APPENDIX I

Aspergillus fumigatus in Compost

Aspergillus fumigatus is a naturally occurring, fast-growing fungus that thrives at temperatures as high as 45-50°C. Thus, it is capable of growing profusely in compost. It lives on dead organic matter in soil and on plants (particularly trees). It is widespread in nature, and under the right conditions it can cause serious respiratory diseases in poultry as well as humans [1].

A. fumigatus is what is known as a secondary pathogen, which means that it cannot invade healthy lungs. It only affects persons whose lungs are already damaged by some other, primary disease. One researcher reports that people with compromised immune systems are at risk of developing a lung infection from *A. fumigatus*, as are smokers working with compost [2]. If someone is debilitated, has another pulmonary disease, or has increased susceptibility due to medication with corticosteroids, the inhaled spores may germinate and the fungus may invade the lungs and cause the lung disease, aspergillosis [3]. Humans appear to become more susceptible if they are being treated with antibiotics and corticosteroids. The fungus can also cause severe allergic reactions, especially in people who are subject to asthma or hay fever.

Of note to landscape service industry is that there is a risk of infection for anyone working directly with the compost, such as turning it, bagging it, or incorporating it into soil. A major source of this fungus may be found in certain types of vegetable compost during early stages of decomposition. When green leaves and branches trimmed from the trees are passed through a chipper, the resulting coarse wood chips and green vegetation provide an excellent medium for the growth of *A. fumigatus*. If a pile of this material is exposed to rain, within a few days microbial fermentation produces a high temperature that supports luxuriant growth of this fungus. Gardeners who use this material for mulch are exposed to millions of spores[3].

Although the fungus does not appear to pose a risk for healthy people, it is advisable to wear a mask when working extensively with compost or decomposing chipped material. It may be possible to heat finish compost to a temperature which would destroy the fungus [1]. It is also desirable, when handling the products, to maintain moisture levels sufficiently high to reduce dust particles.

REFERENCES

[1] Dr. Norman Whitney. QK Fungus Consultants, Fredericton NB. Personal communication.

[2] Author's notes from a compost seminar conducted by Dr. Francis Gouin, acting chairman of the Department of Horticulture, University of Maryland, College Park MD, at Sussex NB, March 7 1996.

[3] Emmons, C.W., Binford, C.H. and J.P. Utz. *Medical Mycology, Second Edition.* 1970. Lea and Febiger. Philadelphia, pp. 266, 268.

FURTHER READING

English, Mary P. *Medical Mycology - The Institute of Biology's Studies in Biology* No. 119. 1980. Edward Arnold, London.

Emmons, C W.1960. The Jekyll-Hydes of Mycology. *Mycologia*. 52:669-680.

Moore-Landecker, Elizabeth. *Fundamentals of the Fungi.* 1972. Prentice-Hall, Inc., Englewood Cliffs, NJ.

APPENDIX II. Web Sites Resources (as of October 2003).

Starting with Soil

Soil Water Monitoring and Measurement. 1974. Washington State University.
http://cru.cahe.wsu.edu/CEPublications/pnw0475/pnw0475.html

Fertilizing the Soil

The first two sites discuss how to vary fertilizer rates with differing soil types:
University of Minnesota Cooperative Extension:
http://www.extension.umn.edu/distribution/horticulture/DG1731.html

University of Illinois Cooperative Extension: http://www.turf.uiuc.edu/extension/ext-fert.html

LILAC (Low Input LAwn Care). A web site for Maine:
http://www.state.me.us/agriculture/pesticides/lilac.htm

Mowing

The Urban Farmer in BC. An interesting discussion of mulching mowers:
http://www.cityfarmer.org/

Grasscycling

University of Rhode Island. http://www.uri.edu/ce/factsheets/sheets/lawnmow.html

Iowa State University: http://www.ipm.iastate.edu/ipm/hortnews/11994/mowyrbot.html

Turfgrass Information Center, Michigan State University: http://www.lib.msu.edu/tgif/

Weed Identification

University of California statewide IPM program. Turfgrass Weed Photo Gallery.
http://www.ipm.ucdavis.edu/PMG/r785700999.html

Horticulture Organizations and Institutes

Guelph Turfgrass Institute: http://www.uoguelph.ca/GTI/gtihome.html

New Brunswick Horticultural Trades Association: http://nbhta.ca/

Landscape Nova Scotia: http://www.landscapenovascotia.ca/

Landscape Ontario: http://www.horttrades.com/

The Canadian Nursery and Landscape Association:
http://www.canadanursery.com/canadanursery/index.lasso

Federal Government Healthy Lawn:
http://www.healthylawns.net/english/index-e.html

Ontario Government Turf Information Website:
http://www.gov.on.ca/omafra/english/crops/hort/turf.html#ipm

Ontario Government Site with specific turf IPM information
http://www.gov.on.ca/omafra/english/crops/facts/info_turfipm.htm

APPENDIX III. IPM for Municipalities and Institutions

Some municipalities and institutions across the country have officially adopted Integrated Pest Management (IPM) policies, while many have parks departments that are successfully applying IPM practices. The following tips are intended to help anyone in a municipality, institutional setting or other agency, work toward putting in place an IPM program for turf.

