CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

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New Light on Freeze Stress

Northern regions of the United States have experienced significant turf loss related to winter injury in the last few years. Historically, widespread winter-kill occurred no more than every eight to ten years. However, it appears to be a more common occurrence now, causing some to reflect on possible causes for the increase.

Many older courses simply have putting greens that are prone to damage due to susceptible grasses and poor drainage. There is growing concern that the lack of light as a result of evergreen tree shade may be exacerbating the problem, yet research is absent.

Over the years, research has focused on a variety of individual aspects of the problem. Studies have investigated ice formation, acclimation and deacclimation from low temperature and winter diseases. Few studies have investigated the role of shade and the effect it could have on acclimation.

To fully understand the role of light on winter-kill, it is vital to understand the complex interactions that occur in the winter. Once we more fully understand the problem, we will be able to effectively address the issue. It's not like we need *another* reason to remove trees!

Freeze Pops

Turfgrass injury from freezing stress is directly related to how, where and whether or not ice forms in cells of the turfgrass stem apex (a.k.a. crown), that region of the grass plant that overwinters. Specifically, if temperatures drop rapidly and water is available for freezing *inside* a plant cell, that cell will die. If several cells in the crown die, the grass plant may not be able to recover. This direct form of freezing injury is thought to be rare, because temperatures generally decline between 1–2° C per hour, allowing the cell time to adapt.

The more common scenario is when ice forms *between* the plant cells. As the ice crystal forms, it will draw water molecules from inside the cell to expand the size of the crystal. As water is drawn from the cell, it becomes dehydrated. Plants utilize various mechanisms to minimize ice crystal formation by holding water inside the cell tighter than the ice crystal can draw it out. The mechanisms of freezing stress resistance lie at the heart of developing strategies for survival.

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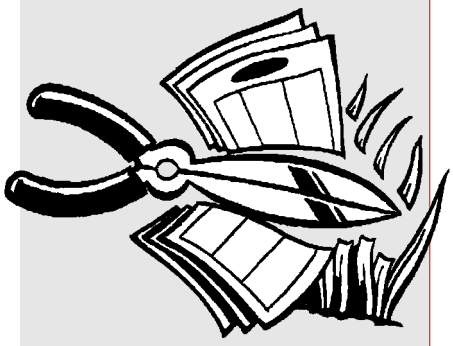
CUTT

Clippings

The goal is to document the amount of turfgrass acreage in New York and the economic value of turf, turf production, services, and expenditures. NASS expects to send out 15,000 questionnaires.

The survey will increase knowledge about this important industry and ultimately enable the public, industry and government to work together to ensure its continued growth and benefit to all New Yorkers.



New York Turfgrass Survey a Reality

The New York State Turfgrass Association (NYSTA), in cooperation with the New York Agricultural Statistics Service (NASS) and the New York State Department of Agriculture and Markets, will conduct the first New York Turfgrass Survey this fall. The goal is to document the amount of turfgrass acreage in New York and the economic value of turf, turf production, services, and expenditures. NASS expects to send out 15,000 questionnaires and to have about a 30-40% return rate.

According to Steve Ropel, NASS State Statistician, "The development of a quality mailing list is essential to making the survey a success." NYSTA, working closely with the agencies involved, is developing a targeted list of turf management professionals in a variety of related industries including landscape, sod farm, golf course, parks and recreation, highway rest areas, and cemeteries. Residential properties, corporate sites and schools also will be evaluated in order to obtain an accurate assessment of turfgrass acreage in New York State. The list of all known operations in each segment of the turfgrass industry will then be combined and a sample will be selected from the resulting list. Turf managers in this sample will be contacted to complete a questionnaire and data collected will be statistically expanded to represent all of New York.

Steve Griffen, NYSTA President and co-owner of Saratoga Sod Farm, Inc., said that the survey, which has been initiated by NYSTA and partially funded by members over the past several years, will increase knowledge about this important industry and ultimately enable the public, industry and government to work together to ensure its continued growth and benefit to all New Yorkers.

