GRASS CLIPPINGS 23
THE UNDERWORLD

A Greenkeeper looks at his green and decides whether it looks healthy or not.
If healthy he continues as before hoping that he has discovered, and applied a winning formula.
If the grass does not look healthy he might spend a considerable amount of time, and money, trying out various remedial measures without success.
Eventually he might decide to look at that part of the green beneath his feet.
It is not just a few grains of sand or clay but a frontier teeming with life where the battle for food, space, and resources ranges continuously.
It is an area the average GKP does not know much about but would be very unwise to ignore.

1.0 THE ROOT ZONE

In this issue of "Grass Clippings" we will be delving into the nether regions often referred to as the "Underworld" but also called the "Root Zone"

1.1 BOUNDARIES

Physically it covers the area from the surface of the green to that point where oxygen is no longer available in the soil which, also happens to be the lowermost point reached by the roots.
When a green has been irrigated the water percolates through the various layers followed by a vacuum which "pulls" air to follow the water.
The air will contain oxygen but as it moves down the roots and organisms in the soil will use up some of the oxygen until a level is reached where oxygen is no longer available. This point defines the lowest boundary of the root zone.
The rate at which the water and air move through the root zone will depend on the size of the pore spaces which in turn depends on the size of the particles which make up the root zone.
In sandy soils, with fairly large particles, the pore spaces are large and the lowest point of the root zone could easily be 200 mm while in clayey soils with much smaller particles and pore spaces, which are correspondingly narrower, the water (and air) would move very slowly and the depth of the root zone might not be more than 20mm.
It is in this "zone" that the health of the grass plant will be determined

1.2 CONTENTS

a) Live plant roots and sub-surface shoots
b) Dead tissue composed of un-decomposed or partially decomposed plant and animal tissue.
c) Macro Fauna including Earthworms
d) Micro- and Macro- Flora - a whole array of microscopic and larger organisms

From the above we can conclude that plants do not thrive alone but rely on a consortium of beneficial soil microorganisms found in healthy soils. These microorganisms are responsible for breaking down organic material releasing nutrients required for plant growth and providing protection against pathogens through the production of chemicals agents

All the inhabitants of the root zone are alive and being alive they will need oxygen and "food" to survive .

- The oxygen is found in the air which moves through the soil layers
- The energy required for all these activities is derived from the sugars which the plant produces during photosynthesis and is "exported" through the roots into the root zone. In return for this energy the micro-organisms make nutrients available to the grass plant

1.3 DETAILS -

a) **LIVE PLANTS** - Live plant roots and subsurface shoots – These are alive and part of the grass plant.
b) DEAD TISSUE – The disposal of waste is a priority wherever

there is any plant or animal activity and unless there is a mechanism which disposes of this waste the root zone would soon be inundated by an accumulation of it's own residue.

When one realises that there are up to 100 million bacteria per gram of soil and their survival rate is 6 hours then they must leave a lot of debris

c) **EARTHWORMS -** Earthworms do not feed on live plants but are extremely effective in reducing the accumulations of residual organic material.

Although their worm casts are a nuisance because they increase the wear on the bottom blades of the mower the advantages of having earthworms in the soil far outweigh the disadvantages of having the worm casts removed before mowing Studies in the U.S.A. showed that removing earthworms led to an increase in thatch formation.

d) MICRO - FLORA The microscopic organisms are mainly Bacteria, Fungi, and Algae – Their functions are -

- To oxidize material (eg Fertiliser - Chemical Elements) into an absorbable form.
- To decompose organic material and re-cycle nutrients contained in plant and animal residue

By converting a patch of "lawn" into a bowling green the GKP is flouting the normal growth pattern of the grass plant and creating a situation which might upset the balance of nature, so carefully nurtured, in the soil. It is the duty of the GKP to ensure that, in spite of his actions, he has been able to retain the balance of nature in the "underworld"

When a soil sample contains a lot of different active micro-organisms, they tend to control one another.

It is this "peaceful co-existence which allows the grass plant to thrive,

If you eliminate one of the players in this system, then everybody else must adjust and sometimes the wrong one is there to fill the void.

