16 Integrated Pest Management and Plant Health Care

16.1. General

16.1.1. Introduction

Integrated Pest Management (IPM) is a multidisciplinary, ecological approach to the management of pest infestation, founded on sound horticultural practices, and relying on the appropriate and integrated use of biological, physical, cultural, mechanical, behavioural and chemical management tools. In ideal IPM programs synthetic pesticides are used only as a last resort and when all preferred methods fail.

Plant health care, as a basis of IPM, is a comprehensive approach which incorporates an array of practices such as pruning, nutrient management, water management, and IPM, among others, into an overall approach to the care of the variety of plants in landscaping. Plant health care focuses on maintaining healthy plants, thus enhancing their natural ability to tolerate, defend or ward off pest attack and infestation.

Combining the methodologies and philosophy of IPM and plant health care in landscape management ultimately leads to healthier plants, trees and turf in the landscape, elimination of unwarranted pesticides, and a healthier environment.

16.1.2. Intent

The intent of this section is to encourage and support the implementation of IPM and plant health care practices in the landscape. The goal of an IPM program is to contain pest populations at acceptable levels through the use of complementary management techniques (physical/mechanical, cultural, biological, behavioural, and chemical). This is accomplished through regular monitoring of pest populations, evaluation of the results, and using that information to make necessary adjustments.

16.1.3. Related References, Standards and Legislation

1. *Canadian Environmental Assessment Act.*
2. *Canadian Environmental Protection Act.*
3. *Canadian Pest Control Products Act.*
4. *BC Pesticide Residue Compensation Act.*
5. *BC Environment and Land Use Act.*
6. *BC Integrated Pest Management Act.*
7. *Integrated Pest Management Manual for Home & Garden Pests in BC*, 2005, BC Ministry of Environment.
8. *Handbook for Pesticides Applicators and Dispensers*, 2005, BC Ministry of Environment. Current editon.

9. *IPM Manual for Landscape Pests*, BC Ministry of Environment.
10. *Nursery & Landscape Pest Management Production Guide,* BC Ministry of Agriculture and Lands.

16.1.4. IPM Basics

1. An IPM program involves the following basic components:
    a. Prevention of a pest problem by means of using proper horticultural practices.
    b. Assessing the site and surrounding areas.
    c. Monitoring the pests, diseases, and weeds.
    d. Monitoring for beneficial organisms.
    e. Acquiring and applying knowledge (e.g. means of identification, life cycles) of potential pests, diseases, weeds, and beneficial organisms.
    f. Determining damage thresholds of pest tolerance.
    g. Calculating action thresholds (when to treat) for potential treatments.
    h. Selecting and implementing management decisions.
    i. Evaluating the results to make necessary adjustments.
    j. Keeping records.
2. Site Review.

    The site review is a systematic inspection performed to collect current and site-specific information to form the basis for mapping, referencing, and record taking, and formulates a strategic approach to monitoring.

    Data required for a site review includes, but is not limited to:

    a. Physical characteristics.
        i. Soil conditions and characteristics.
            - Texture (sandy, loamy, clay).
            - Depth.
            - Drainage/aeration.
            - pH and EC.
            - Soil fertility.
            - OM (organic matter) content.
            - CEC (cation exchange capacity).
        ii. Micro-climate conditions.
            - Temperature.

- Exposure to sun/light and shade patterns.
- Wind/air circulation.
- Water features, both natural and constructed.
- Topography.
- Surface drainage patterns.
- Irrigation system type.

b. Plant inventory should include:

i. Identifying the species, and if possible, the cultivars of plants in the landscape.

ii. The plotted locations, numbers and plant names on a site map.

c. Plant inspection, noting:

i. Overall health.

ii. Signs of insect pest and plant disease.

iii. Symptoms of nutrient deficiency/toxicity.

iv. Growth abnormalities.

v. Pruning requirements.

vi. Structure.

d. Cultural maintenance practices and history such as:

i. Transplanting methods.

ii. Spacing.

iii. Irrigating.

iv. Fertilizing.

v. Pruning.

vi. Staking.

vii. Mowing practices.

3. Landscape use patterns.

a. Frequency and purpose of use.

b. Pedestrian and vehicular traffic patterns.

c. Seasonal changes.

4. Environmental and sociological concerns.

a. Potential for runoff, erosion into water bodies, ditches or storm drains.

b. Use by wildlife, such as birds, mammals, butterflies, and others.

c. Impact on neighbouring properties.

