the other varieties. Empire required 22.05% less mowing compared to the Buffalo varieties on average over the two trial sites at these mowing frequencies. However Couch and Kikuyu at this mowing regime were of unacceptable quality so the results would not be represented accurately and for this reason could not be used for these varieties. It was decided more trialing at different heights was needed for these two types, to accurately determine mowing frequencies, for a height that was to both give reasonable quality, and a minimal mowing frequency.

All varieties were scalped to a height of approximately 40mm. When undertaking this scalping mowing, the independent mowing contractor noticed that from the Buffalo varieties Sir Walter was the hardest to mow back to that height, followed by Shademaster then Palmetto. It was noticed that at both locations Richmond and Pitt Town, Palmetto had considerably less thatch than the other Buffalo's which resulted in less scalping, better mat and greener colour when scalped to 40mm in height. Compared to all the Buffalo varieties; Empire, Couch, and Kikuyu were easier to 'scalp' short with the mower, indicating less thatch.

During the months of July and August Nathan Dutschke, Ian Paananen and Henry Locock conducted individual evaluations of winter colour. The evaluations were conducted at different times in late winter, independently of each other, with none of the observers having any interaction with each other with regards to the results, till after the results were tabled. Each variety of 3 plots was evaluated and given a rating out of 10, with 1 being poor and 10 being excellent. Following is a table of results for the Richmond Site and the Pitt Town site. Please note that the Pitt Town site received a slow release fertilizer on all A plots in Autumn and B plots did not receive any fertilizer. This was performed to evaluate what the difference in winter colour is between fertilizing and not fertilizing leading into winter. It must be noted that in Winter, as both Kikuyu and couch grew more slowly, their quality did improve, which allowed for a good winter colour comparison of all varieties.

Nathan's Results Winter Colour Ratings Richmond

Winter colour rating – Richmond

1 = poor (brown)

10 = excellent (dark green)

| 24/07/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|------------|--------|-------|----------|--------|------------|-------------|
| 1 | 7 | 2 | 6 | 1.5 | 5.5 | 3 |
| 2 | 7.5 | 1 | 6.5 | 1.5 | 5 | 2.5 |
| 3 | 7.5 | 1 | 7 | 1 | 5.5 | 2.5 |

| | | | | | | |
|----------------|------------|------------|------------|------------|------------|------------|
| Average | 7.3 | 1.3 | 6.5 | 1.3 | 5.3 | 2.6 |
|----------------|------------|------------|------------|------------|------------|------------|

Nathan's Winter colour rating – Pitt Town Fertilised A Plots

| 24/07/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-------------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 7.5 | 2 | 5.5 | 1.5 | 5 | 2.5 |
| 2 | 7.5 | 1.5 | 5 | 1.5 | 4.5 | 2 |
| 3 | 6 | 1.5 | 6 | 1.5 | 5 | 2.5 |
| Average | 7 | 1.6 | 5.5 | 1.5 | 4.8 | 2.3 |

Nathan's Winter colour rating – Pitt Town Unfertilised Plots B Plots

| 24/07/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-------------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 7 | 2 | 4.5 | 1.5 | 4.5 | 2.5 |
| 2 | 6 | 1.5 | 4.5 | 1.5 | 4.5 | 2 |
| 3 | 6 | 1.5 | 5 | 1.5 | 4.5 | 2.5 |
| Average | 6.3 | 1.6 | 4.6 | 1.5 | 4.5 | 2.3 |

Henry's Results Winter Colour Ratings Richmond

1 = poor (brown)

10 = excellent (dark green)

| 22/8/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|------------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| 2 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| 3 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| Average | 8 | 1.5 | 6 | 2 | 4 | 2 |

Henry's Results Pitt Town Fertilised A Plots

| 22/8/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|------------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 8 | 2 | 7 | 3 | 5 | 3 |
| 2 | 8 | 2 | 7 | 3 | 5 | 3 |
| 3 | 8 | 2 | 7 | 3 | 5 | 3 |
| Average | 8 | 2 | 7 | 3 | 5 | 3 |

Henry's Results Pitt Town Unfertilised B Plots

| 22/8/2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|------------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| 2 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| 3 | 8 | 1.5 | 6 | 2 | 4 | 2 |
| Average | 8 | 1.5 | 6 | 2 | 4 | 2 |

Ian's results Richmond Site

| Aug 2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-----------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 7 | 1.5 | 6 | 1.5 | 4.5 | 2 |
| 2 | 7.5 | 2 | 6 | 2.5 | 4 | 2.5 |
| 3 | 8 | 1.5 | 6 | 2 | 5 | 2 |
| Average | 7.5 | 1.7 | 6.0 | 2.0 | 4.5 | 2.2 |

