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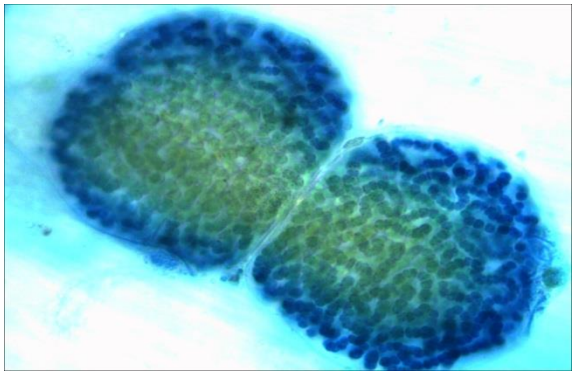

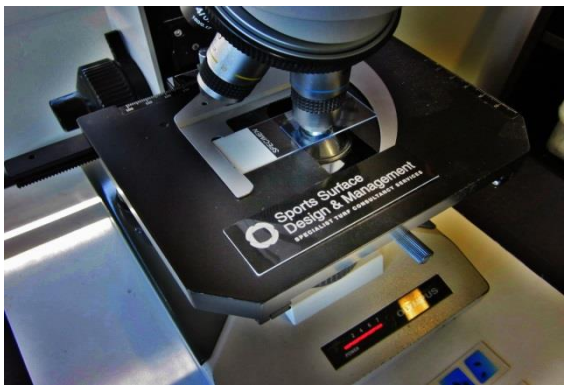


# Guidelines for:

# The Management of Turfgrass Disease on NZ Cricket Blocks

## NZ Cricket

2016

# Contents




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## 1. Introduction

Cricket Turf Managers across New Zealand are faced with a number of significant challenges with regards to the preparation and management of natural turf cricket blocks (at all levels). One of the most significant issues faced by managers is that of controlling and minimising the occurrence and severity of various turfgrass diseases. This challenge tends to be site specific and on a region-by-region basis, with a variety of climatic, geographical and resource factors contributing to the complexity of each scenario.

This 'Guidelines Document' has been produced by Sports Surface Design & Management (SSDM) in synergy with New Zealand Cricket (NZC) in order to provide the New Zealand Turf Manager with a resource for future reference, based upon the best practice guidelines and most recent research regarding turfgrass disease management on cricket clays.

The information provided within this document is designed to be used in conjunction with latest (updated) New Zealand Cricket guidelines and refers to the most recent international research and findings relating to turfgrass disease management. Due to the nature of the topic recommendations and best practice treatments are forever evolving and changing, SSDM recommends that in conjunction with this document the Turf Manager proactively keeps up-to-date with latest research and turfgrass disease control strategies in order to make the best decisions based upon independent research and experiences.

To assist in this, the following links to independent sites and applications are recommended:

- http://turfpath.com/ (excellent App for information regarding turfgrass diseases)
- http://www.msuturfdiseases.net/id-tool/ (turfgrass disease tool)
- http://www.stma.org/sites/stma/files/pdfs/Alan_Windham_-_Microscopic_Identification_of_Turfgrass_Diseases_STMA.pdf (manual on turfgrass disease)
- http://turfdiseaseid.ncsu.edu/ (turfgrass disease tool)

**Note:** The recommendations within this document have been independently written and do not propose to direct the Turf Manager towards specific chemical products for the treatment of turfgrass disease.


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## 2. Major Turfgrass Diseases Affecting New Zealand

Due to the geographical range of cricket venues across New Zealand, a number of environmental factors need to be considered when establishing a site-specific turfgrass disease management strategy.

Figure 1 (below) identifies the variances in terms of annual median rainfall and temperature on a regional basis across New Zealand. Consideration of factors such as this data will influence the prevalence and nature of turfgrass disease infestations and should form the foundation of future management strategies.

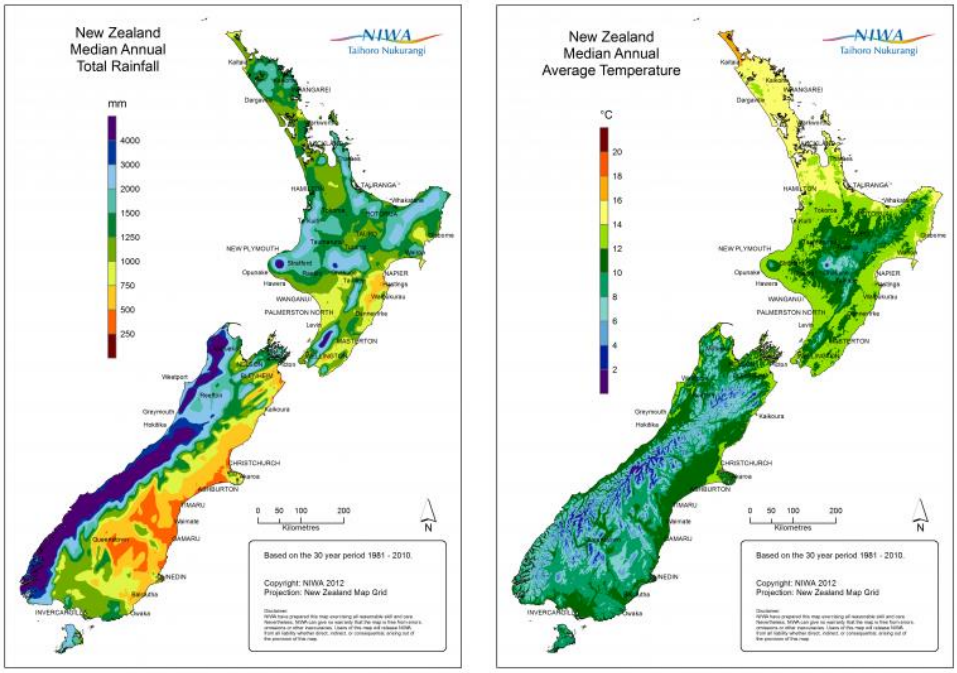


Figure 1: Climatic variances across New Zealand (1981-2010) NIWA.