The target date for the first questionnaire is September and the final report is expected to be completed by the spring of 2004. Once the survey is tabulated, a publication will be prepared. Anyone receiving a questionnaire may request a copy of the publication by checking a box on the survey form. Others may contact the New York State Agricultural Statistics Service by mail at 1 Winners Circle, Albany, NY 12235; by phone at (518) 457-5570 or (800) 821-1276; by fax at (518) 453-6564; or by email at nass-ny@nass.usda.gov. The publication will also be available, when completed, on the NASS web site, www.nass.usda.gov/ny.

The New York State Turfgrass Association is made up of individuals in the green industry who have joined together to share technology, promote environmental stewardship, support education, advance research, and disseminate research findings. For more information, please contact the New York State Turfgrass Association, at (518) 783-1229, nysta@nysta.org, www.nysta.org.

Denise Lewis
NYSTA

Send Us a Letter

We often receive letters from our readers reacting to the articles and information presented in *CUTT*. Encouraging a free-flowing, two-way communication between our readers and Cornell's Turfgrass Team can only make *CUTT* a better, more relevant publication. Accordingly, we will be instituting a "Letters to the Editor" section. Send your comments via regular mail to *Cornell University Turfgrass Times*, 20 Plant Science Building, Cornell University, Ithaca, NY 14853, or via email to fsr3@cornell.edu.

Which Soil Test?

Turfgrass fertilization recommendations often include references to soil nutrient testing as a means of determining desired levels of nutrients other than nitrogen. Typically, once a sample is extracted and submitted, most turf managers look to the interpretation of the results suggesting a nutrient is low, medium or high. However, recent research has been raising some concern over the way in which nutrient testing is conducted, the type of medium submitted (sand vs. soil) and how the results might be interpreted.

Researchers from the University of Connecticut have been investigating the relationship among chemical extractants used in soil testing, extractable soil phosphorus (P) levels, and turfgrass growth and quality in sand-based systems. The goal of this research is to more accurately assess the amount of P available to the plant in sand-based systems and determine the relationship between amount of P and turfgrass quality.

Critical extractable P (above which there is little chance of increasing soil P concentrations) were generated using Mehlich-1, modified-Morgan and Bray-1 extractants. The data was then statistically analyzed to determine how extractable levels related to observed turfgrass growth and quality.

The results indicated that the modified-Morgan extraction (a weak acid solution) correlated well with observed turfgrass quality as well as P deficiency and tissue P levels. For example, creeping bentgrass grown in plots where extractable P was less than a critical level determined by the modified-Morgan were more bluish, purplish green than leaves in plots that were greater than the critical concentration.

This study is one of several soil testing studies published or currently underway to assess the relationship between laboratory methodology and field observations. It is worth noting that most of our current thinking on soil testing in turf comes from studies conducted over 20 years ago or borrowed from production agriculture. Furthermore, the basis for the old recommendations came from studies conducted on soil, not sand-based rootzones.

From: Guillard, K and W.M. Dest. 2003. Extractable soil phosphorus concentrations and creeping bentgrass response on sand greens. Crop Sci. 43:227-281.

Are Sand Rootzones Sterile?

The turfgrass industry has seen an enormous increase the number of products offering "enhanced microbial activity." This is especially true for turfgrass managers who have turf on predominantly sand-based rootzones which have long been thought to be void of significant microbial activity.

Researchers from North Carolina State University conducted an experiment on new sand-based rootzones not amended or amended with several organic (peat moss) or inorganic (greens choice, Profile, Isolite) products. The greens were established to creeping bentgrass turf and then analyzed for various microorganism populations present.

Bacteria, fungi, actinomycetes, and aerobic spore forming (Bacillus sp.) populations, as well as nitrifier and denitrifier organisms were determined. Interestingly, within the first six months after seeding, bacteria population levels were most prevalent and similar to those found in mature sand-based rootzones. There were no differences among amendments as they exerted no appreciable effect on microbial populations. It is important to note that during the establishment of the green through the two years of the study, pesticides were applied on a regular basis which supports previous research that found that modern pesticides have little influence on overall microbial populations.

