rently in the process of regulating fertilizer inputs such as nitrogen (N) and phosphorus (P) source and timing of application (see Figure 1). In Connecticut, schools and municipalities are moving toward an organic program mandate. Natural organic fertilizer sources have effectively escaped regulation in many states because the P cannot be removed from manure or compost. Source ingredients and the manufacturing process of natural organic fertilizers differ, so you should familiarize yourself with the benefits and potential disadvantages of these formulations before making a purchasing decision. Interestingly, many existing and future laws are not based on science, but perception. Poorly written laws produce unintended consequences such as reduced turf vigor and subsequently more leaching, weeds, soil erosion, and runoff. If possible, get involved! Find out what laws may be in the pipeline in our local community and fight for what you believe in; you can take it as far as you see necessary or have the available time to pursue.

SOIL TESTING

I recommend soil testing regularly (at least once a year) to determine if any major chemical problems exist. The pH should fall within a fairly wide range of 5.5 – 7.3. Most calibration and correlation data exists for *exchangeable* nutrient cations, so interpret this data to select fertilizer inputs. Sand sites often contain less calcium (Ca), magnesium (Mg), and potash (K) and hold fewer nutrients in general. If applicable, test the irrigation water. Many chemical problems such as high sodium (Na) and chlorine (Cl) or bicarbonate (HCO_3-) arise due to poor irrigation water quality, or construction/amendment with high lime or calcareous sands. Importantly, soil tests should be used as a rough guideline and your observation equally important. Become a keen observer by carefully assessing turf vigor and how its response to a fertilizer application and/or recovers from mechanical stress, lack of water, and/or divoting?

CONCEPTS OF BEST FERTILIZER MANAGEMENT

Beyond understanding the broad plant/soil community and collecting soil test data, best fertilizer management (BFM) includes selecting the correct fertilizer and applying it at the correct time. The concepts focus on fertilizer use and fate with the goal to maximize plant use of nutrient and minimize loss to the environment. Like everything else in our lives, efficiency is better. This starts with developing a master plan, staying fluid, and making good choices. BFM *requires* an integrated approach and using all available options.

Fortunately, turf mangers now have technologically advanced fertilizer options, from slow release granule formulations that can be applied at higher rates, to highly efficient liquid, or foliar, options generally applied frequently and in low doses. The latter, referred to as “spoon feeding,” allows turf managers the ability to “meter” nutrient inputs. More athletic field mangers now use this approach particularly where resources exist to supplement a granular fertilizer program. Foliar fertilizers can increase the speed of establishment, maximize vigor, enhance recuperative capacity, improve wear tolerance, or maximize aesthetics (see Figure 2). These effects are more pronounced on sand soils, during environmental stress, or when root growth is compromised. The correct use of efficient foliar fertilizers and slow release granule carriers will improve nutrient use by turfgrass plants, maintain a high level of vigor needed to fill voids; and thus limit weed germination and growth, and minimize nutrient losses. Enhancing nutrient uptake efficiency provides an agronomic, environmental, and economic benefit.

▲ **Figure 2: THE USE OF** efficient foliar fertilizers will maximize color and provide added control of nutrient inputs.

A final, yet critically important concept of BFM includes calibration. With so much out of our control, why not fine tune every other aspect of a fertilizer application? Calibration ensures that you apply the correct amount of nutrient, not too little so that turf vigor suffers or too much so that you waste money or potentially cause pollution. Most fertilizer programs start with N because plants require it in the highest amounts, and it should be the focus of a successful Best Fertilizer Management Program.

SELECTING A FERTILIZER

Ratio and Grade: A fertilizer ratio determines the relative amounts of N, P, K, or primary macronutrients in fertilizer, for example 3-1-2, 7-1-3, or 1-0-1. Choose a ratio based on N and K requirements, and/or soil type. The grade refers to the fertilizer analysis and you can attain the desired ratios with different grades. For example, both 21-3-9 and 28-4-12 have the same 7-1-3 ratio. Many fertilizers also contain secondary macronutrients including Ca, Mg, and S and minor nutrients. Generally, I recommend a balanced and complete fertilizer such as the examples above for general maintenance. Synthetic organic sources generally have a higher nutrient analysis and more soluble nutrient compared to natural organic sources, which are used effectively on sandy soils, as a dormant feed, or where laws prohibit P applications to turf.