The term 'Turfgrass disease' refers primarily to a fungal, bacterial or viral (pathogen) infestation of the turf plant which results in some level of visible plant injury. Depending upon the mode of action of the pathogen the target area for treatment of the disease will vary i.e. *Pythium* sp. requires targeting the base or crown of the turfgrass plant, *Sclerotinia homoeocarpa* (dollar spot) will require targeting the leaf tissue of the plant and so on.

Contributing factors that may encourage or initiate a disease outbreak include:

- Inappropriate chemical use/selection
- Poor soil conditions (i.e. excessive compaction, poor drainage pH etc.)
- Plant injury (i.e. scalping, tearing or fertiliser burn)
- Nutrient deficiencies
- Drought
- Wear

Where any number of these (and other) factors exist then disease occurrence will tend to form 'patterns' i.e. at certain times of each year and as environmental conditions allow then specific turfgrass disease pathogens will become more active. In such instances chemical treatment will serve to offer a level of superficial treatment of the issue but investigations should take place in order to identify (and remedy) the deeper cause of the problem. More often than not repeatedly occurring turfgrass disease issues provide the Turf Manager with a 'bio-indication' of a deeper unresolved problem that needs investigation.

The information in Table 1. is designed to form part of a quick reference guide for the cricket Turf Manager when it comes to identifying the key factors associated with each (major) turfgrass disease pathogen.

Table 1: Reference guide to major turfgrass disease affecting NZ cricket blocks.

| Pathogen (botanical & common name) | Characteristic (Fungal or bacterial) | Favoured conditions (turf species, time of year etc.) | Images (surface, leaf and microscopic) | Recommended treatment plan(s) |
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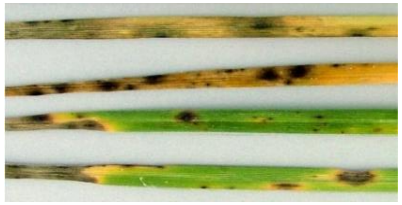
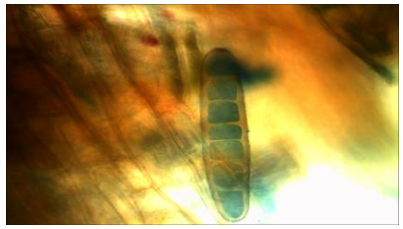
| leaf spot/melting out diseases<br><br>*(Bipolaris, Drechslera, Curvularia* sp.) | Fungal | All year round on all turfgrass species. |  <br>  <br>  | Actively manage spore counts at key times of year i.e. when covers will be most frequently used and/or when leaf wetness is most likely for periods of time >8 hours<br><br>Focus chemical treatment upon achieving good contact with leaf tissue. Recommended chemicals: Chlorothalonil & Mancozeb (750g/kg) at 20 L/ha. Medium droplet size. |

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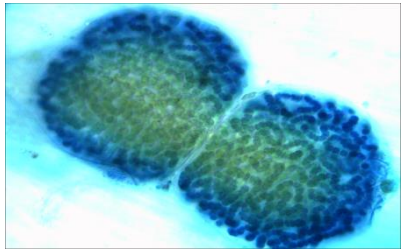
| *Pythium* sp. | Fungal | Primarily spring and early autumn (when temps are mid 20°c to low 30°c).<br><br>Relies on leaf wetness to spread across surface of turf sward. |  <br>  <br>  | Disease widespread across all parts of New Zealand, perhaps less prevalent in south island due to generally lower humidity.<br><br>Maintain effective preventative fungicide programme during the spring and summer months when disease pressures are high.<br><br>'Drench in' systemic fungicides i.e. Azoxystrobin and Propiconazole at 9L/ha. If symptoms persist, alternate with Metalaxyl Mefenoxam at 10L/ha, (in addition to Mancozeb at 20L/ha).<br><br>*Pythium* sp. will sit 'dormant' within the soil environment. SSDM recommends carrying out a drenching application of Azoxystrobin and Propiconazole (as above) in early spring, mid-summer and again in early autumn. |

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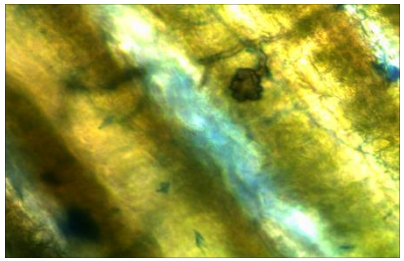
| take-all patch disease & take-all root rot<br><br>*(Gaeumannomyces graminis* sp.) | Fungal | Most prevalent in autumn and winter months when the soil is wet and the temps are around 10-15°c.<br><br>*Gaeumannomyces graminis* has been observed on couchgrass and is associated with the complex; Ectotrophic root-infecting fungi (ERI).<br><br>Particularly prevalent when soil microbiological diversity is low or fungal dominated.<br><br>pH >6.5 will increase disease occurrence and severity<br><br>Check to ensure irrigation water is not at a high pH. |  <br>  <br>  | Soil-based fungal pathogen.<br><br>Optimise the efficacy of chemical treatment by needle-tining prior to applying Azoxystrobin and Propiconazole at 9L/ha.<br><br>Water (drench) in the above fungicide application<br><br>Apply Manganese and a biological mix (i.e. Superzyme and *Trichoderma* sp.) 10 days following the application of fungicide.<br><br>During summer apply monthly applications of 'Superzyme' (*or approved equivalent*). Ideally the selected product will contain: *Trichoderma harzianum, Pseudomonas putida* and *Bacillus subtilis*. Apply at 1Kg/ha (this product should be tank mixed to existing feed programme) **Note**: These products will not cause any increase in the % organic matter of the clay.<br><br>Aim to stabilise the pH of the soil at < 6.5<br><br>Carry out a soil nutrient analysis to identify the existing level of available Manganese within the rootzone. Manganese levels should be maintained at > 10 me/100g if possible.<br><br>Consider incorporating an amendment of 'Mycormax' (*or an approved equivalent*) at time of seeding the block. Application rate: 40-50Kg/ha. This product should be applied just prior to seeding. |