The researchers concluded that the major influence on microbial populations in sand-based rootzones is the presence of a turfgrass root system. Therefore, to the extent that an environment (soil pH, temperature, etc.) influences a root system, it follows that the microbial population will be influenced. So, if you are managing a healthy root system, there will be a plethora of microbes.

From: Bigelow, C.A., D.C. Bowman, and A.G. Wollum II. 2002. Characterization of soil microbial population dynamics in newly constructed sand-based rootzones. Crop Sci. 42:1611-1614.

Scanning the Journals

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Freeze Stress

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As the crown hydrates to grow it becomes more susceptible to freezing than it would be in a hardened state. Simply, more free water is available for freezing.

Researchers at the Prairie Turfgrass Research Center in Alberta, Canada quantified the reduced hardiness of annual bluegrass following 48 hours of temperatures above 40° F. It was concluded that freezing tolerance was reduced 5–10° F following a slight warming.

Transition

It has become apparent over the last several years that the transitional period between winter and spring, characterized by fluctuating freezing and thawing events, is critical to understanding plant death as a result of freezing stress. During this time when plant energy reserves are low, the plant will respond to warming temperatures by stimulating growth. When growth is stimulated, several physiological changes occur. The most significant effect is the hydration of the tissue. The driving force for growth is water. Therefore, as the crown hydrates to grow it becomes more susceptible to freezing than it would be in a hardened state. Simply, more free water is available for freezing.

Researchers have speculated for years that one of the single most important aspects for enhancing winter hardiness is delayed deacclimation or breaking of dormancy. This is most difficult with annual bluegrass that is likely to break dormancy rapidly in the spring. In fact, researchers at the Prairie Turfgrass Research Center in Alberta, Canada have quantified the reduced hardiness of annual bluegrass following 48 hours of temperatures above 40° F. It was concluded that freezing tolerance was reduced 5–10° F following a slight warming.

Water

Remember from high school chemistry how water (or any liquid) will move from a higher concentration to a lower concentration? This is a way of understanding how water will move out of the cell to form an ice crystal. The cell membrane prevents any solutes, like energy sources (sugars and fructans), from leaving the cell and allows water (a liquid) to pass through. This is referred to as a semi-permeable membrane.

As the ice crystal forms it has a lower concentration of water than inside the cell and water moves out of the cell to enlarge the crystal. Maximizing solutes in the cell could reduce the concentration of water in the cell. This reduced concentration would prevent the water from passing through the membrane for ice crystal enlargement. Therefore, the cell would stay hydrated and survive.

Light

A critical aspect of minimizing cellular water that is available for freezing is thought to be related to the energy status of the plant. Energy status is a term used interchangeably with carbohydrate levels. Carbohydrates are the energy currency in the plant generated via photosynthesis.

Dense evergreens inhibit light penetration and may exacerbate injury.

Incipient freeze-thaw cycles and standing water reduce winter hardiness.

Professor George Hamilton of Penn State University recently completed his thesis addressing ice formation on putting greens. Hamilton's work focused on different types of ice, i.e., opaque or clear, dense or slushy, etc. An important conclusion was that ice type did not seem to influence turf injury, but rather the energy status of the plants. He speculates that carbohydrate levels might be the factor determining survival.

Hamilton's theory is supported by the severe winter-kill that damaged greens throughout New England in the 2002-03 winter. One such course was Apawamis Golf Club in Rye, NY. Golf course superintendent Bill Perlee had one area on his 13th green that was winter-killed. Apawamis is over 100 years old with mostly a mixed stand of bentgrass and annual bluegrass greens. The 13th green has two old evergreen trees about 20 feet off the edge of the surface and it appears that the severe winter-kill was associated with the shade from these trees.

Under reduced light conditions, especially when the sun is low in the sky in the shoulders of the northern season, plants produce significantly less carbohydrates. It could be hypothesized that these plants are most susceptible to winter injury due to low energy levels that reduce full acclimation to low temperature.

The turf and tree debate has renewed fervor, as it is likely that light penetration is as vital to turf health in the winter as it is during peak stress periods. Superintendents might wonder if tree removal is any easier to push through than complete reconstruction to improve drainage. It seems to me that it is an excellent first step.

