CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

Spring 2002 • Volume 13 • Number 1

The World Series From the Ground Up

One of the more glamorous aspects of being the New York State Turfgrass Extension Specialist is when professional sporting events request my assistance. One such opportunity occurs on a regular basis with the New York Yankees baseball club.

Dan Cunningham is the head groundskeeper for the Yankees and a friend of mine from college many years ago when we studied at the University of Rhode Island. Like many of us who graduated from the URI program, Dan pursued his interest in turfgrass management on the golf course, working at Winged Foot Golf Course in Mamaroneck, NY. Until, that is, he was encouraged by Bob Alonzi to apply for a grounds position at Yankee Stadium almost 20 years ago.

Dan started out on the crew, working his way into the assistant's position and for the last several years has assumed the Head Groundskeeper position. Dan is aided in every aspect of field care by his assistant Rob Ley, as well as the staff of Steve, Horace and Tommy.

Given the dominance of the Yankees in the American League, it has been an exciting time in the Bronx for the last seven years, especially in Fall. For the last two years I have been able to attend the last game of the season at Yankee Stadium. Neither were the closing games of the World Series, since the Series was concluded, to different results, at the visitor's field. However, both games were memorable.

The Setup

I arrive at the field by noon the day of the game. The starting time for World Series games is generally around 8:00 pm. It is an

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This Times

Can We "Count" on You?

The turfgrass industry in New York is an important aspect of the state's agriculture yet it has not been properly assessed for its economic value to the state. The last survey of the industry was conducted in 1977 and clearly the industry has experienced substantial growth in the last two decades.

Industry surveys conducted in other states have resulted in substantial additional financial and legislative support from state governments. In some cases, several hundred thousand new dollars have been allocated to turfgrass research and education. This is a vital time for New York—with pending legislation and lack of effective pesticide alternatives—to invest in turfgrass research focused on environmentally responsible management. Your participation in a new turfgrass industry survey will help the process and could yield significant additional resources.

The New York State Department of Agriculture and Markets and the National Agricultural Statistics Office is preparing to conduct the survey in Fall 2002. The financial commitment from the state is expected to be over $100,000 while the industry will be asked to provide $65,000. The Board of Directors of the New York State Turfgrass Association has been actively and successfully advocating for this project and now needs your help. Work with

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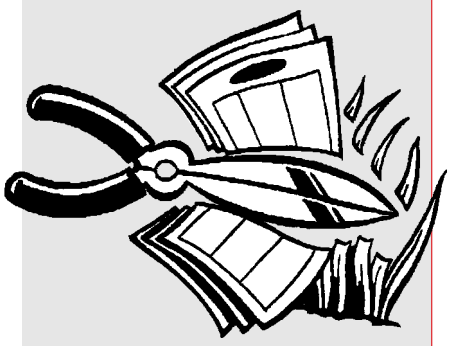
Clippings

Discussion is underway to develop a second Organic Turfgrass Management Short Course that might be offered at a few locations throughout New York.

NYSTA presented its highest honor, The Citation of Merit Award, to one of its most tireless supporters, Michael Maffei, CGCS, of Back O' Beyond, Inc.



Organic Short Course A Hit!

Over 70 turfgrass professionals and environmental advocates attended the inaugural offering of the Cornell Organic Turfgrass Management Short Course held at Bethpage State Park in January, 2002. The program was sponsored in part by the Nassau Suffolk Landscape Gardeners Association.

The four-day program provided a comprehensive overview of the latest research on managing turf areas organically. Specifically, a full day was spent discussing organic soil modification and developing an organic fertilizer program. Two full days were spent on cultural management of an organic lawn including solving pest problems with an organic approach.

Dave Catalano, the Superintendent of Bethpage State Park, and Pat Voges, of the Nassau Suffolk Landscape Gardeners Association, were instrumental in bringing the organic short course to Long Island. Catalano addressed the students and provided an overview of the Park and the environmental aspects of preparing for the 2002 US Open Championship. All five courses at the Park are Certified Audubon Cooperative Sanctuaries.

Discussion is underway to develop a second Organic Turfgrass Management Short Course that might be offered at a few locations throughout New York. If you'd like more information, contact the Director of Turfgrass Education Programs, Joann Gruttadaurio, at (607) 255-1792 or jg17@cornell.edu.

Maffei Receives Citation of Merit

The New York State Turfgrass Association presented its highest honor to one of its most tireless supporters, Michael Maffei, CGCS, of Back O' Beyond, Inc. The Citation of Merit Award was presented at the 26th Turf and Grounds Exposition in Syracuse, NY.

Michael is a native of Clinton, MA and graduated from the University of Massachusetts Turfgrass Program with honors. He has been at the Morefar Club as the Assistant and Superintendent since leaving UMass, but he has rarely confined his activities to one place.

Michael is a passionate industry advocate. He has been intimately involved with most of the major legislative concerns with the New York State Turfgrass Association for the last two decades. Additionally, he provides consistent leadership for the entire green industry with his involvement in a variety of advocacy initiatives. For this activity Michael has been recognized by the Metropolitan Golf Course Superintendent Association with the Sherwood A. Moore Award.

Michael is generous with his time in support of the turfgrass industry. He works tirelessly on causes he believes in and is able to convey confidence and sincerity that builds bridges among all involved.

CORNELL Turfgrass Short CUTT
Your Weekly Link to Turfgrass Information!

Curious?

Read a sample issue on page 18

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CUTT

Scanning the Journals

Fertilizer Effects on Microbes and Disease

Public concern regarding pesticide use continues to pressure the industry to develop non-chemical or organic pest control programs. In addition, there is growing interest in the use of organic fertilizers as a means of "enhancing" soil microbial activity. Only a few studies have explored the role of nitrogen and organic fertilizers with regard to the ability to suppress disease and the effect on microbial activity.

Researchers at the University of Maryland, led by Dr. Peter Dernoeden, conducted a study to investigate the influence of nitrogen fertilizer source on disease, leaf tissue nitrogen and soil microbial activity. This study was designed to supply equal amounts of nitrogen on an annual basis over a seven-year period. Fertilizer applications were made for four years prior to data collection.

Nitrogen sources included urea, sulfur-coated urea (SCU), Milorganite, Sustane Medium, Earthgro 1881 Select, Earthgro dehydrated manure, Ringer Lawn Restore, Com-Pro, and Scotts All Natural Turf Builder (ANTB). All treatments were applied at 1 lb. of actual N per 1000 square feet in October, November, December, and May for a total of 4 lbs. N per 1000 square feet for the season to a creeping bentgrass (Southshore) fairway turf.

There is an enormous amount of data reported from this study that includes the lack of season-long control of dollar spot regardless of treatment, the lack of effect on soil microbial activity, and the low correlation between tissue N level and dollar spot severity. Still, when disease pressure was low to moderately severe, Ringers Lawn Restore provided commercially acceptable dollar spot suppression, yet the compost products Com-Pro and Earthgro in most cases enhanced dollar spot development. It was speculated that carbon from wood bulking chips may have inhibited N release or provided a food source for the dollar spot organism.

The researchers concluded that any mechanism of dollar spot control from organic or synthetic organic materials is more likely related to nitrogen availability as they observed no meaningful microbe response. Much needs to be learned about the role of fertility on turfgrass pest management and this study lays an excellent foundation for future research.

From: Davis, J.G and P.H. Dernoeden. 2002. Dollar spot severity, tissue nitrogen and soil microbial activity in bentgrass as influenced by nitrogen source. Crop Science 42:480-488.

Alleviating Heat Stress

Cool season turfgrasses experience growth reductions under warm summer temperatures due to a variety of physiological factors. Most notably, there is reduced energy production from photosynthesis and significant energy consumption to replace growth removed by mowing. Much of the research in the last several years in this area conducted by Dr. Bingru Huang, formerly at Kansas State University and now at Rutgers University, has identified the role of root growth on summer decline.

The most recent studies conducted in Dr. Huang's lab have explored mechanisms of enhancing heat stress tolerance. Specifically, two studies were published that investigated the role of cytokinin (a plant hormone produced in roots) applications on heat stress tolerance.

Several rates of cytokinin delivered as zeatin riboside were applied to Penncross creeping bentgrass growing under fluctuating air and soil temperatures from 70° to 90°F. During the experiments conducted in a growth chamber, the plants were allowed to acclimate, then exposed to the heat stress conditions, then the rootzone was injected with the cytokinin treatment.

Results identified subtle alteration in leaf decline and cell membrane integrity most likely related to increased antioxidant production thought to be stimulated by the cytokinin treatment. Additionally, a companion study observed less reduction in turfgrass quality and shoot extension in heat stressed plants treated with the high rate of cytokinin.

