UNIVERSITY of GUELPH

GUELPH TURFGRASS INSTITUTE

Addendum for Publication 845

How to use the addendum

This addendum was created to compliment and bring the publication up to date with more modern practices, technologies, and species of turfgrass. The addendum has sections that are titled the same as the original publication. When referring to the sections in the original publication the reader should also refer to the corresponding section in the addendum. The information found in the addendum will complement the existing information or in some cases it should replace the existing information.

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IMPROVE LIFE.

1. Integrated Pest Management for Turf

Introduction (p 11)

- IPM occasionally will implement preventative measures for certain pests or diseases based on the ability to predict the probable occurrence of the pest and the preventative control having a much lower environmental impact than a curative application.

Planning and Managing Turf (p 11)

Soil conditions (p 11)

- Root zones used in turf systems can be native soil or a rootzone mix that is imported to the site, usually a sand based rootzone. Soil rootzones, particularly newly constructed areas, will have reduced infiltration and increased compaction due to the movement and mixing of the topsoil during construction.

Turf selection (p 12)

- When sodding, it is important to choose the right quality and type of sod for the intended use. New species and cultivars of sod are consistently introduced into the market and selection of the right species for the intended use is important.

Note that variety trials conducted by the Guelph Turfgrass Institute are not always posted on the GuelphTurfgrass.ca website but rather with the corresponding sponsors website.

Management

Thatch control (p 12)

- Creeping bentgrass is the most common grass used on golf course greens and tees and it is also used on golf course fairways. Creeping bentgrass is a prolific thatch producer and the newest cultivars meant for greens produce excessive thatch if mowed at higher heights of cut.

Aeration (p 13)

- **Core aeration**: Core aeration can be performed with many different tine sizes and spacings. As the tine size becomes smaller, the time to recovery is quicker but less of the surface is disrupted so the effects of the aeration event are reduced.
- **Solid tine aeration**: Solid tine aeration disrupts the surface and allows for infiltration of water. While it does not physically remove thatch, the increased oxygen levels and water infiltration does influence thatch levels indirectly.
- **Slicing**: Another type of aeration is slicing. This is similar to a solid tine, but the holes are created by vertical blades that slice in the soil. This can be straight downward or curved to fracture the soil. This method is frequently used for aerating sports field because core aeration takes more time.
- **Injection**: There methods of injecting air, water, or sand into the turf canopy to cause increase infiltration and possibly dilute the thatch with the sand. Injecting methods have

minimal surface disruption but have smaller effects on infiltration and thatch levels as core and solid tine aeration.

- **Drill and fill**: Drill and fill is a method to increase infiltration of a root zone that does not drain well. The process drills holes 20–30 cm deep with a diameter of 1.8–2.4 cm approximately 19 cm apart, removes the existing soil, and back-fills the hole with new sand. The surface disruption is minimal due to the spacing of the drills, but some thatch is removed and the increased water infiltration will allow better drainage that will further reduce thatch.

Fertilizing (p 14)

Figure 1-2:

- The low end of the rates expressed for greens (0.15–0.35 kg N/100m^2) are low for most areas of Ontario for a good IPM program. More realistically a range from 0.25–0.5 kg N/100m^2).
- The amount of N required by an irrigated home lawn returning clippings is high for older lawns (more than 5 years of growth) and should be reduced to 0.25 kg N/100m^2 after the lawn is established.
- These fertilizer recommendations can be met with slow-release fertilizers applied a minimum of twice a year or they can be met with low frequent applications of readily available fertilizers.

Aeration (p 14)

- Different methods with different surface disruption will require more frequent implementation to achieve the same effect as core aeration.
- Sports field aeration should be a combination of slicing (monthly) and core aeration (spring and fall)

Topdressing (p 15)

- Many modern varieties of bentgrass are so dense that topdressing is difficult to work into the canopy. Using finer sand in these cases can lead to layering issues that will inhibit water movement in the golf green.