Frank S. Rossi, Ph.D.

Editor's Note: Cornell's Urban Horticulture Institute has a number of publications and videos addressing tree selection and placement. See page 9 for more information.

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Program Spotlight

Many older chemistries on the market today—such as trichlorfon, chlorothalonil and pendimethalin—are applied in pounds of active ingredient per unit area, whereas new chemistries—such as imadocloprid, azoxystrobin and chlorosulfuron—are applied in tenths of ounces or grams per unit area. It follows that simply moving to newer, more active chemistry will result in overall reduced loads.

Is Pesticide Reduction a Numbers Game?

Few issues in the turf industry stir more emotion than the use of pesticides. Considered so essential to our existence, the Canadian government refers to pesticide use in turf as "cosmetic," implying that, beyond aesthetics, there is no functional need for pesticides and their use must be reduced or eliminated.

The drums continue to beat from environmental advocates who demand use reductions as a first step towards possible elimination. Integrated pest management (IPM) is rolled out as the alternative to pesticide use (read elimination) while the turf industry states it is already being implemented.

"How can I wait to see what kind of disease pressure I have for an IPM approach," queries Jeff Wentworth of Pelham Country Club. "If I get anthracnose I will have dead grass on my greens, so I have to spray preventatively." Wentworth's dilemma is common for many with severe pest problems and little curative options.

How can pesticide use be reduced and quality standards remain high? The answers depend on how you calculate use on one hand and whether trying to reduce pesticide use, in some cases, results in improved environmental quality.

By the Numbers

Most pesticide use debates engage a 1990 survey from the New York State Attorney General's office, *Toxic Fairways*. The information was collected from 52 golf courses on New York's Long Island and subsequently has been used to "quantify" the amount of pesticides used on courses. A similar study was conducted to quantify the exposure of school children to pesticides.

The scientists in the Attorney General's office calculated pesticide use on a per acre basis. However, the publication goes on to report on a per *treated* acre basis the numbers are inappropriately inflated.

For example, a crop farm might apply a preemergence herbicide at two pounds of active ingredient per acre to 200 acres then a follow-up postemergence herbicide at two pounds per acre producing a total load of 800 pounds or four pounds per treated acre. A golf course might apply a fungicide at one pound of active ingredient eight times to two acres of greens for a total of 16 pounds of pesticides. However, on a per *treated* acre basis it would be eight pounds per treated acre (twice the amount of pesticides used on the farm).

From an environmental perspective, total loading is much more critical than amount per treated acre in that it quantifies the total amount the environment (soil, air, water, etc.) must confront. So, is it possible to treat as much—or more—acreage and see an overall reduction in pesticide loads?

New Chemistry

Many older chemistries on the market today—such as trichlorfon, chlorothalonil and pendimethalin—are applied in pounds of active ingredient per unit area, whereas new chemistries—such as imadocloprid, azoxystrobin and chlorosulfuron—are applied in tenths of ounces or grams per unit area. It follows that simply moving to newer, more active chemistry will result in overall reduced loads.

In addition to reduced active rates the new chemistries tend to be more highly selective, have reduced nontarget effects and often work preventatively. Clearly, the selectivity and reduced nontarget effects are beneficial, but the preventative approach may serve to increase overall use.

Soil Insect Management

Turfgrass managers have a situation with soil insect management that highlights some important issues. In an effort to reduce widespread insecticide use superintendents could wait to observe white grub populations and then attack curatively with one of the few "rescue" treatment chemicals available, trichlorfon. The active ingredient rates would be four ounces per thousand square feet. In the end, possibly only 10,000 square feet would need treating resulting in a total load of 40 ounces. In addition, this would require intense scouting and proper timing to keep the highest quality turf.

Alternatively, a manager could apply imadocloprid preventatively to all 80,000

square feet of turf at 0.4 ounces per thousand square feet. This would deliver about 32 ounces of material. Also, labor for scouting would be reduced, timing is less critical, the material is considered "softer" on the environment, etc. Why not just treat preventatively if it applies less total material to eight times the area?