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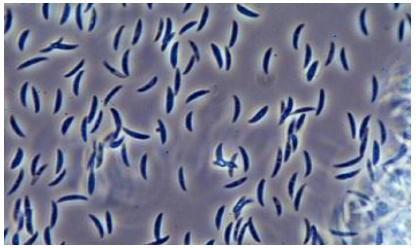
| fusarium patch<br><br>*(Microdochium nivale)* | Fungal | Cold wet weather and shaded conditions i.e. drizzly and overcast for many days.<br><br>Temperatures consistently below 15°c.<br><br>Limited light and air flow.<br><br>Infestations will be most severe when plant has been overfed (i.e. 'soft growth') and/or pH is too high. |  <br>  <br>  | Disease most likely to occur in south island and inland locations. Relatively scarce from Auckland north.<br><br>Treat curatively with applications of either Chlorothalonil or Iprodione at an application rate of 20L/ha.<br><br>Where fusarium is considered a chronic issue SSDM recommends an early autumn application of Chlorothalonil and Thiophanate Methyl at an application rate of 20L/ha, followed by applications of the appropriate contact fungicide until environmental conditions no longer favour disease activity. |

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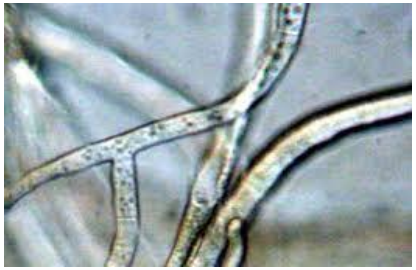
| dollar spot<br><br>*(Sclerotinia homoeocarpa)* | Fungal | Prolonged leaf wetness and humidity (particularly at night).<br><br>Prevalent on ryegrass swards, especially if over-fed with Nitrogen. Appearing initially as small (dollar-sized) tan spots and often accompanied by cottony mycelium (spider web-like) that enlarge, coalesce and form bleached areas of turfgrass loss. **Note**: symptoms likely to be less obvious on cricket blocks.<br><br>Can remain active in NZ at a wide temperature range: 15°c to 30°c. |  <br>  <br>  | Most likely to occur in North island locations (Central north island and northwards).<br><br>Turf Manager should aim to prevent an infestation of dollar spot rather than apply curative chemical treatments. In particular if it is known the block will be regularly covered for prolonged periods of time. Dew control measures will be beneficial.<br><br>In early spring apply Azoxystrobin and Propiconazole at 9L/ha. Every 3 weeks (or as symptoms and/or environmental conditions demand) continue to apply Mancozeb (750g/kg) at a preventative rate of 20L/ha. Maintain this programme until environmental conditions no longer favour the disease |

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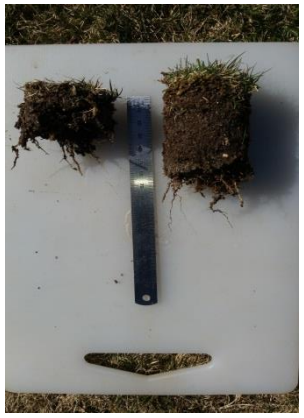
| spring dead spot<br><br>*(Ophiosphaerella korrae)* | Fungal | Spring dead spot (SDS) can occur on couchgrass cricket blocks during early spring and persist throughout the summer until dormancy. Although visual symptoms may appear reduced during dormancy, the pathogen is soil-borne and if not appropriately treated through the spring, summer and early autumn will return the following year (in many cases increasing in severity). |  <br>  <br>  | Due to the host species being couchgrass this disease will be exclusive to couchgrass cricket blocks.<br><br>Long-term strategy:<br>Upon positive identification of SDS:<br><br>1) Ensure any applications of Nitrogen are made in advance of winter dormancy. The couchgrass plant should not 'take' excessive Nitrogen into dormancy.<br>2) Make 2 x applications of Potassium sulphate in the months prior to dormancy. The application rate should be: around 0.8Kg/100m² per application.<br>3) Carry out soil testing to ensure that a pH of between 5.5-6.0 is targeted.<br>4) Apply autumn fungicide application of Fenarimol at 1-1.5Kg/ha rate.<br>5) As soon as couchgrass comes out of dormancy apply 3-4 weekly applications of Propiconazole, Myclobutanil and Fenarimol (as appropriate) throughout the summer. |

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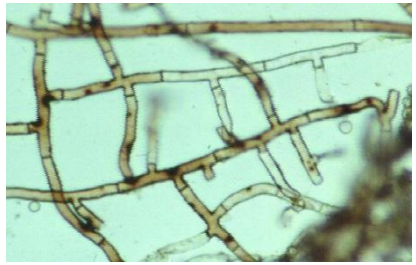
| *Rhizoctonia* sp. | Fungal | *Rhizoctonia* pathogens cover such "patch" diseases as: brown patch, leaf spot and yellow patch. The pathogen is also associated with other root-rot infections, damping off and leaf blights.<br><br>The disease pathogen occurs primarily on ryegrass during periods of warm and humid weather. Infected hyphae from affected plants will contact the soil around the base of the turfgrass crown and spread towards neighbouring turf plants when environmental conditions are conducive. |  <br>  <br>  | Present throughout New Zealand (most likely to occur central to north, north island).<br><br>The nature of cricket block preparation (i.e. compaction and relatively high soil moisture) provides an ideal environment for the development of *Rhizoctonia* sp. Care should be taken to avoid prolong*ed periods of 'High'* soil moisture content (i.e. >60%) at times of the year when humidity is highest or covers are likely to be in place for extended periods of time. Soil moisture will need to be managed around emerging seedlings or young turfgrass plants whilst avoiding seed germination and high Nitrogen feeding during periods of high humidity.<br><br>Chemical treatment: In New Zealand's temperate climate curative applications are most commonly employed. Chemicals from the following groups are effective: carboxamides, benzimidazoles, carbamates, dicarboximides, DMI fungicides, nitriles, and QOIs. |

