Sports Turf Manager
FOR BETTER, SAFER SPORTS TURF. SPRING 2016. VOL. 29. NO. 1.

ENVIRONOMICS IN TURFGRASS MANAGEMENT

Alec Kowalewski, Ph.D.
Turfgrass Specialist, Oregon State University

Environomics is an environmentally and economically effective management approach. The essential tools for a successful Environomics program in turfgrass management include proper cultural practices, which are the primary cultural (mowing, fertilization and irrigation) and secondary cultural practices [cultivation, topdressing, inter-seeding and pest management (which is classically achieved through pesticide use)], and a strong knowledge of the pest triangle.

Proper implementation of the primary and secondary cultural practices will not only improve turfgrass appearance, but will also reduce turfgrass susceptibility to pest encroachment and damage, and prevent conditions conducive to pest development. The primary cultural practices within all aspects of turfgrass management (including golf courses, athletic fields, home lawns and municipalities) are mowing, fertilization and irrigation, while the secondary cultural practices include cultivation, topdressing and inter-seeding. As budget and labour hour constraints come into play, reduce secondary cultural practices while trying to maintain consistent primary cultural practices. In Canada proper implantation of the cultural practices, and a comprehensive understanding of the pest triangle is particularly important considering the current bans on pesticide use in the landscape.

Mowing

When managing an athletic field, home lawn or golf course putting green, mowing is the most demanding of all the cultural practices. Mowing requires more time and money than any other cultural practice to successfully implement. Considering this high demand and Environomics, increasing your mowing height will decrease the mowing frequency necessary to prevent scalping, improve drought and heat stress by increasing the rooting depth, as well as prevent sunlight from reaching the soil, where the light would otherwise germinate existing weed seeds (Image 1).

When considering the appropriate mowing frequency, remember the one-third rule, never mow more than one-third of the top growth in a single mowing. For the average athletic field this will require mowing at least once a week during periods of peak growth (the spring and fall). Much like increasing your mowing height, observing the one-third rule will help prevent scaling. It is also important to note that more frequent mowing

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Presidents' Desk

BY TENNESSEE PROPEDO

As I sit looking at the beginning of spring time in southern Ontario I can't believe how quickly two years have passed. As president of Sports Turf Canada this has been a very rewarding and exciting time. When I took over this office our mandate was to strengthen our bonds across Canada and internationally with partnerships and affiliations with organizations such as the Western Canada Turfgrass Association, the Atlantic Turfgrass Research Foundation/Atlantic Golf Superintendents Association and the Sports Turf Managers Association. We've done this through networking and providing education forums, workshops and field day symposiums to increase our members awareness of factors influencing the turfgrass industry. I am proud to say we have accomplished much. We have also undergone a rebranding to Sports Turf Canada from the previous Sports Turf Association as well as updating our website. This could not have occurred without the great support of the board of directors and the dedication and perseverance of Lee Huether, our executive manager.

I would like to thank Tab Buckner and Ken Pavely our new president and vice president. I feel that this association is being passed on to two very capable sets of hands to lead us for the next two years. I would also like to thank all of our industry sponsors, educators and members who I have had the pleasure to meet during this period. Your dedication, professionalism and willingness to share your knowledge with all are major keys in creating a dynamic association.

Thanks for a great two years. ~ Tennessee

BY TAB BUCKNER

Mother Nature has spared most of Canada this year with a mild winter. Also with the demise of groundhog, Winnipeg Willow, spring has arrived early. With a mild winter and early spring I am hoping this is providing you with the opportunity to get a "jump start" on your sports field maintenance. This, of course, does not apply to Metro Vancouver or Vancouver Island, where they have that opportunity year round.

During the Ontario Turfgrass Symposium this past February the new STC Board of Directors selected me as the first president of the association from outside of Ontario. I feel that this is an honour and a privilege. In me becoming president, this is another step towards STC fulfilling its mandate of being a truly national sports field association in partnership with regional based associations.

Currently I have been having exploratory discussions with new Western Canada Turfgrass Association President Jason Pick about the potential of holding a joint field day in Calgary this summer. Both associations see a joint event as win, win for their sports field members.

I would like to take this opportunity to thank former president Tennessee Propedo, now the current past president, for his leadership over the past two years. Three highlights under his leadership were: STC was incorporated federally, STC initiated a new marketing strategy, and the recent launch of the new STC website.

I also want to especially thank the STC executive manager Lee Huether and her staff for the hard work and dedication they give to this association at all times. Lee has announced she will be retiring at the end of this year and I and the board will truly miss her. At the next board meeting a selection committee will be struck to hire her replacement. ~ Tab

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Sports Turf Management & Maintenance Course
University of Guelph, Guelph, ON
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Contact the STC Office for Member Registration Code

May 30
Sports Turf Canada
Robert W. Sheard Scholarship Deadline
sportsturfcanada.com

August 15
Ontario Turfgrass Research Foundation Fundraising Golf Tournament
Mississauga Golf & Country Club, ON
Registration opens April 1
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"In the Spring, at the end of the day, you should smell like dirt." ~ Margaret Atwood

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Image 1. Annual bluegrass encroachment within a stand of perennial ryegrass maintained at a 0.625" (1.6 cm) height of cut (left), in comparison to a perennial ryegrass stand maintained at a 1.25" (3.2 cm) height of cut (right), Corvallis, OR, 2013. Photos provided by Alec Kowalewski.

will promote lateral growth resulting in increased turfgrass density. Having dense turfgrass in the spring and fall will minimize summer and winter annual weed encroachment, like crabgrass and annual bluegrass, respectively.

Fertilization

The second primary cultural practice is fertilization. Maintaining adequate levels of the primary nutrients (nitrogen, phosphorus and potassium) is the most important component to a successful turfgrass fertility program. Turfgrass will require more nitrogen than any other nutrient, followed by potassium and finally phosphorous. Therefore, when selecting a fertilizer for turfgrass, look for products with high amounts of nitrogen (N), low amounts of phosphorus (P) and moderate amounts of potassium (K), such as 26%N-7%P-14%K, or 30%N-5%K-10%P. Lawns and athletic fields should be fertilized 4 to 6 times per year at 1 lbs N per 1,000 sq ft (0.5 kg per 100 m^2), 4 to 6 lb N per 1,000 sq ft (2 to 3 kg per 100 m^2) annually. Applications should be made in the spring and fall months – avoiding the summer months. White clover, and the pathogens rust and red thread, are all indicators of deficient nitrogen levels in home lawns and athletic fields.

Irrigation

The final primary cultural practice is irrigation. When considering Environomics and irrigation it is important to know irrigation rates and regularly audit your system. Every home owner, athletic field manager and golf course superintendent should have a good understanding of the irrigation depth applied in a single run. This is important because the time required to apply a given depth, for example 0.25 inches (0.6 cm), will vary drastically depending on the type of irrigation heads, spacing, nozzles, etc. (Image 2). Rotors commonly found in athletic fields require 30 to 45 minutes to provide 0.25 inches (0.6 cm) of water. Irrigation audits should be conducted every spring when temperatures are low and plant available water is high, to ensure the irrigation system is running properly. Audits in the summer are often too late to prevent drought stress from developing. While doing an irrigation audit simply run each zone, monitor the heads to make sure they are all working properly, and use a rain gauge or catch can to make sure the precipitation rates are consistent from year to year. Replace nozzles, heads and adjust irrigation run times accordingly.

Weekly irrigation depths typically range from 0.75 to 1.5 inches (1.9 to 3.8 cm) depending on the environmental conditions. Applying irrigation at a 0.25 inch (0.6 cm) depth 4 times per week

Image 2. Use a rain gauge (upper) or collection cup (lower) to determine your irrigation depth. Adjust run time to apply 0.25" (0.6 cm) per application 4 times per week to provide a cumulative weekly depth of 1" (2.5 cm). Photos provided by Alec Kowalewski.