PHYSICAL CHARACTERISTICS

You have the choice of dry or liquid (foliar) fertilizer and this may be determined solely on the equipment available. Foliar fertilizer use represents a supplement to an existing granular program and liquids can also be an effective soil targeted application because the nutrients tend be highly soluble. Many also contain a wetting agent which increases uniformity of application. Among other things, particle size affects ease and distribution of application and rate of nutrient availability for slow release N sources.

Nitrogen Release Characteristics/Burn Potential. Most general maintenance granular fertilizers contain some slow release N (SRN), many ≥ 50% SRN. A variety of SRN formulations are available including those where N is released by temperature, water, or microbial activity. As a consequence, soil physical properties influence the release of N (See Soil Type below). The most common soluble N sources, in the order of high to low burn potential, include *urea, potassium nitrate, ammonium sulfate, di-or monoammonium phosphate*. Focus on the plant community (dominant grass and stage of growth) to determine annual N requirements. Correctly formulated foliar fertilizers contain soluble nutrients with low burn potential.

Soil Type/Reaction Effects. Native soils often contain high levels of residual N, allowing a turf manager the option to cut back on N inputs during certain times of the year, saving money. How can you tell? Conduct a tissue test and target ≥ 5% leaf N. In addition, fewer N inputs will limit excess biomass production, decreasing organic matter and thatch production. Conversely high sand soils drain well, but promote nutrient leaching, such as K and nitrate-N (NO_3-). In this situation, a turf manager might select more foliar fertilizer, use slow release sources of N and K, and not apply too much soluble N in a granule form, particularly during periods of slow growth or prior to heavy rainfall.

Soil pH affects microbial activity and nutrient solubility, for example high pH or alkaline soils limit minor nutrient availability. In addition, high pH soil or water increases urea volatilization, particularly at high pH (≥ 7.3). Soil test P data usually fall in the 'above optimum' category, however P complexes with calcium (Ca) (high pH), Al or Fe (low pH), or clay minerals rendering it unavailable to the plant. With routine fertilizer additions that contain a small amount of P, plants are likely receiving adequate P nutrition. To know conclusively, conduct a tissue test.

▲ **Figure 3: COOL SEASON** root growth can be compromised by high soil temperatures rendering soluble granular sources ineffective with a high burn potential.

Seasonal Adjustments/Timing. For cool season grasses, the optimum timing for higher rates of soluble N is in the spring and fall, ideally fall. Conversely for warm season grasses, the optimum timing for higher rates of soluble N is in the summer months; however this also represents the rainy season in the some southern states like Florida so caution must be used when deciding on how much soluble N to apply at any one time during the summer. Supplement with liquid/foliar fertilizers when plant roots are compromised by temperature stress or on high sand soils due to lower nutrient holding capacity and high leaching potential (see Figure 3).

ADDITIONAL BFM STRATEGIES SPECIFIC FOR SPORTS TURF MANAGERS

Water Management: Do you have access to irrigation or rely on natural rainfall? If you irrigate, how is the water quality? Many fertilizers require post application irrigation to ensure safety, release nutrient, and increase uniformity of coverage. Do not over water. Many granule or liquid products need only 6-8 minutes of irritation to effectively water them in. If you are fortunate enough have to ability to control water inputs, you have the advantage to control soil moisture and speed establishment by supporting microbial activity and nutrient release (see Figure 4).

Wear tolerance/Increase Rooting: Do not over apply N; shoot growth at the expense of root growth, particularly in the spring of the year for cool season turf will negatively affect turf vigor and summer stress tolerance. Cultural practices such as aeration and sand topdressing, and the use soil targeted Ca and N will help wear tolerance and rooting. When you have the opportunity to cultivate, do it aggressively! Calcium supplied to growing root tips will increase overall root depth. For cool season turf, supply

▲ **Figure 4: A SOPHISTICATED IRRIGATION SET UP** provides the ability to control water inputs to the root zone, cool plants, and water in fertilizer.

low dose of soluble N (≤ 0.25 lbs/M) in the mid fall to increase carbohydrate storage in the roots and increase winter hardiness. For warm season turf like bermudagrass raise the height of cut going into winter. Maintain a balanced fertilization program in the fall and limit N fertilization. Be careful in the spring and do not try to push bermudagrass with heavy doses of soluble N; this can have a dramatic negative affect if you encounter extreme cold in late March or April.