This is an important question and one that is not easy to answer. Widespread use of a material with fewer environmental effects could be better than targeted use of a material that poses a greater risk to environmental quality. Also, the preventative approach virtually assures success with minimal technical knowledge beyond application technique.

In fact, a hybrid approach might be the best solution. In areas with a history of problems, treat preventatively; and in areas that have not had trouble, monitor for a curative strategy. This represents a full implementation of IPM with consideration of pest pressure, turf quality thresholds and environmental quality.

Driving Reduction

In the end, we'd all like to think it is more than just a numbers game: manipulate the numbers to make them say what you want them to. Yet, it appears there are a few issues that remain obstacles to meaningful pesticide reduction.

First, consumer expectations for high quality turf is not likely to change and will continue to drive inputs higher. Second, understanding pest biology and ecology that allows for more targeted prevention, rather than widespread prophylactic approaches, must be implemented. Finally, by improving our understanding of pest issues and maximizing good growing conditions, alternatives to chemicals (or at least to the instant gratification of chemical use) will become available.

Frank S. Rossi, Ph.D.

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Building Loyalty

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Effective managers recognize that no one knows more about a job and the challenges of doing a job than the individual who performs that job every day.

5. Provide training and development opportunities. Generally speaking, people want to become more than they are today. They want to grow, learn and become more valuable to themselves as well as to a current and future employer. In addition, employees enjoy doing what they do well. An ongoing process of training and development for each employee will reap big dividends.

Training can be conducted internally or offsite. Many effective turf managers have made very good use of video tapes and other teaching materials at the workplace to give employees the skills they need to do a job effectively. Regardless of how training is done, it is important to reinforce training on the job on a daily and weekly basis until the employee has mastered a particular skill. Some managers fail to get the best results from their training dollars because there is no follow-up to reinforce training.

6. View your compensation package as a total reward system. Nonmonetary compensation includes benefits that do not have tangible value: job security, flexible hours, opportunity for growth, recognition, and friendship. Monetary compensation includes wages and benefits such as insurance, retirement programs, paid leave, etc.

The challenge for any manager is to come up with the right combination of monetary and nonmonetary forms of compensation to create an environment where employees will be motivated. Selecting the compensation elements that motivate both seasonal and year-round employees and provide an attractive work environment is the key to building loyalty and retaining the best employees.

A stable work environment, where turnover is not excessive, benefits the manager and the organization and lowers the direct costs of filling positions. Employers who are constantly building the loyalty of their work force will ultimately lower their turnover costs and create the opportunity to build a productive and satisfied work force over the long term.

Thomas R. Maloney

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CUTT

The Human Dimension

The key to low turnover in many cases is the amount of time the employer has spent being sensitive to employee needs and building loyalty. In short, those employers who create a work environment where employees want to stay, usually are successful keeping turnover rates low.

Building Loyalty Reduces Employee Turnover

High turnover is a costly issue for most employers and turf managers are no exception. In fact, for those turf industry managers in the northern climates, the seasonal nature of the work often increases the potential of high turnover. Many turf managers have a very small year-round crew, and then a larger seasonal crew. To be successful, many managers try to keep the very best year-round crew, and then keep as many quality seasonal employees coming back year after year as they possibly can.

There is a great financial incentive to keep turnover low. It costs hundreds—if not thousands—of dollars in advertising costs, interview costs, training time, and other expenses every time an employee decides to leave your business. The key to low turnover in many cases is the amount of time the employer has spent being sensitive to employee needs and building loyalty. In short, those employers who create a work environment where employees want to stay, usually are successful keeping turnover rates low.

To reduce turnover and keep a satisfied, productive work force, here are six steps to increase employee loyalty:

1. Design jobs with employees in mind. It is hard to sustain interest in tasks that are difficult, repetitive and boring. While the assignment of difficult tasks is inevitable at times, job variety is the key to keeping employees fresh and enthusiastic about what they are doing. Rotate jobs so that the most difficult tasks get distributed among a number of people.