Image 3. Necrotic ring spot of Kentucky bluegrass (left) can be mitigated with core cultivation, red thread of perennial ryegrass (middle) is easily controlled with nitrogen applications, and finally moss can be reduced by improving sunlight and drainage (right). Photos provided by Neil Bell, Tom Cook and Brian McDonald.

will put your irrigation program at 1 inch (2.5 cm) cumulative depth. Deep and infrequent irrigation increases the potential for drought stress between irrigation events making athletic fields more susceptible to soil borne, root feeding pathogens like necrotic ring spot and summer patch. Therefore, if pathogens like these are present consider lighter, more frequent irrigation applications. Athletic field weeds that are an indication of too little irrigation include perennials like dandelion and plantain, as well as summer annuals like crabgrass and knotweed. Weeds that are an indication of excess water include moss, annual bluegrass, and rough bluegrass.

Secondary Cultural Practices

Secondary cultural practices include core cultivation (or aerification), topdressing and inter-seeding. Core cultivation is typically done to relieve compaction, improve drainage and remove organic matter. An indicator of compacted soil is knotweed, while the pathogen necrotic ring spot is a sign of excessive organic matter accumulation. Therefore, when these issues are observed, hollow tine core cultivation should be used. Turfgrass should be core cultivated in the spring and fall. Athletic field managers with sand-based systems will often couple this cultural practice with sand topdressing to prevent excessive organic matter accumulation. Sand topdressing native soil fields will also help improve surface drainage, prevent surface compactions and ultimately increase turfgrass cover, conversely decreasing weed populations.

Inter-seeding is another essential secondary cultural practice. While several seed options are available, a mixture of Kentucky bluegrass and perennial ryegrass will likely provide the best results. Kentucky bluegrass helps stabilize the soil and over winter well with its rhizomatous growth habit, while perennial ryegrass provides quick germination (7 to 10 days). Inter-seeding should be performed whenever turfgrass density is reduced and bare soil is present, for instance, after a football or soccer game. If seed is not applied during these times, summer and winter annual infestations can be expected. Coupling core cultivation with inter-seeding will ensure seed to soil contact, and improve turfgrass establishment.

Pest	Host	Environment	Cultural changes
dollar spot	Creeping bentgrass	low fertility	increase nitrogen levels
necrotic ring spot	Kentucky bluegrass	excessive organic matter	remove organic matter with cultivation
red thread	perennial ryegrass	low fertility	increase nitrogen levels
pink snow mold	Kentucky bluegrass	high fertility	avoid late fall nitrogen applications
common dandelion	all turf species	drought conditions	increase irrigation/raise mowing height
white clover	all turf species	low fertility	increase nitrogen levels
ground ivy	all turf species	shade conditions	improve sunlight by reducing shade
annual bluegrass	all turf species	low mowing height	raise the mowing height
moss	all turf species	shady, wet soil conditions	reduce shade and irrigation

Table 1: Examples of the pest triangle, factors include the pest, host and environment necessary for this pest to become a problem, as well as the cultural practices which will mitigate these pests.

Pest Triangle

The Pest Triangle defines the relationship between the pest, its host and the environment in which it lives. Only when these three components are present will a pest problem occur. For instance, a common pathogen of Kentucky bluegrass is necrotic ring spot. The classic symptom of necrotic ring spot is the "frog-eye", a 6 to 8" (15 to 20 cm) ring of necrotic (dead) turf with living turf in the center of the ring (Image 3). While symptoms of the pathogen are most often expressed during periods of heat and drought stress, the pathogen develops in cool weather [60 to 75° F (16 to 24° C)]. This pathogen can survive as dormant mycelium, but is a strong saprophyte, meaning that the pathogen is capable of feeding on thatch and organic matter in the soil. This is particularly important in reference to Kentucky bluegrass. Kentucky bluegrass produces a considerable amount of rhizomes (underground lateral stems), which contribute significantly to the accumulation of soil organic matter. Therefore, reducing soil organic matter and thatch with cultivation (hollow tine core cultivation or vertical mowing) and sand topdressing is a critical component to managing this pathogen.

Other cultural practices that will increase disease severity within infected turfgrass include high nitrogen levels in the spring, and deep and infrequent irrigation. When considering irrigation, light and frequent irrigation will be required to maintain infected turfgrass. This is because the disease, while feeding on the roots in the fall and subsequent spring, has shortened the rooting system; therefore, resulting in a weakened plant that cannot survive long breaks between irrigation events (i.e. deep and frequent water). Utilizing necrotic ring spot resistant cultivars, which can be found using the "2005 NTEP National Kentucky Bluegrass Test – Final Report" – ntep.org/data/kb05/kb05_11-10f/kb05_11-10f.pdf will reduce infection rates. Inter-seeding infected Kentucky bluegrass with perennial ryegrass will also minimize disease symptoms.

Other examples that illustrate how environmental conditions can be altered to minimize pest pressure include increasing fertility to decrease dollar spot, red thread and clover populations, raising the mowing height to mitigate annual bluegrass and dandelion encroachment, and finally improving sunlight (by pruning or thinning trees) and drainage to decrease ground ivy and moss (Table 1 and Image 3). The point of this discussion is that if the environment (moisture, fertility, organic matter, etc.) is not changed, the pest will persist regardless of the amount and frequency of pesticide applications. •

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Starting Up Your Sports Field Irrigation System

Gary Taylor, GT Irrigation Services

Starting up the irrigation system on your sports field(s) can be an easy task or a very labour intensive undertaking. How well you winterized the system in the fall will translate in large part to how well the startup goes. If you blew out the piping network thoroughly with compressed air then pipe breaks should be non-existent or minimal unless we have a severe winter with deep frost. If you blew out the system excessively then there may be sprinkler and valve issues to deal with. For this article, I will be describing starting up sports field irrigation systems. While landscape irrigation involves similar steps, the use of smaller pipe and in most cases polyethylene (PE) pipe makes these areas simpler and more forgiving for startup and blowout.

Sports fields utilize larger pipe sizes and should incorporate the use of PVC pipe and other components associated with a large turf system. PVC pipe has better flow and pressure characteristics than polyethylene and is the preferred choice for large systems. The piping network of a sports field can be divided into two sections:

1. Mainline piping
2. Lateral piping

The mainline is the water carrying pipe from the water source along the side or sides of the field depending on the type and size of field being irrigated. On large fields the mainline may be looped around the perimeter of the field. The lateral or zone piping is installed into the playing area to the sprinklers. Electric valves are installed on the lateral piping directly off the mainline off of the playing surface. In most cases, the mainline is constantly pressurized while the lateral piping is only pressurized when the zone is turned on and the sprinklers are operating.

During startup, the mainline piping is filled or energized first. It is a good principle to install a quick coupling valve (QCV) at the end of each mainline or in the middle of the loop farthest from the water source during the installation of the irrigation system to allow for evacuation of air during filling of the lines in the spring as well as to blow water out of the lines in the fall. Utilizing the opening of a quick coupling valve, e.g. 1" (2.54 cm) diameter, is preferable to utilizing the smaller orifices of sprinkler nozzles. During startup and blow out, a quick coupler key with a hose swivel (and hose if desired) is installed into the valve. Quick coupling valves can also be used for hand watering and filling sprayers. Quick coupling valves should always be installed on swing joints to provide a 3 point swivel connection to the pipe. In the past, assembled galvanized swing joints were commonly used. These should be avoided because the threaded connection will seize up, preventing the swing joint from swiveling and carrying out its purpose of lifting with frost heaval and allowing the valve to push down from equipment. Today, pre-assembled PVC swing joints with ACME threads and o-rings and a brass threaded outlet are available – these swing joints also incorporate a honeycomb sleeve or other form of retaining ring with lugs or ears to allow for the installation of rebar to stabilize the assembly. It is imperative that the swing joint incorporate a brass

Quick coupling valve and coupler hose swivel.

OCV swing joint with brass nipple and honeycomb sleeve.

threaded outlet – a brass quick coupling valve will unthread from a PVC outlet and create a possible safety risk and a lot of water shooting up into the air. Quick coupling valves should always be installed in a valve box or within a concrete collar to inhibit grass growing over and "hiding" them.