Ian's Results Pitt Town Fertilised A Plots

| Aug 2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-----------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 8.5 | 1 | 5.5 | 3 | 6 | 3 |
| 2 | 8.5 | 1.5 | 6.5 | 2.5 | 5 | 3.5 |
| 3 | 9 | 2 | 6.5 | 1 | 5.5 | 4 |
| Average | 8.7 | 1.5 | 6.2 | 2.2 | 5.5 | 3.5 |

Ian's Results Pitt Town Unfertilised B Plots

| Aug 2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-----------------|---------------|--------------|-----------------|---------------|-------------------|--------------------|
| 1 | 8 | 1 | 4.5 | 2.5 | 5 | 2.5 |
| 2 | 8 | 2 | 5 | 1.5 | 3.5 | 3.5 |
| 3 | 8 | 2 | 4 | 1 | 4 | 3.5 |
| Average | 8.0 | 1.7 | 4.5 | 1.7 | 4.2 | 3.2 |

Average of Nathan's, Ian's, and Henry's results.

| Late Winter 2006 | Kikuyu | Couch | Palmetto | Empire | Sir Walter | Shademaster |
|-------------------------------|-------------|------------|-------------|-------------|-------------|-------------|
| Richmond Pitt Town Fertilised | 7.6 | 1.5 | 6.17 | 1.77 | 4.6 | 2.27 |
| Pitt Town Unfertilised | 7.9 | 1.7 | 6.23 | 2.23 | 5.1 | 2.93 |
| Unfertilised | 7.43 | 1.6 | 5.03 | 1.57 | 4.23 | 2.5 |
| Average all 9 plots * | 7.64 | 1.6 | 5.81 | 1.86 | 4.64 | 2.57 |

* This is an average of all 9 plots, of each variety, from three different evaluations.

The above winter colour ratings collected by this investigation provided us with the following unbiased results:

The best Winter Colour Turf is Kikuyu. The second best is Palmetto Buffalo. Palmetto had a 25% better late winter colour compared to Sir Walter, which was the next best. Palmetto had a 126% better winter colour than Shademaster, and Sir Walter had a 81% better winter colour than Shademaster. Empire had worse winter colour than all the Buffalos, and Couch had the worst winter colour of all varieties. The best winter colour for a low maintenance turf in the trial was Palmetto.

This unbiased data was based on three observers, two independent observers, Ian Paananen, an independent scientist, Henry Locock, an independent Lawn maintenance contractor, and Nathan Dutschke, the trial coordinator, and an employee of Ozbreed Pty Ltd. To demonstrate the absence of bias in the results, by removing the only non independent observer's results, namely Nathan Dutschke's observations from the data, the same order of results remain. The results are still valid.

All observations were based on plot numbers, not varieties, and particularly with the buffalo varieties, the only one to know the names at the time of evaluation was Nathan Dutschke.

Further to the validity of this data, all observers' results matched with regards to overall order of results. All chose Kikuyu as best, then Palmetto, then Sir Walter, then Shademaster, then Empire, then Couch. The only bias that could be claimed here by any third party, is that Nathan Dutschke works for the company that markets Palmetto, and he would naturally have a bias for Palmetto over Sir Walter. If we eliminate Nathan's results, and just use Henry's and Ian's, Palmetto actually has a higher 31% better winter colour than Sir Walter, rather than the 25% claimed by the final results in this research.

Research

We did find some interesting facts from this first stage of results. We found that Empire Turf (*Zoysia japonica*) and Greenlees Park couch (*Cynodon dactylon*) had similar mowing results over the 2 trial sites from a period between 27th September 2005 and 3rd October 2006. It must be noted however, that Empire's quality at this mowing regime was good, whilst Greenlees Park Couch was very poor. (Greenlees Park Couch requires more mowing for acceptable quality). We found this interesting because Site A Richmond had infrequent to moderate irrigation and Site B Pitt Town had adequate irrigation but yet the total no of mows were similar. The possible reason for this may be due to the low Evaporation transpiration rates (ET) for both of these grasses as published in the Australian Turfgrass Management magazine written by John Neylan March/April 2007 edition. The ET Rate for both of these grasses was ranked at 6-7 which is low.

Conclusion

Initially we intended to use the results from the first trial but due to the fact that the quality of Greenlees Park Couch and Kikuyu was so bad, and that they could not be adequately maintained at the set mowing height, we needed to modify the trial. The Buffalo varieties and the Empire turf could tolerate infrequent mowing and keep good quality. They could be left for much longer periods between mowing compared to other varieties like the Kikuyu and Couch which grow too tall, untidy and out of control to be classed as a lawn. The Couch was also prone to weed invasion at this stage due to the open habit. Using the results of the first trial we knew we had to start a second trial with a different mowing regime for both the Couch and Kikuyu. They would need to be kept mown once they reached a shorter height. It can be said that out of the Buffalo's Palmetto performed the best in regards to less thatch and less scalping when mown back hard. Data from the first trial showed us that Empire Turf required 22.5% less mowing than Buffalo, and this data can be used as both varieties maintained good quality. The mowing data for Couch and Kikuyu could not be used, as neither maintained acceptable quality.

This investigation showed that of the Buffalo varieties, Palmetto had the best winter colour, with Kikuyu having overall the best winter colour.

Second Trial Stage

Introduction

The second stage of the mowing trial was initiated to change the mowing heights for Greenlees Park Couch and Kikuyu so that they could be maintained at a good quality. The Greenlees Park Couch and Kikuyu would now be mown once a height of 60mm was reached and taken back down to a height of 45mm. A 40mm mowing height was tried, but the quality was worse than the 45mm height. These mowing heights allowed for the minimum amount of mowing requirements, but yet still maintaining a good quality lawn.

First all plots were cut back and scalped hard to a uniform height of approximately 40mm. The Empire, Palmetto, Sir Walter and Shademaster were split into A and B plots. All A plot varieties including the Empire, Palmetto, Sir Walter and Shademaster were mown once a height of 90mm was reached and mown back down to a height of 70mm. On all B plots once a height of 90mm is reached they were mown down to a height of 50mm. The aim of this change was to see how the two different mowing heights changed the mowing frequency, and the appearance, particularly in dryer periods. The heights were checked on a weekly basis by an independent mowing contractor and the plots that reached the right height were mown.

General Information and Results

The following tables show the results of the 2nd trial 10th October 2006 – 15th January 2007.

1. Average No of Mows between Empire & Buffalo varieties 1st & 2nd trial periods over the two trial sites at Richmond and Pitt Town.

| Variety | 1st Trial Period | 2nd Trial Period | Combined Total |
|-------------|------------------|------------------|----------------|
| Empire | 12 | 5.5 | 17.5 |
| Buffalo Var | 15.2 | 7.25 | 22.45 |

Table 1 shows that Empire requires 22.05% less mowing than the Buffalo Varieties combined over the two trial periods, or Empire requires 24% less mowing over the second trial period. Based on this investigation, it would however be more appropriate to say, on average, under a wide array of mowing regimes, and over a year period, Empire Turf needs 22.05% less mowing than Buffalo Turf. However the results for Couch and Kikuyu could not be used in this table due to both varieties having unacceptable quality during the first trial stage at the set mowing heights, so for these varieties, and for comparisons including these varieties, it is necessary to use only the 2nd trial data on its own.

2. Average number of times mown over the two sites combined for trial 2.

| Variety | Average No of Mows over 2 sites |
|-----------------------|---------------------------------|
| Kikuyu | 15 |
| Greenlees | 11 |
| Buffalo Var (Average) | 7.25 |
| Empire | 5.5 |

Table 2 is a summary of table 4 averaging the total no of mows for each variety including the Buffalo varieties together as one average.

3. Percentage reduction of the mowing required for the variety compared to Kikuyu.

| Variety | Percentage of reduction of mowing vs Kikuyu | Average No of Mows |
|-------------|---|--------------------|
| Greenlees | 26.70% | 11 |
| Buffalo Var | 51.7% | 7.25 |
| Empire | 63.4% | 5.5 |

Table 3 shows, based on this investigation, how much less mowing the turf types need compared to Kikuyu. The Greenlees Couch required 26.7% less mowing than Kikuyu, but the more noteworthy results were that the Buffalo varieties needed 51.7% less mowing compared to Kikuyu, and the Empire needed a very significant 63.4% less mowing than Kikuyu.

4. Percentage increase of the mowing required by a turf type compared to Empire.

| Variety | Percentage of increase of Mowing vs Empire | Average No of Mows |
|-------------|--|--------------------|
| Buffalo Var | 31.80% | 7.25 |
| Greenlees | 100.00% | 11 |
| Kikuyu | 172.70% | 15 |

Table 4 shows, based on trial 2 of this investigation, that the increased percentage at which varieties need to be mown compared to Empire. During this study we found that Empire required the least amount of mowing. The Buffalo varieties required 31.80% more mowing than Empire based on trial 2, and 22.05% more mowing based on the combined trials; Greenlees Park Couch required 100% more mowing compared to Empire Turf; and Kikuyu was found to require a vast 172.70% more mowing compared to the Empire Zoysia.

5. Total minimum amount of mows required for each variety to keep acceptable quality over the two trial sites during stage 2 of the trial.

| Site A Richmond | Total no of mows | Site B Pitt Town | Total no of mows |
|------------------------------|------------------|------------------------------|------------------|
| Kikuyu 60mm-45mm | 15 | Kikuyu 60mm-45mm | 15 |
| Greenlees Park 60-45mm | 11 | Greenlees Park 60-45mm | 11 |
| Sir Walter A plot 90mm-70mm | 10 | Sir Walter A plot 90mm-70mm | 8 |
| Palmetto A plot 90mm-70mm | 10 | Palmetto A plot 90mm-70mm | 7 |
| Shademaster A plot 90mm-70mm | 9 | Shademaster A plot 90mm-70mm | 8 |
| Empire A plot 90mm-70mm | 6 | Empire A plot 90mm-70mm | 6 |
| | | | |
| Sir Walter B plot 90mm-50mm | 7 | Sir Walter B plot 90mm-50mm | 6 |
| Palmetto B plot 90mm-50mm | 7 | Palmetto B plot 90mm-50mm | 5 |
| Shademaster B plot 90mm-50mm | 5 | Shademaster B plot 90mm-50mm | 5 |
| Empire B plot 90mm-50mm | 5 | Empire B plot 90mm-50mm | 5 |

We found that during the second stage of the trial the Richmond site received more frequent to at times excessive irrigation compared to the irrigation it was receiving during the first trial, which was infrequent to moderate. We recorded this aspect, but were unable to alter the irrigation, due to factors beyond our control. The results showed at the Richmond site all varieties of Buffalo grew faster with more frequent to excessive irrigation, thus leading to a higher rate of mowing. Generally a home owners lawn would not be irrigated in this fashion, so that it became water logged for periods of time. The Pitt Town site received more moderate, sensible to sufficient irrigation. Therefore this represented the most significant results because typically this is how turf would be maintained by the general home owner, or commercial user. These results indicated to us that if a more sensible irrigation regime is used it will end up saving you money on water and mowing requirements, if you have a Buffalo lawn. For example, if excessively irrigated, the Palmetto required 40% more mowing, than if sensibly irrigated. However, the data from both trial sites showed how Empire required less mowing than the other varieties, and did not grow faster at the heavier irrigation site at Richmond.

Our first year research proved correct, as in the second year all Kikuyu and Couch plots remained in good condition after modifying the mowing heights to a shorter height. The modified mowing heights for Couch and Kikuyu represented the minimum mowing requirements for the turf to keep good quality.

The different mowing heights for the A and the B plots were used on the second stage of the trial because we wanted to see how the Buffalo varieties and Empire would perform at lower and higher mowing heights. We wanted to see how it affected mowing frequencies and the performance of the grass.

Empire at the 90mm-50mm mowing height required 66.7% less mowing than Kikuyu and 54.5% less than Greenlees Park. That means that at the minimum mowing rates for turf to look good, Empire needs approximately one third the mowing of Kikuyu and less than half the mowing requirements of Greenlees Park Couch. Greenlees Park was the only variety in the trial to be continually affected by an influx of weeds. It was more prone to weed germination and growth through the more open thatchy habit.

When studying the results from the sensibly irrigated trial, Empire required considerably less mowing at the heights of 90mm-70mm compared to the Buffalo's in the trial at Pitt Town. Empire had 25% less mowing compared to Sir Walter and Shademaster. Empire required 14.3% less mowing than Palmetto. Shademaster was reasonable in its mowing requirements, but because it develops high amounts of thatch, has poor winter colour with considerable purpling it has diminished in the market place. At the mowing height of 90mm to 50mm Empire required approximately 16.6% less mowing than Sir Walter, but needed about the same as Palmetto and Shade Master. In general, these results show, Empire does need less mowing than Buffalo, but it does depend on the variety to exactly how much.

If we look at the overall mowing frequencies on both sites, Palmetto needed 6.5% less mowing than Sir Walter and overall Shademaster needed 13% less mowing than Sir Walter and 6.9% less mowing than Palmetto. However, it is more appropriate if we look at the Pitt Town site where the watering frequency was more consistent, the soil was less heavy and periods of over or under watering were rare (more sensible horticultural conditions). Based on sensible maintenance, and analyzing the minimum mowing frequency this investigation shows that Palmetto required 14.3% less mowing than Sir Walter. Shademaster required 7% less mowing than Sir Walter and Palmetto required 7.7% less mowing than Shademaster. From this it can be said that Palmetto and Shademaster need appreciably less mowing than Sir Walter, but it is difficult to say which out of Palmetto and Shademaster needs less mowing.

The thatch levels or amount of play in the Buffalo's when walked over was noticeable. Shademaster had the most sponge followed by Sir Walter and then Palmetto with the least amount of sponginess, in trial 2. This result was also backed up by the thatch reading levels which were taken at the commencement of this second trial stage. The Buffalo varieties had 3 readings taken on each plot (9 readings taken per variety) and after measuring the thatch levels on each plot it was found that Shademaster had the highest average measurement of thatch followed by Sir Walter and then Palmetto with the lowest amount of thatch. Empire, Couch, and Kikuyu appeared to have less thatch than the Buffalo varieties, according to observations made by Henry Locock and Nathan Dutschke. At the Richmond site A plots were again scalped to a height of 40mm by the independent mowing contractor, Henry Locock, and again Henry noted that Sir Walter

was the hardest to cut back to that height followed by Shademaster and then Palmetto. During the second stage trial in December it was observed by Henry Locock, that Sir Walter produced noticeably far more seed head than the other Buffalo's Palmetto and Shademaster. The Greenlees Park Couch was found to regularly seed.

Henry Locock also made observations that if Empire, and the Buffalo varieties, were left to dry out, mimicking drought conditions, which did occur from time to time in the 2nd trial, at a taller mowing height (70mm) the quality of the turf was healthier and superior than if it was kept at the lower mowing height (50mm). The taller height was beneficial for more drought tolerance but yet there was slightly more thatch build up. This is evidence that it is better to leave more length on Empire Turf, and Buffalo varieties, in times of drought, or water restrictions.

Research

Currently in Australia the Environmental Protection Authority (EPA) has not addressed the issues of reducing pollution from petrol driven mowers. However in the U.S a new rule has been unveiled by the Environmental Protection Agency (EPA). Acting under the Clean Air Act, the USA EPA mandated that by 2011 most new mowers sold in the United States must filter out an additional 35 pollutants, such as volatile organic compounds and nitrous oxides. These lawn mowers emit far more pollution than cars do. A regular walk behind mower pumps out as much pollution as 11 cars every hour and as much as 34 vehicles for a ride on mower. As a result most new mowers, will most likely have miniature versions of the catalytic converters used on car exhaust systems, to reduce the emissions. (Cut the smog as you mow your lawn, By Mark Clayton, The Christian Science Monitor). The USA EPA estimates mowers may account for 5 percent of the nation's total air pollution. Based on these figures, if Australia was to switch to better less polluting mowers, millions of tonnes of carbon could be removed from the atmosphere. Alternatively, if turf users switched to preferably Empire Turf, or at least to Buffalo varieties from Couch, or Kikuyu, based on the reduced mowing rates shown in this investigation, millions of tonnes of carbon could be prevented from entering our atmosphere. Preferably for the environment, it would be better if both lawns were switched to varieties that need less mowing, as well as the mowers used produced less pollution.

Electric mowers are another alternative to reduce emissions from entering the atmosphere but they are not going to make a huge difference anytime soon. Every little bit helps, but manufacturers need to build more powerful versions with stronger, more efficient charging systems. A one-hour charge is about the best you can expect from an electric mower which does professional gardeners no good whatsoever. Electric mowers produce no emissions and are lighter, quieter and easier to use, but until they're adaptable to heavy-duty use, low-emission gas mowers are the only logical alternatives short of no-mow landscaping. If they're efficient enough, low-emission gas mowers may be better solutions even after better technology is available for electric mowers. (Alternatives to mowers of traditional kind needed By Robert Price Californian Columnist

www.valleyair.org). So it seems the only real alternative is to use lawns that need less mowing, and petrol mowers that produce less pollution.

Another method to reduce air pollutants from using petrol mowers is to mow at a taller mowing height. From our research the results show using a taller mowing height reduces the mowing frequency required, providing the correct varieties are used, namely Empire Turf or Buffalo. Using a taller mowing height also lets the grass shade itself and it will reduce transpiration and use less water, making it more drought efficient. (A greener green lawn, By Dave Philipps, The Gazette May 17th 2007.) This will not work well for couch and kikuyu.

The cost of mowing for home owners and the commercial industry can be expensive. Our research showed that the costs usually range from between \$45 per hour to \$70 per hour depending on the machines, and contractor used. This can run into many thousands of dollars over a few years, many more times the price of the original lawn. On a purely economic basis it makes sense to use lawns that need less mowing.

Conclusion

Based on the most appropriate evidence put forward by this investigation, and in conclusion it is clear that Empire Turf requires less mowing than couch and kikuyu. In fact Empire needs approximately 1/3 the mowing of kikuyu and less than 1/2 the mowing of couch. Empire in general needs 22.05% less mowing than the Buffalo varieties, however as indicated in the results Buffalo's do not have all the same mowing requirements. The most appropriate trial in this investigation showed Palmetto needs 14.3% less mowing than Sir Walter, providing evidence that different types of Buffalo may need different mowing frequencies.

The results concluded on the different mowing heights that if there are no water restrictions in place and watering can be provided adequately, the Buffalo varieties and Empire can be mown less frequently from 90mm to 50mm with a high quality appearance, without any drought stress. The 90mm to 50mm (Lower minimum mowing height) resulted in less mowing overall compared to the 90mm to 70mm (Higher minimum mowing height.) But if water restrictions are in place and it is difficult to irrigate turf adequately, it showed that at a taller minimum mowing height (90mm mown down to 70mm), the quality of the turf was healthier and superior than if it was kept at the lower mowing height (50mm). The taller height was beneficial for more drought tolerance but yet there was slightly more thatch build up.

Out of the Buffalo's Palmetto and Shademaster produced less seed head, with Sir Walter producing the most, while Palmetto on average had the lowest levels of thatch, with Sir Walter and Shademaster producing more thatch.

The results would suggest that if you are looking for a low maintenance grass, with moderate to low thatch, with less mowing requirements either Empire or Palmetto would be the best choice. Any of the Buffalo varieties however proved to be far better than Couch and Kikuyu, when it comes to less mowing.

Choosing the right lawn variety, can save money and help the environment. A switch to Empire turf, and Buffalo lawns from Couch and Kikuyu could save billions of dollars in mowing costs, and save millions of tonnes of carbon from being released into the atmosphere throughout Australia.

Mowing taller, at higher clipping rates, and at less frequency could also save millions of dollars in mowing costs, and millions of tonnes of carbon going into atmosphere, assuming you have chosen the right lawn type, namely Empire turf, or Buffalo turf. Lawns such as Couch and Kikuyu are not suitable for this type of mowing.

Bibliography

Australian Turfgrass Management Volume 9.2 Mar-Apr 2007
(Cut the smog as you mow your lawn, By Mark Clayton, The Christian Science Monitor)
(A greener green lawn, By Dave Philipps, The Gazette May 17th 2007.)
(Alternatives to mowers of traditional kind needed By Robert Price Californian Columnist)

Disclosure of interests.

Please note; The results in this investigation were achieved in what we believe was an accurate and unbiased manor, and should anyone follow the same experiment again, Ozbreed believes they should get similar results. For purposes of full disclosure, the following information is tabled. This investigation was conducted by Ian Paananen, a scientist, who has completed some other paid work for Ozbreed Pty Ltd in the past, and Henry Locock, a mowing contractor who has worked for the principle of Ozbreed in the past, and Nathan Dutschke a horticulturalist and an employee of Ozbreed. Ozbreed paid for the services of these people to conduct this experiment.

Mowing Trial and Turf Observation and Evaluation Photos



This photo was taken at the time of first mow. Only Kikuyu was mown at this time. As can be seen, the plots were established by instant turf. Richmond.



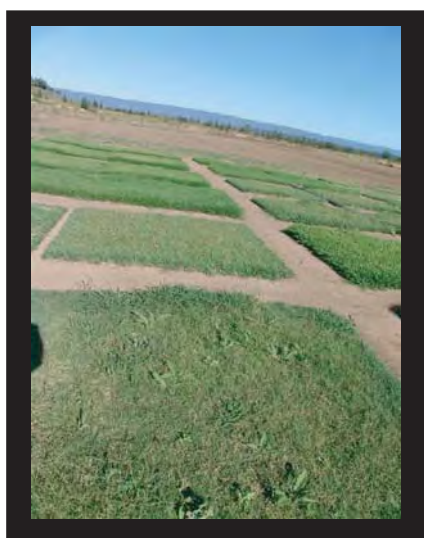
Henry Locock designed this measuring device to allow him to quickly measure if a plot required mowing or not.



The first part of the mowing trial showed clearly that Kikuyu and Couch turf could not cope with frequent mowing. This was an inspection of the Pitt Town site.



Kikuyu remained thin and untidy looking throughout most periods of the first trial. Kikuyu could not cope with being mown from 90mm to 50mm. Pitt Town.



Couch was thin and untidy looking when mown from 90mm to 50mm in the first stage of the trial. It was also the worst when it came to weed invasion. Richmond.



All three Buffalo varieties coped well with the less frequent mowing from 90mm to 50mm, and maintained good quality through out, with little weed invasion.

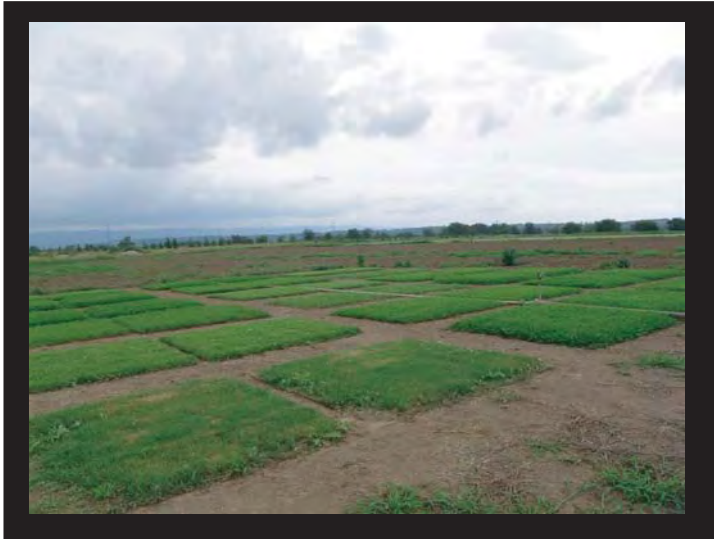
Photographic evidence of the turf investigations.



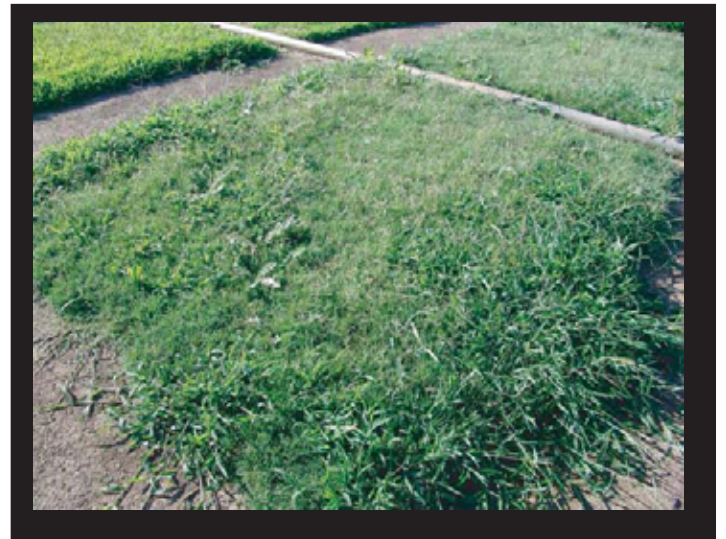
Like the Buffalo, Empire coped well with the less frequent mowing from 90mm to 50mm, and maintained good quality through out, with little weed invasion.



Couch, at the front of the photo, Empire Middle, and Kikuyu behind. The couch and kikuyu could not cope with the infrequent mowing, whilst the Empire did.



The Clarendon site during the first stage of the investigation.



Couch really struggled with weed invasion far more than all other turf types. The surrounding areas at Richmond were a little weedy, so this was a good test.



The Sir Walter Buffalo variety had masses of seed head in the summer months, particularly when drought stressed.; far more than Shade Master and Palmetto.



Palmetto at the same time in Summer, on the same site had very little or no seed head.



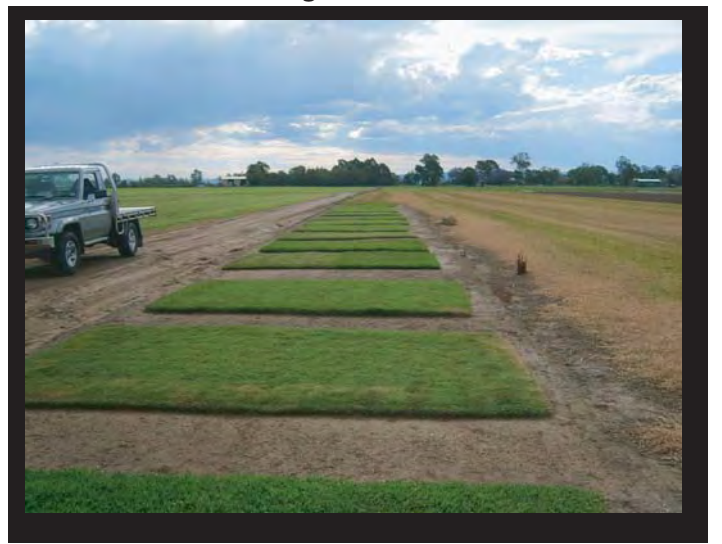
Under drought stress in November, all the Buffalo Varieties showed a common scenario. Those that were mown higher (Left), stressed less than those mown shorter (Right). Richmond.



The top two plots in this photo were mown when 70mm to 50mm, and the bottom were mown 90mm to 50mm. The 90mm to 50mm showed less drought stress. Sir Walter (left), Palmetto (right). Richmond.



Kikuyu seeded at various times through the year. The Kikuyu seed has a very good ability to blow in the wind, due to light weight, and dispersal mechanism.



This photo was taken at Pitt Town in November after mowing, showing how some plots needed mowing, whilst other did not. The different mowing frequency and heights showed no drought stress before summer.



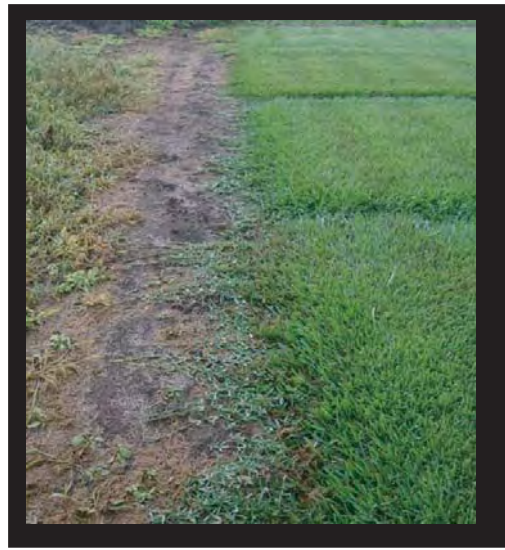
Scalping the Buffalo plots at Clarendon. Shade Master, and Sir Walter were harder to mow short due to the higher thatch compared to Palmetto.



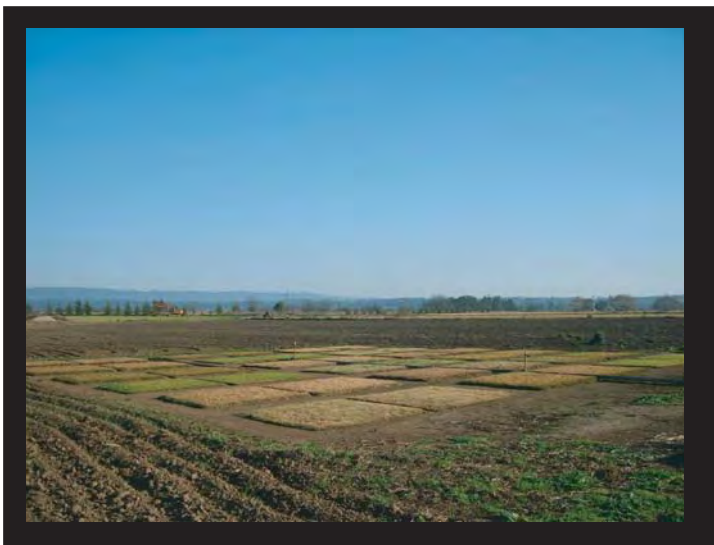
After Scalping, the plots were left to regrow. Note, only one part was scalped. The shorter part. Palmetto, Sir Walter, and Shade Master all regrew well. Richmond.



Couch (left) and Kikuyu (right) grew into the other plots very quickly, showing they need a lot of edging, whilst the Empire (centre) invaded much less.



All three Buffalo varieties invaded much less than the Kikuyu and the Couch.



Late winter colour of the different turf types was similar at both Clarendon and Pitt town. Kikuyu had the best winter colour, then Palmetto, then Sir Walter. After that, the others were much worse.



This picture shows the differences between the best two winter buffalo varieties. Palmetto on the (left), was judged to have 25% better late winter colour than Sir Walter on the (right), by this investigation.



The Pitt Town plots had half the plots fertilised. The Buffalo varieties benefited the most from this. The Palmetto Fertilised (left), had much better winter colour than the Palmetto unfertilised on the (right).



Late autumn colour ratings were also taken for all the varieties. Kikuyu, all the Buffalo types, and Empire had good late autumn colour, whilst the couch had by far the worst late autumn colour.