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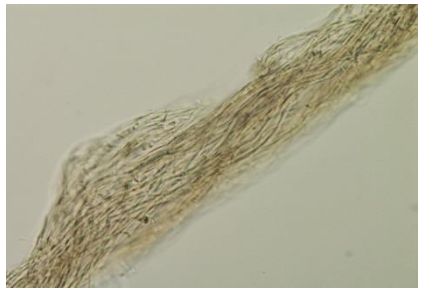
| red thread and pink patch<br><br>*(Laetisaria fuciformis and Limonomyces roseipellis)* | Fungal | Prevalent during periods of moist weather (usually cool temperatures 18°c - 20°c). Generally most active around the times of seasonal change (spring & autumn). Red thread in particular can be associated with a low availability of Nitrogen or Potassium. Turf Managers should be aware that autumn applications of Nitrogen are not recommended to reduce red thread persistence. |  <br>  <br>  | Present throughout New Zealand.<br><br>Maintain a 'clean' sward i.e. attempt to remove majority of desiccated leaf tissue accumulations around the base of the sward – this is where *Laetisaria fuciformis and Limonomyces roseipellis* spores will reside.<br><br>Chemical control only necessary in extreme situations: Chlorothalonil at 20L/ha or Azoxystrobin at 2.4L/ha can be used. |

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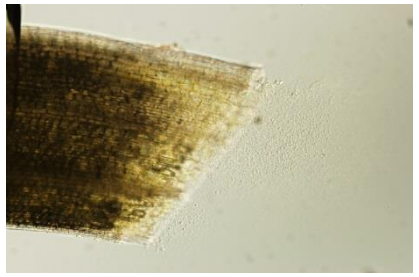
| bacterial wilt<br><br>*(Xanthomonas translucens)*<br><br>Etiolation (ETS). | Bacterial | First observed incidence of bacterial wilt on ryegrass in 2013 (USA). Prevalent in hot and humid weather conditions. Bacterial wilt on *Poa annua* turf was recently identified by SSDM in Auckland.<br><br>Symptoms range from desiccation and wilt of turfgrass plants to etiolation of individual plants (the latter being most likely to occur on cricket blocks) |  <br>  <br>  <br>  | Most likely in central to north, north Island.<br><br>Unlikely to be a significant issue for NZ cricket Turf Managers.<br>Applications of Copper hydroxide (500 g/Kg copper, as copper hydroxide) at the labelled rate for use on fruit crops can be made to the affected turf (each application should be thoroughly watered in and carried out at a time when heat and UV stress on the turf is minimal i.e. early morning or late afternoon). Three applications of Copper should be made at 2 week intervals after which time an evaluation can be made regarding the extent of disease control.<br><br>Where etiolation is the main symptom: SSDM recommends the Turf Manager carry out a soil nutrient analysis to identify existing levels of pH and available Calcium and Magnesium as these can be contributing factors to leaf etiolation if limited in availability. |

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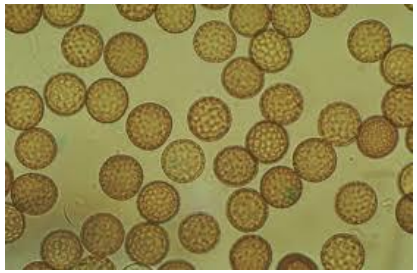
| rust<br><br>(*Puccinia* spp.) | Fungal | Late summer to early autumn (especially in warmer/wetter autumns).<br><br>Ryegrass is particularly susceptible to rust. |  <br>  <br>  | Present throughout New Zealand.<br><br>Generally symptoms shall not be severe enough to require chemical treatment on a cricket block. However, if symptoms do require treatment an application of Azoxystrobin at 2.4L/ha is recommended (note: this will need to be followed up with an application of Tebuconazole at 4L/ha if environmental conditions continue for a number of weeks following initial treatment). |

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| powdery mildew<br><br>(*Erysiphe graminis* sp.) | Fungal | Occurs primarily in autumn on areas of turf that struggle to receive sufficient light and where turf canopy is dense. |  <br>  <br>  | Present throughout New Zealand.<br><br>If symptoms appear persistent and severe enough to justify chemical application: Apply Propiconazole at 4L/ha and if symptoms and environmental conditions persist for several weeks, follow up with an application of Trifloxystrobin at 0.75L/ha (2-3 weeks later). |

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| anthracnose<br><br>(*Colletotrichum cereale* sp.) | Fungal | Low light, leaf wetness and low fertility are major contributors to the occurrence of anthracnose.<br><br>Active in a broad temperature range: 15°c to 25°c.<br><br>Primarily a disease of *Poa annua,* anthracnose will also infest ryegrass and couchgrass cricket blocks if conditions are favourable. |  <br>  <br>  | Occurrence is widespread across New Zealand regions due to broad temperature range of activity.<br>Persistent disease that may be either basal (rot) or plant (blight) based. Depending upon the nature of the infection the best course of treatment may involve spiking and drenching with a broad spectrum fungicide or a leaf application.<br>If applying fungicides preventatively (i.e. before any symptoms have been observed) then a foliar application will be appropriate. A suitable product is: Chlorothalonil (20 L/ha), Mancozeb (20 L/ha) or Propiconazole (5L/ha). Where a curative programme is being established then systemic fungicides are required i.e. products containing: Chlorothalonil, Propiconazole and Fludioxinil at an application rate of 18L/ha. |