These results add much to our understanding of how plants respond to heat stress and how possible reduced levels of cytokinin in the roots might be involved. However, one should exercise caution in extrapolating these results into field situations based on product variability and the dynamics of a managed turfgrass system.

From: Liu, X. and B. Huang. 2002. Cytokinin effects on creeping bentgrass response to heat stress. In two parts: Shoot and Root Growth and Leaf Senescence and Antioxidant Metabolism. Crop Science 457-471.

The researchers concluded that any mechanism of dollar spot control from organic or synthetic organic materials is more likely related to nitrogen availability as they observed no meaningful microbe response.

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Turfgrass Industry Survey

continued from page 1

your allied associations to provide financial support for the industry contribution and fill out the survey when it arrives this Fall. I hope we can count on you!

Overview

Turfgrasses represent one of the more important interfaces where people and plants come together, directly impacting the quality of human lives. Rough industry estimates extrapolated from the 1977 survey suggest that in New York State close to two million acres are covered with turfgrasses, consisting of lawns, parks, golf courses, sod farms, industrial and institutional grounds, rights-of-way, etc. About 321,000 acres of residential and commercial lawns are managed by lawn and landscape services. Of that acreage, approximately 50 percent lies in downstate New York (Westchester, Rockland, Nassau, and Suffolk Counties), where the landscape industry has traditionally been very strong. The approximately 800 golf courses in New York State cover at least 80,000 acres of intensively maintained turfgrass, again concentrated throughout urban areas of the state. In addition, there are over 200,000 acres of highly maintained turf and lawns in parks, public and private institutions, schools, cemeteries, and airports. The rest of the two million acres of turfgrass are lower maintenance areas, such as highway medians and the residential lawns or commercial grounds not serviced by the lawn care industry. Yet, while land estimates can be calculated, there is no current information available on the contributions of the turfgrass industry to the economy of New York State. The old data from 1977 estimated from $313 million to $595 million for total maintenance expenditures.

Several states (IA, WI, VA) have been attempting to determine the economic contributions of the turfgrass industry. Recently, the Virginia Agricultural Statistics Service, in partnership with the Virginia Turfgrass Council, reported a 66% increase in turfgrass acreage from 1982 to 1998, with a concomitant 400% increase in maintenance expenditures that exceeded $1.5 billion. This surpassed the combined cash receipts of all major agricultural commodities combined! Furthermore, in Virginia—a state barely 20% the size of New York—the industry created over 390,000 jobs with an annual payroll of $700 million. Finally, the Virginia study indicated that approximately $85 million was spent on goods, services and individuals outside the state. Therefore, a comparable analysis of the turfgrass industry in New York would fulfill a need to evaluate and assess the magnitude and economic potential of this important service sector industry.

The Project

Total maintenance expenditures for the New York State turfgrass industry was estimated to be between a $313 and 595 million in 1977. Since then no meaningful economic assessment of this important industry has been attempted. Therefore, the contribution of the turfgrass industry to the economy of New York and the opportunity for continued economic expansion cannot be fully understood or capitalized on until a thorough economic analysis is conducted. Consequently, the objective of this project is perform an economic survey of the turfgrass industry in New York.

The New York Turfgrass Economic Analysis (NYTEA) will be the centerpiece of an effort to capture the magnitude of the industry by assessing the overall amount of turfgrass acreage, including an analysis by sector, i.e. golf courses, sod farms, parks, schools, home lawns, athletic fields, and the like. Additionally, total expenditures for turfgrass maintenance that will include such items as paid labor, costs of establishing new turf areas, equipment, supplies, crop protectants, among others, will be calculated. Finally, an educational needs assessment that would aid the state agencies responsible for regulation will determine major turf problems, formal training programs and primary sources of information.

The NYTEA will highlight employment opportunities in the turfgrass industry that might not otherwise be known, identify opportunities for investment in new technologies, such as turfgrass seed production and compost operations, and attract allied industry investment in a state with significant economic resources allocated to turfgrass maintenance.

Objective

The objective of the NYTEA is to provide basis statistics that describe each of the individual industry segments (home lawns, highway roadsides, golf courses, sod farms, general areas, airports, athletic fields, cemeteries,

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Your participation in a new turfgrass industry survey this Fall will help the process and could yield significant additional resources. I hope we can count on you!

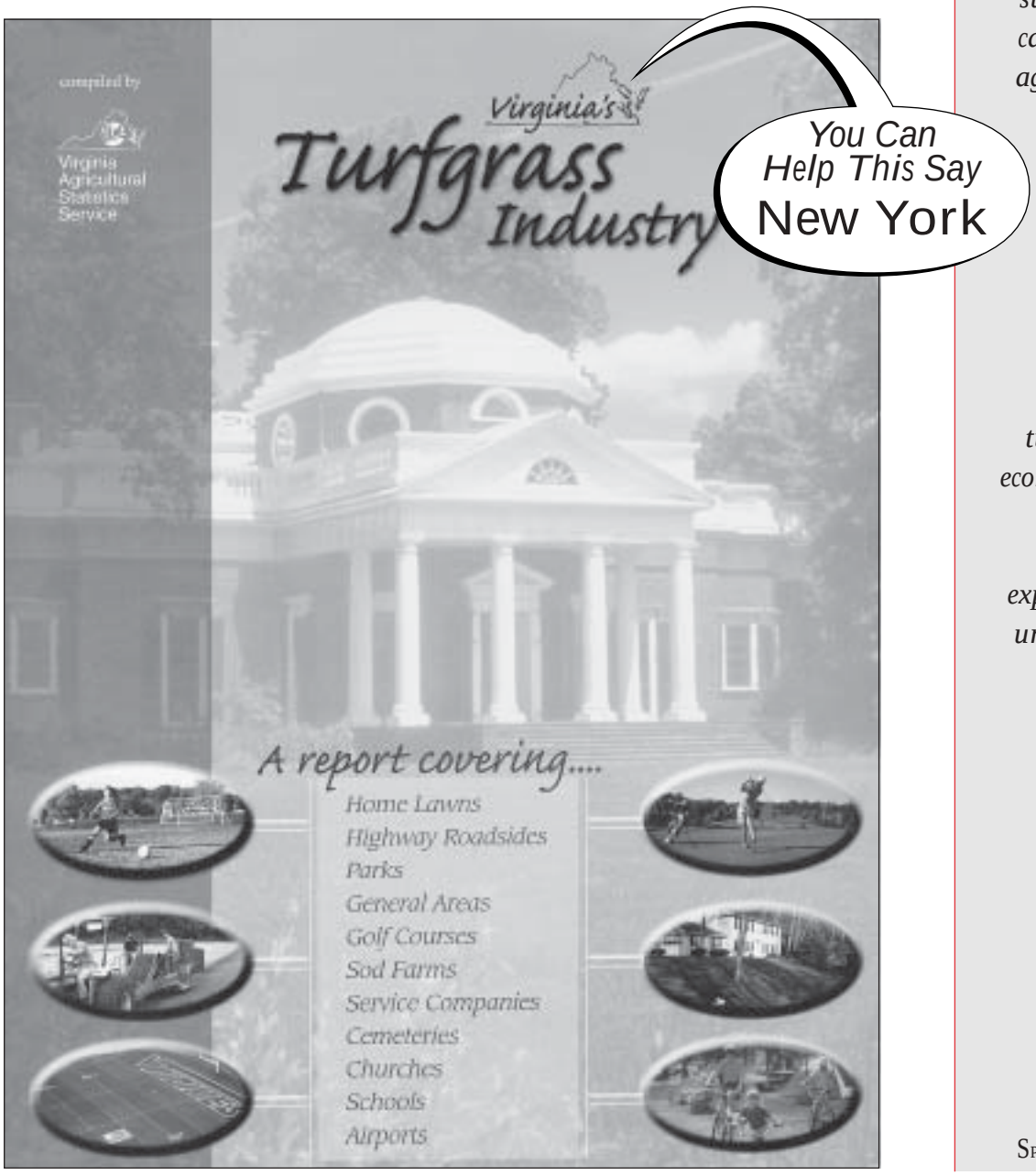
churches, parks, schools, and service companies) for:

- number of hired workers
- value of unpaid family labor
- equipment expenses
- non-equipment expenses
- paid labor expenses
- maintained acreage of turf
- capital improvement expenses

The NYTEA will deliver a comprehensive document that will serve as a basis for continued economic expansion (employment, equipment purchases, etc.) and investment in new technologies. In addition, this economic analysis will be useful for state agencies responsible for regulation by providing a more thorough understanding of the various expenditures, employment opportunities, and challenges facing New York's turfgrass industry.

It is safe to assume that based on the brief 1977 economic analysis of expenditures for turfgrass maintenance in New York and the recent publication of the Virginia Turfgrass Industry Survey that New York's turfgrass industry constitutes a multibillion dollar economic resource. It likely employs hundreds of thousands of citizens, utilizes taxable resources, and significantly supports local communities through tax revenue. Yet, without a properly implemented assessment, the understanding of this industry, as well as opportunities for growth, cannot be realized.

Frank S. Rossi



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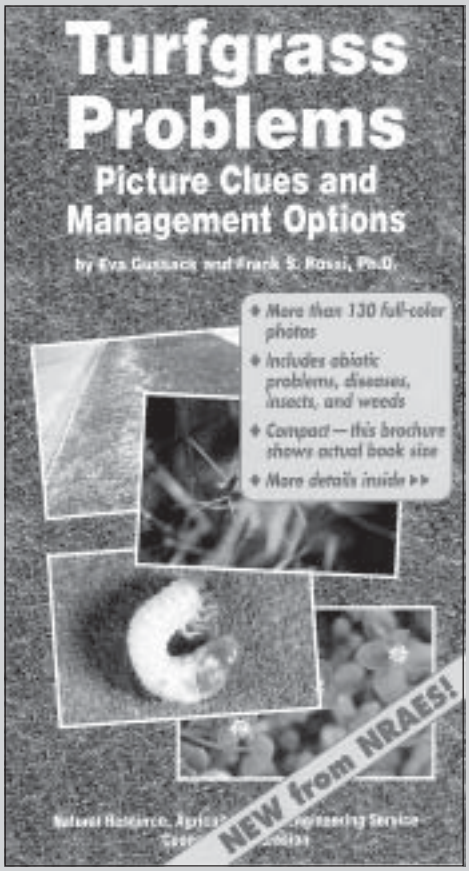
NYSTA members can order the Picture Clues guide for $18, a 30% savings off the retail price. Contact NYSTA at (800) 873-8873.

The Horticulture Elemental/Nutrient Analytical Laboratory, 20 Plant Science, Cornell University, Ithaca, NY 14853-5908; (607) 255-1785; www. hort.cornell.edu/department/facilities/icp/index.html.



*Note: photo does **not** show book at actual size.*

New 3rd Edition of Turfgrass Problems picture clues book now available!

- Triple the number of problems addressed in last edition
- New photos for each problem showing distant and close-up views
- Each problem now has detailed descriptions and cultural management options
- New sections on general problem solving skills and monitoring
- Unique pest timelines that tell when a certain disease, insect or weed is likely to emerge
- Extensive glossary included
- Still a handy pocket size guide

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Nonmembers contact NRAES at (607) 255-7654, nraes@cornell.edu, or www.nraes.org.

The Horticulture Elemental/Nutrient Analytical Laboratory is one of a small number of university laboratories nationwide dedicated to assisting growers and homeowners in evaluating the nutritional and environmental status of their plants, water and soil.

The lab has been performing plant nutrient analyses for growers and researchers since the 1950s. Cornell faculty work closely with lab personnel to provide fertilizer recommendations and consultations on growers' specific problems. Soil or plant samples may also be submitted for total carbon/nitrogen ratios.

In the last decade, lab services have expanded to include environmental testing of water, plants, amended soil, and sewage sludge. This provides homeowners, turf managers and municipalities with levels of potentially toxic heavy metals so that they can evaluate the safety of their environment. State-of-the-art plasma emission technology is used to provide simultaneous elemental analysis of 30 elements.

The Horticulture Elemental/Nutrient Analytical Laboratory is committed to quality data, and the operation is tested quarterly through the North American Proficiency Testing Service. Please contact the lab for more information on sample preparation, available services and prices. The Horticulture Elemental/Nutrient Analytical Laboratory, 20 Plant Science, Cornell University, Ithaca, NY 14853-5908; (607) 255-1785; www.hort.cornell.edu/department/facilities/icp/index.html.

World Series

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incredibly grueling time for the grounds crew who are there from the morning of the game to the early morning hours after the game. The day is busy with mowing, detailing and preparing the skin areas as well as the various oddball requests that come from the media for Dan and his crew.

In 2000, I had ringside seats for the Clemens vs. Piazza thrown bat incident. It was an exciting experience to watch a bunch of rather large men consider brawling on a world stage. The game itself was dominated by the Yanks who went on to close out the series in 5 games. However, this paled in comparison to the 2001 battle with the Arizona Diamondbacks.

As a rule I have avoided much commentary regarding the tragic events of September 11, 2001 in these pages. However, it is impossible to fully appreciate the ambiance at the stadium that early November evening for the Series' 5th game—the final game at Yankee Stadium in 2001—without recalling that horriffic disaster: the deep sense of reverence for those who lost their lives, the Challenger Eagle flying in on cue during the National Anthem, the ragged flag from the World Trade Center, the moving performance of the Harlem Boys Choir, visiting with some of New York's Finest. These would have been enough to ensure a memorable evening, but there was more.

The Game

The game the night before ended in dramatic fashion with Tino Martinez tying the game in the 9th inning with two outs. Derek Jeter came up in the 10th inning to hit a home run and bring the Yankees into a series tying 2 games to 2. Upon my arrival for the 5th game, the stadium was both electric and subdued as well as under tight security. Most all the staff was there late the night before and up early this day to prepare for the game. All I heard was, "you shoulda been here last night, nothing can compare."

The Yankees continued to struggle at the plate, hitting well below .200 for the Series, and fell behind 2-0. It remained 2-0 into the 9th innning as Paul O'Neil approached the plate for what he expected was his final at bat in Yankee Stadium. With one out, Jorge Posada doubled, then the second out was made and Scott Brosius approached the plate. To start the 9th the Diamondbacks had brought in their closer Byung-Hyun Kim who was burned the night before for the Yankees win. Could lightening strike twice?

The buzz began among photographers where I was sitting, but no one could have believed it. With two strikes and the pitch on its way, time seemed to stand still.

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One of the more glamorous aspects of being the New York State Turfgrass Extension Specialist is when professional sporting events request my assistance.

Top: the Challenger Eagle flew in for the National Anthem. Middle: the World Trade Center flag flies over center field. Bottom: the grounds crew prepares for batting practice for Game 5.

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The ball left Kim's hands and Brosius lifted it into the left field seats to tie the score and the place erupted. In all my years as a sports enthusiast and rabid Yankee fan I have never experienced as much excitement as I did in the last few innings of this game.

The Yankees held off a rally in the top of the 11th as the Diamondbacks got to the Yankees' ace closer Mariano Rivera. This situation would repeat itself in the 7th game and bring Arizona their first championship. However, the 5th game and a 3-2 series lead belonged to the Yankees as Alfonso Soriano singled and Chuck Knoblauch beat the throw in a dramatic play at home plate in the 12th inning for the Yankees' win.

The Aftermath

My voice was gone and the crew needed to secure the field while the media circus began. Paul O'Neil garnered much of the spotlight in spite of the heroics of Brosius, Knoblauch and Soriano. Paul was a Yankees favorite and the hard-working intense kind of player that appealed to demanding Yankees fans.

The season for the crew had closed on the highest of notes. Dan and his crew were physically exhausted yet they were clearly a part of one of the greatest two games in World Series history. This is a crew that seems to cherish anonymity. They do their job best when they are not noticed. Still, the players and Mr. Steinbrenner appear to appreciate the consistent playing conditions that in some small way have contributed to an amazing run.

While the Yankees did not prevail in the Series, New York City got the gift of joy for a few days on the heels of an enormous tragedy. I am not a philosopher or a sociologist, but I am a New Yorker. It is hard to say that a game can be such an important part of our social fabric, but last November in New York it proved true and those who lost loved ones received a brief, joyous respite from their grief.

For a moment time stopped and 60,000 people knew they were part of something special. For me it may have been the first time I was not thinking about the grass because so much around me seemed unbelievable!

Frank S. Rossi

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This page top: the Harlem Boys Choir entertains the sold-out crowd. Bottom: Rob Ley of the grounds crew prepares to draw base lines. Opposite page top: fans salute Paul O'Neill's final game in Yankee Stadium. Middle: first base adorned with the World Series logo. Bottom: members of the press capture the action.

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CUTT

Program Spotlight

Research from 1999 to 2001 found that Junction provides consistent moss control. Field research from 2001-2002 provided added evidence regarding Junction's effectiveness, allowing us to more clearly define application parameters.

Cornell Researchers Tackle Moss Control

Bryum argenteum, silvery thread moss, continues to be a significant pest problem on golf courses throughout the United States. Superintendent surveys conducted by Cornell University researchers indicated that close mowing, low soil potassium levels and surface organic matter accumulation correlate highly with increased moss invasion. Additionally, observations suggest that the lack of metal-based fungicides, particularly mercury (Hg), have led to persistent moss invasion.

Postemergence control programs have been reported with variable success. Recently, anecdotal evidence indicates spot treating with Ultra Dawn dish detergent can reduce moss populations but it appears to require consistent follow-up. Here at Cornell we built upon observations from Oregon State University to develop consistent postemergence moss control programs with copper hydroxide based materials such as Kocide and Junction.

Research from 1999 to 2001 found that four to seven applications of 5 ounces of Junction applied between October and December at two-week intervals in 2 gallons of water per 1000 square feet provides consistent moss control. Further research explored the prevention of moss establishment under controlled environmental conditions with multiple low rate (1 ounce) applications of Junction. Questions remained regarding the influence of less than 2 gallons of spray volume, pH of the spray solution and field testing of the prevention program.

Field research from 2001-2002 provided added evidence regarding Junction's effectiveness, allowing us to more clearly define application parameters. A spray volume study looked at Spring vs. Fall applications of 5 ounces of Junction in 0.5, 1.0, 2.0 or 4.0 gallons of water per 1000 square feet. Again, Spring applications are less effective than Fall (see Figure 1). Also 2 gallon spray volume is most effective, providing 40% control, while the 1 gallon spray volume provided almost 30% control.

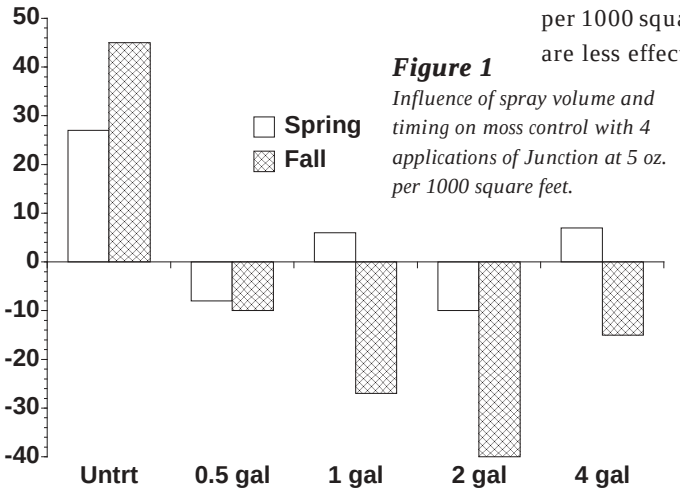
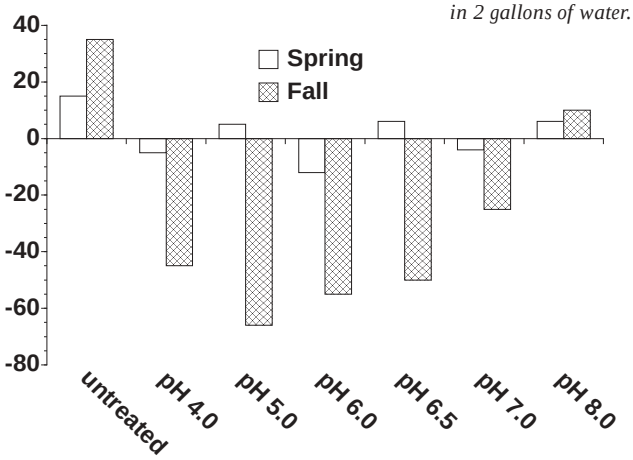


Figure 1
Influence of spray volume and timing on moss control with 4 applications of Junction at 5 oz. per 1000 square feet.

Figure 2
Influence of spray solution pH and timing on moss control with 4 applications of Junction at 5 ounces per 1000 square feet and applied in 2 gallons of water.



A Second Study

Another study looked at similar application rates of Junction (5 ounces) at 2 gallons spray volume in solutions of pH 4.0, 5.0, 6.0, 6.5, 7.0 and 8.0. Fall applications of spray solutions at or below 6.5 provided excellent moss control (see Figure 2). Also, a 0.5 unit increase from 6.5 to 7.0 reduces moss control almost 50%.

Interestingly, as spray solution pH decreased bentgrass injury (yellowing) increased. We determined from tissue samples that iron uptake is reduced as compared to untreated tissue iron levels. A follow up application of iron sulfate seemed to reduce the yellowing and increase iron tissue levels, but more work is needed to determine the role of iron and injury.

The final 2001 study field tested the prevention program identified in the growth chamber. Weekly applications of 0.25, 0.5, 1.0, 1.5 or 2.0 ounces of Junction at the 2 gallon spray volume were made to an area without moss. Similar to growth chamber findings the weekly 1 ounce application completely prevented moss establishment (see Figure 3). Plots treated with rates above 1 ounce developed the yellowing observed in the spray pH experiment. Again these were alleviated with applications of iron.

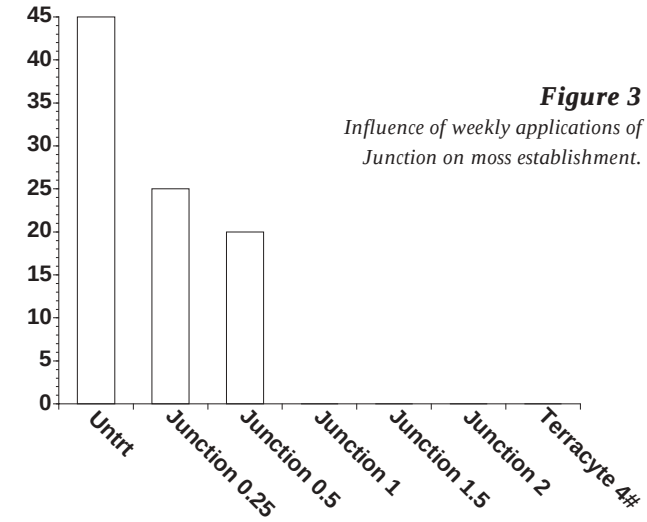


Figure 3
Influence of weekly applications of Junction on moss establishment.

A second series of experiments evaluated Terracyte, a sodium perchloride and lime based product for moss control. Spring applications were slightly less effective than Fall treatments for moss control (see Figure 4). This is consistent with observations of Junction efficacy on moss. Apparently moss begins an acclimation period in response to day-length and temperature. This acclimation either enhances susceptibility or reduces the recuperative ability of the moss.

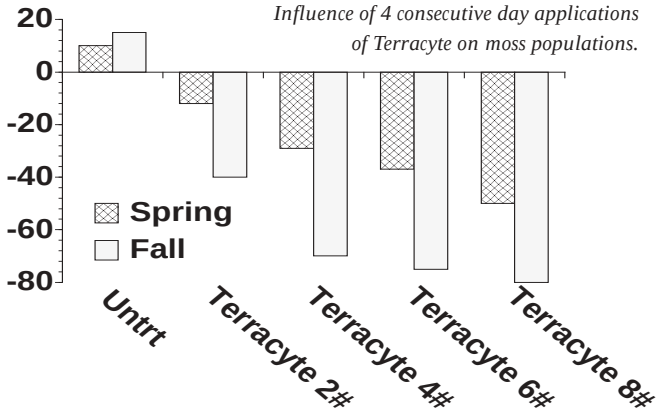


Figure 4
Influence of 4 consecutive day applications of Terracyte on moss populations.

This has been exceptionally productive research, building on initial observations. Follow up research more thoroughly refined application parameters and should result in excellent moss control programs. Financial support from Tri-State Research Foundation and Metropolitan Golf Course Superintendent Association, supplemented by Griffen LLC and the Hudson Valley Superintendents, helped make it possible. We are grateful for this support and look forward to further interaction with these outstanding organizations.

Frank S. Rossi

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Organic Weed Control

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repeated applications may be necessary. The highest concentration of acetic acid (20%) gave better control than lower concentrations. Commercial formulations and the 20% acetic acid treatment provided better control than pelargonic acid in most cases in this study.

Glyphosate was the most effective herbicide, continuing to show excellent control of virtually all weed species at week 13. Acetic acid is quite costly compared to pelargonic acid or glyphosate, especially when three applications are needed to achieve good control. However, some pesticide applicators may opt to use acetic acid despite higher costs if legislation encourages the use of nontraditional pesticides, and acetic acid is seen as an environmentally-friendly alternative. Possible ways to improve the performance of acetic acid and thereby reduce cost per square foot should be examined. Although the plots where this study was conducted were irrigated, overall droughty conditions during the summer of 2001 may have influenced herbicide performance, making it desirable to repeat this work under conditions of "normal" rainfall and earlier in the year. Plots with more consistent weed species populations would also allow a meaningful statistical analysis to be generated.

David Chinery and Leslie Weston

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Program Spotlight

A variety of federal, state and local legislation mandates the reduction or elimination of chemical pesticide use in turfgrass management. Commercial landscapers, turfgrass managers, sports field managers, and golf course superintendents are therefore more interested in low-toxicity or "organic" products than ever before.

How Well Does Organic Weed Control Work?

A variety of federal, state and local leg islation (either proposed or recently enacted) mandates the reduction or elimination of chemical pesticide use in turfgrass management. Commercial landscapers, turfgrass managers, sports field managers, and golf course superintendents are therefore more interested in low-toxicity or "organic" products than ever before.

Professionals and homeowners constantly ask Cooperative Extension Educators about alternatives to pesticides for turfgrass management. A specific interest is in alternatives for the broad-spectrum herbicides, such as glyphosate (sold as "RoundUp" or other trade names). Broad-spectrum herbicides are used in a variety of turfgrass and landscape renovation projects, such as the removal of an existing turfgrass area to install new sod or seed, the removal of turfgrass for other landscaping projects, or general weed management in paved and graveled areas. While a new lawn or garden bed can be managed without pesticides, a broad-spectrum herbicide is generally needed to create a new bed or lawn, since the other alternatives (i.e., stripping the existing sod with a sod cutter, rototilling the existing sod into the soil, etc.) are often not practical or desirable.

Recently, a great deal of interest has been expressed in the use of acetic acid (vinegar) as a broad-spectrum herbicide. While anecdotal reports of success with vinegar have been published in the popular press and on the internet, research to substantiate these claims is limited. A keyword search on Michigan State's Turfgrass Information Center, a vast database of turfgrass abstracts, produced only five matches for acetic acid, none of which detailed its use as a herbicide. At least two acetic acid-based herbicides were commercially available for the 2001 grow-

Table 1. Treatments, Manufacturers and Treatment Schedules.

Treatment Number	Treatment Name and Active Ingredient	Manufacturer	Treatment Schedule
1	Nature's Glory Weed and Grass Killer (25% acetic acid)	Monterey Lawn and Garden Products	Sprayed once at 0 days
2	Nature's Glory Weed and Grass Killer (25% acetic acid)	See above	Sprayed 3 times (at 0, 7, and 14 days) or as per label directions
3	BurnOut Weed and Grass Killer (25% acetic acid)	St. Gabriel Laboratories	Sprayed once at 0 days
4	BurnOut Weed and Grass Killer (25% acetic acid)	See above	Sprayed 3 times (at 0, 7, and 14 days) or as per label directions
5	Scythe (57% pelargonic acid, 3% related fatty acids)	Mycogen, Inc.	Sprayed once at 0 days
6	Scythe (57% pelargonic acid, 3% related fatty acids)	See above	Sprayed 3 times (at 0, 7, and 14 days) or as per label directions
7	5% acetic acid	Mallinckrodt, Inc.	Sprayed once at 0 days
8	5% acetic acid	See above	Sprayed 3 times (at 0, 7, and 14 days)
9	10% acetic acid	See above	Sprayed once at 0 days
10	10% acetic acid	See above	Sprayed 3 times (at 0, 7, and 14 days)
11	20% acetic acid	See above	Sprayed once at 0 days
12	20% acetic acid	See above	Sprayed 3 times (at 0,7, and 14 days)
13	RoundUp (glyphosate)	Monsanto, Inc.	Sprayed once at 0 days
14	Check		

Table 2. Weed Populations for Three Replicate Plots

Replicate Number	Weed Population
1	70% quackgrass (*Elytrigia repens*), 20% crabgrass (*Digitaria sanguinalis*), 10% ground ivy (*Glechoma hederacea*)
2	90% ground ivy, 5% dandelion (*Taraxacum officinale*), 5% violet (*Viola sp.*)
3	60% plantain (*Plantago major*), 20% Kentucky bluegrass (*Poa pratensis*), 10% dandelion, 10% ground ivy

ing season. Numerous other "recipes" for acetic acid herbicides exist using store-bought vinegar (which contains about 5% acetic acid). This project addressed the lack of data by evaluating the broad-spectrum herbicidal activity of two new acetic acid type herbicides, one herbicidal soap (containing pelargonic acid), three treatments of commercially available acetic acid, and a traditional herbicide.

Objectives and Procedures

1. Observe and document the *initial damage* done to turfgrass species and lawn weed species by two new acetic acid type herbicides, one herbicidal soap (containing pelargonic acid), three treatments of commercially-available vinegar, and a traditional herbicide.

2. Observe and document the *long-term control* (with some use of repeated applications) of turfgrass species and lawn weed species by two new acetic acid type herbicides, one herbicidal soap (containing pelargonic acid), three treatments of commercially-available vinegar, and a traditional herbicide.

The treatments, manufacturers and treatment schedules are shown in Table 1.

The study was to be conducted at the City of Troy Golf Course on unirrigated rough areas. However, in 2001 the Capital District experienced prolonged dry weather starting in May, and turfgrass went into an early dormant period. Thus, the starting date for the study was delayed in the anticipation that rain would soon fall and turf would initiate growth. When this did not happen, the study was conducted in August on a partially irrigated lawn at the project leader's property in Castleton, NY.

Applications for each product were made either once (at 0 days) or three times (at 0, 7 and 14 days), except for glyphosate, which was applied only once. Each treated plot measured 3 ft. by 3 ft. Plots were arranged randomly within the block. Each treatment was replicated three times. Weed populations varied somewhat among the replicates (see Table 2). All treatments were evaluated at 6, 24, and 72 hours and one week after each application, then periodically thereafter. A 0-100% visual rating scale was used, with 0 appearing like the check plots (no injury) and 100% appearing as total injury. Visual symptoms of injury (i.e., twisted foliage, discoloration, necrosis, etc.) were noted for each plant species. Weed populations varied among the replicates, as described in Table 2. Since prolonged warm Fall weather encouraged plant growth, observations were continued until October 31.

Results and Discussion

Since the results for each set of replicate plots were so different, data for the three replicates is shown individually in Tables 3 and 4.

Initial Damage

All acetic acid treatments caused discoloration and damage (control) to the plots by the 6 hours posttreatment observation. Initial damage for all weed species was a dramatic discoloration and necrosis, with foliage quickly becoming blackened and water-soaked. No twisting or yellowing was seen for any treatment or species. Initial control was rated at 90 to 100% for all of the treatments containing acetic acid, except for the 5% treatments, where for the Replicate 2 plots damage was rated at 70 to 85%. Ground ivy was thus seen to be initially slightly more resistant to lower concentrations of acetic acid. By the 24 hours after treatment observation, however, the control in the Replicate 2 plots had increased to 95% (see Tables 3 and 4). By the 72 hours after treatment observation, control in all plots with an acetic acid product was 95 to 100% (data not presented).

Plots Sprayed With One Application (1x Plots)

Data for plots sprayed with one application are shown in Table 3. Nature's Glory and BurnOut performed similarly, giving an average control for all replicates well above 90% after 24 hours and at two weeks. At five weeks, good control was still seen except for one Replicate 3 plot where aggressive Kentucky bluegrass regrew. At nine weeks and beyond, control was significant only in Replicate 2 plots (with ground ivy). The 20% acetic acid performed

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Organic Weed Control

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All treatments of acetic acid provided excellent control of crabgrass and broadleaf plantain

Ground ivy appears to be very susceptible to acetic acid. Virtually all treatments provided excellent initial and long-lasting control of this difficult-to-manage species.

Although all of the acetic acid treatments did a good job of initially controlling quackgrass, it regrew by the 9 week observation date for many treatments, and by 13 weeks, the percentage of quackgrass for many treatments increased beyond what was initially seen in the plots.