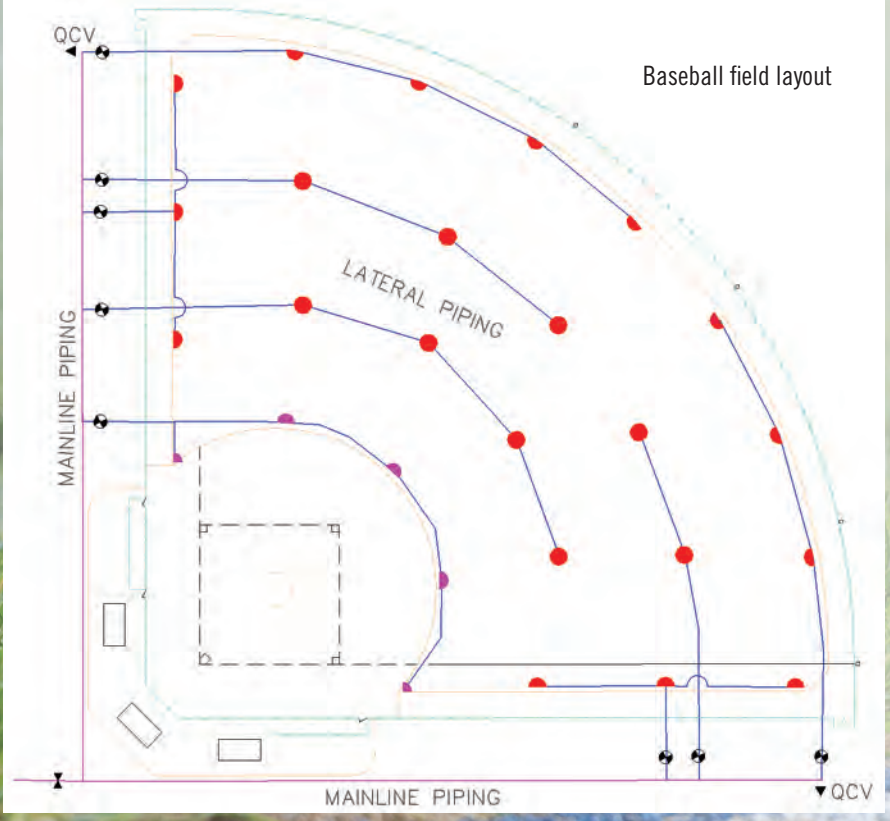
Before beginning the startup, it is always a good idea to walk the system and see if there is any visible damage. Check inside all valve boxes to ensure that everything appears intact. If there is ice inside of a valve box that is an indication that there is still frost in the ground and the system should not be started up yet. Though you may not be able to see any of the sprinklers, it is sprinklers that you can see that have heaved with the frost that you are looking for. If a sprinkler is raised or heaved up, grab the head and confirm that it hasn't separated from the swing joint. If it comes out of the ground with a tug, the sprinkler inlet threads are likely stripped and the body needs to be replaced. If it is firmly attached, gently step on the sprinkler. If the ground is wet, the sprinkler may push back down to ground level as the swing joint does its job. If not, then this head will need to be leveled at some point before mowing takes place.

If the water source is potable water, check to make sure that the backflow preventer and water meter are connected and ready for operation. If there is a booster pump present, make sure all connections are secure and any drains are closed. If you are pumping from a body of water, ensure that the pump is ready for operation. If your system has a master valve and flow sensor, manually open the valve and ensure that the flow sensor internal assembly is securely installed.

Now it is time to begin filling the mainline pipe. If you have a quick coupling valve(s) at the end of the mainline(s), install the coupler key(s) with hose swivel(s). If you don't, manually open the last electric or zone valve on the mainline(s) or at the midpoint of a looped mainline. Slowly open the main valve to the irrigation system only partially so that you can hear the water "screaming" through the valve. If you have a booster pump do not operate the pump to fill the system. If there is a bypass for the pump, isolate the pump and utilize the bypass. If you are pumping out of a body of water and the pump station has a variable frequency drive, operate the VFD at the lowest speed and only open the discharge valve slightly. While industry practice is to allow the velocity of water in the piping network to be a maximum of 5 ft (1.5 m)/sec. during normal operation, during filling the goal is 1 ft (0.3 m)/sec. or less.

Slowly filling the system will allow all of the air in the pipe to evacuate through the quick coupling valves or sprinklers on the last zone and minimize any potential pressure spikes caused by air compressing in the pipes. Remember the phrase, "Air compresses, water doesn't." Air trapped in pipe or that cannot evacuate fast enough can result in pressure surges of 10-15 times the water pressure. These conditions can exceed the ratings of the irrigation system components (sprinklers, valves, pipe and fittings) and cause failure. With pipe and fittings this could result in breaks and with sprinklers the proverbial launching of sprinklers into the air like a rocket.

With a system with quick couplers, once all air has visually and audibly exited the mainline and only water is flowing, open the first zone valve and wait for the sprinklers to pop up and spray only water. Please note that the sprinklers will not operate at pressure because this exercise is to fill the pipe with water and "bleed" off the air. Once the first zone is complete, move on to the next zone. Progress through each zone with the quick coupler(s) installed until all zones have been operated and only water is flowing.



Baseball field layout

If there are no quick coupling valves, once the sprinklers on the end zone(s) are operating and flowing only water, turn on the next zone leaving the first zone on. When the second zone sprinklers are operating and flowing only water, turn on the next zone and turn off the first zone. Progress through all of the stations until all zones have been turned on. The key is to ensure that two zones are operating simultaneously to keep the pressure low.

Once this is completed, close all zone valves and remove the quick coupler(s). Let the mainline build up to static pressure. If there are no visual leaks and there is no sound of water running through the main valve, the valve can be fully opened. The booster pump can now be employed or the pump station set into automatic mode. The master valve can be closed in preparation for operation from the controller. Each station can now be operated at full pressure to check for sprinkler rotation and proper spray pattern. Proper valve operation can be checked at this time as well

including pressure regulation readings if pressure regulating valves are installed.

The controller can be turned on at any point in the startup. If you have a maintenance radio for the controller, the controller can be used to progress through the stations. Otherwise it is recommended that you manually turn the valves on during startup so you can visually see the sprinklers bleeding off air and not let the process be dictated by the station timing of the controller.

In the event that you do experience problems, here are some of the common issues and the solution to each. Pipe and swing joint breaks can occur from water left in the pipe over the winter that freezes but they can also occur from very deep frost heaving the ground. If you experience pipe breaks, the quickest and easiest method to repairing them is to install gasketed (eg. HARCO) repair couplings. Once installed and backfilled, the system can be re-pressurized immediately versus waiting the prescribed cure times for solvent welded (glued) fittings. Depending on where the swing is damaged only the top elbow or another portion may need to be replaced if it is the same manufacturer (eg. Lasco, Dura, etc.), unless it is the bottom elbow which would warrant entire swing joint replacement. If there are non-rotating sprinklers, only the internal (or guts) need to be replaced if it is the same manufacturer/model. Please note it is imperative to install the same nozzle in the new sprinkler from the supplied bag or tree of nozzles to ensure matching application rate with the other sprinklers on the station. If a sprinkler becomes separated from a swing joint, only the body may need to be replaced if it is the same manufacturer/model. If you do decide to change to a different manufacturer or model, the entire sprinkler will need to be changed and a nozzle with similar radius of throw/discharge installed to maintain a similar application rate. Electric valves not turning on may be indicative of a solenoid or wire issue. Electric valves not turning off may indicate a diaphragm issue which can be replaced by removing the bonnet only instead of the entire valve.

In summary, the success to starting up an irrigation system in the spring is directly related to the winterizing of the system the previous fall. The key to starting up an irrigation system is to fill the piping network very slowly to allow the air that was pushed into the system in the fall to evacuate as the system is refilled. You should never rush through a startup of a sports field irrigation system – any time save may be more than taken up completing repairs. As the size and complexity of the system increases, this principle becomes all the more important. By following these simple steps, you will minimize inflicting damage to the irrigation system during spring startup. •

Gary Taylor is owner of GT Irrigation Services, an independent irrigation consulting and water management firm specializing in golf and sports field irrigation design as well as central irrigation control for municipalities.

