

**FINAL REPORT ON THE EFFECTS
OF 'MICRO CLOVER' ON THE
APPEARANCE & GROWTH OF
AMENITY SEED MIXTURES WITH
& WITHOUT PERENNIAL RYEGRASS**

For

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**FINAL REPORT ON THE EFFECTS OF 'MICRO CLOVER' ON THE
APPEARANCE & GROWTH OF AMENITY SEED MIXTURES WITH &
WITHOUT PERENNIAL RYEGRASS MANAGED UNDER LAWN/LOW
MAINTENANCE CONDITIONS**

SUMMARY

A trial to evaluate whether the inclusion of 'micro clover' had any effect on the growth and appearance of two amenity seeds mixtures (a perennial ryegrass mixture and a fine turf mixture) under a lawn/low maintenance management regime was established in the STRI trial grounds (NGR SE 095 391; altitude 200 m) on 25 May 2004. Two very similar seed mixtures were also evaluated with and without the application of fertiliser at an annual rate of 75 kg N ha⁻¹. The inclusion of the fine turf mixture and the perennial ryegrass mixture in this study enabled the differences in the turf quality, colour and growth characteristics of the two mixtures with 'micro clover', with fertiliser and without either 'micro clover' or fertiliser to be evaluated.

This work has shown that the inclusion of 'micro clover' in a sward managed under a lawn/low maintenance regime can improve the quality and greenness of the sward and also its ability to withstand red thread disease. Once established the fine turf seed mixture was also found to be superior in appearance and greenness to the mixture containing perennial ryegrass.

During the initial stages of the trial, before the application of the first additional fertiliser treatment no real differences were observed between the plus fertiliser and no additional fertiliser treatments for both the fine turf and the perennial ryegrass mixtures. However, once the first additional fertiliser dressing was made in early September 2004 the treatments with additional fertiliser were found to have a higher turf quality and be darker green than the corresponding mixtures without the addition of fertiliser.

The fine turf mixture with no additional fertiliser had a comparable turf quality and greenness to the perennial ryegrass mixture with additional fertiliser for much of the trial. The perennial ryegrass mixture with no 'micro clover' or additional fertiliser had the poorest turf quality and was found to be the least green of all the treatments.

INTRODUCTION

Reduced management costs, in terms of inputs and time, while maintaining a sward with a healthy and attractive appearance, would be of benefit for the management of grass mixtures under a lawn or low maintenance regime. This study, funded by DLF-Perryfields Ltd, examined the effects of:

- The inclusion of 'micro clover' in amenity grass seed mixtures both with and without the inclusion of perennial ryegrass
- The use of additional fertiliser in amenity grass seed mixtures both with and without perennial ryegrass that did not include 'micro clover' in the mixture.

MATERIALS AND METHODS

Experimental design and management

A trial to evaluate the effects of 'micro clover' on the appearance and growth of amenity seed mixtures with and without perennial ryegrass managed under a lawn/low maintenance regime was established in the STRI trial grounds (NGR SE 095 391; altitude 200 m) on 25 May 2004. In this study four different amenity seed mixtures were used (Table 1). These included two straight grass seed mixtures, one with and one without perennial ryegrass and two similar mixtures with a minor variation in composition to include a small percentage of 'micro clover'. The two commercial mixtures that contained 'micro clover' were DLF 'Ecosward' mixtures Pro 26 (without perennial ryegrass) and Pro 27 (with perennial ryegrass). The composition of the mixtures used is presented in Table 2.

TABLE 1

Treatments used in the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on amenity seeds mixtures with and without perennial ryegrass.

Treatment number	Mixture
[1]	Perennial ryegrass & 'micro clover'
[2]	No perennial ryegrass & 'micro clover'
[3]	Perennial ryegrass & fertiliser
[4]	No perennial ryegrass & fertiliser
[5]	Perennial ryegrass
[6]	No perennial ryegrass

To help clarify the effects described the following treatment structure has been used: Treatments 1 and 2 contained 'micro clover'; Treatments 3 and 4 had additional fertiliser applied at an annual rate of 75 kg ha⁻¹ but no clover and Treatments, 5 and 6, had no additional fertiliser applied after the seedbed application. These treatments have also been classified into perennial ryegrass and fine turf mixtures. The odd numbered treatments all contain perennial ryegrass and the even numbered treatments have no perennial ryegrass.

The trial was sown in a randomised block design with four replications per treatment giving a total of 24 plots to assess. Individual plots measured 1.5 m x 1.5 m. A 25 cm path, sown with perennial ryegrass, separated the plots from each other to try to eliminate 'micro clover' creeping into the without 'micro clover' plots. Following normal practice a seedbed fertiliser (8:12:8, N:P₂O₅:K₂O) was applied to the experimental area (application rate = 50 g m⁻²) before seeding. All plots were sown by hand at the rate of 25 g m⁻². After sowing the trial area was covered with Tildenet germination covers. These were removed on 4 June 2004 when a lightweight roller was used on the trial area. Mowing commenced on 11 June 2004 at a cutting height of 50 mm. Reductions in cutting height were then made to 40 mm,

30 mm and 25 mm, reaching the final cutting height of 20 mm on 19 July 2004. Mowing continued weekly at this height until 22 November 2004. From 6 December 2004 until 21 March 2005 mowing was carried out as and when necessary. On 21 March 2005 a weekly mowing regime was reintroduced. Mowing continued once, or twice weekly during periods of rapid growth, until 14 November 2005. Mowing then continued as and when necessary until the trial finished at the end of December 2005. Other details of trial management are summarised in Table 3.

TABLE 2
Seed mixtures used in the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on amenity seeds mixtures with and without perennial ryegrass.