Table 3. Percent Control for Selected Dates for Plots Sprayed with One Application (1x Plots)

Product	Treatment	Replicate	24 Hours	2 Weeks	5 Weeks	9 Weeks	13 Weeks
Nature's Glory	1	1	100	90.0	80.0	15.0	10.0
		2	90	99.0	95.0	90.0	90.0
		3	98	95.0	85.0	40.0	30.0
		average	96.0	94.7	86.7	48.3	43.3
BurnOut	3	1	100	98.0	90.0	60.0	20.0
		2	95	100.0	95.0	85.0	80.0
		3	95	95.0	60.0	15.0	10.0
		average	96.7	97.7	81.7	53.3	36.7
Scythe	5	1	100	90.0	50.0	10.0	10.0
		2	98	99.0	95.0	80.0	80.0
		3	98	90.0	40.0	10.0	5.0
		average	98.7	93.0	61.7	33.3	31.7
5% Acetic Acid	7	1	100	40.0	5.0	5.0	5.0
		2	85	99.0	95.0	85.0	85.0
		3	95	85.0	40.0	10.0	10.0
		average	93.3	74.7	46.7	33.3	33.3
20% Acetic Acid	11	1	100	90.0	85.0	50.0	30.0
		2	95	100.0	98.0	98.0	98.0
		3	100	98.0	95.0	80.0	70.0
		average	98.3	96.0	92.7	76.0	66.0
Glyphosate	13	1	90	100.0	100.0	95.0	90.0
		2	0	98.0	100.0	100.0	100.0
		3	70	95.0	98.0	95.0	95.0
		average	53.3	97.7	99.3	96.7	95.0

slightly better than the commercial products, maintaining an average control of 92.7% at five weeks, and 76% at nine weeks. The 5% acetic acid treatment showed good control in Replicate 1 for less than two weeks, and for less than five weeks in Replicate 3, making it much less favorable than the higher concentration treatments. Scythe showed good weed suppression for less than five weeks in Replicates 1 and 3, with good control seen for 13 weeks in Replicate 2. Glyphosate, as expected, provided 90% or better control from two weeks to 13 weeks.

Plots Sprayed With Three Applications (3x Plots)

Data for plots sprayed with three applications are shown in Table 4. Nature's Glory and BurnOut again performed similarly, showing

Table 4. Percent Control for Selected Dates for Plots Sprayed with Three Applications (3x Plots)

	Treatment	Rep.	24 Hours	2 Weeks	5 Weeks	9 Weeks	13 Weeks
Nature's Glory	2	1	100	98.0	95.0	70.0	20.0
		2	90	100.0	100.0	98.0	90.0
		3	100	100.0	98.0	75.0	50.0
		average	96.7	99.3	97.7	81.0	53.3
BurnOut	4	1	100	98.0	90.0	60.0	20.0
		2	90	100.0	100.0	98.0	95.0
		3	100	100.0	100.0	95.0	80.0
		average	96.7	99.3	96.7	84.3	65.0
Scythe	6	1	100	98.0	98.0	20.0	5.0
		2	98	100.0	98.0	95.0	92.0
		3	98	98.0	90.0	40.0	40.0
		average	98.7	98.7	95.3	51.7	45.7
5% Acetic Acid	8	1	100	98.0	90.0	25.0	10.0
		2	70	100.0	100.0	98.0	98.0
		3	100	98.0	95.0	70.0	60.0
		average	90.0	98.7	95.0	64.3	56.0
20% Acetic Acid	12	1	100	98.0	98.0	85.0	60.0
		2	95	100.0	100.0	98.0	98.0
		3	100	100.0	98.0	92.0	85.0
		average	98.3	99.3	98.7	91.7	81.0
Glyphosate	13	1	90	100.0	100.0	95.0	90.0
		2	0	98.0	100.0	100.0	100.0
		3	70	95.0	98.0	95.0	95.0
		average	53.3	97.7	99.3	96.7	95.0

control at 90% or above for at least five weeks. By nine weeks, Kentucky bluegrass and quackgrass began to regrow, and average control slipped to just above 80%. After 13 weeks, control of 90% or above was seen only in the Replicate 2 plots on ground ivy. The 20% acetic acid treatments again showed slightly better control than the commercial products, with an average control of better than 90% maintained to nine weeks, and 81% after 13 weeks. Why there was better performance is unknown. The 5% acetic acid treatment showed surprisingly good control of 90% or better to five weeks, but proved much less effective at nine and 13 weeks. Scythe showed 90% or better control at the five week observation, but regrowth was significant thereafter, with only 20% and 40% control in the Replicate 1 and 3 plots, respectively, by the nine week observation.

Observation of Individual Weed Species

Crabgrass and Broadleaf Plantain: All treatments of acetic acid provided excellent control of crabgrass and broadleaf plantain, two annual weeds, with virtually no regrowth of these species during the 13 weeks and no new seedlings were observed. If this experiment took place earlier in the growing season, or under less droughty conditions, it is unknown if regrowth or seedling germination would have occurred.

Ground Ivy: Ground ivy appears to be very susceptible to acetic acid (see Replicate 2 data in Tables 3 and 4). Virtually all treatments provided excellent initial and long-lasting control of this difficult-to-manage species. Control with acetic acid in the Replicate 2 plots was still 80% or better for the 1x plots and 90% or better for the 3x plots. Pelargonic acid also performed well on ground ivy (80% control in the 1x plots and 92% control in the 3x plots after 13 weeks) as did glyphosate (100% control after 13 weeks).

Quackgrass and Kentucky Bluegrass: Although all of the acetic acid treatments did a good job of initially controlling quackgrass, it regrew by the 9 week observation date for many treatments, and by 13 weeks, the percentage of quackgrass for many treatments increased beyond what was initially seen in the plots (see Table 5). In most cases, the increases were less for the 3x plots than the 1x plots. One acetic acid treatment (20% acetic acid in the 3x plots) saw a dramatic decrease in quackgrass, however. Why this happened is unclear and the use of this type of treatment on quackgrass, bluegrass and other perennial, rhizomatous grasses should be investigated further.

Herbicide Costs

Cost per liter of some of the products used in this study as well as the cost to treat a 1,000 square foot area is in Table 6. Costs shown are for products purchased locally in the Troy, NY, area. The commercial acetic acid herbicide shown is more than three times as costly per square foot than glyphosate, and almost three times as costly as pelargonic acid. Acetic acid can be used at the 5% rate at an attractive price, but its effectiveness is limited. If 20% acetic acid or a commercial formulation must be sprayed three times to achieve effective control of most species, the cost per square foot increases accordingly.

Table 5. Percentage Change in Quackgrass and Kentucky Bluegrass After 13 Weeks

Treatment	Rep.	% change in quackgrass	% change in Kentucky bluegrass
Nature's Glory (1x)	1	20	
	3		36
Nature's Glory (3x)	1	6	
	3		30
BurnOut (1x)	1	-2	
	3		7
BurnOut (3x)	1	10	
	3		-2
Scythe (1x)	1	20	
	3		37
Scythe (3x)	1	15.5	
	3		28
5% acetic acid (1x)	1	25	
	3		61
5% acetic acid (3x)	1	15.5	
	3		20
20% acetic acid (1x)	1	0	
	3		4
20% acetic acid (3x)	1	-40	
	3		-6.5
Glyphosate	1	-64	
	3		-17.5

Future Research

This study showed that acetic acid is a useful herbicide. Acetic acid at 5% concentration (as would be found on the supermarket shelf) provided only short-term control of most perennial weeds, but did effectively control crabgrass and plantain. Three applications of acetic acid were seen to be much more effective than one application in most cases. Pesticide applicators following the advice of various gardening media who suggest vinegar as an herbicide should be aware that

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Table 6. Retail Cost Per Liter and Cost of Treating 1,000 Square Feet for Selected Herbicides

Product Name	Retail Cost/Liter	Cost/1,000 square feet
Nature's Glory Weed and Grass Killer (acetic acid)	$6.27	$38.87
Scythe (pelargonic acid)	$9.95	$19.90
17.4 M acetic acid (at 5% concentration)	$10.28	$10.28
17.4 M acetic acid (at 20% concentration)	$10.28	$41.12
RoundUp (glyphosate)	$51.85	$12.34

Point Source Pollution Prevention

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Point source pollution at turfgrass facilities can be the result of accidental spills of chemical concentrate, improperly contained pesticide management facilities, equipment washing areas, or subsurface drainage systems that discharge directly into surface water bodies. Many of these activities are centered at the maintenance facility and can be addressed with proper planning and design.

Storage facilities should have impervious flooring, either poured concrete or steel, and be kept locked at all times. The building should have good ventilation, shelving should be non-wooden and all light fixtures should be explosion proof. Solid materials should always be stored above liquids and absorbent floor sweep materials should be on hand for spills.

From an environmental perspective, was there consideration for proximity to sensitive areas such as surface water bodies, wetlands or well heads? There might be instances when the most efficient working location will create environmental concerns. In this case, proper design could mitigate any problems.

There are practical considerations for designing a facility where equipment will be stored. The building should have plenty of floor storage space and wide, well positioned openings for efficient traffic flow. There are few things more frustrating than having to move three or four pieces of equipment to get to a necessary item.

The design of a building that secures environmental quality is focused on containment. Specifically, containment of all potential pollutants from soil and water and only allowing clean stormwater to be discharged onto the ground or into surface water bodies.

Chemical Containment

Containment begins with recognizing the potential pollutants around the maintenance facility. The obvious, fertilizer and pesticide storage, but also fuel storage, debris from equipment waste, and equipment lubricants and cleaners require specific containment. “Source prevention,” says Charles Peacock of North Carolina State University, “precludes the possibility of movement of sediment, nutrients or pesticides from the property or from toxic materials being introduced into ecologically sensitive areas.” This includes reducing the amount of material stored at the maintenance facility.

An effective Integrated Pest Management (IPM) program that establishes tolerances and action thresholds is the cornerstone for reducing storage requirements. For example, on fairway turf, chemical storage needs are reduced if no preventative controls are applied, some injury is tolerated, and only infected areas are spot treated.

The safe storage of chemicals requires the recognition that only persons trained to handle chemicals will be exposed. A recent survey of golf course best management practices (BMP) to protect water quality in the Northeast United States, conducted by Cornell University, found that 20% of the respondents stored chemicals in the maintenance building with other equipment and supplies. Thirty eight percent have a dedicated storage facility. This same survey revealed that 85% of pesticide and fertilizer storage and handling areas were greater than 100 feet from the nearest surface water body or well.

Storage facilities should have impervious flooring, either poured concrete or steel, and be kept locked at all times. The building should have good ventilation, with some states requiring that the air be capable of being changed 6 times per hour. Shelving should be non-wooden and all light fixtures should be explosion proof. Solid materials should always be stored above liquids and absorbent floor sweep materials should be on hand for spills.

An equipment washing facility.

Handle with Care

Once chemical handling begins, the risk to the environment increases exponentially. In recognition of this there has been some research conducted with direct injection spray units. First developed for agricultural applications, these units are designed to leave the concentrate in the original container and to carry a large tank of clean water. There are many benefits to this technology beyond reduced mixing risk that includes not having to carry and clean 100-200 gallons of pesticide solution, minimize product waste by using only the concentrate needed, and increased ease of spot treating.

Chemical handling areas can reduce environmental risk by having a poured concrete floor able to contain 120% of the largest volume container, a sump where rinsate and spills can be cleaned and recycled, and preferably be covered. Rinsate tanks should be placed on the containment pad. After a pesticide application, equipment should be triple rinsed—including the exterior—to remove chemical contaminants.

Equipment Washing

Regular equipment washing should not take place in the chemical containment area. For example, with a completely contained chemical area the collection of equipment debris would burden the sump and rinsate system not designed for particulate matter. A dedicated equipment washing area is also critical for environmental safety.

"The simple objective of the washing operation," says Greg Lyman, Turfgrass Environmental Education Specialist at Michigan State University, "is to remove clippings from the equipment so it's clean for the next use." Lyman continues, "While engine cleaning is not the target of the daily wash process, petroleum products can be dislodged from grease fittings, engines or hydraulic systems." As a result, nutrients in clippings, soil particles, and hydrocarbons from engine fluids can contaminate water bodies if not properly contained.

Equipment washing systems are not commonplace at most maintenance facilities. The Cornell University BMP survey found that only 13% of respondents had a filtration system associated with equipment washing. In fact, 60% of all respondents allow water to directly percolate into the soil, with no mention of how debris is managed. Interestingly, 45% of the respondents used compressed air to remove clippings from equipment before washing. In this case, the clippings and debris are easily collected and used for composting.

Equipment wash station systems include where the water is treated through specialized equipment and where the clippings are separated from the water so that the water can be discharged on-site. On-site closed loop systems are by far the most sophisticated and expensive treatment system available. This system recycles the wash water so that there is no discharge from the system. There are a variety of filter systems that can include ozone infusion and biological digestion. These systems trap and process petroleum products, nutrients and other organic waste.

Separation systems are less expensive than treatment systems, but because the water is not treated, the discharge needs to be more controlled. Also, more care must be taken to not remove engine fluids and grease into the wash water. A simple "dog leash" system requires that the equipment be washed on a turf area and regularly moved to avoid puddling and excess clipping accumulation. Also, catch and release systems capture the clippings with screening and then water is allowed to infiltrate either into the soil or discharged into a septic tank-like system. Regardless of the type of separation system, there should be no direct discharge of the wash water or clippings into surface water bodies.

Get Help!

A myriad of demands and expectations continues to force most golf course superintendents to seek expert advice on environmental quality issues. Many surveys indicate that a primary source of information is superintendent colleagues. This is a good place to start before embarking on building a maintenance facility to improve environmental protection.

Be sure consult with local planning officials as well as EPA personnel for any specific regulations. Next, programs such as Audubon International and the Michigan Environmental Stewardship Program can provide suggestions for facilities looking to upgrade. This will lead to further interaction with superintendents about what works and doesn't. Protecting the environment from point source pollution around the maintenance facility does not have to cost more, nor compromise function.

Frank S. Rossi

CUTT

Equipment washing and engine cleaning can result in clippings, soil particles, and hydrocarbons from engine fluids contaminating water bodies if not properly contained.

A myriad of demands and expectations continues to force most golf course superintendents to seek expert advice on environmental quality issues. A primary source of information is superintendent colleagues. Also consult with local planning officials as well as EPA personnel for any specific regulations. Programs such as Audubon International and the Michigan Environmental Stewardship Program can help. Protecting the environment from point source pollution around the maintenance facility does not have to cost more, nor compromise function.

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April 5, 2001
Week 2

Weather Highlights

- **Temperatures:** Cold this past week. Temps were 4° to 5.5° ↓for most of the region, 6° to 7° ↓ to the south and warmest to the west, 2° to 4° ↓.
- **GDD:** None accumulated this past week. This time of year NYC south would see 30 to 40 and points north should have accumulated ~ 10 to 20.
- **Precipitation:** Abundant across the region. 1" to 2" for most of us. Driest to the west < 0.25", 0.5" across central PA and the highest amounts NYC area with 3".
- **ET:** 0.25" for the region. ET at this time of year can be critical when annual bluegrass suffers winter injury and lower plant crown damage that inhibits early spring rooting.
- **Soil Temperatures:** 36° at 2" in Geneva, 40° at 2" Philly and mid 40°'s as you move west.
- **Forecast for the Coming Week:** Expect a change in the weather pattern bringing ↑ normal temps. (2° to 5°). Weekend will bring a warm front to the northeast. South of the front temps will be in the 60°'s and north of the front 50°'s. Rainfall expected Friday thru Monday particularly to the north of NY and drier to the south. Precip will be ~ 0.5" to 0.75".

Around the Region

- **LI:** Wet with 3" of rainfall. Grass is starting too green-up.
- **Hudson Valley:** Snow molds and salt damage along roadways.
- **Western NY:** Snow molds
- **Jennifer Grant:** Right of Way conference update: Dept. of Transportation is doing some interesting work on alternative weed control including mowers and mats. Demo plots are located around the state. Contact Jennifer for more info.

Grazing in the Grass with Frank Rossi

Turf Covers: In the last decade a few studies have investigated the use of covers to prevent winter injury, with the most comprehensive being conducted in Canada. Several types of covers were used that included completely impermeable blankets, curled wood shavings mat, straw mulch covered with impermeable material, felt material, and a wood frame that created a 2 inch air space above the green and covered with an impermeable material. An uncovered treatment was included to determine the influence of snow or ice cover on winter injury.

Deep prolonged snow cover at the Quebec City location on the uncovered plots afforded the warmest soil temperature and provided best protection from winter injury. However, there were some problems noted from severe snow mold damage. These snow mold scars on putting greens with the new generation bentgrasses can persist for months into the growing season. Results from the Montreal site demonstrated substantial differences in soil temperatures, explanations of how plants are injured and variable survival depending on the type of cover. Temperatures as low as -10° F were recorded under the felt material, and consequently considerable winter damage was observed. In fact, a subsequent study suggested that anoxic conditions, where oxygen levels decrease and carbon dioxide levels increase, might be responsible for severe winter injury to annual bluegrass if experienced for more than 40 days. The researchers went on to suggest that anoxic conditions are exacerbated when soil respiration is high, a condition noted with high organic matter soils.