2. Developing a Turf IPM Program

Mandatory Golf IPM Accreditation Program

Public Meeting (p 24)

Suggested to delete this section

IMPORTANT NOTE: REG. 63/09 AMENDMENTS IN EFFECT MAY 1, 2020

For golf courses, the annual public meeting has been eliminated, but annual notification of neighbors and the Ministry has been added, if you do not have a fence around the property.

3. IPM for Turf Weeds

Cultural Controls

Irrigating (p 29)

- Irrigation can impact weed encroachment, particularly of moss into golf course putting greens. Dry root zones with a moist surface for part of the day greatly increase moss encroachment. Irrigating daily with small amounts of water will significantly increase moss populations while irrigating deeply every 4 days or more will reduce moss populations.
- Weeds that do not go dormant during drought are often considered drought tolerant and they gain area while the grass is dormant. Many of these weeds though (particularly clover and black medic) cannot survive a prolonged drought of more than 5 weeks and will therefore die off during an extended drought on an unirrigated lawn.

Chemical Controls (p 30)

- With the alternative iron-based herbicides the application volume on the label should be followed. Most turf spray equipment is not properly calibrated for these higher volumes of spray and adjustments will need to be made to apply the products properly.

Evaluation (p 31)

- Many products with lower active ingredient or with alternative mode of action need to be applied multiple times or will take longer than 2–3 weeks to have an effect. Regrowth is also possible, even after several herbicide applications, so weed encroachment should be monitored throughout the year.

4. IPM for Turf Insect

Control Methods

Biological control (p 42-43)

- Identification of the insect is important if using nematodes to control insects because most nematodes control a specific species of insect larvae. It is also important to remember that nematodes are living organisms and proper transport and storage of the bio-pesticide is essential.

5. IPM for Turf Diseases

Diseases (p 63)

Bacteria (new section- insert between Fungi and Disease triangle)

Bacteria are microscopic single-celled organisms which exists almost everywhere on Earth. These prokaryotic organisms do not have organized nuclei bound by a membrane, their DNA is structured as a single chromosome within the nucleoid, and they also have circular pieces of DNA contained in plasmids and mitochondria.

Many bacteria exist in mutually beneficial relationships with other organisms, such as the beneficial bacteria that support healthy gut systems in animals. Beneficial bacteria in plant systems, called endophytes (endo=inside, phyte=plant), aid in nitrogen fixation and improved stress tolerance for plants. Plant pathogenic bacteria exist as a minority in the natural world, and plant diseases caused by bacteria are less common than those caused by fungi. Most plant pathogenic bacteria are necrotrophs which can digest dead organic material but survive and multiply best in contact with their host plants. Some vascular bacteria, however, survive only inside the xylem or phloem of their host plants.

Bacteria can be classified as Gram-negative or Gram-positive, which is determined by the process of Gram staining with crystal violet stain. Gram-negative bacteria will be pinkish-red when stained, whereas gram-positive bacteria exhibit a dark purple colour. There are other morphological characteristics that differentiate these two groups of bacteria, but Gram staining is a quick and efficient method used in diagnostics. Only two diseases of turfgrass are caused by bacterial pathogens, both of which are Gram-negative bacteria.

Viruses (new section - insert between Fungi and Disease triangle)

Viruses are the smallest pathogens, and they cannot be detected under a microscope. Plant viruses cause a wide variety of symptoms on the plants they infect. Viruses spread within susceptible plants through the vascular system, often resulting in mosaic patterns that follow leaf veins. Infected plants might exhibit ringlike lesions, bumpy or necrotic patches, or stunting. Viral pathogens are spread by mechanical means which transfer sap containing the virus from infected plants to new hosts.

The only documented diseases of turfgrass in North America are mosaic disease of St. Augustinegrass, caused by Sugarcane Mosaic Virus (SCMV) and St. Augustine grass decline caused by Panicum Mosaic Virus. These have not yet been documented in Canada.