5. Identification of insect pests, plant diseases, weeds and beneficial organisms.

a. Information collected provides the scouting or monitoring individual(s) with easy identification of any potential or current pests, pathogens, or beneficial organisms.

b. Profiles should be developed for each insect pest, plant disease, or weed, invasive/noxious species that is prevalent to the area. A basic profile should include:

i. Insect Pest, Plant Disease and Beneficial Species Identification: common and scientific name.

ii. Insect Pest, Plant Disease and Beneficial Species identification keys, stages of development, photos, diagrams.

iii. Life Cycles/Natural Histories:

- When and how damage occurs – what it looks like.
- Where insect pests and plant diseases are to be found and generations per year.

iv. Knowledge of Treatment strategies.

- Which stages are most susceptible to the various control strategies.
- Which beneficial species have potential to exert control and when.

v. Sources and cause.

vi. Monitoring techniques that are effective and will yield good information.

vii. Identification of host species range.

viii. Symptoms of infestation/infection: Visible signs evident when activity is present.

ix. Favourable environmental conditions: Seasonal and weather conditions that coincide with pest/pathogen/beneficial activity.

x. Record-keeping documents.

xi. Reference materials.

6. Scouting and Monitoring.

a. Scouting is an essential component of IPM and Plant Health Care programs. The goal of scouting is to survey the landscape for pests, weeds, and diseases. At the same time the presence of natural enemies should be noted.

b. Monitoring consists of regular and systematic visual inspections and/or sampling techniques.

c. Accurate plant identification, knowledge of pest life cycles (and appropriate monitoring techniques), and weather conditions are all part of monitoring program.

d. Primary objectives of scouting and monitoring:

i. Identification and population estimation of target insect pests and plant diseases, and weeds.

ii. Identification and populations of natural enemies.

iii. Location of areas where the population concentrations are the greatest.

iv. Identification of maintenance or cultural practices that may affect pest activity.

v. Notation of prevalent seasonal weather conditions:

- Air temperature, minimum and maximum.
- Soil temperatures.
- Precipitation.
- Wind direction and prevalence.
- Hours of sunlight.

7. Monitoring is used to:

a. Detect pests, diseases, and weeds and to detect the changes in their populations.

b. Predict changes in their populations.

c. Determine the injury from the pests, diseases, and weeds and then calculate the corresponding damage.

d. Evaluate the effectiveness of treatments or natural enemies.

8. Basic Tools.

a. Bucket.

b. Camera.

c. Clipboard and recording forms/note pad/pencils.

d. Cooler with ice to keep samples.

e. Cup cutter.

f. Dish detergent.

g. Flagging ribbon.

h. Hand lens (10-20X).

i. Hand trowel.

j. Insect pest and plant disease guides.

k. Plastic bags, bottles and identification tags.

l. Pruning shears.

m. Rain gauge.

n. Rating grid.

o. Ruler/tape measure.

p. Secateurs/sharp knife.

q. Tweezers.

r. Shovel or spade.

s. Soil probes.

t. Sweep net.

u. Soil thermometer and soil moisture sensor.

v. Traps for monitoring.

9. A monitoring program consists of:

   a. A series of inspections or counts, consistently performed at regular intervals

   b. Written records of counts and observations.

      i. When and where:

         - The time and place to start monitoring varies according to the site, plants and the pest/disease/beneficial organisms involved.

      ii. Examples of monitoring information to record includes:

         - General condition and species of plant infected/infested, and location.
         - Weather and site conditions.
         - Counts of pests and beneficial species.
         - Counts or notes of damage or symptoms.
         - Plant phenology.

10. Plant and insect/microorganism phenology: Plant growth depends on temperature, so the time a particular plant blooms is dependent upon the weather seasonal accumulation of heat units or growing degree days above a lower developmental threshold. Therefore, the calendar dates differ from year to year but plants, arthropods and microorganism pests generally develop in the same relationship to each other in any given year. Insect and microorganism development is also dependent on ambient temperature. Therefore the appearance of particular insects/diseases can be expected to correlate to plant phenology much better than to a calendar date.

11. Monitoring techniques.
    a. Insects.
        i. Soil sample.
        ii. Soap flush or irritating drench.
        iii. Flotation or flooding.
        iv. Traps (pheromone/light/pitfall/sticky).
        v. Sweep net.
        vi. Beating tray.
        vii. Black lights.
    b. Diseases.
        i. Active fungal mycelium/reproductive structures.
        ii. Symptoms appearance/colour/location/tissues affected.
    c. Weeds.
        i. Weed species, numbers, and stage of growth.
        ii. Soil conditions.
12. Abiotic conditions to note at the time of infestation/infection.
    a. Soil: moisture, temperature, compaction, and fertility levels.
    b. Thatch: thickness, density.
    c. Drainage.
    d. Irrigation/precipitation patterns.
    e. Air circulation.
    f. Hours of direct sunlight or shade.
    g. Slopes.
    h. Mowing height and frequency.
    i. Damage during or following what kind of weather.
        i. High night temperatures.
        ii. High humidity.
        iii. Heavy rainfall.
        iv. Drought.