Uncovered plots reached as low as -17° F. Insulating covers like straw, curled wood mat and the 2 inch air space reduced temperature fluctuations at the soil surface and the annual bluegrass overwintered successfully. Spring removal of covers should be dictated by temperature and leaving them on longer may lead to more rapid green-up. This green-up could result in increased injury, so moving covers on and off in the spring may be required to avoid freezing the succulent tissue. There are some anecdotal reports that indicate that while covered greens do grow sooner, if they are not protected in the early spring from frost, the greens will get set back and be delayed in their performance.

Fungicide Injury: Pentochloronitrobenzene (PCNB) is a uniquely persistent soil active fungicide that affords the winter long disease protection. However, there have been an increasing number of reports regarding turf injury relate to PCNB. Researchers at Penn State University led by Peter Landschoot investigated two formulations (liquid and granular) of PCNB, applied at half, full and double rate (to simulate application overlap) and three timings (late fall, winter and spring). The most objectionable injury was noted after the late and spring applications of the liquid product. The spring application is not available to the superintendent based on label restrictions. Injury from applications of the granular formulation did not appear until after three years of treatments, especially in the final year of the study with follow-up spring applications. The persistence of PCNB was noted with enhanced dollar spot control. Winter and spring applications of PCNB provided up to five months of dollar spot control, regardless of formulation. Finally, Dr. Landschoot and his colleagues observed significant annual bluegrass encroachment in some of the PCNB treated plots in the final years of the study. It was suggested that PCNB reduces the competitiveness of bentgrass or possible enhances annual bluegrass.

Preemergence Herbicides and Rooting: Preemergence herbicides do not inhibit germination, in fact they require weed germination to be effective. Following germination the seedling absorbs the herbicide which is resident in the top 2" of soil. The majority of preemergence herbicides (pendimethalin, benefin, trifluralin, oryzalin, bensulide, prodiamine, DCPA, napropamide, dithiopyr) act by inhibiting cell division which eventually exhausts the seed reserves before the weed can emerge and begin photosynthesizing. The effect of preemergence herbicides on rooting has focused on establishing Kentucky bluegrass sod. In general, preemergence herbicides are thought to be less injurious to established turf, though, the ability to detect subtle differences in rooting remains a critical void in turfgrass research. Grass root tips are regions of active cell division (meristems). The root meristems could be affected if it contacts a preemergence herbicide that inhibits cell division. Ecologically, turfgrass rooting will be most active in the early spring when the soil is cool and top growth is yet to be initiated. This root development aids the turf's ability to withstand summer stress periods where evaporative demand is high and

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emergence
during a
application
active stage
would avoid injuring the new roots. Yet, if crabgrass has already emerged most preemergence products will not provide postemergence control, hence, proper timing remains critical.

Our Guest: Dr. Gail Schumann, Dept. of Plant Pathology, U. Mass.

- **Grey Snow Mold:** The prolonged snow cover has made this a good year for snow molds. Under long snow cover we tend to see more Grey snow mold (*Typhula incarnata*) but the good news is that for the most part Grey snow mold eats the leaf blades and does not damage the crown. Once the snow melts the *T. incarnata* activity ceases. Best option is to rake off the matted surface and let the turf recover. Avoid excess nitrogen.
- **Pink Snow Mold:** Pink snow mold (*Michrodochium nivale*) will persist as long as the weather is cool and wet. It does not require snow cover. This fungus will get into the crown, unlike the Grey snow mold, and can appear greasy like Pythium and be difficult to distinguish. This pathogen can be problematic when you start to mow and walk on diseased areas spreading the spores. If this is an issue rope off area to avoiding spreading. This is the time to avoid excess nitrogen and divert water that will move the spores. Pink snow mold is primarily a problem for GC's that need to get out and get going early in the season. Usually homelawns and athletic fields aren't seriously effected. Spring treatments are not recommended. Occasionally a fall treatment may be necessary for a newly established lawn or field (fall) that will have weak reserves to come out of winter.
- **Anthracnose:** Early sightings of Anthracnose (*Colletotrichum graminicola*) on Poa and Bent may be the resting structures from last fall. There was a lot of crown rot last year from the wet, cool summer and stressed poa. It is hard to believe the pathogen is actively growing in these soil and air temps. Anthracnose is typically associated with summer temps (>70°) and stress. Now is not the time to treat the turf. Once you see the blackened crown its too late for fungicides. Granular materials are not effective for crown rots.
- **Leaf Spots:** Reports of Red Leaf Spot (hot weather disease) this time of year are usually a result of winter stress and nutrient issues not the pathogen (Ophiosphacrella). We can expect Drechslera and Bipolaris as soon as it turns warm and wet especially areas that were fertilized. Fungi grow when the grass grows with the exception of snow molds.

Take Home

- **Avoid making applications when the turf is dormant**. If you're going to treat…make sure the grass is growing and you are mowing. Fungi grow when the grass grows.

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CUTT

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The Cornell Turfgrass Team has a long tradition of conducting important fundamental scientific research focused on turfgrass management. Our scientists are recognized as *the* experts in their field, including biological control, soil insect management, turfgrass ecology, and environmental quality. Still, much of this information doesn't effectively reach you, the end-user.

In the last few years we have seriously addressed this information transfer need. Specifically, in 1998 we initiated the Turfgrass Hotline, now known as *Turfgrass ShortCUTT* (CUTT=Cornell University Turfgrass Times). *ShortCUTT* is a brief, concise, weekly newsletter delivered by noon each Monday during the growing season via electronic mail or FAX.

ShortCUTT includes comprehensive regional weather information, including a weekly forecast; regional pest observations available from turf educators throughout the northeast, including USGA NE Regional Agronomists; cultural and pest management recommendations based not only on current weather patterns, but also on the latest research available from around the world; and finally, each week a national expert is interviewed on a relevant topic such as nematodes, cutworms, bentgrass deadspot, annual bluegrass decline.

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ShortCUTT is a weekly newsletter delivered each Monday during the growing season via email or FAX. ShortCUTT includes comprehensive weather information, a weekly forecast, pest observations from turf educators throughout the Northeast, and cultural and pest management recommendations based on the latest research.

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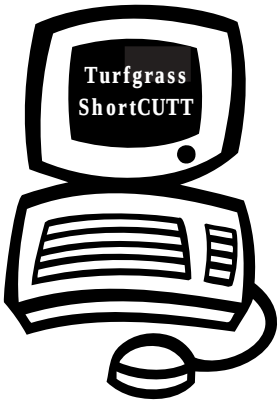

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CUTT

Point Source Pollution Prevention

A Healthy Ecosystem

The maintenance facility is one of the most important components of the turfgrass operation. Neglecting the importance of the maintenance area reduces workforce efficiency and may have environmental consequences.

The maintenance facility (barn, shop, turf care center, etc.) is the center of activity for a turf operation. Many consider the facility simply a storage area for equipment staging and maintenance, equipment cleaning, pesticide and fertilizer storage, and personnel offices and lockers.

"The maintenance facility," says Keith Happ, USGA MidAtlantic Regional Agronomist, "is one of the most important components of the turfgrass operation." It is surprising that at many facilities the maintenance area is an afterthought. Neglecting the importance of the maintenance area reduces workforce efficiency and may have environmental consequences.

Public concern for the use of pesticides and fertilizers typically focuses on the application to turf. It seems odd that the application of a one to five percent chemical solution draws more attention than the handling of the concentrated product. In fact, very few states have strict regulations for the storage and handling of pesticides and fertilizers at maintenance facilities where bulk material is not stored.

Point Source

Chemicals arrive at large bodies of water (surface or subsurface) through two major processes. Where the direct source of the input is not easily identified (non-point source pollution), or through the direct discharge of a pollutant into a water body, such as a pipe directly discharging into a stream (point source pollution).

Non-point source pollution is difficult to quantify and identify a particular pollutant. For example, when making a pesticide application to a lawn or golf fairway, it might be difficult to know where to find the chemical or which treatment actually caused the pollution. Within non-point source pollution, the two transport processes are downward movement through the soil profile (leaching) or surface movement (runoff).

Point source pollution at turfgrass facilities can be the result of accidental spills of chemical concentrate, improperly contained pesticide management facilities (storage, mixing, rinsing, etc.), equipment washing areas, or subsurface drainage systems that discharge directly into surface water bodies. Many of these activities are centered at the maintenance facility and can be addressed with proper planning and design.

Plan to Prevent

The location of the maintenance facility may have been dictated by land that would not be used for other purposes. There may not have been practical consideration to the ingress and egress of delivery vehicles or for the need to efficiently complete tasks in construction of a new golf course.

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