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Considerations with Biostimulants and Sports Turf

Michael Fidanza, Ph.D., Pennsylvania State University and Giovanni Tracanzan, Province of Vicenza, Italy

The terms "silver bullet" or "miracle cure" or "best thing since sliced bread" should not be used to describe a biostimulant product or any other turf maintenance product. A biostimulant product can certainly find a valuable place in your turf management toolbox, however, it cannot magically correct or compensate for poor agronomic growing conditions or practices. Many types of products legally are placed into the category or description of "biostimulant". It is important to know the different kinds of biostimulants available and how they benefit plants and the soil rootzone (i.e., plant and soil health), and how biostimulants can improve your sports turf management program.

What are biostimulants and what do they do?

The European Biostimulants Industry Council (biostimulants.eu) states: "Agricultural biostimulants include diverse formulations of compounds, substances and other products that are applied to plants or soils to regulate and enhance the crop's physiological processes, thus making them more efficient. Biostimulants act on plant physiology through different pathways than nutrients to improve crop vigour, yields, quality and post-harvest shelf life/conservation." Biostimulant compounds and substances are derived from materials such as living microbial cultures, extracts from microbial, animal or plant products, soil organic residues (i.e., humic and fulvic acids), industrial by-products and chemicals, synthetic molecules, and others. The Biostimulant Coalition (biostimulantcoalition.org) is a non-profit group of industry members that cooperate to "address regulatory and legislative issues involving biological or naturally-derived additives and/or similar products, including but not limited to bacterial or microbial inoculants, biochemical materials, amino acids, humic acids, fulvic acid, seaweed extract and other similar materials."

From their stated purpose, biostimulants are placed into several categories:

Amino Acids. Amino acids are the building blocks for proteins and enzymes, and only the "L" form of these amino acids are assimilated by plants. In plants, these L-amino acids are reported to increase roots mass, activate natural defense mechanisms, and enhance photosynthesis. For example, L-proline is an amino acid that has been shown to improve water-stress tolerance in plants.

Humic and Fulvic Acids. These substances typically are derived from leonardite or "brown coal". Benefits of these compounds include increased nutrient and water holding capacity of soils (i.e., increased cation exchange capacity), prevention or reduction in leaching of soil nutrients, chelators of organic molecules and minerals thus making them readily available for plant root absorption, increase in enzyme and metabolic activity, and more.

Microbial Inoculants. There has been an increased interest with including *Bacillus* sp. bacteria and other microorganisms in biostimulant products to help with plant disease defense and soil rootzone nutrient availability. For example, mycorrhizae are fungal organisms that form a beneficial relationship with plant roots, essentially increasing the roots' ability to absorb water and nutrients.

Plant Hormones. Abscisic acid (ABA) is the first example of these "chemical messenger", and is involved with water regulation as indicated by an increase in ABA concentrations in plant leaves under drought stress. Auxins are responsible for phototropism (shoots bend toward the light), gravitropism (roots grow downward) and cell enlargement leading to root and shoot elongation. Indoleacetic acid (IAA) is one of the more common auxins used in biostimulant products. Cytokinins promote cell division and delay leaf senescence, and gibberellic acid promotes cell elongation. It has been reported that plant hormones extracted from seaweed can stimulate the production of antioxidants, which scavenge free radicals and thus protect plant cells from damage.

Seaweed Extracts. These naturally occurring products can contain plant hormones, amino acids and vitamins, mineral nutrients and other compounds that may affect plants in many ways. University research has shown that seaweed extracts, humic acids, amino acids and other biostimulant-type products benefit turf either through plant hormone effects or by increased antioxidant levels.

Other Compounds. Vitamins, proteins, various minerals,

metabolites and more can be considered as biostimulants. For example, vitamin E, glutathione, beta-carotene and others provide beneficial antioxidant activity in plants. Salicylic acid, which is essentially aspirin, is used to improve plant resistance to diseases and various abiotic stresses. Plant growth regulators, soil surfactants, and perhaps other turfgrass maintenance products also may be considered as biostimulants due to their direct and indirect beneficial effects on plants and the soil rootzone environment.

Dr. Richard Schmidt, Emeritus Professor of Turfgrass Science at Virgina Tech (Blacksburg, VA, USA), is considered the pioneer of research on turfgrass biostimulants in the USA. He once wrote that: "Biostimulants are organic materials that when applied in small quantities enhance plant growth and development." This is still a good definition. Some commonly reported benefits of biostimulants include: increasing plant tolerance and recovery from biotic stresses (i.e., insect pests, weeds, diseases) and abiotic stresses (i.e., heat, drought and other adverse environmental conditions), improved plant nutrient uptake (i.e., nutrient assimilation, translocation and use), improved rooting, reduced nutrient losses to the environment, enhancing soil physiochemical properties to facilitate the growth of beneficial microorganisms in the soil rootzone, and when used as a soil amendment the improvement of soil structure and function which translates to positive plant response, and more. Keep in mind, the exact mode of action of most biostimulants is poorly understood, but their function in plants has been associated with the presence of various plant signaling molecules or molecules that facilitate the transport and efficacy of mineral nutrients. Determining the exact function of biostimulants is difficult since many products contain naturally occurring or commercially added micronutrients, sugars, amino acids and other compounds that may have synergistic, complementary or no plant/soil health effects or may have been added merely for marketing or commercial registration purposes. Thus, separating the effect of one or more ingredients from the others is difficult. Some sports turf managers have to think about reducing their reliance on synthetic fertilizers due to community pressures or fertilizer laws, and look to biostimulants for help. The difference between biostimulants and traditional fertilizers is that biostimulants operate through different mechanisms than fertilizers, regardless of the presence of nutrients in the products.

Example of a municipal soccer pitch in Northern Italy.

Example of goal mouth wear area of a soccer pitch in Northern Italy. Photos by G. Tracanzan.

How can biostimulants fit into your sports turf program?

On athletic fields, mowing and traffic are two common and persistent reasons why turf is under stress, which leads to visible and detrimental surface wear and overall poor turf

quality and playing conditions. Sports turf managers should keep in mind that the turfgrass species used has an optimal range for mowing height, and that going outside that range by lowering the height-of-cut will add more abiotic stress and wear, and overall this makes the plants less tolerant of any stress. Traffic, of course, is a reality on athletic turf, and field rotation, goal rotation, use-time limits, overseeding and aerification are all part of reducing stress in addition to a sound fertility program which could include biostimulants. Turf wear and poor surface playing quality is also attributed to poor drainage. Good agronomic practices, with or without biostimulants, cannot correct poorly drained athletic fields.

Managing abiotic (environmental) and biotic (traffic, use and wear, pests) stresses on athletic fields must begin before the stress appears. Therefore, pre-stress management strategies are needed to ensure the turf has an abundant about of carbohydrate reserves:

- start with a good fertility program including soil testing to assure nutrient requirements are met;
- apply nutrients using foliar applications, with light rates and frequent applications;
- with foliar applications, include products containing biostimulants (particularly cytokinins, antioxidants and vitamins, and others);
- use growth regulators prudently to manage growth and conserve carbohydrates; be aware of using biostimulants that contain gibberellic acid when also using plant growth regulators that inhibit the effects of gibberellic acid;
- monitor rooting to be sure that all cultural inputs are improving rooting and/or preserving the current level of rooting.

Irrigation management also is an important part of pre-stress conditioning. Monitor rooting depth and keep adequate moisture available throughout that depth for good root growth. Soil surfactants can certainly help as well and have become an important water conservation method in turfgrass management. Remember that letting the rootzone get too dry does not encourage deeper rooting, since roots do not have "eyes" and therefore have a hard time "looking" for water. By not letting the rootzone get too dry, localized dry spots will be less of a problem as summer heat and drought stress occurs.

Scouting your sports fields and monitoring weather conditions for disease and insect occurrence also should be part of an overall stress management program. Early detection is mandatory in order to ensure optimum control and efficient use of pesticides and/or plant and soil health products. Also scout for early indication of excessive wear areas.