1. Understand the IPM Process

The first requirement is a solid understanding of the elements of IPM. It is essential that everyone involved in the issue is using the same definition.

The elements of IPM, as defined nationally,[1] are:

1. preventing organisms from becoming pest problems by planning and managing ecosystems,
2. identifying pest and beneficial species,
3. monitoring pest and beneficial species populations, pest damage and environmental conditions,
4. using injury and action thresholds to determine when to treat pests,
5. using treatments that usually include a combination of methods, such as cultural, biological, physical, mechanical, behavioural, or chemical methods, to achieve acceptable control with minimal impact on the environment, and
6. evaluating the effects and efficacy of pest management strategies.

At the core of any IPM definition are two important concepts: IPM is based on preventing pest problems, and IPM is a decision making process for determining what actions to take when pest problems occur. A common misunderstanding about IPM is the idea that it necessarily means a pesticide based control program. Pesticides may or may not be used as treatments in an IPM program depending on the situation. For example, organic landscape services would only use products approved for organic practitioners. Where pesticides cannot be used, it is even more important to follow an IPM program to achieve good results.

2. Get Support From Decision-Makers

Adopting an IPM policy boosts the image of the municipality as environmentally responsible and complements other environmental initiatives such as composting and recycling programs. To obtain approval and support from municipal councils and managers it is important that they know the benefits of an IPM approach.

Promote the many benefits from using an IPM approach, including:

- protecting the environment,
- reducing or eliminating pesticide use[2],
- reducing use of fertilizers and other inputs,
- reducing the risk of groundwater contamination,
- improving pest management results and appearance of turf, and
- short- and long-term savings in materials and labour.

Knowing that an IPM approach incorporates sound turf management practices and provides a scientifically sound system for making decisions can reassure citizens that are concerned about turf management practices. For a particularly informative handout to use for public education, see Beard and Green.[3]

Is IPM a Fad?

Jim Moore, Supervisor of Parks and Grounds for the City of Moncton, comments:
"The combined efforts of Health Canada, the New Brunswick Department of Environment and Local Government, the New Brunswick Horticultural Trades Association, the Federation of Canadian Municipalities and Communities in Bloom reassure all involved that IPM is fact, not fad. Citizens and staff fully endorse these new common sense approaches to gardening and turf management. Now is the time to give everyone involved with gardening activities in our city the opportunity to learn more about IPM."

Water Conservation Benefits: When IPM practices are used by homeowners to produce healthy, deep root lawns, it can substantially reduce the demand on municipal water supplies for summer watering. Where water comes from wells, the water savings that can be achieved may help defer, or avoid altogether, the need for the major expense of expanding the water system.

Most lawns established over the past 50 years have construction deficiencies in the underlying soil that make it necessary to irrigate turf to maintain the green colour throughout the summer. At the municipal level, this takes a lot of water. Irrigating 100 average (500 m^2) home lawns through the summer consumes over 14,000 m^3 of water, assuming no waste (poor irrigation practices can easily double this figure). With changes in watering practice, the green colour in turf can be maintained through the summer with half this consumption.

Healthy turf can also be allowed to go dormant, which eliminates the need to water and does not normally harm established turf.

3. Review Turf Management Practices

Review all current turf management practices to ensure that they encourage deep root growth, which is the foundation of healthy turf. Every aspect should be reviewed, questioned and improved, including the design of upcoming construction projects: there is no room for "that's the way we've always done it".

A striking example is questioning the normal practice of fertilizing in the spring. Consider that this additional fertilizer is being put on when spring growth is naturally vigorous. Fertilizing with nitrogen just increases this growth, at a time when workloads for mowing in May and June are usually a problem. Why compound the problem, when research[4] has shown that September or late June nitrogen applications are more beneficial to turf than spring feeding?

One way to start on the review is to list key problems and pest concerns. These may be divided into cultural problems and pest management problems (though these may also be related to cultural problems). Cultural problems are generally a result of poor construction or maintenance practices, foot traffic and wear, or a combination of these factors. Explore each problem or concern, discuss

them with other managers and resource people and develop possible solutions. Some of these will be short-term and immediate, while others are intended to make long-term improvements in turf health. Begin making the changes where possible and keep good records of results. Review these records over the winter to make plans for the next season. Over time, incorporate the improved practices into a coordinated IPM program.