In addition, try to fit the employee's interests to the tasks that they are assigned to. If, for example, an employee has a particular aptitude for working with equipment or for organizing tasks and projects, matching the employee's interests with specific jobs will enhance employee motivation.

Working conditions are also an important part of job design. Proper equipment, including safety equipment and clothing that will protect them from various weather conditions will enable your employees to do a job safely and effectively.

2. Create performance expectations and goals. Employees want to know what their job is and what specifically is expected of them. Management research clearly indicates that employees who set goals accomplish more than employees who don't. Effective managers work with employees to establish job goals and expectations. To the greatest extent possible, goals should be in writing so that they can be referred to from time to time and evaluated. Above all, goals and accomplishments expected should be realistic.

If an employee views his or her goals as unattainable, chances are the individual won't even try to achieve them. Likewise, if the goals are too easy to attain, performance will suffer. A good set of performance goals provides an opportunity for ongoing performance discussions between manager and employee. In addition, the accomplishment of performance goals can provide employees with a great deal of job satisfaction and motivation.

3. Provide ongoing support and feedback. By providing coaching and feedback, managers put themselves in the position to support top performance in their employees. Effective managers also provide encouragement when needed. Higher levels of performance can be achieved when the employee knows that the manager has confidence in him or her, and that the manager will help them succeed at a difficult task.

By receiving continuous feedback, employees know how they are doing and what corrections they can make to proceed in their work more effectively. Employees also want to know why a job is being done a particular way or why a specific procedure is important to success. Explaining why a job is important and letting employees know that good performance is appreciated, will help you build employee loyalty.

4. Listen. Listening is perhaps the most important aspect of communication for a manager or supervisor. Effective managers make it clear that they want their employees' feedback and that their comments about the workplace and job performance are welcome any time.

Listening is an important way to show respect for employees' contributions, abilities and ideas. Managers who put priority on taking the time to listen are more likely to identify improvements in job design and performance.

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Publications and Videos from the Urban Horticulture Institute

Recommended Urban Trees:
Site Assessment and
Tree Selection for Stress Tolerance

Urban Horticulture Institute
Department of Horticulture
Cornell University
Ithaca, New York

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New! 76-page Pocket Guide

Tree ID Guide for Common Urban Trees in New York State

Fully illustrated 4x6 inch pocket guide helps people with little or no experience to identify common urban trees throughout the year. **$12 including postage and handling (US only).**

23 min. VHS Video

Tough Trees for Tough Sites

Aids in tree selection in the urban landscape. Explains the process of site assessment—understanding environmental limitations to plant growth that determines appropriate plants for any particular site. Follows a real-life tree planting project in the city of Ithaca, NY. Makes a great companion to *Recommended Urban Trees*. **$20 including postage and handling (US only).**

13 min. VHS Video

Support Your Local Tree: Cornell Structural Soil Mix

Demonstrates new soil mix that safely bears traffic loads after compaction and still allows root penetration and vigorous tree growth. Includes the recipe for the soil mix, the specifications, and an article: *Structural Soil: An Innovative Medium Under Pavement that Improves Street Tree Vigor*. **$20 including postage and handling (US only).**

15 min. VHS Video, 16-page Booklet

Creating an Urban Forest: The Bare Root Planting Method

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Cornell University
Ithaca, NY 14853

Questions?

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www.hort.cornell.edu/uhi/outreach

Agricultural Health Study

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drank alcohol. Information was gathered on the farmer's age, ethnic background, family history of prostate cancer, and other factors that might affect the risk to this disease.

During the next four and a half years, 566 cases of prostate cancer were reported in the men enrolled in the study. Overall, the risk of prostate cancer was small—about 14% higher in men who were pesticide applicators compared to men living in the same state who were not applicators. Of the 50 pesticides studied, only exposure to the fumigant methyl bromide was consistently linked to a higher risk of prostate cancer. Applicators with high levels of exposure to methyl bromide had prostate cancer risk that was more than doubled. Those with very high exposure to methyl bromide had a 347% higher risk of prostate cancer.