The turf manager has to decide, what is the purpose of using biostimulants? Do you use biostimulants as a component of an overall turf nutrition or plant/soil health program? Do you use biostimulants to prevent and/or alleviate plant stress caused by adverse environmental conditions and excessive turf use and wear? Do you use biostimulants to enhance your current fertility program? Do you use biostimulants to help you sleep at night? Remember, there is no such product as "sunshine in bottle", at least not yet. Ask the distributor or manufacturer for research to support product claims. Remember, some biostimulant products may include N and Fe and other traditional fertilizer components in addition to plant hormones and various other substances. Also, work closely with your university researchers and turf consultants to see what has been tested that could provide insight on biostimulants and sports turf.

Conventional wisdom says that the use of biostimulants on athletic fields starts with a sound turfgrass fertility program, and to address/correct any soil rootzone issues first. To really know if a biostimulant product, or any product, is working for you, you should leave a "check plot". For example, place a 1m x1m piece of plywood within the area to be treated. After the product application is made, remove the plywood and observe the site over the next several days and weeks. That way, you can make a visual comparison between the treated and untreated turf and determine if your program produces the benefit you want. Monitor and observe your turf frequently, both above ground turf and below ground roots, especially during heat/drought stress times. Biostimulants can improve plant and soil health, but does this always translate to improved turf surface characteristics (i.e., visual quality and playability)? You may need to include biostimulants as part of an overall, season-long program. Don't expect to "squirt" once and get instant results. An alternative to treatment of large areas would be to apply your chosen product or program to a small test area first and observe.

In conclusion, if you are expecting miracles, then you may be asking a lot from a little bit of product. However, biostimulants may have a place in your overall turf management program. If you choose to use biostimulants, then have a plan. Start with an objective like improved rooting, greater turf density, or healthier turf during heat/drought stress, and then develop a sound agronomic turf management program to include the biostimulant products that address your objective. Follow the program and make frequent observations for a period of time, which could be at least several months or a season, and then make evaluation or changes. Did it work or not? Why or why not? What adjustments are needed? If your newly revised turf management program works then you have added a valuable tool to your turf management toolbox. •

Some of the information for this article was previously published: Fidanza, M., J. Cisar, and T. Watschke. 2015. A perspective on biostimulants and sportsturf. SportsTURF 31(6):8-10, 12.

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SURREY 2016 ISF XV WOMEN'S WORLD FASTPITCH CHAMPIONSHIP

Resurrecting Softball City

For the 2016 Women's World Fastpitch Championships

Jamey Serediuk, Athletic Field Operations Coordinator
City of Surrey

In the fall of 2013 it was announced that the City of Surrey in British Columbia Canada would host the 2016 Women's World Fastpitch Championships. The tournament, the largest of its kind with over 32 countries represented will be held at Softball City, a 25 year old complex in desperate need of major renovations. With two years before the tournament, City staff had their work cut out to turn a worn out complex into a world class facility.

Facility History

Softball City was developed in 1990 through the efforts of a local group with a passion for softball. They wanted to help develop Canadian talent by bringing the best teams in the world to Surrey to compete against. But first they needed a proper facility. Through the municipal rezoning process they were able to secure seven hectares of City land in South Surrey Athletic Park and begin construction of a four diamond complex complete with stadium seating for 1000, batting cage, and a 5000 sq ft (465 m^2) two level field house with restaurant, bar and wrap around deck. The group was able to negotiate a 25 year lease with the City of Surrey to operate Softball City as a privately run facility. For more than two decades the facility was operated with little to no City involvement. Over time, Softball City sadly deteriorated due to inadequate funding for maintenance and renovations. A change was desperately needed to bring it back to the crown jewel it was in the 90's.

For over 20 years Softball City has been the venue for the annual "Canada Cup" most recently known as the "Canadian Open Fastpitch International Tournament". It is the largest softball tournament of its kind in Canada and is seen as one of the premier international tournaments in the world. The event is organized by a committed group of volunteers known as the Canadian Open Fastpitch Society. This group had the vision to host the 2016 Women's World Fastpitch Championship on home soil. The Tournament would be the largest of its kind ever held for the sport with over 1,800 athletes, 500 coaches, officials and trainers, 650 volunteers and an expected attendance of over 125,000. It was expected to have an economic impact in excess of $20 million for the City. This statistic helped the Society secure the City as a partner for the bid. Having the Mayor's support ensured the necessary improvements would be made to Softball City to make it a world class facility once again for 2016.

Renovation Plan

In the fall of 2013 City staff began planning a two year $1.6 million facility renovation. The plan included renovations to the outfield grass, replacing existing infield material, bringing in the arcs with sod, creating warning tracks, extensive irrigation upgrades, erecting four brand new backstops (including dugouts and foul line fencing), lighting upgrades, deck repairs, washroom renovation, stadium seating upgrades, additional paving, and new passive area landscaping. It was a lot of work that needed to be completed in a short period of time. To complicate things the operators of Softball City relied on the income they made from leagues and tournaments that ran out of the facility so needed to keep the doors open. Renovations would have to occur in stages with much of the work being done in the off season. Working with the operators of Softball City, a schedule was developed.

Outfield Renovation

For many years very little maintenance was done on the grass in the outfields. Staff at the complex had limited turf knowledge so other than mowing and running the irrigation no other cultural practices were performed. City staff quickly realized the need to bring the maintenance back under the Athletic Field Operations (AFO) Department in order to get the outfields up to world class standard by 2016. The operators of Softball City agreed and in the spring of 2014 AFO implemented a turf maintenance program. Soil tests were taken and from that information a

fertility program was developed. The outfield grass was sparse and full of weeds so in May of 2014 the outfields of all four diamonds underwent a major renovation. They received an aeration with 1" (2.54 cm) diameter hollow core deep tines, top dressing of 80 ton 3 mm (72.6 metric tons 3 mm) washed sand, overseeding of perennial ryegrass seed at a rate of 6lbs/1000 sq ft (3 kg/100 m^2), and the irrigation heads were upgraded to Rainbird 8005's. In June, one application of herbicide was made to take care of the broadleaf weeds.

Infield Conversion

The original infield material was a crushed lava rock that was very course. Over the years red shale was introduced to the infield and rock from surrounding areas had migrated onto the surface contaminating the mix. It was a difficult material to maintain and players often complained about the irregular hops the ball would take after hitting the surface. It needed to be replaced so the City decided to go with a material they had been successfully using on their baseball diamonds for a decade. The material, developed with the help of a local supplier, is a mix of sand, silt, clay and field conditioner (65-70% sand, 30-35% silt/clay, 12% by volume conditioner).

Phase 1 of the infield renovations began in August of 2014. The scope of work included replacing the infield material of Diamonds #1 and #2, installing six new irrigation zones on each diamond, creating warning tracks along the first and third baselines and sodding in both arcs to bring them back to their original 60 feet (18.3 m) from pitchers plate. City staff had two weeks to complete the work before the diamonds were reopened to play.

Excavation included scraping four to six inches of old material from the infield. A total of 500 yards was eventually removed from each diamond. New material was then brought in, roughly levelled to grade with an excavator and then packed with a five ton roller. A laser grader was then utilized to get the final grade (1% slope from backstop to outfield).

Three new irrigation zones were installed to water the grass in the outfield: one on the new arc and two along the wings of the first and third base lines, areas that would often burn out in the summer months. The other three zones were installed on the infield and would be used for wetting down the infield material. A unique system was implemented where maintenance staff, coaches and players could press a button that would start a schedule for the infield zones. A given amount of water would be put down through the use of high speed rotary heads. It would be a quick way to wet down the infield prior to games. All too often not enough water was being put down in the dry summer months. The infield would become very hard which created a number of issues including safety concerns for players. With this system, infield watering would be quick and easy. Quick couplers were also installed for doing additional hand watering.

