

In the last instalment of Tech Talk, AGCSATech agronomist John Geary examined the role of turf root systems. In this edition he looks at the range of environmental and cultural factors that can have a significant impact on the health of root systems.



Maximising root health

Understanding the dynamics of a healthy turfgrass root system is vital in the establishment and production of high quality sports turf. In the previous issue of ATM (Volume 11.5, pg 36-37), Tech Talk outlined that two of the major functions of a turf root system are water absorption and nutrient uptake. To maintain adequate water and nutrient absorption it is important to maximise rooting depth by encouraging roots to draw water and nutrients from as much of the soil profile as possible.

So how can turf managers promote increased root depth? Well, there is a range of environmental and cultural factors (Table 1) they can manipulate which influence the overall health and depth of root growth. In isolation, these factors may have little influence, however, when combined they can have a dramatic impact, both positive and negative.

PLANT SPECIES

Different turf species have different potentials for root depth and root:shoot ratios. This genetic characteristic is most evident when comparing annual plants with perennial plants. The survival of annual plants is dependent on the species successfully producing enough seed to carry over from one year to the next. As a result, the root systems of annual plants are shallow with nutrients and carbohydrates prioritised towards seed production.

On the other hand, perennial plants invest in deep and extensive root systems as it improves the survival prospects of the plant. The take-home message here is to select the grass species/variety that is best suited to your needs and environmental conditions.

PROFILE MOISTURE

Probably the most important role turf roots perform is water absorption. If you were to observe a soil profile over several weeks, whereby one half of the profile received double the volume of water, you would see a changing pattern of root growth and density through the profile with roots growing in the moist profile proliferating, while roots in the drier zone would be reduced.

In effect, roots will 'chase' water deep into the profile if allowed. Infrequent deep watering which promotes deeper root depth should be adopted while the management of excessive thatch is also vital in promoting deeper rooting. Excessive thatch causes an increased percentage of roots to be concentrated in the upper root zone, limiting the area from which water uptake occurs.

PLANT HORMONES

The interaction of hormones controls the way a plant divides up its carbohydrates and nutrient

resources, particularly between roots and shoots. In effect, a priority system is adopted whereby each part of the plant is given a priority. Seedhead production is always given the highest followed by the youngest leaf shoot, the second youngest leaf shoot and so on. Root tips and those roots locating water successfully have middle priority.

When the plant is under stress or lacking in resources (water and nutrients) this priority system means the root system will only receive carbohydrates and nutrients after areas of higher priority such as seedheads and leaf shoots are satisfied.

TEMPERATURE

While there is little the turf manager can do to influence the temperature of soil, it is helpful to regularly monitor soil temperature. Use soil temperature readings to gauge what part of the life cycle the root system is experiencing.

SOIL PH

Soil tests should be conducted every one to three years to check soil pH trends. Turf managers should be aware that each turf species has an optimum soil pH and maintain that pH accordingly. Root growth and function is severely restricted at soil pH levels below 5.6 and above 7.4.

COMPACTION

Soil compaction can be caused by a number of factors, resulting in the closure of non capillary pore spaces within the soil profile. Given that these larger pore spaces are the conduits for root growth and air and water movement into, through and out of the soil, it is important to alleviate any compaction via soil cultivation methods such as coring, verti-draining, slicing and backfilling/topdressing with a coarse, free-draining sand.

There are a range of environmental and cultural factors that turf managers can manipulate which influences the overall health and depth of turfgrass root growth

WATERLOGGING

Waterlogging is a condition where the soil porosity is saturated with water leading to the elimination of adequate oxygen for root growth and general turfgrass health (i.e.: anaerobic conditions). To promote adequate root growth, turf managers should ensure that aerobic conditions exist in the soil at all times.

Don't forget that anaerobic conditions can easily develop in sand profiles if thatch is allowed to accumulate. The same can be said for perched water table constructions whereby the wrong sand/gravels are selected.

LACK OF OXYGEN

Turfgrass roots require oxygen for continued growth. Soil compaction and waterlogging can seriously limit the soil oxygen level. The USGA recommends the following parameters for greens construction

- Total porosity (%V/V): 25-55
- Volumetric water (%V/V): 15-25
- Aeration porosity (%V/V): 15-30

PESTS AND DISEASE

There is a range of pests which can feed actively on turfgrass root systems and cause damage. Subterranean pests such as mealy bugs and plant parasitic nematodes have the potential to feed on root tips leading to a reduction in root depth.