1) Bacteria

A GKP applies dissolved fertilisers to the surface of the green. As the fertilisers in solution percolate slowly through the root zone the fertilisers are "digested" by the micro- organisms (mainly bacteria) into an absorbable form and taken up by the roots

Two things are of significance –

- Without bacteria in the soil none of the fertilisers will become available to the grass plant.
- Are there sufficient bacteria in the root zone to convert all the fertilisers at one time while the fertilisers move through the root zone – a good case can be made out here for small frequent fertilising rather than once a month.

2) Fungi - Fungi are divided into three categories –

- **Parasitic Fungi** - Parasitic Fungi feed off plants and cause plant diseases. There are about 25 types causing serious turf diseases – yet - many of them like the other benevolent organisms also contribute to the breakdown or "rotting ' of thatch or the debris of other plants and microbes, all of which become organic nutrients for the turf..

Although most of these parasitic fungi are naturally present in the root zone their numbers are kept static by "the balance of nature 'which allows for the peaceful co-existence of these organisms.

Each year that you manage a turf, most of the Big 25 diseases will occur but only occasionally will any of them become severe enough for the GKP to either notice them or do something about them

It is said that a plant disease must occupy 3.5 % (. about 50 sq.m). of a bowling green before the GKP should do something about it. Below that figure the prudent GKP would adopt a policy of "watchful expectancy". He would allow that part of the green to grow and assist the defence mechanism to overcome the disease. The perfectionist would, immediately he saw disease–affected leaves, run to the fungicide and promptly upset the balance of nature for a few weeks. This "Fungicide

Addiction" is the reason why mild infections become severe problems and require major intervention.

Far too many GKP's suffering from "Fungicide Addiction" even apply fungicides as a preventative measure rather than the occasional curative procedure. Good turf management does not start with a fungicide budget – it should be the last item in the budget.

The GKP should learn to live with these parasitic fungi - In the same way that human beings exposed from childhood to low grade local infections are less likely to contract severe infections so will grass which has over the years, been exposed to frequent small doses of these fungi develop an immunity to major disease outbreaks - Biological Buffering

Note In the RSA in 1947/8 there was a severe outbreak of polio in Johannesburg. Many young children from affluent suburbs leading sheltered lives contracted the disease with many becoming paralysed - not a single child from the townships became paralysed because he had lived with and been in contact with small quantities of the virus since birth.

The virulent fungi only break loose when conditions in the root zone (often instigated by the GKP) allow them to multiply eg. a breakdown in the defence mechanism of the grass plant due to the GKP reducing the leaf area and the production of Carbo-hydrate (CHO)

- **Saprophytic Fungi** -These fungi decompose residual material - Responsible for re-cycling of nutrients contained in plant and animal residues.
- **Symbiotic Fungi** - (Symbiosis -When two organisms form an association which is of mutual benefit to both). Symbiotic Fungi form an intimate association with some plant roots that aid the absorption of specific nutrients. This association is called *Mycorrhizae.*

Whilst it can be difficult for the GKP to grasp the complexity of the activities taking place in the root zone he should be conversant with enough of these activities to avoid the obvious pitfalls eg.

- The amount of energy (CHO) the grass plant can produce is directly related to the amount of leaf area exposed to the sun
- The ideal situation would be for the grass plant to produce slightly more CHO than it is using and to store this in different parts – mainly the roots
- Whenever there is a reduction in CHO production the first casualty, being the furthest from the source, will be the organism living in the root zone. The second casualty will be the defence mechanism of the grass plant after it's supply of CHO is cut off..

If, in his quest for speed the GKP reduces the leaf area to a level where there are not sufficient CHO reserves the supply of CHO will be cut off as shown above and the organisms will die – the fertilisers will not be digested, germs will gain entry unopposed, and there will be a build–up of thatch.

- Whenever the GKP applies a Pesticide to the green, He might prevent pathogenic, virulent fungi or smaller animals gaining access to the grass but , at the same time, **he is killing off the benevolent fungi in the root zone with the same results as described above**

2.0 ANTI – BIOTICS

First used in World War 2 anti-biotics have proved to be a boon to mankind and probably saved millions of lives

Unfortunately the bacteria have, over the years, developed a resistance to the anti-biotics forcing the scientists to develop newer forms.