Nematodes (new section- insert between Fungi and Disease triangle)

Nematodes are microscopic worm-like animals. Most nematode species live in fresh- or saltwater but several species can diseases of animals and plants. Symptoms of infected plants include root lesions or swellings (called galls), necrotic root tips, root stunting or branching, and death of the plant. Nematodes can be 300 µm to 4 mm long, with the larger species being visible to the human eye during some life stages.

Diagnosis (p 64)

Updated website for GTI Turfgrass Diagnostics Clinic: www.guelphturfgrass.ca/gti-diagnostic-clinic

Table 5-1. Key to Turfgrass Diseases of Ontario (p 96):

To be updated in future versions to include bacterial wilt, bacterial etiolation, nematodes, brown ring patch (aka Waitea patch) and bentgrass dead spot.

Winter Diseases

Grey snow mould, also known as Typhula blight, snow scald and winter scald (p 67)

Suggested to rename this section to “Grey snow mould” and add the following:

Common names: grey snow mould, Typhula blight, snow scald, winter scald, and speckled snow mould

Pink snow mould and Fusarium patch (also known as Microdochium patch) (p 68)

Suggested to rename this section to “Microdochium patch” and add the following:

Common names: pink snow mould, Microdochium patch, Fusarium patch

- Throughout section, replace “Fusarium” with “Microdochium”

Summer Diseases

Dollar spot (p 74)

Pathogen: *Clarireedia jacksonii* (most common in Ontario), *C. monteithiana*, *C. bennettii*, and *C. homoeocarpa*. Formerly *Sclerotinia homoeocarpa.*

Anthracnose basal rot (p 76)

Common names: Anthracnose basal rot, crown rot

Pythium blight (p 76)

Common names: Pythium blight, cottony blight, grease spot

Pythium root rot (p 77)

Common names: Pythium root rot, Pythium root dysfunction, Pythium crown rot, damping off (on seedlings only)

Bentgrass dead spot (p 78)

Pathogen: *Ophiosphaerella Agrostis* also known as *Ophiosphaerella agrostidis*

Plant parasitic nematodes (new section -insert between “Bentgrass dead spot” and “Other Diseases”)

Nematodes were introduced in the insect section as a potential biological control for insects, but there are several species of nematodes that are directly damaging to plants as well. These are known as plant-parasitic nematodes (PPN).

Nematodes are worm-like animals that thrive in aquatic environments and are present in high numbers in soils. They move in the water between the soil particles and the species that feed on turfgrass plants feed primarily on roots. When they encounter a turfgrass root, they insert a needle-like mouthpart, called a stylet, into the root tissue and siphon out nutrients from the plant.

Some species of PPN feed exclusively outside of the root (ectoparasites) while others can enter the root tissue and feeding from inside the plant (endoparasites). Both can be very damaging, although the endoparasitic species tend to cause more damaging by blocking the vascular system of the plant.

These nematodes are microscopic, so a hand lens or microscope is required to see them. They spend most of their life cycle in the top 10 cm of the rootzone, where the majority of the turfgrass’s root system is found. Most PPN will only cause visible damage to the turfgrass plant when the turf is under stress, unless the nematodes are present in very high numbers. However, their feeding can weaken the plants and predispose the turf to drought damage and diseases.

Nematode populations on a site can be assessed by collecting soil cores and sending them to a lab to have the PPN extracted and counted. This is a good practice on golf course putting greens where the low mowing heights and increased stress can increase the likelihood of symptoms or weakened plants when PPN populations are moderate to high. Recommendations for collecting soils samples for PPN analysis can be found in Appendix B.

Other Diseases

Bacterial wilt (new section- add after “Slime moulds")

Pathogen: *Xanthomonas translucens* pv. *poae*

Hosts: Annual bluegrass, especially on putting greens, collars, and approaches

Symptoms: Individual leaves wilt and turn reddish-brown or yellow and die. Whitish-ten, dime-sized spots may appear, and irregular patterns or streaks may form in severe cases. Symptoms may appear between June–October, and this disease is more severe during extended periods of rainfall.