IMPLEMENT THE PLAN

Develop a rough yet integrated fertilizer use plan based on your evaluation of the site, resources, and expectations and use it as a template for your agronomic plan. Consider fertilization a critical cultural practice along with water management, cultivation, seeding, and mowing which forms the foundation for turf vigor.

Get involved with state legislatures and understand existing or pending laws regarding fertilizer use. If necessary, begin to experiment or even implement programs to meet the requirements of these law(s). Given that you might as a consequence have to use more natural organic fertilizers, understand the benefits and limitations of these materials.

Education is the key to procuring the resources needed to provide safe, functional, and aesthetically pleasing turf for sports use. For fertilization, choosing the correct source, time and rate of N applications, (based on species) will have the biggest impact on rooting, turf vigor and recuperative capacity. Maximize efficiency and minimize environmental losses by supplementing soil targeted slow release fertilizer applications with low dose and soluble foliar nutrition. Use quickly available sources with low burn potential to speed recovery and during establishment. Evaluate new organic fertilizer technologies and always look for research to back up any claims. And lastly, become a keen observer and trust what you see! ■

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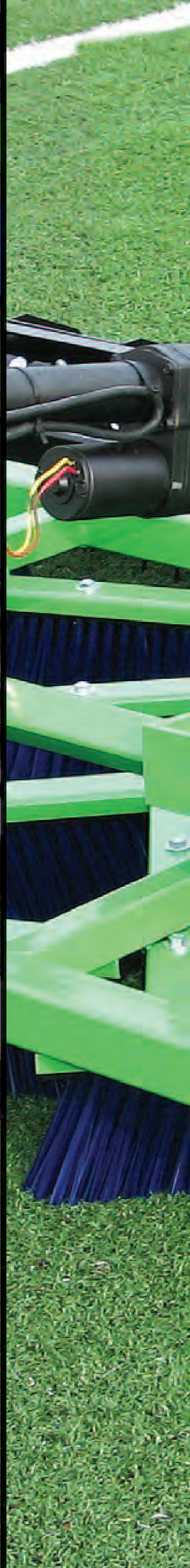

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Healthy chloroplasts for healthy sports turf

Plant chloroplasts are large organelles that, like mitochondria, are bounded by a double membrane called the chloroplast envelope. In addition to the inner and outer membranes of the envelope, chloroplasts have a third internal membrane system, called the thylakoid membrane. The thylakoid membrane forms a network of flattened discs called thylakoids, which are frequently arranged in stacks called grana. Because of this three-membrane structure, the internal organization of chloroplasts is more complex than that of mitochondria. In particular, their three membranes divide chloroplasts into three distinct internal compartments: (1) the intermembrane space between the two membranes of the chloroplast envelope; (2) the stroma, which lies inside the envelope but outside the thylakoid membrane; and (3) the thylakoid lumen.