13. Threshold Establishment.
    a. Insect, disease, or weed pests cannot be completely eliminated, so the Contractor must learn to manage the grounds keeping pests at acceptable levels. This pest population level is defined as the Economic Injury Level (EIL): the pest population level where the dollar loss from injury equals the cost of implementing a control measure.
    b. Disease and weed thresholds are subjective and vary according to maintenance levels and site usage. Limits can be established by the Owner or Consultant in consultation with the maintenance Contractor.
14. Control Options.
    a. Control Options are various mamagement tools, methos and strategies, which should be selected using the following criteria:
        i. Least disruptive method/tool.
        ii. Least hazardous to human health.
        iii. Least harmful to non-target organisms.
        iv. Least harmful to the environment.
        v. Effective on target organism.
        vi. Adheres to municipal by-laws, provincial and federal regulations.
15. Control options are often divided into six major classifications (refer to Glossary for definitions).
    a. Cultural.
    b. Biological.
    c. Chemical.
    d. Physical.
    e. Mechanical.
16. Cultural Control Options:
    a. Alteration of the micro-environment to create less favourable condition for insect pests and plant disease occurrence resulting in the suppression of endemic species.
    b. Improvement of the plants' growing conditions making them less vulnerable to attack by insect pests, plant diseases and invasive plants encroachment.
    c. Selection of resistant or tolerant plants.
    d. Cultural practices or selections that promote plant health care including:

i. Mowing operations.

ii. Irrigation systems and frequency.

iii. Selection of disease and insect resistant species and cultivars.

iv. Pruning and thinning.

v. Mulching practices.

vi. Fertility management.

vii. Cultivation of beds.

viii. Amending soils to affect characteristics (e.g. water holding capacity, pH, CEC, fertility levels).

ix. Planting timing.

x. Sanitization and hygiene.

17. Biological Control Options.

a. Biological controls incorporate the use of living organisms or their metabolic products to suppress the pest or pathogen populations eliminating or reducing the need for use of other methods. The integration of complementary control methods to reduce or maintain pest populations at acceptable levels are generally more effective when used in conjunction with cultural practices.

b. Insect and disease biological controls include:

i. Bacteria.

ii. Fungi (including endophytes and mycorrhizal fungi).

iii. Parasitoids.

iv. Pathogens.

v. Predators.

18. Chemical Control.

a. Pesticides are a considered as a last resort when cultural, biological and other IPM management strategies are insufficient to maintain pest populations at an acceptable or threshold level.

b. Pesticide usage consideration factors:

i. Environmental risks:

- Bioaccumulation.
- Effect on non-target organisms.
- Leaching.

- Runoff.
- Toxicity.
- Volatilization.

ii. Timing of application for optimal effect.

iii. Characteristics of the pesticide:

- Formulation/class.
- Mode of action and mammalian toxicity.
- Residual activity.
- Speed of efficacy.
- Likelihood of resistance development.

iv. Provincial and municipal restrictions of product type or use.

19. Physical Control Options.

a. Physical controls include manual techniques such as hoeing, pulling weeds, picking off insects, and pruning. Passive techniques such as barriers and traps are also physical control options.

i. Barriers: These stop or exclude pests and diseases from reaching their target host.

- Insect barriers (screens).
- Weed barriers (mulches and landscape fabric).
- Animal barriers (fences and meshes).

ii. Traps: These attract and catch pests thereby removing them from the population.

- Sticky tree bands.
- Sticky yellow board traps.
- Baited traps.

20. Mechanical Controls Options.

a. Mechanical controls are machines or devices used to control or suppress insect pests and plant diseases and include:

i. Vacuum equipment.

ii. Cultivators.

iii. Mowers and line trimmers (used to control weeds).

iv. Heat applicators, such as propane flamers.

v. Hot-water or steam applicators.

vi. Infra-red radiation equipment.

vii. Animal repellers, such as devices that squirt water when activated by a motion sensor.