The following notes outline areas of turf management that may require improvement (for more information, consult the relevant chapters in this manual).

Categorize Turf: As a way to focus management activities, consider separating turf areas into Class A, B and C categories according the maintenance levels.[5] Each of these categories would have different thresholds for treatment decisions. Using such categories to allocate maintenance work and inputs helps turf managers provide a reasonable compromise between aesthetics and economics.

Examples of Turf Areas in Each Category

Class A – High level of service: *fine ornamental lawns, golf and bowling greens, irrigated sports fields.*
Class B – Moderate level of service: *residential and commercial lawns, boulevards, recreational areas, golf fairways.*
Class C – Low level of service: *Meadows, picnic areas, rough grass, undeveloped and naturalized areas.*

Fertilizing: Take soils tests and choose fertilizers based on plant needs. Maintain soil pH around 6.5 so that nutrients are available to the plants and the soil microbial population is healthy.

Review whether too much nitrogen is being applied annually (i.e., more than 0.5 to 1.5 kg/100 m^2 may be excessive). Use the uniformity of green colour, rather than depth of colour, as a criterion for turf appearance. Reducing nitrogen rates results in a lighter green, healthier turf—and saves both money and labour. It also reduces the risk of nitrate leaching into the groundwater.

Mowing. Cut at a 6.5 to 7.5 cm (2 ½ to 3 in) mowing height to encourage deep root growth. Manage mowing operations based on plant growth rates rather than the calendar, and cut no more than ⅓ of the plant growth at each mowing. This fosters healthy plant growth, and can reduce the number of mowing operations required per year. Sharpen mowers every 10 to 15 operating hours to improve appearance of the turf and reduce plant stress, while reducing fuel consumption.

Recycle clippings to reduce fertilizer and labour requirements, improve soil organic matter and reduce the disposal burden on landfills.

Watering: If the decision has been made to water the turf through the dry period, then it should be done as efficiently as possible to conserve water and obtain the best results. Rather than promote growth, consider watering just enough to keep the turf green; this generally takes about 15 mm (⅝ in) per week (reduced by amounts of natural rainfall). Water deeply, once or twice a week, to develop deep roots and stronger turfgrass plants.

Use water efficiently. Each irrigation setup should be carefully evaluated to maximize both irrigation efficiency and water conservation. Irrigation systems must be calibrated to determine how long to it takes the system to deliver a given quantity of water. Check delivery rates, apply just enough and stop watering before runoff occurs.

An alternative to watering is allowing the turf to turn brown. This normally doesn't hurt well established, healthy turf, and it conserves water.

Weed Management: Weeds, particularly dandelions, probably create the most controversy in turf pest management. Maintaining healthy, vigorous turf can reduce the size of established weeds, and dramatically reduce invasion of new ones. Selective herbicide use may be the most practical approach at present to restore a site to, and maintain, a Class A status. However, if dandelions are the only problem, hand weeding, using a well-designed weed tool can be done efficiently and cost-effectively. Experience shows that 5-10 plants can be removed per minute; where there are 5 weed per m^2, this means that around 100 m^2 can be weeded per hour.

The use of herbicides alone, without building up the turf in advance, merely opens up the soil for re-infestation as the broadleaf plants collapse and leave bare soil areas behind.

Tolerating a variety of plants in lawns (a 'biodiverse' lawn) is the most environmentally responsible and cost-effective approach. For example, uniformly distributed populations of white clover are attractive and can supply more than half of the nitrogen requirements for the turf grasses.

Insect Management: Pest insects, notably hairy chinch bug, are not often a problem in municipal turf. This may be because due to reduced budgets, less nitrogen is applied and a greater diversity of plants is tolerated in the turf. The most visible damage from chinch bugs seems to be correlated with high fertility, weed-free turf.

Where infestations have caused damage in the past, begin a monitoring program using the Laval quadrat method of counting chinch bugs. Where counts exceed a threshold of 10 chinch bugs per 0.1 m^2 (ft^2), insecticides may be required. Using spot applications, in the July 15 to August 15 window, is effective. Recent research in New Brunswick, however, suggests that considerably higher insect counts may be tolerable without visible damage. For example, some Class C turf with population counts of 600 to 1200 per 0.1 m^2 (ft^2) had little visible damage.[6]

New Construction: For any new construction, it is quite practical to establish lawns that stay green through the summer with natural rainfall, without increasing construction costs. Such sustainable turf is achievable with a soil foundation that makes adequate soil moisture available throughout the season. This usually means providing at least 60 cm (2 ft) of subsoil material (soil textures could range from sandy loam to a silt loam rocky subsoil) without barriers to capillary movement of moisture. At the same time, this increases the absorption of water and reduces runoff. This reduces the load on drainage systems and reduces contamination of ground water from silt, fertilizer and other chemicals.