The Structure and Function of Chloroplasts

Plant Cell Chloroplast Structure

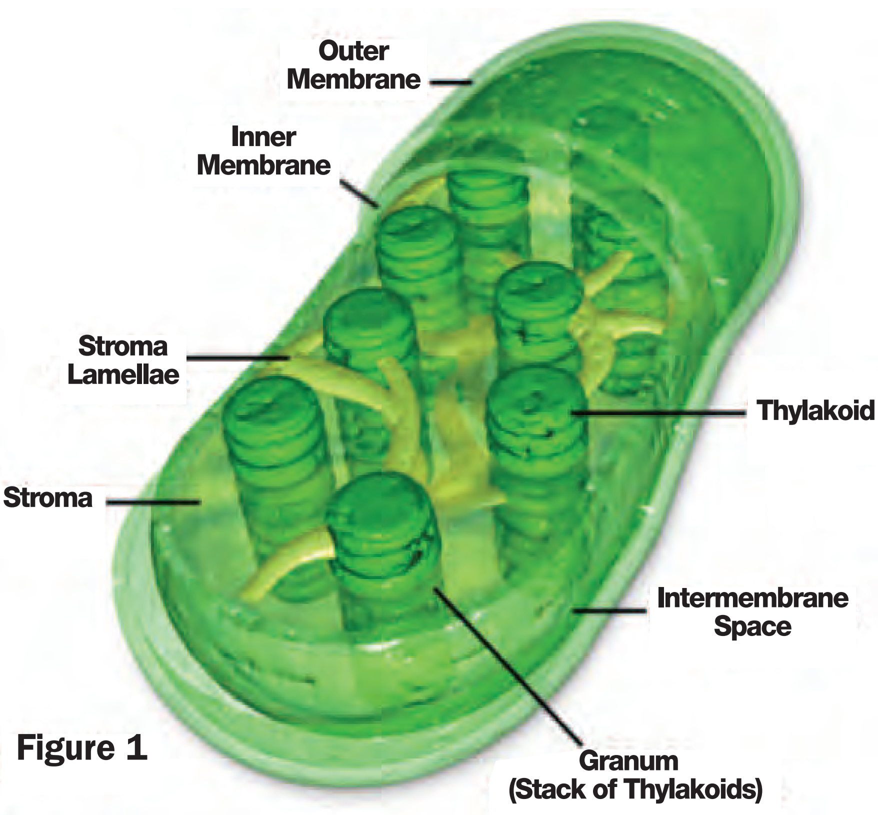


Figure 1

In addition to the inner and outer membranes of the envelope, chloroplasts contain a third internal membrane system: the thylakoid membrane. These membranes divide chloroplasts into three internal compartments.

The major difference between chloroplasts and mitochondria, in terms of both structure and function, is the thylakoid membrane. This membrane is of central importance in chloroplasts, where it fills the role of the inner mitochondrial membrane in electron transport and the chemiosmotic generation of ATP. The inner membrane of the chloroplast envelope (which is not folded into cristae) does not function in photosynthesis. Instead, the chloroplast electron transport system is located in the thylakoid membrane, and protons are pumped across this membrane from the stroma to the thylakoid lumen. The resulting electrochemical gradient then drives ATP synthesis as protons cross back into the stroma. In terms of its role in generation of metabolic energy, the thylakoid membrane of chloroplasts is thus equivalent to the inner membrane of mitochondria.

THE CHLOROPLAST GENOME

Like mitochondria, chloroplasts contain their own genetic system, reflecting their evolutionary origins from photosynthetic bacteria. The genomes of chloroplasts are similar to those of mitochondria in that they consist of circular DNA molecules present in multiple copies per organelle. However, chloroplast genomes are larger and more complex than those of mitochondria, containing approximately 120 genes.

The chloroplast genomes of several plants have been completely sequenced, leading to the identification of many of the genes contained in the organelle DNAs. These chloroplast genes encode both RNAs and proteins involved in gene expression, as well as a variety of proteins that function in photosynthesis. Both the ribosomal and transfer RNAs used for translation of chloroplast mRNAs are encoded by the organelle genome. These include four rRNAs (23S, 16S, 5S, and 4.5S) and 30 tRNA species. In contrast to the smaller number of tRNAs encoded by the mitochondrial genome, the chloroplast tRNAs are sufficient to translate all the mRNA codons according to the universal genetic code. In addition to these RNA components of the translation system, the chloroplast genome encodes about 20 ribosomal proteins, which represent approximately a third of the proteins of chloroplast ribosomes. Some subunits of RNA polymerase are also encoded by chloroplasts, although additional RNA polymerase subunits and other factors needed for chloroplast gene expression are encoded in the nucleus.

IMPORT AND SORTING OF CHLOROPLAST PROTEINS

Protein import into chloroplasts generally resembles mitochondrial protein import. Proteins are targeted for import into chloroplasts by N-terminal sequences of 30 to 100 amino acids, called transit peptides, which direct protein translocation across the two membranes of the chloroplast envelope and are then removed by proteolytic cleavage. As in mitochondria, molecular chaperones on both the cytosolic and stromal sides of the envelope are required for protein import, which requires energy in the form of ATP. In contrast to the pre-sequences of mitochondrial import, however, transit peptides are not positively charged and the translocation of polypeptide chains into chloroplasts does not require an electric potential across the membrane.

Protein import into the chloroplast stroma: Proteins are targeted for import into chloroplasts by a transit peptide at their amino terminus. The transit peptide directs polypeptide translocation through the Toc complex in the chloroplast outer membrane. Proteins incorporated into the thylakoid lumen are transported to their destination in two steps. They are first imported into the stroma, as already described, and are then targeted for translocation across the thylakoid membrane by a second hydrophobicsignal sequence, which is exposed following cleavage of the transit peptide. The hydrophobic signal sequence directs translocation of the polypeptide across the thylakoid membrane and is finally removed by a second proteolytic cleavage within the lumen.

The goal of every turfgrass manager is to provide a playable surface and aesthetically pleasing green turfgrass. Achieving the latter involves a reciprocal balance between soil, fertility, moisture, temperature, humidity, grass species, mowing techniques, cultural practices and cooperation from Mother Nature. All these aspects have to be working in sync for turfgrass to perform properly and be appealing color wise.

Protecting and strengthening chloroplasts would seem like the logical action to take because this is where chlorophyll, a pigment that gives turfgrass its green appearance, is developed.

The most important characteristic of turf plants is their ability to photosynthesize: to make their own food by connectinglight energy into chemical energy. This process is carried out in specialized organelles called chloroplasts. A photosynthetic cell contains anywhere from one to several thousand chloroplasts. The electrons from chlorophyll molecules in photosystem II replace the electrons that leave chlorophyll molecules in photosystem I.

Located inside the chloroplast are thylakoid membranes where light reactions take place. This is where chlorophyll is found, therefore, there's a synergistic relationship between keeping the chloroplasts and the thylakoid membranes as healthy as possible.

There are events that can be harmful to chloroplasts and thylakoid membranes, as well as necessary components that can prevent damage to them.

FREE RADICALS

One event that can damage chloroplasts is the development of free radicals. Typically, free radicals are stable molecules that contain pairs of electrons. When a chemical reaction breaks the bonds that hold the paired electrons together, free radicals are produced. They contain an odd number of electrons, which make them unstable, short-lived and highly reactive. As they combine with other atoms that contain unpaired electrons, new radicals are created, and a chain reaction begins.

This chain reaction or accumulation of reactive oxygen species, in turf plants is generally ascribed to several possible sources: cell-wall-bound perxidases, membrane-located NADPH oxidases, amine oxidases, xanthine oxidase, chloroplastic electron transport chains, mitochondrial electron transport chains, and peroxisomal fatty acid B-oxidation, which includes the H_20_2-generating argyl-coenzyme A oxidase steps. These sources can be attributed to environmental causes such as drought, heat, and ultraviolet light, or chemicals such as herbicides.

Accumulation of reactive oxygen species is central to plant response to several pathogens. One of the sources of reactive oxygen species is the chloroplast because of the photoactive nature of the chlorophylls. The free radicals, or reactive oxygen species, are singlet, hydroxyl, superoxide and hydrogen peroxide.

LIGHT

When photosynthetic organisms, such as turf, are exposed to ultraviolet radiation, significant, irreversible damage to important metabolic processes within the cell might occur (such as lesions in DNA and inhibition of photosynthesis). Through these reactions and others, radical forms of oxygen are often created. Many reports suggest this damage is because of oxidative stress resulting from UV-A exposure.

Photosynthetic light absorption and energy usage must be kept in balance to prevent formation of reactive oxygen species in the chloroplasts. Drought causes stomatal closure, which limits the diffusion of carbon dioxide to chloroplasts and thereby causes a decrease of carbon dioxide assimilation in favor of photorespiration that produces large amounts of hydrogen peroxide. Under these conditions, the probability of singlet oxygen production at photosystem II and superoxide production of photosystem I is increased. These can cause direct damage or induce a cell suicide program.

It has been known for a long time wavelengths in the ultraviolet-B region of the spectrum are effective in inactivating photosynthesis, and the molecular target is photosystem II. An excess of light brings about the inactivation of oxygenic photosynthesis, a phenomenon known as photoinhibition, and the molecular target of photoinhibition is photosystem II, a thylakoid multisubunit pigment-protein complex. The major effect of ultraviolet-B light on the thylakoid proteins is the breakdown of the reaction centre D1 protein.

SENESCENCE

Senescence results in massive levels of cell death, but the purpose of senescence isn't cell death; rather death only occurs when senescence has been completed. Senescence occurs in two stages. The first stage is reversible, and the cells remain viable throughout. The second stage results in cell death.

The key enzyme in the pathway to chlorophyll degradation during senescence appears to be pheophorbide-a-oxygenase. The activity of pheophorbide-a-oxygenase increases dramatically during senescence, implicating this enzyme as a control point in the process. Light absorption by pheophorbide-a-oxygenase also is believed to cause the production of singlet oxygen, which is a free radical.