The same can be applied to agriculture where anti-biotics have also been developed to kill off virulent organisms decimating the crops. Here too the organisms developed a resistance to the chemicals forcing the scientist to develop newer forms of Pesticides

In agriculture the next stage was the use of these pesticides as a preventative before there was any sign of a virulent pathogen.

The wheel has now turned and mankind, aware of the deleterious effect of the indiscriminate use of pesticides, has now gone "organic" with many of the pesticides which

were used freely before now being banned.
In the RSA the authorities are a little behind some of the other countries and are still using Pesticides which are no longer being produced elsewhere.
We as GKP's would be well advised to start looking elsewhere to alternatives to the pesticides we use so freely. It will not be long before some of our systemic fungicides are banned. Contact fungicides would still be acceptable if applied correctly to the surface of the green with a sticky substance like Oleum to ensure adhesion to the leaves.
The problem here is that immediately after application the fungicide will act on the pathogen in the damaged leaf , but, in the meantime the leaf has grown and that new part is not protected against the pathogen.
Repeated application of the same Contact Fungicide will eventually fail because rapid plant growth and environmental conditions will allow pathogens to attack the newly produced and unprotected grass tissue.
The cry for "organic" has encouraged scientist all over the world to "return to nature" and to find natural means of dealing with the problems relating to sports turf management
It is in this field that the use of benevolent fungi has gained more prominence.

3.0 RETURN TO NATURE

Working on the assumption that it would be more difficult for a virulent pathogen to gain access to healthy grass than to one under stress the GKP ,in his efforts to restore the balance of nature on his green, could consider the following –
1 Allow for enough leaf area to ensure a positive nutritional balance.
2 As far as possible use organic fertilisers
3 Avoid using systemic fungicides - let nature take it's coarse or use contact fungicides carefuloly.
4 Introduce Fungi which would promote a more efficient uptake of nutrients.

Mycorrhiza

Mycorrhizal Fnngi fall into the Symbiotic group of Fungi. They are critical microbes in the soil connecting plant roots to the soil and environment – somewhat similar to the myriad of cables which connect our world,
A microscopic examination would reveal that in undisturbed soil the roots appear to have been taken over by the fungi.
These fungi live within the roots of the plant and extend fungal threads into the soil where they search for nutrients far beyond the host plant's rooting zone.These nutrients are absorbed by the fungi and conveyed to the roots where they are exchanged for energy.
It is estimated that for every 1.00mm of root there is 1.0 metre of fungal thread forming a network in the soil which might go well into those regions not touched by the roots.
The ultimate result is that with the aid of the mycorrhizae, the host plant has gained access to nutrients which it would not normally have enjoyed – more particularly Phosphorous
Unfortunately all this applies to grass growing in it's natural state. On a bowling green the advent of over-fertilisation with inorganic fertilisers, and the indiscriminate use of pesticides has greatly reduced their numbers.
Every effort should be made to re-introduce the mycorrhizae to the soil of the green.
A Research Scientist at Rhodes University (Dr Jo Dames) has now produced a granular product (Mycoroot) which can re-introduce these fungi to our greens. Mycoroot was used successfully on some of the fields used in the Soccer World Cup recently. For further information visit www.mycoroot. Com or E-Mail j.dames@ru.za
Note Mycorrhiza must be inserted into the green, when planting a new green, after hollowtining, or if it has been severely scarified when the bare soil is exposed
I have applied it to one green and am awaiting results
If successful I can expect a greater uptake of whatever fertilisers I apply and might even be able to reduce the amount of fertiliser none of it is going through untouched into the nether regions below the "Root Zone"

4.0 CONCLUSION

I hope we have learnt two things from this –

1 Waste. Cities spend millions of Rand disposing of our waste. The same applies to the underworld except that we are the losers – if we interfere with the natural processes the thatch will get thicker and it will then be up to us to dispose of it if we want to continue playing on a decent green.

2 Absorption of Nutrients When I started in medicine I assumed that when I gave a patient a prescription that was the end of it and the medicine would reach the target area and the patient would recover. In took me many years to realise that this did not always happen.

As a GKP I also assumed that what I put on top of the green would be absorbed. I know now that this does not happen and that through my ministrations on the green I have reduced the number of Mycorrhizae and, therefore the feeding area for the roots to absorb the nutrients