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| Slimes<br><br>(Cyanobacteria etc.) | Fungal | Prolonged soil/surface wetness. Overcast and mild days in particular early spring and late autumn when turfgrass growth is slow and the sward coverage likely to be sparse.<br><br>High soil pH will increase the persistence of many slimes (i.e. alkaline clays opposed to those that are more acidic).<br><br>Slimes can also be 'artificially' brought about as a result of high NPK fertilisers being applied inappropriately. |  <br>  | Chemical treatment: Apply Mancozeb and Chlorothalonil every 10 to 14 days leading up to and during periods of humid, moist weather.<br><br>Application rates:<br>Mancozeb = 200ml/100 m²<br>Chlorothalonil = 300ml/100m²<br>**Note**: if weather is conducive to slimes and algae development, these applications will need to be followed up within 1-2 weeks and repeated up to 3 times.<br><br>Control of an existing algae/slime issue may also be gained from applying Iron Sulphate at a rate of 80ml/100m² |

## 3. Preventative Strategies

In most cases the occurrence of turfgrass disease occurs at a point when environmental conditions are conducive to infestation and is to some extent unavoidable. In these scenarios the onus is upon the Turf Manager to have strategies in pace that control or limit the extent and severity of such turfgrass disease infections.

In order that the Turf Manager is able to mitigate and minimise disease severity an appreciation of the key factors that contribute to turfgrass disease infection is important. This Section identifies the major factors that contribute to the plants susceptibility to pathogen infestation and consequently the severity of disease infection.

### 3.1 The disease cycle

No single turfgrass disease pathogen acts in exactly the same way. The mode of action of fungal pathogens will differ significantly from those of Bacterial and Viral; however a fundamental awareness of the 'typical' disease cycle for turfgrass diseases is valuable for the Turf Manager to understand.

Figure 2 illustrates the principle of a fungal pathogen lifecycle:

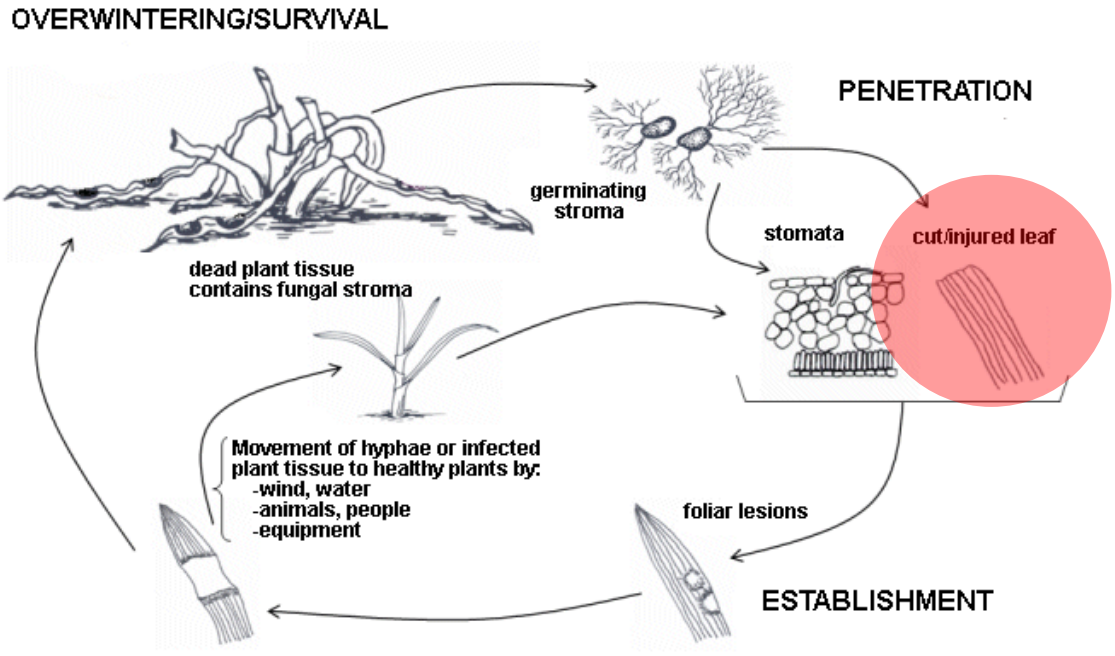


Figure 2: Turfgrass disease cycle- dollar spot
(Source: http://www.apsnet.org/edcenter/intropp/lessons/fungi/ascomycetes/pages/dollarspot.aspx0

As highlighted in figure 2, prevention of serious disease infestation should be focussed upon reducing the opportunity for pathogen 'stroma' (spores) to enter the turfgrass plant. Primarily, entry to the plant will be through some form of turfgrass injury or creation of an artificial environment conducive to turfgrass disease.

Commonly opportunities for pathogen infestation will be caused as a result of:

- Mowing turf with dull/blunt cutting units (figure 3).
- Carrying out abrasive cultural practices such as topdressing and/or brushing when the weather is too hot, too dry or plant is too wet (soft).
- Excessive wear and tear on the turf. (i.e. poor machine operation or carrying out maintenance tasks when ground conditions or environmental conditions are inappropriate [too dry or too soft]).
- Creating 'artificial' conditions around the turf (i.e. a humid micro-climate beneath covers).
- Damaging the turfgrass plant with inappropriate applications of chemicals and/or fertilisers. (i.e. avoid applying chemicals and fertilisers during periods of prolonged heat or leaf wetness)

Fungal pathogens in particular are highly opportunistic and will rapidly infest a damaged turfgrass plant. The extent of potential infestation will depend upon how the Turf Manager mitigates against providing further opportunities for fungal pathogens to spread and cause serious harm.