Construction of playing fields should ensure that the soil has sufficient structural strength to reduce compaction from traffic.

4. Take Advantage of Training

IPM training and seminars are frequently held in the province. If budgets permit, have key staff attend as many as possible, including one or both of the major trade shows: Hort Congress in New Brunswick and Hort East in Halifax (held in alternate years). There is also a Turf Seminar held annually in Halifax.

Read key references, including the *Integrated Pest Management Manual for Landscape Pests in British Columbia*[5] and *Understanding Turf Management.*[7] An excellent primer in ecological management approaches is *Ecologically Sound Lawn Care Practices for the Pacific Northwest*[8], although the fertility rates and turf species must be adjusted for our climate. *Turf Management – Principles and Practices Study Guide*[4] provides a more in-depth scientific treatment of all aspects of turf behaviour for real fine-tuning.

5. Keep Citizens Informed

Spread the word. Keep management and the public informed of your approaches and successes. When they see the municipality taking the lead, the public is encouraged to participate in environmentally friendly turf care practices.

6. Consider IPM Accreditation

Consider enrolling in an IPM Accreditation program and introducing the IPM Accreditation requirement for contractors hired for turf management operations within the municipality.

The IPM Accreditation program is an independently audited industry certification program similar to the ISO 9000 concept. It has been developed by the IPM/PHC Council of Canada. The program began in Ontario and is now being implemented in some provinces. NBHTA (1-866-752-6862), Landscape Nova Scotia (1-877-567-4769), and Landscape Newfoundland and Labrador (709-726-2000) are provincial contacts for the program.

IPM/PHC of Canada Definition of IPM

The IPM/PHC (Plant Health Care) Council has re-stated the national IPM definition for use in its Industry IPM Accreditation program, as the following steps:

- manage landscapes to prevent pests from becoming a threat,
- identify potential pests (weeds, diseases and insects),
- monitor environmental conditions, pest and beneficial organism populations and pest damage,
- decide whether treatment is needed on the basis of population and damage thresholds,
- use biological, mechanical and behavioural control methods (such as resistant plant varieties, physical barriers and traps) to reduce pest populations to acceptable levels,
- when necessary, use targeted applications of pesticides, and
- have a built-in evaluation process.

REFERENCES

[1] Working Group on Pesticide Education, Training and Certification. *Applicator Core: Basic Knowledge Requirements for Pesticide Education in Canada*. 2003. Pest Management Regulatory Agency of Health Canada. 67 pp. Available on-line: http://www.hc-sc.gc.ca/pmra-arla/english/edutran/edutran-e.html

[2] Beard, J. B. and R. L. Green. The role of turfgrass in environmental protection and their benefits to humans. 1994. *Journal of Environmental Quality*. 23:3, May 1994, pp. 452-460. Available on-line on the NBHTA website at http://nbhta.ca/

[3] Research at Laval with IPM approaches documented a reduction of over 80% in herbicide and insecticide use in "conventional" turf care programs in Quebec, while maintaining the same appearance standards. From: Rochefort, S., J. Brodeur, Y. Carrière, and Y. Desjardins. *Making IPM Work in Turf.* Presentation by S. Rochefort at NB Horticultural Congress 2002, Moncton NB, Feb.12, 2002.

[4] Eggens, J. L. *Turf Management – Principles and Practices.* Study Guide. 1998. Dept. of Horticulture, University of Guelph, Guelph ON. 1-519-824-4120 Ext 2232. Cost $25. *See* Chapter 4, p.30.

[5] Gilkeson, L. and R. Adams. *Integrated Pest Management Manual for Landscape Pests in British Columbia*. 2000. BC Ministry of Environment, Lands, and Parks. 128 pp. Available on-line: http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/ipm-manuals.htm

[6] Wellwood, A., G. Nickerson and J. Wetmore. *Hairy Chinch Bug Survey, Demonstration and Monitoring in New Brunswick, 2002.* New Brunswick Department of Agriculture, Fisheries and Aquaculture and New Brunswick Horticultural Trades Association. Fredericton NB. Available on-line at: http://nbhta.ca/Chinch_Bug_Report.pdf.

[7] Sheard R. W. *Understanding Turf Management*. 2000. Sports Turf Association of Ontario, Guelph ON.

[8] McDonald, David K. *Ecologically Sound Lawn Care for the Pacific Northwest*. 1999. Seattle Public Utilities. Seattle, WA. Available on-line: http://www.ci.seattle.wa.us/util/lawncare/LawnReport.htm; Hard copies from New Brunswick Horticultural Trades Association (address on the website http://nbhta.ca/). Cost $15 ppd.