Seeds mixture	
No perennial ryegrass mix.	25 % Darwin (Chewings fescue) 20 % Leonora (slender creeping red fescue) 40 % Aniset (strong creeping red fescue) 15 % Conni (smooth-stalked meadow-grass)
No perennial ryegrass mix. & 'micro clover' (Pro 26)	25 % Darwin (Chewings fescue) 20 % Leonora (slender creeping red fescue) 40 % Aniset (strong creeping red fescue) 10 % Conni (smooth-stalked meadow-grass) 5 % 'micro clover'
Perennial ryegrass mix.	50 % Margarita (perennial ryegrass) 20 % Aniset (strong creeping red fescue) 10 % Darwin (Chewings fescue) 20 % Conni (smooth-stalked meadow-grass)
Perennial ryegrass mix. & 'micro clover' (Pro 27)	50 % Margarita (perennial ryegrass) 20 % Aniset (strong creeping red fescue) 10 % Darwin (Chewings fescue) 15 % Conni (smooth-stalked meadow-grass) 5 % 'micro clover'

TABLE 3
Details of trial management for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass.

Fertiliser applications (N:P ₂ O ₅ :K ₂ O)	Rate	Date
8:12:8 (seedbed fertiliser)	50.0 g m ⁻²	25 May 2004
12:3:9	29.3 g m ⁻² (with fertiliser plots only)	1 September 2004
12:3:9	31.2 g m ⁻² (with fertiliser plots only)	26 April 2005
12:3:9	31.2 g m ⁻² (with fertiliser plots only)	4 August 2005
Watering		
Hose & Jet 45 minutes duration		25 & 28 May 2004
Hose & Jet 30 minutes duration		26 May & 4 June 2004
Oscillating sprinkler 1 hour duration		9 June 2004
Oscillating sprinkler 30 minutes duration		10 June 2004
Impact sprinkler 45 minutes duration		11 June 2004
Oscillating sprinkler 45 minutes duration		15 June 2004
Impact sprinkler 30 minutes duration		8 June 2005
Weeding		
Hand weeding of broadleaved weeds		17 August 2004

Experimental assessments

Set out below are descriptions of the measurements and assessments that were made on the trial between June 2004 and December 2005. Where stated these measurements and assessments were made in accordance with the appropriate STRI Standard Operating Procedures. Copies of all relevant STRI Standard Operating Procedures are presented in Appendix 1. Turf quality (SOP no. 1B0703) and colour (SOP 1B0803) were assessed, by subjective visual assessment using a 1 to 10 scale. This was done monthly from June 2004 until the end of the trial in December 2005. Sward height was measured weekly (weather permitting) prior to mowing, from June to October 2004 and again from April to October 2005 with the results being expressed as a monthly average (SOP no. 1B1499). Red thread was assessed five times on the trial; twice during 2004 (24 August and 8 November) and three times during 2005 (21 June, 19 July and 21 September) by subjective visual assessment. The amount of disease was scored on a 1 to 9 scale where 1 = most disease and 9 = least disease. Weed invasion by broad-leaved weeds and weed grasses was assessed on 3 August 2004 (SOP no. 301198, method 2).

RESULTS AND DISCUSSION

The measurements/assessments made between June 2004 and December 2005 are presented in tabular form below. These tables are set out using the treatment structure laid out in Table 1. In this structure Treatments 1 and 2 both contained 'micro clover'; Treatments 3 and 4 had additional fertiliser applied two times per year to give an annual application of 75 kg ha⁻¹. The final two Treatments, 5 and 6 had no 'micro clover' or additional fertiliser. Within this treatment structure a further subdivision into perennial ryegrass and fine turf mixtures was made. All the treatments with odd numbers contained perennial ryegrass and all the treatments with even numbers had no perennial ryegrass. The results will be described using this structure.

All data collected were analysed using an appropriate analysis of variance. Statistically significant variation, at the 5% level of probability ($P < 0.05$), is shown by the calculation of a least significant difference (LSD). Data that were not found to be statistically significant (n.s.) have also been included in the presentation of the results. Photographs were taken throughout the duration of the trial. A picture of the trial area taken in January 2005 and a pictorial comparison of the six different treatments taken in July, September and December 2004 and February, April, May, July, October and December 2005 can be found in Appendix 2.

Turf quality

Turf quality assessments were made monthly from June 2004 until the end of the trial in December 2005. Yearly turf quality means were calculated for 2004 (July to December) and 2005 (January to December). An overall mean for the trial was also calculated using data from July 2004 until December 2006. However, data from June 2004 were not included, as this assessment was not found to show any significant differences among the treatments. These means are presented in Table 4.

Looking at the overall trial mean (2004/2005) and the mean for 2005 it can be seen that they both show a very similar result. The inclusion of 'micro clover' was found to improve the turf quality of the sward. Treatments 1 and 2 were both found to be significantly more attractive than the other four treatments. The addition of fertiliser also had a positive effect

on the perennial ryegrass and fine turf mixtures with Treatments 3 and 4 scoring higher for turf quality than the corresponding mixtures without additional fertiliser (Treatments 5 and 6). Treatment 4 (fine turf) had a significantly higher value for turf quality than Treatments 3, 5 and 6. It is interesting to note that no significant difference was found between the turf quality of Treatment 3 and Treatment 6. Treatment 5 had a significantly lower turf quality than all the other treatments.

TABLE 4

Mean overall turf quality scores (1 = poor, 10 = very good) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are yearly means for monthly assessments made between July and December 2004, January and December 2005 and an overall trial mean for assessments made between July 2004 and December 2005.

Treatment number	Mean 2004	Mean 2005	Overall mean 2004/2005
[1] PRG+'micro clover'	5.5	7.0	6.5
[2] No PRG+'micro clover'	6.8	7.4	7.2
[3] PRG+fertiliser	3.8	4.1	4.0
[4] No PRG+fertiliser	5.8	5.5	5.6
[5] PRG	1.8	2.0	1.9
[6] No PRG	4.4	3.9	4.0
<i>LSD</i>	<i>0.9</i>	<i>0.9</i>	<i>0.8</i>

The overall mean for 2004 (July to December) shows some minor variations from that for 2005 and the overall trial mean. The addition of 'micro clover' during the first seven months of the trial was, as later on, found to improve turf quality. However, the effect of the 'micro clover' was not as pronounced at this time. Treatment 2 had the highest turf quality and was significantly more attractive than the other five treatments. Interestingly Treatment 4 had the next highest score for turf quality, however, it was not significantly higher than that of Treatment 1. As with the overall trial mean and that for 2005 there was no significant difference in turf quality between Treatments 3 and 6. Treatment 5 had a significantly lower score for turf quality than all the other treatments.

The results of the monthly turf quality assessments made between June and December 2004 are presented in Table 5.

TABLE 5

Average monthly turf quality scores (1 = poor, 10 = very good) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are for monthly assessments made from June to December 2004.

Treatment number	6/04	7/04	8/04	9/04	10/04	11/04	12/04
[1] PRG+'micro clover'	6.3	4.3	4.8	6.0	6.5	5.5	5.8
[2] No PRG+'micro clover'	3.8	4.8	6.8	7.5	7.0	7.5	7.3
[3] PRG+fertiliser	5.8	3.5	2.0	4.8	5.3	4.0	3.3
[4] No PRG+fertiliser	4.0	5.5	6.3	6.5	6.8	5.3	4.8
[5] PRG	4.8	3.0	2.0	1.3	1.3	1.5	1.5
[6] No PRG	4.8	5.5	5.8	4.8	4.0	3.3	3.0
<i>LSD</i>	<i>n.s.</i>	<i>0.9</i>	<i>1.0</i>	<i>1.9</i>	<i>1.4</i>	<i>1.1</i>	<i>1.0</i>

It should be noted that before sowing a seedbed fertiliser was applied to the whole trial area. The fertiliser differential between the with and without additional fertiliser treatments was not established until after the first additional fertiliser application to Treatments 3 and 4 in early September 2004. No significant differences were found among the treatments when the first assessment was made in June 2004 and so no further comment will be made on these data.

During July and August the composition of the seed mixture was found to have a greater effect than that of 'micro clover' with the fine turf treatments (Treatments, 2, 4 and 6) scoring higher for turf quality than those with perennial ryegrass. By August 2004 the 'micro clover' was starting to have an effect, particularly in the fine turf mixture, with Treatment 2 scoring significantly higher for turf quality than all the other treatments. At this time Treatments 3 and 5 had a significantly lower score for turf quality than the other four treatments.

During the last four months of the year Treatment 2 continued to have the highest score for turf quality and in November and December scored significantly higher than the other five treatments. The appearance of Treatment 1 began to improve relative to Treatments 3, 5 and 6 as the year progressed. During the last four months of the year (September to December) no significant differences in turf quality were found between Treatments 1 and 4.

The effects of the fertiliser on the perennial ryegrass and fine turf mixtures can be seen when the data are examined over time. During July and August marked and significant differences were found between the turf quality scores for Treatments 3 and 6. On both of these occasions the fine turf mixture (Treatment 6) scored better for turf quality than Treatment 3. However, after the application of a fertiliser dressing in early September these differences became much less noticeable and no significant difference was found between these two treatments for the last four months of the year.

Treatment 5 had the lowest score for turf quality on each occasion that assessments were made from July to December 2004 and was significantly less attractive than all the other treatments from September to December.

Monthly turf quality data for 2005 are presented in Table 6. These demonstrated that the inclusion of 'micro clover' in Treatments 1 and 2 improved the turf quality relative to the other treatments. These two treatments scored significantly higher for turf quality than the other four treatments in nine out of the 12 months during 2005. In the other three months (May, July and August 2005) no significant difference was found amongst Treatments 1, 2 and 4.

As would be expected the effects of fertiliser on the perennial ryegrass and fine turf mixtures showed some variation with time. For the first four months of the year there was no significant difference in the turf quality scores for Treatments 3 and 4. However, throughout the summer and autumn (May to November) Treatment 4 scored significantly higher for turf quality than Treatments 3, 5 and 6. It is interesting to note that for nine months of the year no significant difference was found in turf quality between Treatment 3 and Treatment 6. Thus in appearance terms, the fine turf mixture without fertiliser was a match for the perennial ryegrass mixture with fertiliser.

TABLE 6

Average monthly turf quality scores (1 = poor, 10 = very good) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are for monthly assessments made from January to December 2005.

Treatment number	1/05	2/05	3/05	4/05	5/05	6/05
[1] PRG+'micro clover'	6.0	7.0	7.5	6.8	6.5	6.3
[2] No PRG+'micro clover'	7.0	8.0	8.0	7.8	6.8	6.3
[3] PRG+fertiliser	2.5	4.0	3.3	4.0	5.3	4.3
[4] No PRG+fertiliser	3.0	5.0	4.0	5.0	6.8	5.5
[5] PRG	1.3	2.0	1.3	1.8	1.3	2.3
[6] No PRG	2.0	3.3	3.0	4.0	3.0	3.3
<i>LSD</i>	<i>0.9</i>	<i>1.1</i>	<i>1.4</i>	<i>1.2</i>	<i>1.5</i>	<i>0.8</i>

Treatment number	7/05	8/05	9/05	10/05	11/05	12/05
[1] PRG+'micro clover'	6.5	7.3	8.0	7.8	7.8	7.0
[2] No PRG+'micro clover'	5.8	7.0	8.5	8.0	7.8	8.0
[3] PRG+fertiliser	3.8	5.0	4.5	5.0	5.3	2.8
[4] No PRG+fertiliser	5.3	6.0	6.5	6.5	6.5	5.5
[5] PRG	2.8	2.3	2.5	2.8	3.0	1.5
[6] No PRG	3.8	4.3	5.3	5.0	5.3	4.5
<i>LSD</i>	<i>1.4</i>	<i>1.7</i>	<i>1.1</i>	<i>1.0</i>	<i>1.0</i>	<i>1.2</i>

Significant differences were found between Treatments 3 and 6 in May, June and December 2005. During the two summer months Treatment 3 was found to score significantly higher for turf quality than Treatment 6. This difference was probably due to the application of fertiliser at the end of April. In December this situation was reversed with Treatment 6 scoring higher for turf quality than Treatment 3.

Treatment 5 had the lowest score for turf quality for all 12 months of the year and had a significantly lower score for turf quality than any of the other treatments for nine of the 12 months.

Colour

Colour assessments were made at the same time as the turf quality assessments, monthly from June 2004 until the end of the trial in December 2005. Yearly colour means were calculated for 2004 (June to December) and 2005 (January to December). An overall mean for the trial was also calculated using data from June 2004 until December 2006. These means are presented in Table 7.

As with the turf quality data the overall trial mean for colour and the annual colour mean for 2005 were found to follow the same pattern. In this pattern the inclusion of 'micro clover' in the seed mixture produced a darker green turf. Treatment 2 was found to have the darkest green colour, however, it was not significantly darker green than Treatment 1. The addition of fertiliser was also found to have a positive, and significant effect on the greenness of the turf. Treatments 3 and 4 were found to be significantly darker green than the corresponding mixtures with no additional fertiliser (Treatments 5 and 6). Treatment 6 had a darker green colour than Treatment 3, however, this difference was not significant.

Treatment 5 had the lowest score for greenness and was significantly less green than the other five treatments.

TABLE 7

Mean overall colour scores (1 = light green/yellow/brown, 10 = very dark green) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are yearly means for monthly assessments made between June and December 2004, January and December 2005 and an overall trial mean for assessments made between June 2004 and December 2005.

Treatment number	Mean 2004	Mean 2005	Overall mean 2004/2005
[1] PRG+'micro clover'	6.2	8.1	7.4
[2] No PRG+'micro clover'	7.3	8.3	7.9
[3] PRG+fertiliser	4.4	4.3	4.4
[4] No PRG+fertiliser	6.7	6.2	6.4
[5] PRG	2.8	2.5	2.6
[6] No PRG	4.7	5.0	4.9
<i>LSD</i>	<i>0.7</i>	<i>0.8</i>	<i>0.7</i>

The overall colour mean for 2004 (June to December) shows some differences to the overall trial mean and the annual mean for 2005. The addition of 'micro clover' was again found to have a positive effect on greenness particularly for the perennial ryegrass mixture. The addition of 'micro clover' to Treatment 1 produced a turf that was significantly darker green than Treatments 3 and 5. The positive effect of 'micro clover' on the fine turf mixture was not as pronounced. Although Treatment 2 had the darkest green colour of all the treatments it was not found to be significantly darker than Treatment 4. The addition of fertiliser also had a positive effect on colour with Treatments 3 and 4 being significantly darker green than Treatments 5 and 6 respectively. As with the overall trial mean and the annual mean for 2005 Treatment 5 was found to score significantly lower for greenness than the other five treatments.

The results of the monthly colour assessments made between June and December 2004 are presented in Table 8.

TABLE 8

Average monthly and overall colour scores (1 = light green/yellow/brown, 10 = very dark green) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are for assessments made monthly from June to December 2004.

Treatment number	6/04	7/04	8/04	9/04	10/04	11/04	12/04
[1] PRG+micro clover'	4.5	4.3	6.8	6.8	6.8	7.0	7.3
[2] No PRG+'micro clover'	6.3	5.3	7.8	7.8	7.5	8.5	8.3
[3] PRG+fertiliser	5.5	4.3	2.0	6.0	5.5	4.3	3.5
[4] No PRG+fertiliser	7.0	7.0	5.8	9.0	7.8	5.8	4.8
[5] PRG	5.8	3.5	2.5	1.8	1.5	2.3	2.0
[6] No PRG	7.3	7.0	5.5	4.3	3.0	3.0	2.8
<i>LSD</i>	<i>0.5</i>	<i>1.1</i>	<i>0.7</i>	<i>1.0</i>	<i>1.4</i>	<i>1.4</i>	<i>1.5</i>

In reviewing these results it should be noted that before sowing a seedbed fertiliser was applied to the whole trial area. The fertiliser differential between the with and without

fertiliser treatments was not established until after the first additional fertiliser application to Treatments 3 and 4 in early September 2004.

As with turf quality, during the establishment phase of the trial, the species composition of the seed mixture and the residual levels of fertiliser in the seedbed appeared to be having a greater influence on colour than the 'micro clover' or fertiliser. In June, July and August there was no significant difference in greenness between Treatments 4 and 6. Treatments 3 and 5 were significantly less green than the above two treatments, however, no significant difference was found between them at this time.

The effect of including 'micro clover' in the seed mixture started to become apparent in August when Treatments 1 and 2 were found to have a significantly darker green colour than the other four treatments. However, when the fourth colour assessment was made in September 2004, after the application of the first additional fertiliser dressing, this situation had changed. Treatment 4 was found to have the darkest green colour and was significantly darker than the other five treatments. No significant difference in greenness was found between Treatments 1 and 3 at this time.

During the last two months of the year the treatments that included 'micro clover' (Treatments 1 and 2) were found to have the darkest green colour. Within these, Treatment 2 had the darkest green colour on both occasions. However, this difference was only significant in November 2004.

Throughout the first seven months of the trial the difference between the perennial ryegrass mixture and the fine turf mixture was quite noticeable. Treatment 4 (fine turf) was found to be darker green than Treatment 3 throughout this period with differences being significant for six of the seven months (June to November). Treatment 6 was also found to score more highly for greenness than Treatment 3 for the first five months of the trial (June to October 2004).

The results of the monthly colour assessments made between January and December 2005 are presented in Table 9. During this year the inclusion of 'micro clover' in the seed mixture was found to have a very positive effect on the greenness of the turf. The two mixtures that included 'micro clover' (Treatments 1 and 2) were found to be darker green than the other four treatments for 10 out of the 12 months. This difference was found to be significant in nine of those 10 months. However there was no real species effect between the mixtures that included 'micro clover' with no significant difference being found between Treatments 1 and 2 throughout the year.

Interestingly a considerable species difference was found amongst the other four treatments, with differences being most marked during the summer months. During the early part of the year (January to March) no significant difference was found between the two treatments, which were receiving additional fertiliser, Treatments 3 and 4. However, on all of the assessment dates from April to December Treatment 4 was found to have a significantly darker green colour than Treatment 3. These differences were particularly pronounced after the additional fertiliser applications in late April and early August. The effect of fertiliser was also more pronounced on the perennial ryegrass turf than on the fine turf. Treatment 3 had a significantly higher score for greenness than Treatment 5 for seven out of the 12 months. These were February, April, May, June, August, September and November. On the fine turf the effect of fertiliser on greenness was only significant for four months of the

year; with Treatment 4 having a significantly darker green colour than Treatment 6 in February, May, June and August.

TABLE 9

Average monthly and overall colour scores (1 = light green/yellow/brown, 10 = very dark green) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are for monthly assessments made from January to December 2005.

Treatment number	1/05	2/05	3/05	4/05	5/05	6/05
[1] PRG+'micro clover'	6.3	8.0	8.0	8.3	8.3	8.0
[2] No PRG+'micro clover'	7.3	8.5	8.3	8.8	8.8	8.0
[3] PRG+fertiliser	3.0	5.3	2.8	4.0	5.5	3.5
[4] No PRG+fertiliser	2.5	4.8	3.3	5.8	7.8	7.0
[5] PRG	2.5	2.8	1.3	2.3	1.5	2.0
[6] No PRG	2.0	2.8	3.3	5.5	3.5	5.8
<i>LSD</i>	<i>1.2</i>	<i>1.2</i>	<i>1.7</i>	<i>1.0</i>	<i>1.0</i>	<i>0.8</i>

Treatment number	7/05	8/05	9/05	10/05	11/05	12/05
[1] PRG+'micro clover'	8.3	8.0	8.0	8.0	8.8	9.0
[2] No PRG+'micro clover'	8.5	8.0	8.0	8.0	8.8	9.0
[3] PRG+fertiliser	4.0	6.0	4.5	5.0	4.8	3.8
[4] No PRG+fertiliser	6.8	8.5	8.0	7.3	7.0	5.8
[5] PRG	3.5	2.5	1.8	4.0	3.0	2.8
[6] No PRG	6.3	4.3	7.0	7.3	6.8	5.3
<i>LSD</i>	<i>1.0</i>	<i>1.0</i>	<i>1.5</i>	<i>1.4</i>	<i>1.2</i>	<i>1.8</i>

Sward height

Sward height was measured weekly (weather conditions permitting) from June to October 2004 and from again from April to October 2005 with the results being expressed as a monthly average. Accumulated annual totals for 2004 (June to October) and 2005 (April to October) were calculated. An overall accumulated total for the trial was also calculated using the June to October 2004 and April to October 2005 data. These data are presented in Table 10.

TABLE 10

Sward height (cm) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seed mixtures with and without perennial ryegrass. The data presented show total accumulated height (cm) for 2004 (June to October), 2005, (April to October) and a total accumulated height (cm) for the trial (June to October 2004 and April to October 2005).

Treatment number	Total 2004	Total 2005	Total 2004/2005
[1] PRG+'micro clover'	21.3	24.1	45.5
[2] No PRG+'micro clover'	20.7	22.5	43.2
[3] PRG+fertiliser	21.3	21.1	42.4
[4] No PRG+fertiliser	20.1	21.2	41.4
[5] PRG	18.5	18.0	36.5
[6] No PRG	19.5	18.8	38.3
<i>LSD</i>	<i>1.7</i>	<i>1.7</i>	<i>3.3</i>

Looking at the total accumulated sward height for 2004 and 2005 it can be seen that Treatment 1 had the greatest amount of re-growth. However, it was not significantly greater than Treatments 2 and 3. Treatment 4 was found to have greater re-growth than Treatments 5 and 6 but was only significantly greater than Treatment 5.

The accumulated total sward height for April to October 2005 again shows that Treatment 1 had the greatest amount of re-growth although it was not significantly greater than Treatment 2. No significant differences in re-growth were found between Treatments 5 and 6. However, they did have significantly less re-growth than the other four treatments.

The data for total accumulated sward height for June to October 2004 shows that Treatments 1 and 3 had the greatest amount of re-growth, however, there was no significant difference in re-growth among Treatments 1, 2, 3 and 4. Treatment 5 had significantly less re-growth than the four treatments that either contained 'micro clover' or additional fertiliser (Treatments 1, 2, 3 and 4).

Sward height data for the five months (June to October) that assessments were made during 2004 are presented in Table 11.

TABLE 11

Average monthly sward height (cm) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seed mixtures with and without perennial ryegrass. The data presented are for assessments made between June and October 2004.

Treatment number	6/04	7/04	8/04	9/04	10/04
[1] PRG+'micro clover'	6.2	3.9	4.5	3.6	3.2
[2] No PRG+'micro clover'	5.5	4.0	4.6	3.4	3.3
[3] PRG+fertiliser	6.5	3.9	4.1	3.6	3.2
[4] No PRG+fertiliser	5.2	4.0	4.2	3.4	3.3
[5] PRG	5.7	3.4	3.6	3.0	2.8
[6] No PRG	5.3	4.0	4.5	3.0	2.7
<i>LSD</i>	<i>0.7</i>	<i>0.4</i>	<i>0.5</i>	<i>0.4</i>	<i>0.4</i>

If the sward height measurements for the individual months during 2004 are looked at it can be seen that in June Treatment 3 had the largest amount of re-growth. However, it was not significantly greater than Treatment 1. No significant difference in re-growth was found among the other four treatments at this time. In July 2004 re-growth amongst all the treatments, except Treatment 5, varied by only 0.1 cm. Treatment 5 had significantly less re-growth than all the other treatments at this time. An interesting situation was found in August 2004. No significant difference in the amount of re-growth was found among Treatments 1, 2, 4 and 6. Treatment 3 had significantly less re-growth than these four treatments. Also at this time Treatment 5 had significantly less re-growth than the other five treatments. This was associated with low visual appearance scores for these two treatments.

In September and October 2004 no significant differences were found among the treatments that either included 'micro clover' or had additional fertiliser added. Treatments 5 and 6 had significantly less re-growth than the other four treatments in both of these months. This situation was most probably due to the application of fertiliser to Treatments 3 and 4 in early September 2004 increasing the amount of re-growth on these treatments.

Sward height data for the seven months that assessments were made (April to October) during 2005 are presented in Table 12.

Looking at the individual months for 2005, during April and May Treatments 5 and 6 were found to have the least amount of re-growth. No significant differences were found among the other four treatments.

TABLE 12

Average monthly sward height (cm) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seed mixtures with and without perennial ryegrass. The data presented are for monthly assessments made between April and October 2005.

Treatment number	4/05	5/05	6/05	7/05	8/05	9/05	10/05
[1] PRG+'micro clover'	3.3	3.1	3.6	3.3	3.5	3.7	3.6
[2] No PRG+'micro clover'	3.3	3.0	3.6	3.1	3.2	3.2	3.1
[3] PRG+fertiliser	3.3	2.9	3.0	2.5	3.0	3.3	2.9
[4] No PRG+fertiliser	3.3	2.9	3.1	2.6	3.1	3.4	2.9
[5] PRG	2.8	2.4	2.5	2.3	2.5	2.7	2.7
[6] No PRG	2.8	2.6	2.5	2.4	2.6	3.0	2.8
<i>LSD</i>	<i>0.3</i>	<i>0.4</i>	<i>0.3</i>	<i>0.3</i>	<i>0.4</i>	<i>0.4</i>	<i>0.3</i>

During June, July and August a similar re-growth pattern was seen with the two mixtures that included 'micro clover' (Treatments 1 and 2) having the greatest amount of sward growth with no significant difference between them. Treatments 5 and 6 had less re-growth than Treatments 3 and 4. Little difference was found between the perennial ryegrass and the fine turf mixture during these months. September showed a slight variation in the trend that had been seen during the previous three months. During this month Treatment 1 had a significantly greater amount of re-growth than all the other treatments, except Treatment 4. When the last set of height measurements were made on the trial in October 2005 the mixtures that included 'micro clover' were found to have significantly greater re-growth than the other four treatments. It is also interesting that a species effect was also seen at this time with Treatment 1 having significantly greater re-growth than Treatment 2. No significant differences in re-growth were found among Treatments 3, 4, 5 and 6 at this time. Some care is needed when assessing these results. In this case some growth was associated with good appearance and it is expected that healthy green will grow! In terms of rates of growth, it is likely that these were not excessive in relation to traditionally maintained lawns.

Disease

Red thread disease was observed on the trial twice in 2004 and three times during 2005. This was scored by subjective visual assessment where 1 = most disease and 9 = least disease. The results from the red thread assessments made during 2004 and 2005 are presented in Table 13.

The effect of including 'micro clover' in the seed mixture on the incidence of red thread disease was very marked. On four out of the five occasions that red thread assessments were made the two treatments that included 'micro clover' (Treatments 1 and 2) were found to have significantly less red thread than the other four treatments. The only assessment that differed from this was the one made in November 2004. On this occasion no significant difference was found among Treatments 1, 2 and 4. Also at this time the treatments that

received additional fertiliser (Treatments 3 and 4) had significantly less red thread than the treatments that received no additional fertiliser (Treatments 5 and 6).

TABLE 13

Red thread values (1 = most disease, 9 = least disease) assessed on 24 August and 8 November 2004 and on 21 June, 19 July and 21 September 2005 for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are for assessments made in August and November 2004 and in June, July and September 2005.

Treatment number	24/8/04	8/11/04	21/6/05	19/7/05	21/9/05
[1] PRG+'micro clover'	7.0	7.3	7.0	9.0	8.0
[2] No PRG+'micro clover'	8.3	8.3	9.0	8.8	8.5
[3] PRG+fertiliser	2.5	4.8	3.8	4.5	2.5
[4] No PRG+fertiliser	5.0	7.0	3.0	5.3	3.3
[5] PRG	2.8	1.5	2.8	3.8	1.3
[6] No PRG	4.8	3.0	1.0	3.3	2.8
<i>LSD</i>	<i>1.8</i>	<i>1.8</i>	<i>2.5</i>	<i>1.2</i>	<i>1.6</i>

Weed invasion

The trial was hand weeded on 17 August to remove broad-leaved weeds, annual meadow-grass, other weed grasses and, from the without 'micro clover' treatments, clover. Prior to weeding an assessment of weed invasion was made on 3 August 2004. Results from this assessment are presented in Table 14. It should be noted that clover was not counted in Treatments 1 and 2 as any clover present was assumed to be part of the sown mixture.

TABLE 14

Weed content (number of weeds present per treatment) for the 25 May 2004 sown DLF-Perryfields trial to examine the effects of 'micro clover' on the appearance of amenity seeds mixtures with and without perennial ryegrass. The data presented are from an assessment made on 3 August 2004.

Treatment number	Total no. of weeds	B-L weeds	<i>P. annua</i>	Other weed grass	Clover
[1] PRG+'micro clover'	1.3	1.0	0.3	0.0	0.0
[2] No PRG+'micro clover'	1.0	0.3	0.5	0.3	0.0
[3] PRG+fertiliser	3.5	3.0	0.0	0.0	0.5
[4] No PRG+fertiliser	12.3	3.0	7.3	2.0	0.0
[5] PRG	1.3	0.8	0.3	0.0	0.3
[6] No PRG	12.3	3.0	7.3	1.8	0.3
<i>LSD</i>	<i>7.4</i>	<i>1.5</i>	<i>6.1</i>	<i>1.2</i>	<i>n.s.</i>

The two treatments that had the highest total weed content were Treatments 4 and 6. These two treatments had significantly more weeds than the other four treatments. The largest proportion (60 %) of the total weed content for these treatments was made up of annual meadow-grass, with 24 percent broad-leaved weeds. The remaining proportion was made up of other weed grass and for Treatment 6 two percent clover.

CONCLUSION

This study examined whether the inclusion of 'micro clover' had any effect on the growth and appearance of two amenity seed mixtures (a perennial ryegrass and a fine turf mixture)

under a lawn/low maintenance management regime. To enable the effects of the clover to be compared two very similar grass mixtures excluding 'micro clover' were sown. These two mixtures were treated in two different ways; no fertiliser after the initial seedbed fertiliser and fertiliser applied at an annual rate of 75 kg N ha⁻¹ split into two dressings. Differences in the turf quality, colour and growth characteristics of the two mixtures with 'micro clover', with fertiliser and without either 'micro clover' or fertiliser were examined.