Disease cycle: The pathogen overwinters in diseased plants and thatch and is spread by water or physical transmission by equipment, sod or transplant plugs, and human activity. Typically, *X. translucens* will enter the plant through natural openings (stoma) or wounds, but there is some research that suggests this pathogen could be seedborne. Warm and humid conditions are thought to be important for disease, however the exact environmental conditions conducive to bacterial wilt are not well known.

Management: Mowing only once the turf is dry can decrease the spread of this disease. Mowers should be dedicated for affected greens and should be disinfested with bleach after use. Aggressive cultural practices such as verticutting, topdressing, and aeration are not recommended with the pathogen is active. In severe cases, reseed with resistant cultivars or species.

Bacterial etiolation (new section- add after “Bacterial wilt")

Pathogen: *Acidovorax avenae* subsp. *avenae*

Common names: Bacterial etiolation, bacterial decline of creeping bentgrass

Hosts: Bentgrass species are susceptible, especially creeping bentgrass at green-height. Light-to-moderate symptoms may occur on annual bluegrass, fescues, and bluegrasses.

Symptoms: Symptoms begin as small (15–30 cm) irregularly-shaped spots of foliar discoloration progressing from green to a light-green or yellow. Often associated with discoloration, the affected leaf blades elongate (this process is called etiolation), extending 0.75–4.0 cm above the turf canopy. Damage is typically most severe on intensively managed putting greens and symptoms first appear on the most stressed or trafficked areas of the turf stand due to frequent and repetitive mowing and rolling practices.

Disease cycle: This pathogen was first characterized in 2012 and the disease cycle has not been published at the date of this addendum. Although bacterial etiolation is initially a cosmetic problem, high summer temperatures (>30°C) can lead to thinning and necrosis of the foliar canopy.

Management: Minimize plant stress, raise mowing height, and continue regular fertilization practices. As with bacterial wilt, a dedicated mower is recommended for severely infested areas. Reseed with resistant cultivars.

6. Soil Management and Fertilizer Use

Soil Testing (p 83)

- Plant analysis can be a useful tool when something is extremely deficient, particularly a micronutrient. However, the nutrient requirements in plants are not well understood, and sufficiency ranges vary based on species, use, and other management factors such as irrigation. Plant analysis is best used to compare a similar site over time rather than comparing to absolute numbers at one time.
- Soil testing is important to determine deficiencies of some nutrients in the soil. There is no soil test for nitrogen.
- Soil testing for soil physical properties is also important particularly when constructing rootzones and determining potential uses for an existing soil. A small section of soil physical properties is added to the addendum (see below).

Soil Sampling (p 83)

- Most soil labs now receive soils in bags. It is important to send the sample soon after it is sampled.

When to Sample (p 83)

- Generally, clippings should not be removed unless necessary. Leaving clippings on the turf will reduce overall fertilizer requirements. High amounts of clippings can result in smothering the turf, so raking is recommended after mowing if clippings have collected in noticeable piles.

Micronutrient tests (p 83)

- Micronutrient testing can also be valuable to determining potential excessive levels of micronutrients that reduce turfgrass health and at times mimic pest symptoms.

Testing for soil physical properties (new section)

- Soil physical properties refer to the size of particles in the soil and the relative portions of sand, silt, and clay and the ability of water to move in the soil.
- The sand fraction can further be broken down into fractions of different sand particle size ranges, which is particularly important when constructing a sand-based rootzone for sports fields, golf greens, and golf tees.
- It is essential to test the water movement of any constructed soil mix in the lab to confirm that it will drain once installed. The test for this is a saturated conductivity test and is measured in cm/hour.
- When constructing an artificial rootzone, it is highly recommended to become familiar with different specifications for rootzones outlined by Sports Turf Canada and/or the United States Golf Association.