Because senescence is reversible, it suggests that fully developed chloroplasts retain enough genetic information to support re-greening and chloroplast reassembly.

CALCIUM AND POTASSIUM

From a nutritional standpoint, there are various nutrients and compounds that can be applied in the process of strengthening and defending chloroplast damage.

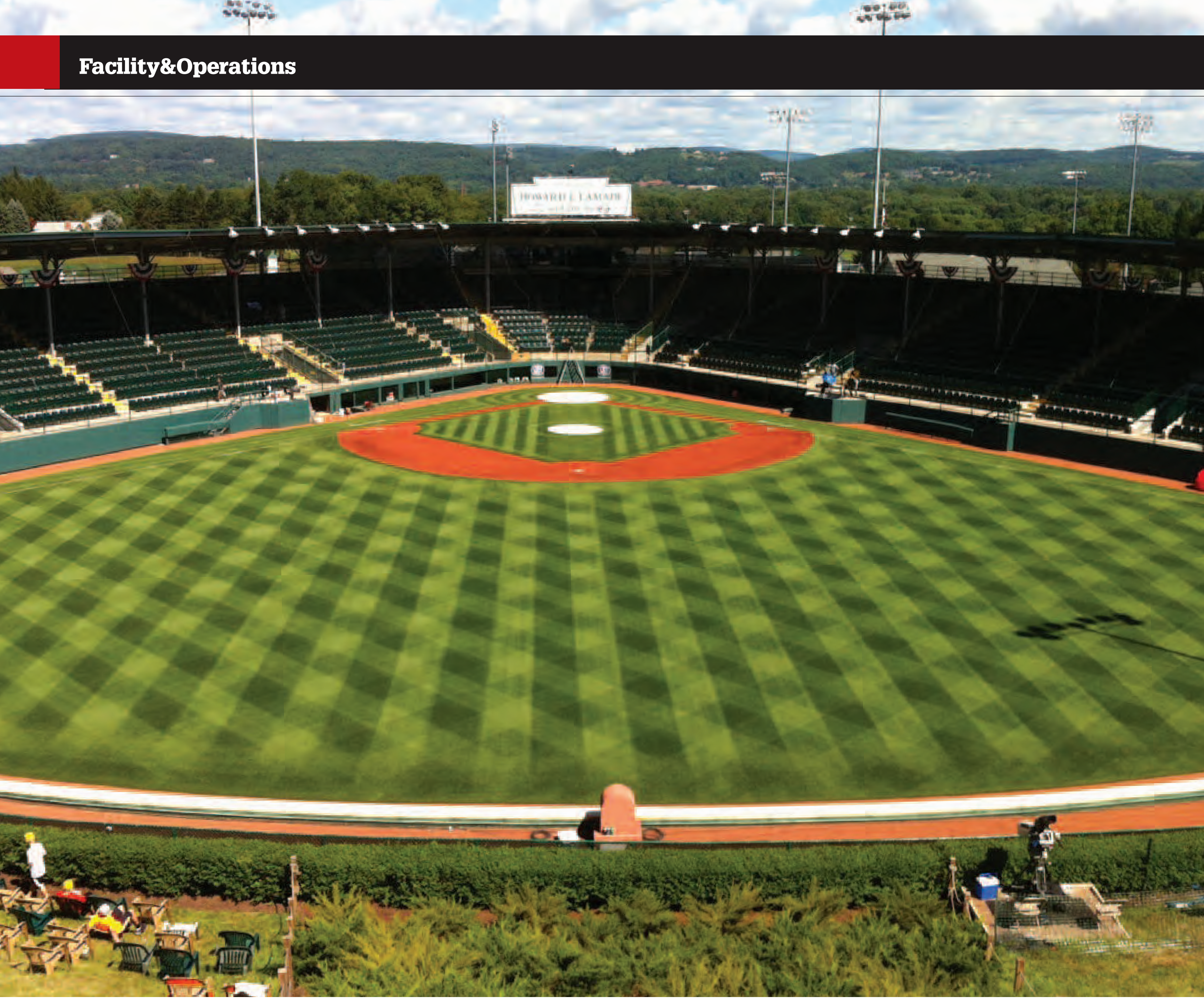
Because the chloroplasts and thylakoid membrane are located inside the plant cell, the first line of defense would seem to be to strengthen the plant cell by keeping calcium and potassium at optimal levels. Calcium plays a key role in strengthening the cell walls of the turf plant, while potassium helps strengthen cell walls inside the turf plant, which makes it harder for physiological problems to occur inside the cell wall.

AMINO ACIDS

Amino acids are the building blocks of proteins. Under optimal conditions, proteins are able to perform the normal physiological function to synthesize amino acids, but intensively manicured turfgrass, such as golf courses and athletic fields, are rarely operating under optimal conditions because of stress caused by low mowing heights and traffic.

To date, 154 proteins in the turfgrass plant have been identified – 76 (49 percent) are integral membrane proteins. Twenty-seven new proteins without known functions, but with predicted chloroplast transit peptides, have been identified – 17 (63 percent) are integral membrane proteins. These new proteins are likely to play an important part in thylakoid biogenesis.

The application of amino acids plays an extremely important part in developing the proteins specifically designed to help chloroplasts, thylakoid membranes, photosystem I and photosystem II to function properly. These proteins are known as D1, D2 CP43, CP47 and cytochrome b559. Of special



Working with your distributor

Little League World Series groundskeeper appreciates advice

SETH WHITEHILL, head grounds-keeper for the Little League World Series (LLWS) complex in South Williamsport, PA, for several years has been working with distributor's rep Phil Easton of Direct Solutions, a division of Agrium Advanced Technologies. The complex holds more than 75-80 games in the 3-week tournament; there are six fields on 80 acres including two stadiums. Whitehill takes care of the fields on his own during the spring and fall, but during the weeks leading up to and the during the World Series, volunteers (organized by the Keystone Athletic Field Managers Organization, the state's STMA chapter) come in from all over to help with the fields' maintenance.

"We didn't have a consistent growth rate throughout this year, and 2012 was hell," Whitehill said. "Clay is the native soil at the LLWS complex and there are sand slit drains cut through the fields. Wetting agents are crucial so you don't look and see the dry spots across the entire field. This year we had a large amount of rain during the beginning of the summer months, following a hot spell."

Whitehill said he has never seen a worse disease problem than he did during 2013. Neighboring facilities were experiencing a lot of dollar spot, brown spot and summer patch and pythium, with some of the diseases surfacing two or three times in certain areas. With Easton's help, Whitehill got a step ahead of the game and his turf remained disease free.

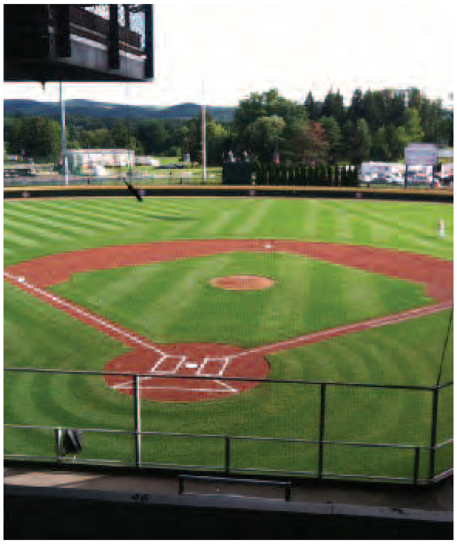
"When I started with Little League we had an existing relationship with a distributor but I didn't see eye-to-eye with them, so we had a bidding process to find a new one. Jeff Fowler (of Penn State Extension and STMA Board member) and I worked together to draw up a maintenance plan and then asked three bidders to tailor their bids to that plan, and we then selected the most cost-effective bid," Whitehill said.

"Phil Easton has become a good friend of mine. He is a great reference; he is really good with diseases and he loves to fix a problem. He likes the challenge of fixing problems. I consult with him regularly, for example on fungicide products when a period of extreme heat is expected. We also developed a granular and foliar fertilizer program.

"He knows what to look out for and what products to use so we don't get into any trouble. During the weeks leading up to the World Series, from May-September, foliar applications were made every other week. Easton also worked in a liquid for color and a root builder into the management program.

"Phil comes here 5-6 times a year and we walk around to discuss what's working or not. He has a real good grasp of the sites here at Little League, and we use soil tests regularly to see how we might improve it, and also to tailor the next year's plan to alleviate any possible issues," Whitehill said.