This study showed that the inclusion of 'micro clover' in low maintenance perennial ryegrass and fine turf amenity seed mixtures improved turf quality and increased the overall greenness of the sward. The fine turf mixture was also found to have a higher overall turf quality and be darker green than the corresponding perennial ryegrass mixture throughout most of the year. The exception to this was during the early part of the year when no real difference was observed between the two mixtures. Interestingly the fine turf mixture that received no additional fertiliser (Treatment 6) had a higher turf quality and darker green colour for much of the study than the with perennial ryegrass mixture with additional fertiliser (Treatment 3).

Overall this work has demonstrated that the inclusion of 'micro clover' in amenity seeds mixtures, maintained under a low maintenance regime (no additional fertiliser after sowing), can lead to increased turf quality and a darker green, less disease prone turf. The use of an amenity mixture that did not include perennial ryegrass further improved the appearance and greenness of the sward. It should, however, be noted that the inclusion of 'micro clover' produces a sward that appears to be predominantly 'micro clover' at some times of the year. This may not be to everyone's taste for a turfed area. However, these mixtures could have great value in areas that will be viewed from a distance producing a healthy dark green turf year round with minimal inputs and maintenance.

QUALITY STATEMENT

I confirm that this report is a true representation of the original data collected and that the Standard Operating Procedures referred to in the STRI Manual of Standard Operating Procedures, and those relevant to data collection, data preparation, archiving of data and preparation of reports have been implemented in full.

Signed:

Report Checked by:

Final version checked and reviewed by:

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APPENDIX 1

STRI STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE NO. 1B0703 (1 page)

VISUAL ASSESSMENT OF TURF QUALITY

[1] Scope

This standard operating procedure specifies methods for assessing the visual quality of sports and amenity turf.

[2] Principle

Turf quality is determined by subjective visual assessment using a 1 to 10 scale. Factors taken into account are sward density, uniformity, turf colour, grass cover, weed content and disease and pest invasion.

[3] Procedure

One of two assessment methods shall be used depending on whether there is a need to define the overall quality and acceptability of turf or whether it is desirable to score visual differences which are apparent among treatments but are not necessarily linked to one particular use.

(a) *Assessment to define the quality and acceptability of turf*

The turf is assessed on a 1 to 10 visual scale where a score of 1 represents very poor turf quality and a score of 10 signifies very good turf quality. A value of 5 represents turf that is just acceptable and values below 5 shall be used if turf quality is not considered acceptable.

(b) *Subjective assessment of observed variations among grass cultivars, species and mixtures*

Individual plots will be assessed on a 1 to 10 scale (1 = very poor, 10 = very good). For each assessment a score of 5 will be used to describe plots which could be placed in the middle of the ranking order for that particular assessment. Scores below 5 should be given to plots which fall below this average and above 5 for those which are observed to have greater visual appeal. For each assessment the maximum range between 1 and 10 which can be reasonably scored should be used.

Two or more observers shall be used, except under unusual circumstances (e.g. external visits with only one observer present) or with written approval by the relevant head of division.

Each sampling area is assessed once by each assessor on each occasion. Where two or more individuals are carrying out the assessment, each should obtain a unique score by acting independently.

[4] Expression of results

Where two or more individuals carry out assessment, the mean turf quality value is calculated for each test area.

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STANDARD OPERATING PROCEDURE NO. 1B0803 (1 page)

VISUAL ASSESSMENT OF TURF COLOUR

[1] Scope

This standard operating procedure specifies a method for assessing the turf colour.

[2] Principle

Turf colour is assessed using a 1 to 10 scale taking into account the depth of colour on the greater part of the turf sward.

[3] Procedure

The turf is assessed on a 1 to 10 visual scale where a score of 1 represents brown/bleached turf; 5 represents moderate green colour considered just acceptable and a score of 10 represents a very dark green turf colour, where appropriate ignoring patches due to disease, weeds etc. Two or more observers shall be used, except under unusual circumstances (e.g. external visits with only one observer present) or with written approval by the relevant head of division.

Each sampling area is assessed once by each assessor on each occasion. Where two or more individuals are carrying out the assessment, each should, acting independently, obtain a unique score for each plot.

[4] Expression of results

Where two or more individuals carry out the assessment, the mean value for turf colour is calculated for each test area.

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STANDARD OPERATING PROCEDURE NO. 1B1499 (2 pages)

DETERMINATION OF SWARD HEIGHT

FOREWORD

This standard operating procedure was based on a draft European Standard in preparation by Technical Committee CEN/217, Surfaces for sports areas.

[1] Scope

This standard operating procedure specifies a method of test for the determination of sward height of natural turf sports surfaces.

[2] Principle

Sward height is determined by measuring the distance between the base of a lightweight disc, which rests on the grass blades, and the soil or thatch surface.

[3] Apparatus

A 80 ± 5 g, 480 ± 5 mm diameter disc, constructed from a lightweight material (e.g. polystyrene), which is centre-bored to allow movement up and down a rod of 28 ± 2 mm diameter (Fig. 1). The strips of reinforcement material are used to strengthen the disc and the sleeve is designed to allow free movement between the disc and rod. A measurement scale, graduated in millimetres, is positioned on the rod, so that zero is indicated when the base of the disc is resting on a smooth surface.

[4] Procedure

Hold the measuring rod vertically and press it down sufficiently firmly for the tip to be in contact with the surface of the soil or thatch. Ensure that the rod is not pushed into the thatch layer and avoid obvious holes or bumps. Do not use on swards of height less than 10 mm or more than about 150 mm, as at that height leaves tend to be fewer in number and structurally weaker, so that the disc is not fully supported.

The weight of the disc lightly compresses leaves projecting above general sward height until the weight of the disc is supported by the sward. Read off the height value given on the graduated scale.

Note: Readings cannot be regarded as valid if ground cover, measured using apparatus given in the standard operating procedure relating to ground cover, is less than 50%, as compression of the grass is likely to be accentuated and unrepresentatively low values could be obtained.

[5] Number and distribution of readings

Unless otherwise specified, take at least eight readings at random on areas less than 100 m², take 8-15 readings as appropriate on areas of 100 m² to 1000 m² and 15-20 readings for areas of 1000 m² to 5000 m². Larger areas should be subdivided into two or more areas for testing.

[6] Expression of results

Calculate the mean sward height for each test area.

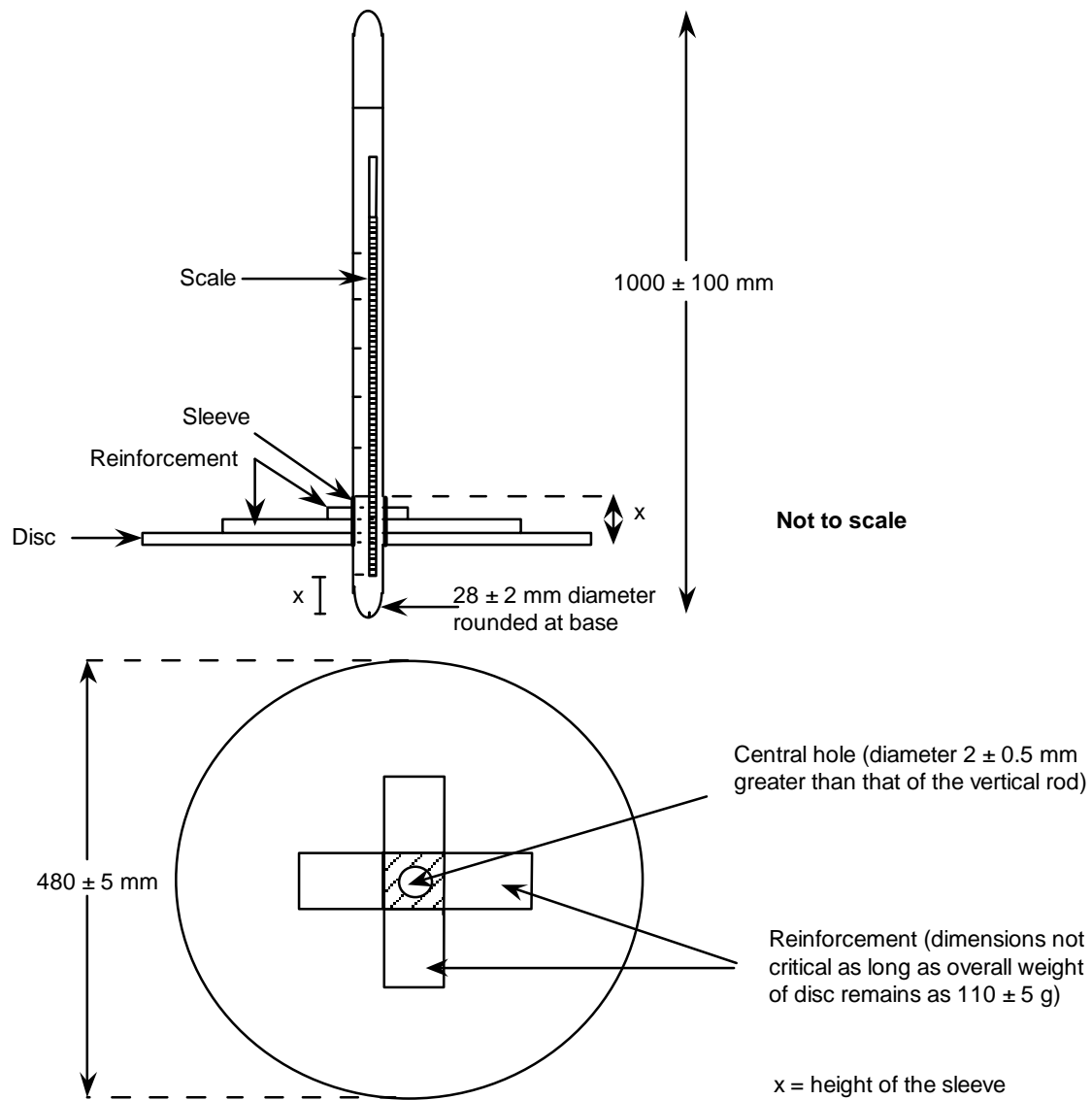


FIGURE 1. Vertical section and plan of rising disc used for measuring sward height

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STANDARD OF OPERATING PROCEDURE NO. 301198 (1 page)

WEED CONTENT

[1] Scope

This standard operating procedure specifies the method of assessment of weed content on cultivar trials.

[2] Procedure

Two types of scoring system are used:

1 The area affected by weed is estimated by comparing each plot with a series of scoring cards which have a known area shaded. The system scores plots on a 1 to 13 scale (0 = no weeds, 1 = 0.02%, 2 = 0.05%, 3 = 0.1%, 4 = 0.5%, 5 = 1%, 6 = 3%, 7 = 5%, 8 = 10%, 9 = 20%, 10 = 40%, 11 = 60%, 12 = 80%, 13 = 100% of the plot affected). Half scores are used where the severity of the weed invasion appears to lie between two scores..

2 The actual number of weeds per plot is counted and recorded.

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APPENDIX 2

PHOTOGRAPH OF THE TRIAL AREA TAKEN ON 10 JANUARY 2005

PHOTOGRAPHS OF EACH OF THE SIX TREATMENTS (AMENITY GRASS SEEDS MIXTURES WITH & WITHOUT PERENNIAL RYEGRASS WITH NO ADDITIONAL FERTILISER, WITH FERTILISER APPLIED AT AN ANNUAL RATE OF 75 kg ha⁻¹, WITH THE ADDITION OF 'MICRO CLOVER' TO THE SEEDS MIXTURE) TAKEN ON THE FOLLOWING ASSESSMENT DATES

16 JULY 2004
23 SEPTEMBER 2004
6 DECEMBER 2004
3 FEBRUARY 2005
25 APRIL 2005
19 MAY 2005
19 JULY 2005
14 OCTOBER 2005
6 DECEMBER 2005