Root-borne diseases such as ectotrophic root infecting (ERI) fungi has been observed throughout Australia and is a common problem associated with warm-season grasses. The ERI fungi consist of spring dead spot (*Leptosphaeria* spp.) and Take-all patch (*Gaeumannomyces graminis*) with turf damage tending to occur when there are other stresses such as high temperatures, high humidity, low light and wear. If Take-all patch is considered extensive, it is recommended the following action be undertaken;

- Check soil pH. Alkaline soils are conducive to the presence of *Gaeumannomyces* spp and acidifying fertilisers should be applied to lower pH.
- Apply manganese as a foliar spray. Manganese is tied up by the *Gaeumannomyces* spp fungi and becomes unavailable to the plant.
- Soils low in potassium make turfgrasses more susceptible to the disease.
- Make sure that the thatch is kept under control. Thatch not only harbours the disease organism it also reduces the effectiveness of fungicides that are applied.
- Apply a fungicide such as azoxystrobin (e.g. Heritage) as a preventative treatment. The fungicide needs to be applied about



Cultural practices, such as dusting, can limit the build-up of thatch

six weeks before the disease is likely to appear. Also, apply in late summer/early autumn while there is good growth.

TOXICITIES

Root growth can be severely restricted by a range of different toxicities. Anaerobic soil conditions can quickly lead to black layer, producing gases and related compounds that are toxic to roots.

Turf managers using treated effluent need to also closely monitor the build-up of copper, boron, chlorine and aluminium within the soil profile as these elements can reach toxic levels harming root and plant health. Turf managers need to also be cautious when using pre-emergent herbicides as many such compounds are known to cause root pruning, severely restricting root growth.

SALINE AND SODIC SOILS

Increased salinity not only severely restricts root growth, but can also have adverse effects on overall plant health. Regular soil and water tests should be undertaken monitoring electrical conductivity levels.

Managing increased salinity levels is very complex, however, it is vital to promote leaching of the salts through the profile. This is best achieved through the careful management of irrigation practices and aerating the top 200-300mm of the soil profile as often as possible. The selection of grass varieties that tolerate higher salinity levels such as the seashore paspalums may also need to be investigated.

A build-up of sodium in the soil profile should also be closely monitored. Any imbalances should be corrected by the incorporation of gypsum.

MICROBIAL ENVIRONMENT

There is no doubt that the diversity and activity of the soil microflora play an important role in the health of the turfgrass root system. Some soil scientists believe that the increasing use of free-draining sands due to their excellent drainage and porosity characteristics has been to the detriment of the soil biology, resulting in nutrient and microbial imbalances that harm the root system.

An example is the group of *Pythium* species involved in the disease complex known as Pythium Root Dysfunction. The incidence of these problems is strongly associated with the

poor nutritional and microbiological status of new sand greens and it seems apparent that more emphasis should be placed on the use of organic and microbe enhancements such as molasses and composts in free-draining sand greens.

CULTURAL PRACTICES

While the above environmental factors play a critical role, there are also a number of cultural factors which play their part as well, most prominently cutting height, nutrition and thatch management.

Mowing practices, in particular very low mowing, can be especially detrimental to deep rooting. Turf managers should observe the 'one-third rule' which refers to not removing more than one third of the above ground grass height in any one time. This is particularly important as carbohydrates which are normally available to the roots are redirected to restore damaged shoots.

There is also a strong correlation between increased nitrogen levels and reduced turf grass root depths. While nitrogen is essential for turfgrass root growth, excessive nitrogen promotes shoot growth at the expense of root development. As a result, carbohydrates are drawn from the roots which in extreme cases can lead to carbohydrate exhaustion of the roots and root senescence.

It is important to only apply enough nitrogen to aid sustainable plant growth and recovery, while avoiding infrequent, heavy applications of nitrogen. It is also important to avoid deficiencies of phosphorus and potassium as both nutrients play a major role in root development and enhancement.

Regular soil testing and/or tissue testing should be carried out to establish base levels of both nutrients. A general rule of thumb for potassium is to apply at a rate which is 50 to 75 per cent that of nitrogen.

As discussed earlier, thatch accumulation increases the percentage of roots to be concentrated in the upper root zone, limiting the area from which water uptake occurs. Cultural practices, such as scarifying and light topdressing (dusting), are proven techniques aimed at limiting the build-up of thatch.

REFERENCES

- Beard, J.B. (1986):** *A new perspective on root growth. Proceedings, 9th AGCSA Conference, Brisbane.*
- Ford, P. (2001):** *HRT 416: Recommend plants, products and treatments (Book 2), NMIT, Turf Management Section, Topics 26, 27a and 28.*
- Ford, P. (2001):** *HRT 424: Manage irrigation, drainage and treatment systems, NMIT, Turf Management Section, p4-5.* 🌱

TABLE 1. FACTORS INFLUENCING ROOT GROWTH

| Environmental Factors | |
|-----------------------|----------------------------------|
| Plant species | Waterlogging |
| Profile moisture | Lack of Oxygen |
| Plant hormones | Toxicities |
| Temperature | Pests and disease |
| Soil pH | Saline and sodic soils |
| Compaction | Microbial environment |
| Cultural Practices | |
| Mowing height | Nutrients - fertiliser practices |
| Thatch accumulation | |