Figure 3: Example of turfgrass mown with blunt cutting units.

## 3.2 Contributing factors of turfgrass disease

Understanding how best to limit the opportunities for pathogen infestation of turf requires the Turf Manager to have a basic understanding of the key factors that can work in association to effectively create a 'perfect storm' for a severe turfgrass disease outbreak.

These key factors are described graphically in figure 4.

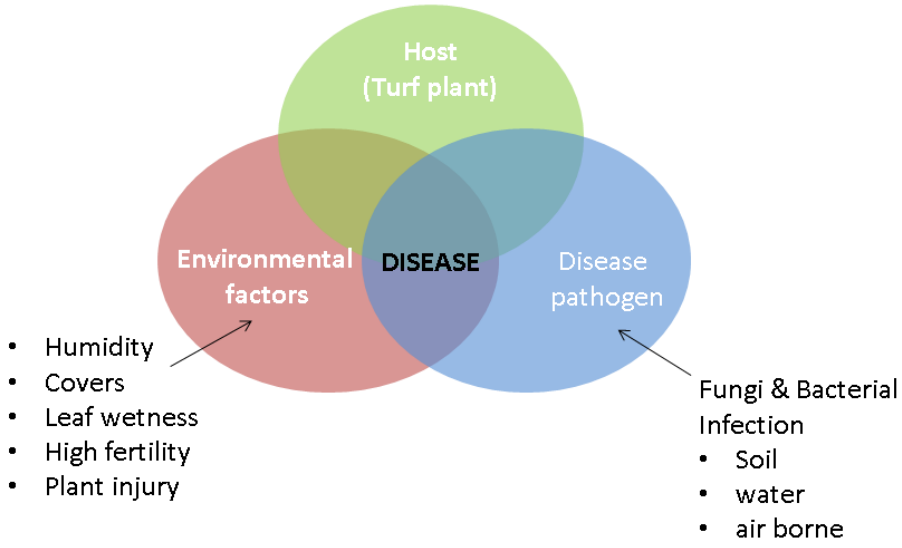


Figure 4: Key factors contributing to severe turfgrass disease infestations.

As illustrated in figure 4, where environmental conditions support pathogen occurrence and turfgrass injury occurs through any of the opportunities identified in Section 3.1 a 'perfect storm' for turfgrass disease infestation occurs.

Although many of the factors leading to turfgrass disease infection can be avoided through following 'best practice' management techniques and not adversely injuring or compromising the integrity of the turfgrass plant, there are occasions when it is necessary to ensure a preventative chemical programme is in place in order to limit the opportunities for turfgrass infection. Most commonly these will be during preparations for match fixtures where covers may be required along with the manipulation of soil moisture content.

In such circumstances the Turf Manager should aim to apply a preventative broad spectrum fungicide (i.e. Azoxystrobin) a minimum of 2 days in advance of having to cover the pitch for prolonged periods of time.

This application will be made in conjunction with a basic understanding of the key 'cultural' factors that encourage disease infestation (as outlined within this Section of the guidelines).

## 4. Turf Disorders

A range of turf 'disorders' that can mimic the visual symptoms of turfgrass disease include:

**1. Chemical or Fertiliser burn:**

Caused by a number of factors: leaking equipment, inappropriate application rates, applying chemical at the wrong time of year/day, and not understanding the 'burn potential' of a particular product etc.

Figure 5: Chemical burn on a golf green.

**2. Chemical tracking through groundwater:**

Some chemicals have a residual mode of action (i.e. the active ingredient remains active within the soil profile for a number of days or weeks). When using such chemicals the Turf Manager should ensure that a) weather conditions are appropriate for use of the particular product and b) appropriate measures have been taken to limit the potential 'tracking' of the chemical through the soil to wider areas of turf. This may be particularly relevant where managing multiple turfgrass blocks of different species i.e. couchgrass and ryegrass. Where any risk of chemicals tracking through the soil profile exists, the Turf Manager must ensure that soil moisture content is managed and no rainfall or irrigation is likely to occur over the week (or so) following the chemical application.

Understanding the life of chemicals within the soil is very important. Most turfgrass chemicals will have some form of "half-life" (the half-life of an herbicide in soil is the time it takes
for 50% of the chemical to degrade or break down within the soil) after which point the active ingredient will be unlikely to have any adverse effects upon adjacent areas. By means of example, Amitrole has a half-life in the soil of approximately 40 days, and MCPA may still be 'active' within the

soil for up to 5 weeks. A further example (particularly relevant to use on couchgrass cricket pitches) will be Simazine. This is a soil-based herbicide that remains active within the soil for long periods of time; it is also liable to track through soil ground water/moisture and has the potential to damage surrounding (non-target) areas.

When using chemicals that have a significant half-life within the soil it is important to apply these when environmental conditions a favourable (i.e. no forecast rain) and also understanding that it may be preferable to use less residual foliar-based alternatives.

**3. Dull mower blades:**

Figure 6: 'Whitening of turf' caused from mowing with a dull blade.

Mowing with a dull blade will effectively tear the turfgrass plant, leaving the tip of the plant torn and desiccated. Not only does this create an opportunity for turfgrass disease infestation, but sometimes the appearance of the sward can be so 'off colour' that the Turf Manager can assume the turf is under attack from a disease pathogen. Where this has happened it is recommended to apply a contact fungicide as soon as possible (avoiding the heat of the day if in summer). A broad spectrum contact such as Dithane Rainshield (Mancozeb) at 20 L/ha is recommended.

**5. Plant nutrient deficiency:**

SSDM recommends that the Turf Manager submit representative samples of their soils for basic nutrient analysis on an annual basis. This information will provide some objective measurements to assist in the setting up of on-going fertiliser plans for the year ahead. The recommended Laboratory in New Zealand to provide this service is: Hill laboratories, Hamilton (www.hill-laboratories.com/). Interpretation of these results should be made by an independent turf agronomist.