For other pesticides, the data was not as clear. Most were not related to the risk of prostate cancer. For other pesticides, both age and family history played a role in whether they were linked to prostate cancer. In men over 50 years of age, there was a higher risk of prostate cancer if they had been exposed to the organochlorines aldrin, DDT or heptachlor (insecticides that are not used any more, but that stay in the environment for a long time), permethrin (used on livestock) or to carbofuran.

Exposures to certain pesticides were linked only to men who had relatives with prostate cancer. This included applicators with a father or brother with prostate cancer who were exposed to six different pesticides. They included butylate, a herbicide; the crop insecticides coumaphos, fonofos, chlorpyrifos, and phorate; and an insecticide used on livestock, permethrin. For most of these pesticides, prostate cancer risk was doubled in exposed applicators with a family history of prostate cancer. Men without a relative with prostate cancer did not have a higher prostate cancer risk if exposed to these six pesticides.

Following Into the Future

The investigators are seeking funding to continue the *Agricultural Health Study* for at least another 5 years to see if the higher rates of prostate cancer and links to specific pesticides are seen over time. These results also need to be confirmed by other studies. More information is needed to link actual exposures to pesticides with cancer rates. The *Agricultural Health Study* also plans to look at cancer rates in spouses of farmers and professional female pesticide applicators. Over 33,000 women are enrolled in this study. Both breast cancer and ovarian cancer risk will be evaluated.

The results of the *Agricultural Health Study* to date suggest that farmers who are pesticide applicators have a higher risk of prostate cancer, and this may be due to exposure to certain pesticides, including methyl bromide. Age and family history may also play an important role in prostate cancer risk in men exposed to certain pesticides.

It's important that applicators take precautions to reduce exposures to pesticides, including frequent hand washing and using personal protective gear. It is hoped that regulatory agencies use the results of this study to evaluate the safety of pesticides used in agriculture.

For more information on the *Agricultural Health Study*, including background information, important findings and a listing of all relevant scientific publications, visit the study's Web site: http://www.aghealth.org.

Suzanne M. Snedeker, Ph.D.

Associate Director of Translational Research for the Program on Breast Cancer and Environmental Risk Factors

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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.

Need your irrigation water tested?

Not sure of the nutrient content of your fertilizers?

Need an inexpensive tissue nutrient test?

Check out the Horticulture Analytical Laboratory.

CUTT

Some Pesticide Applicators at Higher Risk for Prostate Cancer

A Healthy Ecosystem

Until recently, researchers have not been able to find out if there are specific types of pesticides or other chemical exposures on the farm that are linked to prostate cancer.

In results published in the May 2003 issue of the *American Journal of Epidemiology*, researchers from the National Institutes of Health reported a higher risk of prostate cancer in male pesticide applicators. The applicators were enrolled in the *Agricultural Health Study* sponsored by the National Cancer Institute, the National Institute of Environmental Health Sciences, and the Environmental Protection Agency (EPA).

Prostate cancer is the most common cancer in men in the United States. According to a report released by the National Cancer Institute and the Centers for Disease Control, prostate cancer rates ranked number one of all cancers for both white and African-American men. Farming is one of the jobs linked to a higher rate of prostate cancer.

But, until recently researchers have not been able to find out if there are specific types of pesticides or other chemical exposures on the farm that are linked to prostate cancer. The linkages have been difficult to make because most of the studies done in the past have been based on only a few hundred farmers.

The Agricultural Health Study

A new study, the *Agricultural Health Study*, is following over 55,000 men from Iowa and North Carolina who are professional pesticide applicators. Over 80% of the licensed pesticide applicators in both states are enrolled in the study, which started in 1993. This long-term study is designed to investigate whether exposure to pesticides, or other farm practices, increases the risk of cancer and other illnesses that may take many years to develop.

Researchers asked many questions of the farmers before the any of the men in the study were diagnosed with prostate cancer. By using questionnaires, investigators asked the men whether they had or had not ever used 50 different agricultural pesticides. For many of the pesticides they also asked how often, for how many years, and what method was used to apply the pesticides. They gathered information on the use of protective equipment such as gloves, hats and protective suits. Farmers were asked about their diet and lifestyle, including whether they smoked, exercised or

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