"Every field is different; my job is to recommend the correct products to fix problems," Easton said. In Williamsport, there is a lot of wear and some rooting problems so we had to work to get the turfstand to withstand the pressure. My job is to try and find out what turf managers are trying to accomplish first, and then supply some supporting data to back up my recommendation and earn the trust of the turf manager."



"I don't have a big staff here, I'm grinding it out every day, so to have someone I can call up and talk about what I'm seeing, and what he's seeing, is important. If I call Phil he calls me back within 15 minutes to talk about what we can do. He can really save my butt."

Whitehill said, "I call Phil several times a month to update him on what's happening here and to talk about what diseases or other problems he's seeing in this area. Developing this kind of relationship with a distributor can be such a beneficial tool for turf managers; he knows what others are seeing in the region and so talking with him regularly makes my life a heckuva lot easier. We are great friends now and I didn't even know him a few years ago.

"I don't have a big staff here, I'm grinding it out every day, so to have someone I can call up and talk about what I'm seeing, and what he's seeing, is important. If I call Phil he calls me back within 15 minutes to talk about what we can do. He can really save my butt."

"What my job really is not salesman; it's consultant. My job is to help the turf manager figure out what his or her field needs, then put together a program within the available budget," Easton said. "'What can we do for what you can spend?' is the question that needs answered.

"For Seth, I recommended a silica product and it's really helped with the wear; he has a better stand now. I've found that sports turf managers are not as familiar with foliar products as golf superintendents. Seth's attitude is to do everything correctly; he has excellence built in and wants his fields to be the best they can be, and he's willing to work the hours necessary to make that happen. He is also open to new ideas; his attitude is 'let's see what happens'." He is the reason the LLWS fields looked as good as they did this year," Easton said.

"Many of our volunteer staff have bee helping with field preparations and for 17 consistent years. This year, feedback Seth received from volunteers was that the fields look better than they ever have," Whitehill said. "Even the ESPN camera crew noticed how nice the fields looked this year.

"We have a break room at Lamade Stadium with a TV in it so during games sometimes we are in there watching. There is about a 10-second delay on the broadcasts, so we'll hear the crowd roar and then guess what happened, " Whitehill said. "TV helps us out because you can't see any spots that are thin or beat up, where we might have used grass clippings to hide any brown spots. There are 38 games on the two stadium fields over the 2 weeks and there isn't much time to get much done except the between game fixes on the mounds and batters boxes, dragging the infields, and of course putting down fresh lines." ■

Soil stabilization important for synthetic fields

BEAUTY CAN BE DECEIVING especially when a new synthetic field is completed. School administrators look at the pristine green surface, take their first steps on it and imagine the thrilling games it will host and the immense value it will provide as recruiting tool. But for many, it can also lead to heartache when imperfections begin to show more and more prominently; a portion of the turf puckering here, a persistent pool of water there, and humps or divots mysteriously materializing. All are generally signs of one thing: an improperly stabilized soil sub-base.

The most common mistake high schools, colleges and other organizations make when planning an artificial surface is failing to realize the importance of the sub-base. How important? It is not only essential to ensuring lasting value over a synthetic turf's 10-year life span, but a properly stabilized sub-base can last three synthetic turf life spans, 30 years. It's one reason why Byrne & Jones Sports recommends allocating $50,000 to $100,000 of a budget to fixing potential soil issues.

> When considering an investment of a $1 million or more in a new athletic field and subsequent replacement surfaces that will be needed every 10 years or so, it makes eminent sense to invest in a good sub-base.

One of the more common missteps in athletic field installations is becoming too enamored with compaction as a "catch all" solution to sub-base issues. Compaction is not a substitute for the stability of soil. You can compact a soil, test it to confirm all the air in the soil has been voided and still wind up with a mud bog. It is one of the more common issues we encounter when contacted to evaluate turf imperfections on surfaces we didn't install.

The ideal soil for synthetic fields is found in the northern states of Midwest farm country and is comprised of silt and top soil. In some areas, like Gary, IN the surface can appear to be the ideal silt/soil combination until you probe deeper and find that it's all sand 8 inches below the surface. Otherwise, clay soils tend to be most common problem. Clay will retain water and impede effective drainage. Water that persistently pools on a