Figure 7 (below) provides an example of how a nutrient deficiency can often appear.

Figure 7: Nutrient deficiency of turf.

Carrying out an annual soil test will also identify whether your soil is deficient in any key nutrient groups or whether there might be accumulations in potentially damaging factors such as Sodium or a high pH etc. Without this background information sometimes the wrong diagnosis can be made without successful resolution.

Where your facility may be connected to a private water source (i.e. not town supply) it may also be worthwhile analysing the irrigation water every few years to ensure key criteria such as Sodium, pH and Calcium etc. are in balance.

## 5. Current Chemical Options for Turfgrass Disease

The efficacy of fungicides will depend greatly upon the methodology and calibration of use. It is recommended to identify the pH (ideally 6.5-7.0) of your water source prior to mixing chemicals as in order to encourage efficacy a pH buffer solution may be required. Timing of applications is also critical, i.e. early morning or late evening is generally the optimum times to apply fungicides. DMI fungicides should not be applied when weather conditions are hot and/or dry as these can result in significant turfgrass injury.

Table 2: Inventory of the current chemicals available in New Zealand to manage fungal and bacterial turfgrass issues.

| Active Ingredient | Chemical group (fungicides only) | Trade name (Options include but are not limited to) | Chemical control | Rate of application | Comments: *'Burn potential'* use on seedling/establishing turf |
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| **Fungicides** | | | | | |
| Azoxystrobin 500g/L | QoI, Strobilurin | Amistar | Systemic<br>Broad spectrum | 2.4L/ha | Suitable for use as a seasonal 'protectant' i.e. following renovation and during spring and autumn transitions<br><br>Do not use on dollar spot as can worsen symptoms.<br><br>Medium – High risk of resistance. Do not apply more than 6 applications of Azoxystrobin in any single year.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Azoxystrobin 62 g/L & Propiconazole 104 g/L | DMI, Strobilurin | Headway MAXX | Systemic<br>Broad spectrum | 9 L/ha | As above (added cost implication of combined product)<br><br>As with all DMI grouped fungicides, a high risk of resistance exists. This can be managed by applying no |

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| | | | | | more than 3 consecutive applications of DMI grouped fungicides before changing and applying no more than 5 applications of DMI grouped fungicides per '*active turf growing season*'.<br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Carbendazim 500g/L | Benzimidazole | Prolific[1], Protek | Broad spectrum | 20L/ha[1] | Not effective on diseases such as; *Pythium*, leaf spot/damping off/melting out or take-all-patch.<br><br>Offers some control over worm casting.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Chlorothalonil 250g/L and Thiophanate Methyl 250g/L | DMI | Tratek 5F | Broad spectrum | 15-20L/ha | As above.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Chlorothalonil 362 g/L, Propiconazole 57 g/L & Fludioxinil 14.5g/L | DMI, Strobilurin | Instrata | Broad spectrum systemic and protectant | 9-18L/ha | As above.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Chlorothalonil 720g/L | DMI | Cavalary, Bravo WeatherStik | Broad spectrum contact and protectant | 14-20L/ha | Suitable for the majority of turfgrass diseases (apart from *Pythium* and take-all-patch).<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |

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| Cyproconazol 100g/L | Triazole | Alto | Broad spectrum contact and protectant | 4L/ha | Particularly effective on dollar spot<br><br>Do not tank mix with copper fungicides.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **High** |
| Fosetyl-Aluminium 800g/Kg | Triazole | Aliette | Broad spectrum contact and protectant | 20L/ha | Primarily used when *Pythium* sp. is considered a high risk.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Moderate** |
| Iprodione 250g/L | Dicarboximide | Rovral Flo | Contact and Protectant | 10-20L/ha | Particularly effective on melting out diseases.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Mancozeb | Dithiocarbamates | Dithane Rainshield, | Protectant | 6-20L/ha | Ensure leaf is well coated, this works well as an on-going protectant against leaf spot and melting out diseases (apply every 2-3 weeks during main growth season).<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Metalaxyl Mefenoxam 40g/Kg & Mancozeb 640g/Kg | Benzimidazole | Ridomil Gold | Broad spectrum systemic and protectant | 10-20L/ha | Primarily used for control of *Pythium* sp. and root rot<br><br>Can be washed in (drenched) in order to increase efficacy at the base/crown of the turf plant.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Prochloraz 450g/L | DMI | Mirage, Sportak | Broad spectrum systemic and protectant | 2-7L/ha | Leaf spot control i.e. dollar spot, *Bipolaris* sp. and fusarium. |

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| | | | | | Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Propiconazole 250g/L | DMI | Tilt, Aurora | Broad spectrum systemic and protectant | 2-10L/ha[2] | [2]Dependent upon target pest. Suitable for control of dollar spot, leaf spots, fusarium etc. Can be watered in for treatment of soil-borne pathogens.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Tebuconazole 500g/L | Triazole | Axis Gold | Broad spectrum systemic and protectant | 2-6L/ha | Particularly effective on anthracnose, when used in conjunction with Propiconazole.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Thiram 400g/L | DMI | Thiram 40F | Protectant | 15-20L/ha or 1L per pitch when breakout is severe | Effective on dollar spot and when mixed with a systemic fungicide.<br><br>Also used as a slime control on cricket blocks at 15L/ha.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Triadimenol 250g/L | Triazole | Cereous | Systemic and protectant | 3-6L/ha | Control of powdery mildew and rust.<br>Safe for use during turfgrass establishment.<br>Burn potential = **Moderate** |