Over the years the arcs on each diamond had grown from 60 to more than 75 feet (18.3 to more than 22.8 m) in spots. They needed to be brought back to their original 60 foot dimension for the Tournament. The entire arc was initially cut back to 80 feet (24.4 m) to eliminate any high spots and to give the new sod a uniform look after it was installed. The old grass was removed with a sod cutter and the subgrade levelled. The area was then ready for new sod. It took 5000 sq ft of 1 inch (465 m^2 of 2.5 cm) thick big roll sod to cover the area on each diamond. Thicker big roll sod was used because of its ability to stay in place even before it had rooted. This allowed the diamond to be opened sooner. The sod was put down on a Friday and teams played on it the very next day.

Phase 2 of the infield renovations began one year later in August 2015 on Diamonds #3 and #4. The scope of work was exactly the same as on Diamonds #1 and #2 plus much more. Once again City staff had only two weeks to have everything completed before the facility was open to play.

In addition to all previously mentioned work, City staff also installed a new irrigation mainline, controller, chamber and pump, did all the associated wiring and re-landscaped all the passive areas within the complex. The irrigation mainline was upgraded from a 2.5 to 3" (6.4 to 7.6 cm) line which allowed the system to be scheduled to run multiple zones at once. A new 7.5 hp (5.6 kW) vertical pump with a variable frequency drive was

Old infield material

New infield material

also installed making it possible to achieve 80 psi (550 kPa) at the irrigation heads.

Structural Upgrades

Structural work has been primarily done in the off season (fall and winter of 2014 and 2015). Improvements have included renovating interior and exterior washrooms, renovating the bar and restaurant, constructing three officials booths, installing 1,000 new stadium seats and erecting four new backstops complete with dugouts. Diamond #1, the stadium diamond, will have a state of the art post tension style backstop with netting and sunken dugouts.

With the majority of the upgrades nearing completion, City employees are now working on detailed operation plans for the World Championships in July. Everything from field preparation to garbage removal is being considered. During the tournament the facility will operate from 7am to midnight with games running the majority of the day. Time for maintenance will be limited. Volunteers and City staff will be spending many a sleepless night preparing fields for the next day's games.

After more than two years, Softball City is close to being the crown jewel it once was and a facility worthy of hosting the 2016 Women's World Fastpitch Championships. It will be an exciting 10 days in July and for many a once in a lifetime experience! •

Excavation of old infield material

Installation of new infield material

Turfgrass Seed Sources in Ontario

Advertising Supplement to the Sports Turf Manager, Spring 2016

Sports Turf Canada strongly recommends to athletic field managers that they use only improved cultivars that have been tested and found superior under local conditions.

SPECIES	SUPPLIER			
	BrettYoung Seeds	Graham Turf Seeds Ltd.	Lawn Life	Ontario Seed Company
Kentucky bluegrass	Argyle Award Bedazzled Bewitched Blue Chip Plus Blueberry Brooklawn Everglade Jumpstart Midnight Moonlight SLT NuDestiny Right	Award Baron Bluechip Corsair Dauntless Everest Full Moon Impact Jumpstart NuDestiny NuGlade Rugby II Rush Skye SR 2100 SR 2284 Sudden Impact	Mallard Monte Carlo Oasis Ridgeline Wildhorse	Award Beyond Blitz Freedom III Midnight Star NuGlade Perfection
Texas/Kentucky bluegrass hybrid				
Poa compressa		Reubens		Canada Blue Reubens
Poa supina		Supranova		
Poa trivialis	Darkhorse	Maximum Sabre III		Havana
Fine fescue: Blue		SR 3200		
Fine fescue: Chewings	Enchantment Shadow II	J-5 Jamestown IV King James SR 5100 SR 5130	7 Seas Survivor	J-5 Survivor
Fine fescue: Creeping Red	Aberdeen Boreal Celestial Common Seabreeze GT	Audobon Boreal Crossbow SR 5210 SR 5250 Trapeze	Lustrous Penn ASC 295 Razor	Aruba Audubon
Fine fescue: Hard	Bighorn GT Soil Guard	Bighorn GT Ecostar Soil Guard SR 3100 SR 3150	Predator	Ecostar
Fine fescue: Sheep		Marco Polo Quatro		Marco Polo
Tall fescue	Deputy Turf Gazelle II	Darlington Grande II Talladega	RK4	Arid III Inferno
Tall fescue: Spreading/ Rhizomatous		Speedway	Marauder	
Perennial ryegrass	Coastal 4-Way Estelle Silver Dollar Triumphant	Accent Arctic Caddyshack Calypso III Champion Extreme Harrier SR 4220 SR 4420 SR 4500 SR 4600 Top Gun	Applaud II IG2 Integra Shining Star	Evolution Revenge
Perennial ryegrass: Creeping/Regenerating		CSI	Allante Natural Knit	CSI
Weeping alkali		Fults Salty		Fults
Contact Information	**BrettYoung Seeds** ***brettyoung.ca*** P:1-800-665-5015 Head Office: Box 99, St. Norbert Postal Stn. Winnipeg, MB R3V 1L5 Clifford, ON P:519-510-8873 Calmar, AB P:1-800-359-5503	**Graham Turf Seeds Ltd.** ***grahamturf.com*** 1702 Elm Tree Road, RR 1 Lindsay, ON K9V 4R1 P:795.878.8822 F:705.878.1978 graham@grahamturf.com	**Lawn Life** ***lawnlifenaturalturfproducts.com*** 935023 Airport Road Mono, ON L9W 6C6 kpavely.lawnlife@xplornet.ca	**Ontario Seed Company** ***oscturf.com*** 77 Wellington Street South Kitchener, ON N2G 2E6 P:519.886.0557 F:519.886.0605 dave@oscturf.com

Turfgrass Seed Sources in Ontario

Turf Seeding Rates are available in Table 7—2 Turfgrass Species Characteristics and Uses in OMAFRA publication 845, *Integrated Pest Management for Turf*, available for download at omafra.gov.on.ca/english/crops/pub845/pub845.pdf.

SPECIES	SUPPLIER							
	Pickseed Canada Inc.		Quality Seeds			Speare Seeds	
Kentucky bluegrass	America Appalachian Armada Blue Velvet Crest Evora	Explorer Granite Langara Mercury Touchdown Touche	Argyle Aviator Barduke Baron Barimpala Barrister Barvette BlackJack Blue Angel	Blue Coat Blue Devil Blue Note Cadet Corsair Courtyard Dauntless Everglade Gaelic	Hampton HGT Jumpstart Midnight Midnight II Prosperity Right Rubicon Rubix	Argyle Award Baron Barrister Bedazzled Bonaire Brooklawn Diva Everest	Guiness Jumpstart KenBlue Midnight Newport Palouse Rockstar Shamrock Wildhorse
Texas/Kentucky bluegrass hybrid	Bandera	Spitfire	Farenheit 90	SPF 30		SPF 30	
Poa compressa	Canon	Reubens	Reubens			Canada Blue	
Poa supina	Supernova		Supranova				
Poa trivialis	Colt Darkhorse	Racehorse	Laser	Sun-Up	Winterlinks	Bartalon	
Fine fescue: Blue	Azay Blue		Little Big Horn	MX 86			
Fine fescue: Chewings	Silhouette Victory II	Windward	Jamestown IV Longfellow II	Shadow II		Bridgeport II Culumbra II	Shadow II
Fine fescue: Creeping Red	Boreal Garnet Jasper II	Mystic Shoreline	Boreal Crossbow Kent Lifine	Navigator II Seafire Slender Trapeze		Aberdeen Boreal	Miser Seabreeze
Fine fescue: Hard	Bornito	Spartan II	Bighorn GT Firefly Heron	Rhino Ridu Sword		Bighorn GT Oxford Reliant IV	Soil Guard Stonehenge
Fine fescue: Sheep	Azay		Quatro			Marco Polo	
Tall fescue	Crossfire 3 Farin	Mustang 4	Darlington Lexington Sitka	Tahoe II Talladega		Coronado Gold Fury	Lexington Tombstone
Tall fescue: Spreading/ Rhizomatous	Blade Runner II	Team Blend	RTF Rhizomatous			Falcon IV	Titan Ultra
Perennial ryegrass	Arctic Green Cutter II Dasher 3 GLSR Double 4N Edge II Express III Fiesta 3	Mighty Nightsky Sunshine II Transist 2600 Intermediate TXR Annual Wicked	Amazing GS Home Run Palace Pillar Premium	Presidio Primary Prominent Provost		Affirmed Arctic Green Charismatic II Dominator Doubletime Elegana	IQ Manhattan 5 Passport Plateau Wind Dance 2
Perennial ryegrass: Creeping/Regenerating	Blazer 4 Fiesta 4 GLSR	Karma Sideways	RPR Regenerating			Baralpha	
Weeping alkali	Fults II	Salty	Fults	Fults II		Fults	
Contact Information	**Pickseed Canada Inc.** ***pickseed.com*** 1 Greenfield Road, PO Box 304 Lindsay, ON K9V 4S3 P:705.878.9240 F:705.878.9249 pstevens@pickseed.com		**Quality Seeds** ***qualityseeds.ca*** 8400 Huntington Road Vaughan, ON L4L 1A5 P:905.856.7333 support@qualityseeds.ca			**Speare Seeds** ***speareseeds.ca*** 99 John Street Harriston, ON N0G 1Z0 P: 519.338.3840 F: 519.338.2510 info@speareseeds.ca	