Plant Analysis (p 84)

- Tissue testing is particularly valuable when there are factors inhibiting the uptake of nutrients that may be sufficient in soil such as reduced rooting or excessive levels of sodium, micronutrients, or other salts in the soil.
- Desirable nutrient contents of turfgrasses have a wide range and are dependent on species, cultivar, and use of the turfgrass.

Sampling (p 84)

- If the testing lab is nearby and if the samples are received and processed by the lab within a few hours of sampling, the drying step can be omitted. This usually needs to be pre-arranged with the testing laboratory.

Nitrogen (p 84)

- Nitrogen is the nutrient that is most responsible for growth and recovery of turfgrasses. Turfgrasses sufficient in nitrogen will be greener in colour and have better turf density than turfgrasses deficient in nitrogen.
- When to apply: Need for recovery

Nitrogen sources (p 85)

- Quick-release nitrogen sources are often referred to as readily available nitrogen and slow-release are often referred to as controlled release or enhanced efficiency fertilizers.
- Readily available fertilizers are more prone to nitrogen lose through leaching, run off and volatizing into the atmosphere (contributing the climate change). If applied at higher rates, readily available fertilizers have the potential to burn the turf (cause salt damage to the turf). Therefore, if readily available fertilizers are used, apply the sources of nitrogen more frequently but at lower rates and water the turf after application.
- If a fertilizer has a prolonged fertilizer effect (beyond non-coated urea) it is considered to be slow release. This is achieved with different mechanisms and most of the mechanisms will reduce burn potential of the fertilizer, but not all of them.
- Synthetic forms of nitrogen include salts such as ammonium sulfate, potassium nitrate, ammonium phosphate (MAP and DAP) and others. The most common synthetic form of nitrogen is urea. These forms of nitrogen are easily dissolved, are immediately available for plant uptake, and should be watered in to prevent burn.

Inorganic Nitrogen (p 85)

Deletion of this section is recommended

IMPORTANT NOTE: Generally, fertilizers are classified as synthetic or organic and the term “synthetic organic” is no longer used. Both synthetic and organic fertilizers can be slow-release or readily available and can cause burn if not applied properly, based on the release of the fertilizer.

IMPORTANT NOTE: Ammonium nitrate is no longer easily purchased, and its storage is highly regulated at the federal level.

Synthetic Organic Nitrogen (p 85)

New name for this section is recommended – "Synthetic nitrogen"

Slow-release synthetic organic nitrogen (p 86)

New name for this section is recommended – "Slow-release forms of nitrogen"

Slow-release forms of nitrogen (new heading)

- Slow-release nitrogen can be categorized different ways. One of the most helpful ways is to categorize them by the environmental conditions that speed the release. Slow-release nitrogen can be categorized as water-based release, temperature-based release and stabilized nitrogen which is not a true slow release.
- Water-based release includes:
  - Sulphur coated urea (including those with thin polymer coatings) (SCU)
  - Isobutylidenediurea (IBDU)
- Water-based release fertilizers will release more quickly with increased rainfall or irrigation. Fertilization schedules should be altered based on the release of the fertilizer because dry periods will result in limited release and periods with heavy rainfall will have faster release.
- Temperature-based fertilizers include:
  - Polymer coated urea (PCU)
  - Methylene urea (MU)
  - Urea formaldehyde (UF)
- Temperature-based release fertilizers require a minimum amount of water to be present but then release based upon the ambient temperature, with higher temperatures resulting in faster release. Fertilization schedules should be adjusted based on the weather because a long cold spell will reduce release and thus delay the need for the next application by a week or two.
- By and large, temperatures are more predictable than rainfall and this makes temperature-based release fertilizers more predictable from season to season. However, it is important to remember that nitrogen fertilization should be adjusted to account for environmental conditions and plant growth.
- Stabilized nitrogen fertilizers contain a readily available form of nitrogen (usually urea) and additives that reduce the action of chemical and biological processes in the soil that allow the nitrogen to escape. These forms of nitrogen extend the length of time a fertilizer works by increasing the amount of fertilizer available for plant uptake and reducing loss to the environment. These additives work best when soil temperatures are cool. While these fertilizers may be categorized as slow-release due to their increased longevity, they are also readily available and have a potential to burn that is more similar to urea than other forms of slow-release fertilizers.