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| Trifloxystrobin 500g/L | Strobilurin | Twist, Flint | Broad spectrum systemic and protectant | 0.3-0.75L/ha | Control of powdery mildew, rust and leaf spot disease.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Low** |
| Fenarimol | DMI Pyrimidine | Rubigan | Protectant | See Technical rep. | Reduced likelihood of resistance (in comparison to other DMI grouped fungicides). For control of dollar spot.<br>Suggested in use with a surfactant.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Moderate** (Note: DMI fungicides can have a growth regulating effect during periods of hot weather) |
| Phosphite | NA | Phoscare | Biological preventative | 5L/ha | Apply every 2 weeks during main growing season. Thought to assist the turfs natural defence systems against anthracnose and root rot fungi.<br><br>Safe for use during turfgrass establishment.<br>Burn potential = **Moderate** |
| **Herbicides** | | | | | |
| Amitrole 400g/L | | Zelam | Non-selective | 16 ml/L | Short life within soil (4-6 weeks) can be used to 'cleanout' areas prior to re-seeding in spring<br><br>Should not be used on seedling turfgrass<br>Burn potential = **HIGH** (particularly phytotoxic to couch upon repeated application) |
| Picloram 100g/L & Triclopyr 300g/L | | Conquest, Brushkiller | Selective herbicide | 2L/ha | Broad selective, particularly good on Oxalis and will assist in *Poa annua* control also.<br><br>Should not be used on seedling turfgrass.<br>Burn potential = **Moderate** (Triclopyr has **HIGH** burn |

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| | | | | | potential on *Poa annua* and couchgrass) |
| Triclopyr 600g/L | | Grazon | Selective herbicide | 2L/ha | Good control of Hydrocotyle and *Poa annua* (not advisable to apply to couchgrass).<br>Provides control of summer grasses in cool season blocks.<br><br>Should not be used on seedling turfgrass.<br>Burn potential (See above) |
| Mecoprop 600g/L, MCPA 150g/L & Dicamba 18.7g/L | | Trimec | Selective (broad spectrum) herbicide | 3L/ha | Excellent control of a wide range of broadleaf weeds, in particular good control on toad rush.<br><br>Should not be used on seedling turfgrass.<br>Burn potential = **Low** to **Moderate** |
| MCPA 750g/L | | Maestro | Selective herbicide | 3L/ha | Broad range of control, including starweed (will require multiple applications).<br><br>Should not be used on seedling turfgrass.<br>Burn potential = **Moderate** |
| Ethofumesate | | Nortron | Pre-emergent herbicide | 2L/ha | Good all round control of weed species. Should be applied at the time of seeding turfgrass.<br>Should be used at time of seeding turf as a pre-emergent.<br><br>Burn potential = **Moderate** (best applied to couchgrass swards during dormancy as a pre-emergent to combat spring growth of *Poa annua* and weeds). |
| Oxadiazon 380g/L | | Oracle | Pre-emergent herbicide | 2L/ha | Up to 6 weeks protection from pre-emergent weed species. Note: product forms a 'skin' over the surface of the soil and will lose efficacy if disturbed through cultural practices during this time. |

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| | | | | | Should not be used on seedling turfgrass.<br>Burn potential = **Low** |
| Propyzamide 500g/L | | Kerb | Selective herbicide (for couchgrass) | 1.2L/ha | Excellent control of weed species on couchgrass surfaces.<br><br>Safe to use on seedling turf (2-leaf stage of growth)<br>Burn potential = **Low** (effective for control of Paspalum in couchgrass) |
| Fenoxaprop-P-Ethyl 69g/L | | Puma | Selective herbicide | 750ml/ha | Best applied in springtime on ryegrass blocks for control over broad leaf weds and invasive summer grass.<br><br>Should not be used on seedling turfgrass.<br>Burn potential = **Low** (cool-season) **Moderate** to **High** (warm-season) grasses. |
| Trifloxysulfuron 100g/L | | Monument | | 100-300ml/ha | Application rate will depend upon target species. Trifloxysulfuron will control winter grass species in the couchgrass cricket block as well as broad leaf weeds. Applications should be made as plants are actively growing, targeting stem and crown of undesirable turfgrass plants.<br><br>Should not be used on seedling turfgrass.<br>Burn potential = **Low** |
| **Wetting agents/dew control** | | | | | |
| Polyether 1020g/L | | Breakthru Gold | Penetrant/surfactant | Varies | 1) Initial early season application = 3L/ha<br>2) Bi-weekly applications (thereafter) = 800ml/ha<br>3) Dew suppressant = 3L/ha<br>Note: apply only in early evening or early morning when dew is still present on the ground. |
| Oxirane- | | DewCure | Surfactant | 6L/ha | Can last up to 1 week of dew control (ideal for 'match |

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| methyloxirane polymer | | | | | day' situations). |
| **Moss/algae control** | | | | | |
| Carfentrazone 240g/L | | Smackdown | Selective herbicide (additional moss-control benefits) | 500 ml/ha | **Important**: This product is an accelerant and therefore all equipment used to apply Carfentrazone must be triple rinsed and thoroughly cleaned post application.<br><br>Will require follow-up application within 14 days of initial application. |
| Dichlorophen 432g/L | | Mostox | Selective biocide | 500ml/L | |
| Benzalkonium chloride 500g/L | | Surrender | Algaecide | 250ml/10L | |
| Iron Sulphate | | Iron Sulphate | | 100g/ha in 600 L or water | Apply 2-3 times during the autumn or early spring to sliver moss and algae etc. The action of the Sulphate Iron may also be enhanced by the addition of 200-250ml of Acid (i.e. white vinegar) to every 5L of tank mix. |

**Important Notes:**

1. Where 'Burn *Potential*' is described as being '**Low**' to '**Moderate**' the product can be applied adhering to manufacturer's guidelines and GROWSAFE best practice, throughout the day. Where '*Burn Potential*' has been described as '**High**' the product should only be applied early morning or later in the evening and may require some washing off the leaf.

2. DMI fungicides have the potential to stunt growth and act as a 'growth retardant' during periods of environmental stress i.e. heat or drought. The use of DMIs should be carefully considered during such times.


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