IN THE NEWS

Sports Turf Canada Elects 2016/2017 Directors

Members of Sports Turf Canada elected the 2016/2017 directors at the annual general meeting held February 17 at the University of Guelph during the Ontario Turfgrass Symposium.

Joining the board is new director Stan Kazymerchyk of Kwantlen Polytechnic University in Langley, BC. Returning for a new term are directors Tab Buckner/Township of Langley BC, Gord Dol/Sports Turf International Ltd. ON, Paul Gillen/Wood Bay Turf Technologies ON, Terry Henderson/City of Guelph ON, Roger Macklin/ Retired ON, Ken Pavely/Lawn Life ON, Tennessee Propedo/City of Hamilton ON, and Paul Turner/ G.C. Duke Equipment Ltd. ON.

Continuing into the second year of their term are directors John D'Ovidio/City of Mississauga ON, Gord Horsman/City of Moncton NB, Jason Inwood/Town of Innisfil ON, Ben Tymchyshyn/ MMM Group Limited AB, and Dave Warden/City of Mississauga ON.

At the subsequent meeting of the new board of directors Tab Buckner was appointed president, Ken Pavely/vice president, Jason Inwood/secretary and Ben Tymchyshyn/treasurer of Sports Turf Canada. Tennessee Propedo continues as immediate past president.

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Biological Control in Turf: Fantasy or Reality?

Michael Brownbridge, Ph.D., Research Director, Horticultural Production Systems
Vineland Research and Innovation Centre

White grub infected with Cordyceps fungus

European chafer grubs infected with Steinernema glaseri

White grub parasitized by Tiphia sp.

There are many definitions of "biological control" that differ subtly from one another but essentially, biological control is a method that can be used to manage pests, weeds and diseases using other living organisms, and typically also involves an active human role. In this article, I've focused on the use of biological control to manage pests in turf; my apologies to plant pathologists and weed specialists (therein lies another article or two for another day) but there's just not enough space to cover everything. However, many of the basic principles are relevant to the management of all three groups of organisms.

Let's start with first principles: growth of any plant in any environment is affected by a range of interactive biotic (living) and abiotic (environmental) factors, which can be beneficial or detrimental to the plant. Biotic stresses can come in the form of pests, diseases and weeds, whereas abiotic factors include light, temperature, rainfall, soil type and condition. All of the abiotic factors affect living things, and in a turfgrass system they can affect the quality and performance of the grass, as well as the incidence and impact of pests, weeds and diseases. So it is a very inter-related system.

In residential and urban settings, there are additional influences which can compound the challenge to grow healthy turf. These include pesticide bans, which in Ontario limits how we can control pests and weeds; potential restrictions around the use of water and fertilizers; soil compaction and poor soils, which are typical of many new residential developments. All-told, urban areas are probably some of the toughest environments in which to grow healthy turfgrasses.

Where are we today?

Canada has relatively few products registered for pest control in turf. Urban pesticide bans in a number of provinces mean that even fewer registered materials are available for pest control in residential areas. Access to softer chemistries and "biologicals" has been anticipated for several years, yet in 2016, there are no Class 11 pesticides registered for white grubs. Nematodes have become the "standard" for grub control in urban turf, but nothing is available for crane fly (apart from nematodes), billbug or sod webworm. *Metarhizium brunneum* (formerly *anisopliae*), aka Met52®, is the only biological registered for chinch bug.

Use of nematodes

In trials we carried out over 3 years, in collaboration with Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) specialists, two nematodes, *Heterorhabditis bacteriophora* and *Steinernema glaseri*, consistently provided between 40-60% control of European chafer grubs when applied in late August/early September. Later applications or those made in the spring, were relatively ineffective. This highlights one of the most important factors to biocontrol success: Timing. The late summer/early fall applications are effective because soil temperatures are warm enough for nematodes to infect the grubs (> 15 °C), the grubs are relatively susceptible when in their early developmental stages (first/second instar) and are easier to target as they are feeding close to the soil surface. In late fall or spring, grubs are typically too large (3rd instar, very resistant), too deep and soil temperatures too low for nematodes to work effectively. Applied correctly (right time, right place, right concentration), the nematodes reliably provided a reproducible level of suppression. But is the level of suppression obtained (approximately 50%) enough? Well, it all depends.

If you started with a heavy infestation of chafer larvae (e.g. 20/sq ft) and applied nematodes, you would kill plenty of grubs, but you'd still be left with a damaging population.

Whereas if the initial population was lower (say 10/sq ft) and nematodes were applied, this time, the turf would be able to tolerate any feeding damage from the remaining grubs. Our challenge is to grow turfgrass in a way that limits grub populations so that the level of control provided by the biologicals will then be sufficient to prevent grub damage.

Biological controls, part of the solution

When biologicals can be used in this way, they are definitely part of the solution. In research, though, more often than not we have been tasked with finding a silver bullet solution, a biological replacement for pesticides which provides the same level and speed of control, at equivalent cost. But if we accept that 50% suppression may be as good as it gets, then we need to consider where such biological control agents can realistically be used, given the other tools available to us. To function effectively, biological control has to integrated into a turfgrass "system" where a range of components within that system function together to provide the desired level of suppression.

The primary goal is to grow grass right in the first place. Selecting the best grass type for the location in which it will be grown, and then using good cultural practices to support healthy growth. If this is done successfully we have a system that is inherently less prone to pests and diseases, grass that is more robust and able to quickly recover from insect feeding damage. Furthermore, if we have fewer pests to begin with, then applied and native natural enemies will have greater impact.

Supporting the successful use and impact of biocontrols

Good turfgrass maintenance (cutting, feeding, aerating, seeding, watering) is essential. This is a season-long activity where the goal is to establish thick, healthy, deep-rooted turfgrass which is robust enough to tolerate biotic and abiotic stresses.

In spite of these efforts, pests can still appear. And while populations typically fluctuate from year to year, there are three main pests we have to deal with in Ontario: white grubs (European chafer, Japanese beetle, June beetle), chinch bugs and crane flies. What can we do to promote biological control of these insects?

Conservation biocontrol. What can we do to conserve and improve the impact of our native biocontrol agents? There are plenty of indigenous biocontrol agents which already take care of a huge number of pests in our gardens and agricultural settings. In turfgrass, this includes a range of generalist predators (beetles, mites) which happily feed on eggs and young grubs, for example; insect pathogens (fungi, bacteria, viruses, nematodes) which will infect and kill a pest (there are also many other microorganisms which support healthy plant growth); and parasitoids, which live in or on an insect host, and ultimately kill that host. A pesticide-free environment has doubtless benefitted many of these organisms.

We made some interesting observations in our field trials this past year that are perhaps emblematic of the type of ecosystem services that we can expect from a healthy landscape. First, was the recovery of a European chafer larva infected with a Cordyceps fungus. We commonly recover insects that are infected with other more common entomopathogens, such as *Metarhizium* or *Beauveria*, but this was a first for us in more than five years of field work.

The second, was a parasitic wasp, *Tiphia*, that we found developing on at least 10% of the grubs collected at one site. Two *Tiphia* species, originally collected in Japan and Korea (the region of origin of Japanese beetle), were released back in the 1930's, 40's and 50's in the northeastern US in an effort to control Japanese beetle. *Tiphia vernalis* and *T. popilliavora* parasitize a wide range of white grubs in the spring and summer, respectively. Parasitism rates as high as 100% have been observed in some locations in Connecticut.

Adult *Tiphia* wasps feed on nectar-rich flowers (such as peonies) and honeydew produced by aphids. Access to these resources can enhance survival, longevity, egg-laying and parasitism, i.e., they live longer and can kill more grubs. One of the benefits of maintaining a diverse landscape which includes flowering plants adjacent to grassed areas, which also provides habitat and food for ground predators and other beneficial species.

Selection of grasses to support biocontrol. We have long recommended certain grasses for areas that are typically in shade or full sun. An extension of this approach is to consider planting (seeding) or installing (sod) grasses which have other desirable traits that can improve urban performance; improved water-use efficiency, for example. Given our changing climate, greater tolerance of abiotic stresses (cold and heat extremes, salt tolerance) will become increasingly important. In addition, given the poor soils in many new developments and the potential for restrictions around fertilizer use, we need grasses that can use nutrients more efficiently and can flourish in poor soils. Lastly, we know that some grasses demonstrate superior disease and insect resistance. If we are able to plant less preferred species, then pest populations are likely to be lower, their development will be affected, creating conditions under which biocontrols can function more effectively.

Rye grasses and tall fescues have traditionally been used to fulfil many of these requirements, but some new 'high-endophyte' turf grasses are now being considered. The presence of an endophyte can significantly improve grass performance in the face of biotic and abiotic stresses. The endophytic fungus in question belongs to the genus Epichloë (formerly classified as *Neotyphodium)*.

So what are endophytes? These are non-pathogenic microorganisms that colonize plant tissue. *Epichloë* is a naturally-occurring fungus that infects a wide range of cool-season grasses including ryegrasses and fescues. Breeding has focused on *Epichloë* strains that produce lolines and peramines (alkaloids) which impart insect resistance. These are water-soluble which means that they may be translocated throughout the plant, including the roots, potentially providing some protection against both leaf- and root-feeding pests.

One pest such grasses may be very useful against is chinch

bug, which feeds on the crown of grasses. In trials we ran in July 2015, which included a high endophyte rye and a prototype mix developed for insect resistance, these grasses were consistently less preferred by chinch bugs across trial sites and experimental replications.

Results suggest that endophyte-containing and other grasses may play a valuable role in the suppression of both chinch bugs, grubs and (potentially) other leaf/root feeders. Work is still needed to figure out how to best integrate them into a turf management system: whether they should be used alone or as a component in a seed blend in new seeding; whether they can be used in sod production; or whether the best way to introduce them is by over-seeding to increase the proportion of endophyte grasses in a stand over time. Above all, though, rate of establishment and survival of the grass and endophyte over time needs to be defined in northern climates, as these will be key to their effective deployment and sustainability.

In addition to microbes colonizing plants internally, microorganisms have also evolved close associations with plant roots. Colonizing the surface of the roots, they derive nutrients from root exudates and in return can deliver a range of benefits to the host plant, including protection of roots from diseases and pests, and stimulating plant growth and performance, even when soil conditions may be less than ideal. We have been considering several fungi and bacteria for this role, and looking at their application via seed coatings, with a view to their naturally establishing and persisting on developing roots, supporting plant growth and resilience.

Several insect-pathogenic fungi can also colonize plant roots or the rhizosphere. This has been shown for several species of *Metarhizium* (same species in Met52). Interestingly, work done in Oregon showed that black vine weevil adults were more attracted to plants whose roots were colonized by *Metarhizium*, a behavioural response that is also shown by Japanese beetle in turfgrass. You might ask "Why do I want to attract pests?" Well, it turns out that the larvae which hatched from Japanese beetle eggs laid in the fungus-colonized grass, were quickly infected and killed by the insect pathogen, perhaps raising the opportunity to use these fungi in a lure and infect approach in the soil.

Active use of microbial and other biopesticides

If we utilize some or all of these other tools and strategies, then the active use of biological controls may be sufficient to achieve the level of control desired. Effectiveness of all of the microbial biopesticides (e.g. fungi, bacteria, nematodes) relies upon selection of the right species or strain for the target pest. Efficient application and delivery methods are then key; some of the microbials work by contact, others need to be ingested, others will seek out a host. But all have to be placed in the right place at the right time to be effective. It is also likely that more efficacious biocontrol tools will be available in the future and improvements in biopesticide strains and formulations will further enhance efficacy and impact.

Putting it all together

In an ideal world, here's how it could work: good cultural practices (grass species, turf health) reduce egg laying; a healthy population of natural enemies, supported by biodiversity in the surrounding vegetation further reduces the pest population; with the survivors largely controlled through the active use of a biopesticide. Successful biocontrol in turf.

So, biological control in turf – fantasy or reality? I think increasingly, it has to become reality. Let's stop looking at biologicals as direct replacements for chemicals and instead take a more integrated approach towards their effective use in turf pest management, exploring other complementary ways to improve the resilience of the system, enabling development of sustainable solutions that support the growth of healthy turf. •

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The Guelph Turfgrass Institute is Moving to a New Home on the University of Guelph Campus

The Guelph Turfgrass Institute (GTI) was officially established by the Senate of the University of Guelph in 1987. An agreement between the Ontario Government, the University and the private sector, through the Ontario Turfgrass Research Foundation, allowed the GTI to become a reality – the original sod-turning ceremony was in November of 1991 to begin construction of the G.M. Frost Research and Information Centre. The current Frost building, a GTI focal point, is named in honour of Mac and Beth Frost, who provided a very significant founding donation for the project.

Why is the GTI moving?
The Province owns the land the current GTI is built on and with the lease expiring in 2018 they have identified that land for real estate development. The City of Guelph has also re-zoned the land for development. The province is supporting moving the GTI and establishing a new GTI.

Where the GTI is moving to and proposed site plan description
The proposed development for the new GTI is located on University of Guelph lands at the north west corner of the Arboretum property, and is adjacent to the Cutten Fields Golf Club. In addition, some land will also be developed at the Elora research station for larger scale GTI projects.

The site plan is available upon request.
Please contact John Watson, GTI Communication Assistant at watson01@guelph.ca or 519-824-4120 x 54032.

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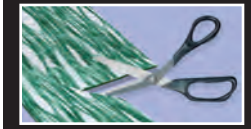
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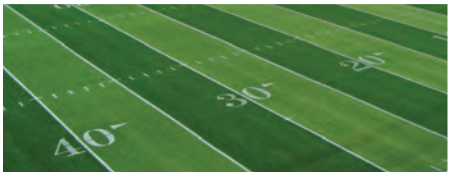

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A Permanently Enclosed Natural Grass Rugby Pitch

R. W. Sheard, PhD, Retired Professor, University of Guelph

The architectural firm for the stadium was POPULOUS.com.
Information Source: Google Dunedin New Zealand, stadium. Photo courtesy of Dunedin Venues

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The City of Dunedin, New Zealand (population 120,000) opened a unique enclosed natural grass rugby pitch in 2011. The all-weather Forsyth Barr Stadium is capable of hosting both athletic events and various cultural events with seating capacity of 30,750 at sporting events and 36,000 for concerts. In 2011 the first major cultural event was a sold out concert by Elton John. That same year it hosted World Rugby competitions and was authorized for the 2015 FIFA U-20 World Cup soccer games.

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The predominately ryegrass turf was grown on a soil rooting medium which was strengthened with plastic fibres. The turf is fully irrigated and drained and is maintained as normal ryegrass turf.

Ventilation and humidity control are provided by having the ability to open the lower 15 feet (4.5 m) of the end walls and through vents above the seating area.

The cost of the stadium was 224.7 million NZ dollars, or $1,872.50 NZ dollars/city resident. •

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