Natural organic nitrogen sources (p 86)

- Generally, these sources are referred to as organic in that they meet the requirements for organic certification.

- There are forms of organic fertilizers such as sewage biosolids that are not allowed for organic certification. There are commercially available bagged fertilizers produced from biosolids and they are not subject to municipal sewage biosolid application restrictions.

IMPORTANT NOTE: Many but not all natural organic fertilizers are slow release. Some contain significant proportions of readily available nitrogen and other nutrients. Readily available organic fertilizers do have the potential to burn and must be applied at lower rates.

Phosphorus and Potassium (p 86)

- The percent of P and K in a fertilizer is expressed as P_2O_5 and K_2O equivalents and recommendations are given in P_2O_5 and K_2O equivalents. If for some reason you would like to report the amount of elemental P and K applied multiple the amount of P_2O_5 equivalents by 0.44 and the amount of K_2O equivalents by 0.83.
- Note: “Do not use this table with soil test results from labs not listed in Appendix A”- “This table” refers to Tables 6-4 and 6-5.
- For establishing new turfgrasses where the turf has been regularly fertilized or heavily fertilized, with fertilizers containing P and K, in recent years use the rates for the low response (LR). If the turf has received little to no fertilizers containing P and K use the rate associated with the middle of the high response (HR)
- For established turfgrasses, the K needs are closely related to the growth rate of the turf and therefore there is a correlation between the amount of nitrogen applied and the amount of K needed by the plant. A general rule is the amount of K in K_2O equivalents should range from one third to equal to the amount of N applied.
- Good coverage of the fertilizer is needed, particularly during seeding, because phosphorus does not move well in solution. To achieve better coverage, a fertilizer with smaller particle size (larger Size Guide number) can be used.

Applying Fertilizer (p 88)

Turf Use, conditions and soil type (p 88)

- Higher rates of application can be used with some of the newer slow-release fertilizer technologies although using multiple applications is still preferred.
- Using more frequent fertilizer applications does not necessarily mean more total fertilizer. One can apply the same amount of fertilizer for the year by applying less at each application over more application events.

Type of fertilizer (p 88)

- Fertilizers can contain all nutrients, just the macronutrients or just one element such as nitrogen.
- Fertilizers are typically applied in granular form and there are many different sizes of particles. Smaller particles have better coverage at low rate of application but take longer to apply due to narrower throw width from broadcast fertilizers.
- With low rates and frequent applications, liquid fertilizers can be applied. These can target the soil or the foliage for uptake based on amount of water applied during

application. It is important to minimize the fertilizer rate with liquid application to minimize burn and reduce the risk of fertilizer loss.

Timing of application (p 88)

- As a rule, apply fertilizers when the turf is actively growing. If the summer has adequate rainfall apply fertilizers to allow for growth and recovery of turf whereas applications during droughts are not likely to benefit the turf as water is needed for uptake of nutrients and small amounts of water may cause burn.
- Avoid mid to late fall applications as very little nitrogen is taken up by the plant and most of it is lost to the environment.

Soluble Salts in Soil (p 90)

- One of the major contributions to salts is the irrigation water source. Many rivers in urban areas have high salt, particularly sodium, content. During a prolonged drought salts from the irrigation water can build up in the root zone. For particularly sensitive areas such as golf greens it is recommended to water deeply once a week to allow the salt to move deeper in the soil reducing the salt content at the surface.

7. Turfgrass Species (p 91)

- Many of these species can be grown as a sod either as a blend or in a mixture with other species. Generally, fine fescues are found in a mixture with Kentucky bluegrass sod. It is also possible to overseed into a sodded area to introduce other species.

Kentucky Bluegrass (p 91)

- Kentucky bluegrass has very good wear tolerance at maturity due to its rhizomes but in the juvenile state Kentucky bluegrass has moderate to poor wear tolerance.
- Kentucky bluegrass goes dormant readily but survives drought in a dormant state and therefore has very good drought survival. However, insect feeding during the drought can reduce survival of this species.

Canada bluegrass (p 91)

- Canada bluegrass seed is difficult to find and is rarely used in turf settings, although Canada bluegrass can be found in older turfgrass stands.

Rough bluegrass (p 91)

- Currently, rough bluegrass or rough stalk bluegrass is rarely found in seed mixes. It is usually categorized as a grassy weed in turfgrasses and is an indicator of poorly drained soils.
- Rough bluegrass is sometimes used in winter overseeding of fine turfgrass areas in the southern United States.

Supina bluegrass (p 92)

- Supina bluegrass is currently very hard to find in Canada and has a very high seed price.
- Supina bluegrass is generally not used on golf greens in North America and is uncommon to be seen in sports field mixtures.

Weeping alkaligrass (p 92)

- Weeping alkaligrass is a not commonly used in turf mixtures although it has uses in specialized circumstances.

Fine fescue (p 92)

- Like most low-maintenance grasses, fine fescues have limited wear tolerance and should not be used on sports fields because they are not likely to persist.
- Fine fescue is particularly susceptible to traffic during times of high heat and will often show damage from mower wheels or other vehicles such as golf carts during the summer.

Turf-type perennial ryegrass (p 92)

- Perennial ryegrass is generally not recommended as a monoculture in Ontario, particularly for sports fields, due to its susceptibility to winterkill and some diseases.

- Perennial ryegrass stays green longer than Kentucky bluegrass during drought, but it is more likely to die during prolonged droughts.
- Perennial ryegrasses have naturally occurring endophytes which make them less susceptible to insect feeding, therefore increasing survival during drought when insects are present.
- Modern perennial ryegrass cultivars mix well with Kentucky bluegrass and form a consistent turf in the mixture.
- There are new varieties of tetraploid perennial ryegrasses that have a larger seed and are slightly larger plants. These varieties are not currently well researched in Ontario.

Spreading turf-type perennial ryegrass (p 92)

- These cultivars require lower mowing heights than most perennial ryegrass cultivars and may be used for overseeding driving range tees.

Creeping bentgrass (p 93)

- Some modern cultivars of creeping bentgrass are meant specifically for golf course putting greens and can create excessive thatch when mowed at typical fairway heights of cut.

Colonial bentgrass (p 93)

- Generally, this grass is not available in Ontario although it can be used in combination with fine fescue on golf greens in coastal areas in Canada. It is also known as browntop bentgrass.

Velvet bentgrass (p 93)

- Velvet bentgrass is best used on lower traffic areas, such as golf course putting greens that see very little play.

Tall Fescue (p 93)

- Tall fescue is also known as *Lolium arundinaceum.*
- Tall fescues exhibit a wide variety in colour density and texture of the leaf blades with most modern turf-type cultivars having fine leaf blades and the ability to withstand lower mowing heights. Some varieties can survive mowing heights as low as 3 cm.

Spreading Tall Fescue (p 93)

- Another name for spreading tall fescue is turf-type tall fescue.
- These tall fescues now dominate the turf market with regards to tall fescue and almost all modern cultivars would be categorized as turf-type tall fescue.
- One issue with tall fescue in Ontario is snow mold. The turf typically survives the disease, but growth can be stunted in the spring and this reduces recovery from wear early in the season.

Seeding

Table 7-3 (p 94):

Many of the seed companies have changed names or merged. Search the internet for up-to-date information of seed suppliers near you. Note that:

- Bishop Seeds can no longer be contacted at this website
- Direct solutions can no longer be contacted at this website
- Master's turf supply can no longer be contacted
- Pickseed is now DLF Pickseed: dlfpickseed.ca

Time of seeding (p 95)

- For tall fescue, seeding in the late summer is preferable due to its preference for warmer temperatures.

Weed control (p 95)

- Many of the alternative weed controls have limited safety on newly seeded turf while others have been shown to be safe. Please read labels instructions carefully and follow them with regard to newly seeded areas.
- Apply weed control products at the proper rates and with the appropriate application volume
- Note that most commercial turf spray equipment is not optimized for the products listed on the Allowable List.

Mowing (p 95)

- When mowing newly established turf, make sure the mower is well maintained and the turf is well rooted to not lift or damage the plant. This is particularly important when establishing turf in a sand root zone.

Table 7-4 (p 95):

- Mowing heights after establishment are significantly lower on golf courses than when the manual was first published. Greens are 3–5 mm, Tees 6–10 mm and fairways 10–20 mm. These are all dependent on a number of other factors such as rolling, species, time of year. Generally speaking, higher mowing heights within these ranges lead to healthier turf.

8. Water Management

Laws and Regulations (p 97)

- Note: 1 Acre = 0.4 Hectares

Irrigation Scheduling for Golf Courses, Irrigated Sports Fields, and Sod (p 97)

- When scheduling irrigation, the best course of action is to water as infrequently as possible with more water at each irrigation event. Watering this way encourages deeper roots, flushes salts deeper in the root zone, and increases the likelihood of a natural rain event providing the needed moisture.

Measuring soil moisture (p 97)

- New technologies allow us to measure volumetric water content (% water by volume) quickly and accurately. Generally saturated sands will hold less water than saturated soils.
- The most common soil moisture meters use time domain reflectometry (TDR) or some form of reflectometry to measure soil water content.
- Turfgrasses reach a point with soil moisture that they will wilt or go dormant. This is dependent on soil type, salt levels in the soil, and turf type. It is important to know at what soil moisture level the turf begins to stop growth.

Rain and Irrigation vs. evapotranspiration

Table 8-3 (p 99):

- The values of ET listed here are good estimates, but actual ET from turf is dependent on factors including height of the turf, type of turf, depth of roots to extract water, and previous exposure to water deficit. Generally, most estimates published of turfgrass irrigation needs overestimate ET of maintain lawn and sports field turf. Soil moisture at root depth is a good estimate of the need to irrigation.

Water budget example (p 99)

- Turfgrass has been shown to use excess water when it is available. If a turf is always at sufficient water, then it will grow faster but it also will use more water than needed to provide a playing surface. Allowing the water levels to be drier and then watering deeply will decrease irrigation frequency while maintaining turfgrass growth and quality.

Scheduling home lawn irrigation (p 100)

- Needs of home lawn irrigation vary based on the species and the conditions. Modern cultivars of Kentucky bluegrass can often go 3–4 weeks without water before becoming discoloured. Home lawns can be watered when dormancy is becoming apparent for most moderately used turf areas. This will minimize the need for irrigation and will use less water throughout the year.

Appendix A: Accredited Soil-Testing Laboratories in Ontario

Deletion of this table is recommended

For the most recent list of accredited labs refer to:

http://omafra.gov.on.ca/english/crops/resource/soillabs.htm

APPENDIX E: Glossary

Terms to add:

- Acervuli: a saucer-shaped asexual fruiting body found in fungi, adorned with black hair-like projections often compared to eyelashes.
- Ectoparasite: a parasite that lives on the outside of its host.
- Endoparasite: a parasite that lives inside of its host.
- Endophyte: a microorganism that lives, at least for part of their life cycle, inside a plant without causing disease and may have a symbiotic relationship with the host.
- Etiolation: the growth process of plants characterized by long, weak stems, smaller leaves, and a pale-yellow color, which may be caused by low light or bacterial infection.
- Necrotroph: a parasitic organism that kills the living cells of its host and then feeds on the dead matter.
- Nematode: a microscopic worm-like animal.
  Saprotroph: an organism that feeds on nonliving organic matter.