16.1.5. Plant Health Care (PHC) Basics

1. Plant Selection.

   a. Maintenance or control options will not compensate for the site conditions if plants are not adapted to the site. Species selection to suit the site is critical.

   b. Horticultural considerations for plant selection include:

      i. Planting site characteristics

         - Environmental conditions.
         - Soil type.
         - Major insect pest and plant disease presence.
         - Plant characteristics, tolerance and requirements for growth and development.
         - Cultural practices.
         - Plant and turf tolerance is specific and dependent on several factors:
            - Insect pest or plant disease species present or combination thereof.
            - Inherent tolerance of the cultivar to the insect pest or plant disease.
            - Vigour and condition of plants.
            - Time of year.

2. Planting.

   a. Proper planting procedures include:

      i. Preparation of planting area.

      ii. Planting pit width/depth.

      iii. Time of digging/planting.

      iv. Irrigating.

      v. Fertilizing.

      vi. Pruning of roots and shoots.

      vii. Backfilling.

      viii. Staking.

ix. Mulching.

x. Sod or seed.

3. Plant Maintenance.

   a. Cultural practices that optimize plant health include:

      i. Monitoring and regular check-ups.

      ii. Diagnosis of plant problems.

      iii. Cultural considerations:

         - Fertilization.
         - Soil pH adjustment.
         - Irrigating.
         - Aeration of soils.
         - Mulching.
         - Pruning and mowing.
         - Thatch removal.
         - Over-seeding.

4. Evaluation.

   a. After any pest/disease management strategy is implemented, monitoring to assess effects and efficacy should be conducted. Impact on pest populations, beneficial populations and other elements of the ecosystem should be determined. The assessed effectiveness of the management program may indicate the necessity to perform additional monitoring and implementation of additional/multiple management measures.

   b. Monitoring, follow-up treatment, records, observations from field staff, and other feedback should be analyzed for assessment of the effectiveness of the IPM program and to identify areas for IPM practice and pest management improvement.

   c. The evaluation process should include:

      i. Analysis of treatment results.

      ii. Fine-tuning of monitoring techniques.

      iii. Review of management options..

5. Standard IPM & Plant Health Care monitoring form outline.

   a. Date of observation(s).

   b. Monitor/scout name(s).

c. Client name/address/location/grid number.

d. Plant/turf species.

e. Sampling techniques used.

f. Plant/turf location.

g. Pest/disease quantity and activity.

h. Natural enemy quantity and activity.

i. Environmental conditions.

j. Abiotic and biotic conditions.

k. General notes.

l. Recommendations.

Table 16.1. Turfgrass Insect Development Timetable

Insect		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
European Chafer	Adults/Egg Laying								
	Larval Feeding								
Japanese Beetle	Adults/Egg Laying								
	Larval Feeding								
June Beetle Year 1	Adults/Egg Laying								
	Larval Feeding								
June Beetle Year 2	Adults/Egg Laying								
	Larval Feeding								
June Beetle Year 3	Adults/Egg Laying								
	Larval Feeding								
Chinch Bug	Adults/Egg Laying								
	Larval Feeding								
Turfgrass Scale	Adults/Egg Laying								
	Larval Feeding								
Sod Webworm	Adults/Egg Laying								
	Larval Feeding								
Bluegrass Billbug	Adults/Egg Laying								
	Larval Feeding								
Crane Flies	Adults/Egg Laying								
	Larval Feeding								
Ataenius	Adults/Egg Laying								
	Larval Feeding								
Bluegrass Weevil	Adults/Egg Laying								
	Larval Feeding								
Black Cutworm	Adults/Egg Laying								
	Larval Feeding								
		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV

Table 16.2. Turfgrass Disease Development Timetable

Disease		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Snow Moulds	Pathogen	■	■	■								■	
	Symptoms	■	■	■								■	
Fusarium Patch	Pathogen	■	■	■							■		
	Symptoms				■						■		
Red Thread	Pathogen				■					■			
	Symptoms				■					■			
Yellow Patch	Pathogen					■					■		
	Symptoms					■					■		
Smuts	Pathogen						■				■		
	Symptoms							■			■		
Leaf Spots	Pathogen					■	■	■	■	■			
	Symptoms					■	■	■	■	■			
Melting Out	Pathogen						■	■	■	■			
	Symptoms							■					
Dollarspot	Pathogen						■	■	■				
	Symptoms							■	■	■			
Brown Patch	Pathogen						■	■					
	Symptoms							■	■				
Anthracnose	Pathogen							■	■				
	Symptoms							■	■				
Pythium Blight	Pathogen							■					
	Symptoms							■					
Rust	Pathogen								■				
	Symptoms								■	■			
Ring Patch	Pathogen				■	■	■	■	■	■			
	Symptoms				■	■	■	■	■	■			
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC