

# **University Park Campus Landscape Integrated Pest Management Program**



**March 25, 2019**

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## Introduction

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. Our IPM program uses current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to minimize pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. Historical data, such as rainfall, wind, temperature, types of plants, disease outbreaks, and past pesticide use, is also analyzed and consulted and informs our decision making.

## Scope

While IPM can be implemented anywhere and in any situation, this plan forms the basis for actions taken in response to pest issues in landscaped areas in the core areas of the University Park campus.

## Goals

Penn State has embraced sustainability as a core value and uses the following definition: the simultaneous pursuit of human health and happiness, environmental quality, and economic well-being for current and future generations. Surveys of Penn State students consistently show that they select Penn State over other universities due to the beauty of our campus, which has been recognized through many national awards and accolades. In part this is due to our thriving, robust, and sustainable landscape. This IPM plan conforms to our sustainability values providing our campus users with a safe and healthy environment, while ensuring that pest problems are addressed effectively and economically. Additionally, our IPM Plan considers the showplace nature of our campus and the desire to maintain its beauty.

## Integration with other Plans

The *Penn State Landscape Management Guidelines* and Penn State Tree Care Plan are the overarching plans for University Park landscape areas. They address priority designations for maintenance, maintenance standards and procedures, tree care, and personnel responsibilities.

The *Arboretum Maintenance Manual* is the overarching plan for the Arboretum. The Manual addresses maintenance standards and procedures, tree care, and personnel responsibilities.

The *Office of Physical Plant Drought Contingency Plan* provides the restrictions in place during drought watch, warning, and emergency time periods.

The *Invasive Species Control Policy* provides guidance for invasive species management on campus.

The *Wellhead Protection Plan* is intended to minimize impacts to source water and includes a restriction on pesticide use within Zone 1 areas.

The *Penn State Pesticide Management Program* provides the overall guidance on the use of pesticides at Penn State including regulatory requirements and best management practices.

## Roles and Responsibilities

### Integrated Pest Management Committee

The Integrated Pest Management Committee is made up representatives of the Physical Plant Landscape Services, The Arboretum at Penn State, Environmental Health and Safety, and academia, and is responsible for the overall implementation of IPM at the University Park Campus. The IPM Committee meets quarterly during the academic year. The IPM Committee is responsible for evaluating performance and making updates to this plan as necessary; contact information for these members is available in Appendix I.

Members of the IPM Committee and their roles and responsibilities are provided in the table below:

<b>Title/Name</b>	<b>Responsibilities</b>
IPM Coordinator/ EHS Environmental Compliance Engineer	<ul style="list-style-type: none"><li>• Ensure that this plan is executed</li><li>• Coordinate meetings of the IPM Committee</li><li>• Ensure that hypersensitive people are identified to pesticide applicators for proper notification and receive all copies of notifications</li><li>• Liaison to address concerns about pesticide use</li><li>• Administer PSU Pesticide Management Program</li></ul>
Manager Grounds and Equipment	<ul style="list-style-type: none"><li>• Serve as Physical Plant point of contact</li><li>• Oversee outdoor pest control</li><li>• Ensure that the pest control applicators are fully trained on this plan and adhere to the plan procedures</li><li>• Coordinate site visits for regular inspections and as needed for implementation of pest controls</li></ul>
Director of Horticulture	<ul style="list-style-type: none"><li>• Serve as point of contact for Arboretum pest issues</li><li>• Oversee pest control within the Arboretum</li><li>• Identify pests during site visits and inspections</li><li>• Ensure staff are educated on their roles in implementing IPM</li></ul>
Facility Supervisors, Landscape Services	<ul style="list-style-type: none"><li>• Serve as point of contact for landscape pest issues</li><li>• Identify pests during site visits and inspections</li><li>• Adhere to the procedures outlined in this plan</li><li>• Ensure staff are educated on their roles in implementing IPM</li></ul>
OPP Communications	<ul style="list-style-type: none"><li>• Ensure that public is notified as appropriate for tree applications</li><li>• Serves a point of contact for public questions</li></ul>
Associate Professor of Turf Grass Science	<ul style="list-style-type: none"><li>• Serve as subject matter expert on turf grass issues for IPM Committee</li></ul>
Insect Identification Lab Director	<ul style="list-style-type: none"><li>• Serve as subject matter expert on insect identification for IPM Committee</li></ul>
Plant Science Greenhouse Manager	<ul style="list-style-type: none"><li>• Serve as subject matter expert on greenhouse pest control for IPM Committee</li></ul>

<b>Title/Name</b>	<b>Responsibilities</b>
Coordinator Plant Disease Clinic	<ul style="list-style-type: none"><li>• Serve as subject matter expert on plant diseases for IPM Committee</li></ul>
Plant Science Research Support Associate	<ul style="list-style-type: none"><li>• Serve as subject matter expert on weed ecology for IPM Committee</li></ul>

### Landscape Maintenance

The Office of the Physical Plant's Landscape Maintenance is committed to providing a safe, clean, environmentally friendly, aesthetically pleasing and academically supportive campus environment that contributes to the University's mission of teaching, research and service. Members of the Landscape Maintenance crews handle routine landscape maintenance duties, mowing, fertilizing, tree and shrub pruning, and pesticide application. Other work includes turf renovation and plant material installation. The group consists of Landscape Maintenance, Arboriculture, and Ornamental Horticulture.

The Landscape Maintenance group is divided into three area shops – Pollock Landscape, Nittany Landscape, and Tower Road Landscape. The campus is divided into Landscape Maintenance Areas that are each staffed by a member of either the Pollock or Nittany Landscape facilities. This landscape professional is responsible for all aspects of grounds maintenance in their area including, mowing, fertilization, weed control, and disease identification. Through their daily work in the assigned areas, they are well-suited to notice pest problems and diseases early when non-pesticide interventions may be possible. When issues arise that require a specialist, they contact their supervisor who may contact one of the subject matter experts identified above on the IPM Committee.

The Tower Road Landscape shop has the Ornamental Horticulture and Arborist groups. They are responsible for growing and selecting the ornamental plants used throughout the campus and have a small nursery and several greenhouses to assist in these operations. The arborists are responsible for all trees throughout the campus and perform pest/disease monitoring, tree pruning, pesticide application, and tree planting. The Penn State tree IPM program is well established and due to the historic elm trees on campus, pest monitoring has been on-going for many years.

### Arboretum

The Arboretum at Penn State was developed in 2009 and is growing within the established footprint with the regular addition of new gardens. The mission of The Arboretum is to engage the academic strengths of the University in promoting scholarship and education about plants and their history and importance on earth. The Arboretum at Penn State strives to be a place of beauty and renewal, a venue for the arts, and a pathway to discovery and enrichment.

The Director of The Arboretum at Penn State is appointed by the Provost. The director's principal responsibility is to coordinate the implementation of the Arboretum plan as approved by the Board of Trustees in March 1999. In doing so, the director works with scores of faculty and staff representing

most University colleges, as well as many non-University experts, in the design, utilization, and execution of all Arboretum elements and programs. The director reports to a Steering Committee of deans that is the overall governing body for the implementation of the Arboretum plan.

In addition to the Director, the Arboretum is currently staffed by:

Director of horticulture/curator who is responsibilities include the development and care of the Arboretum's plant collections, oversight of new garden planning and construction, coordination of the internship programs, and facilitation of public education and outreach efforts. The work in the arboretum is performed by Office of Physical Plant Landscape department.

Event and marketing coordinator, is responsible for collaborating with other staff to develop and host special Arboretum events and for renting spaces in the H.O. Smith Botanic Gardens to the University and public for such activities as academic receptions, reunions, and weddings. their duties as marketing coordinator for the Arboretum include developing promotional materials, maintaining the website, creating marketing strategies, coordinating public relations, assisting with fund-raising activities, and preparing grant applications.

Director of development, who coordinates and manages fund-raising efforts.

Development assistant/volunteer and tour coordinator responsibilities include providing support to the Arboretum's director of development, and reviewing volunteer applications, interviewing prospective volunteers, scheduling volunteer activities and assignments, planning training sessions, and coordinating tours.

Horticulture and plant records coordinator responsible for overseeing the use of the plant records system, accessioning and mapping the plant collections, labeling, developing plant records and mapping standards and procedures, coordinating staff for annual events, and providing support for horticultural projects.

Coordinator of children's educational programs is responsible for developing the programs for our Childhood's Gate Children's Garden,

Natural areas program assistant the Arboretum include planning, coordinating, documenting, and executing targeted restoration and maintenance efforts on the Marilyn Quigley Gerhold Wildflower Trail and surrounding areas within Hartley Wood.

## How does our IPM program work?

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, we will follow a six-tiered approach. The six steps include:

- *Acceptable pest levels*—the emphasis is on control, not eradication. We first work to establish acceptable pest levels, called action thresholds, which are pest and site specific, and apply controls if those thresholds are crossed.

- *Preventive cultural practices*—Selecting varieties best for local growing conditions and maintaining healthy crops is the first line of defense.
- *Monitoring*—Regular observation is critically important.
- *Mechanical controls*—if a pest reaches an unacceptable level, mechanical methods are the first options. They include simple hand-picking, barriers, traps, vacuuming and tillage to disrupt breeding or propagation.
- *Biological controls*—Natural biological processes and materials can provide control, with acceptable environmental impact, and often at lower cost. The main approach is to promote beneficial insects that eat or parasitize target pests
- *Responsible use*—Synthetic pesticides are used as required and often only at specific times in a pest's life cycle.

In the landscape areas, we are primarily concerned with insects, weeds, and diseases. Appendix II contains a listing of diseases we may encounter based on the types of plants we have on campus. Appendix III contains a listing of broadleaf and grass weeds. Appendix IV is a listing of the insects we may encounter, the life style stage and its associated growing degree days.

## Set Action Thresholds

Before taking any pest control action, our IPM program first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. These thresholds will differ by location, based on their priority designation in the *Landscape Management Guidelines*.

Campus trees are on a preventative maintenance plan due to the historic elm trees and the destructive nature of other pests. These preventative actions are scheduled based on Growing Degree Days (see below for detailed explanation). Refer to Appendix V for other action thresholds.

## Monitor and Identify Pests

Our IPM program works to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used. Appendix V contains a list of the current known pests and treatments on campus.

OPP issues a weekly IPM report (See Appendix VI) which shows weather for the month/year and calculated Growing Degree Days (GDD). GDDs are calculated from the daily maximum and minimum air temperature and allow us to estimate the growth-stages of weeds and life stages of insects; this allows us to predict best timing of fertilizer or pesticide application, so we are applying the procedure or treatment at the point that the pest is most vulnerable. Appendix IV, the Growing Degree Day Life Stages, provides a correlation of the GDD with the pest's life cycle.

Objectives of the monitoring program are as follows:

- Determine the extent and nature of any turf or plant damage;

- Determine the presence and population of pests;
- Establish ambient environmental conditions (e.g., temperature, sunlight, humidity and precipitation) and the associated impacts on pests;
- Identify the growth stage of the pest and its susceptibility to treatment;
- Identify the current life or growth stage of the pest's host (if applicable) and its conditions;
- Identify the presence, identity and population levels of beneficial insects, wildlife and birds; and
- If a pesticide needs to be applied to control the pest outbreak, the following information is recorded:
  - The name of the pest;
  - Where it was encountered;
  - Date of occurrence;
  - Weather conditions present; and
  - Control measures used.

## Prevention

As a first line of pest control, the IPM program will work to prevent pests from becoming a threat. Prevention involves removing the conditions that might attract a pest or disease or provide it with the food and environment it needs to thrive. Some plants need full sun, some do better in shade. Some grow best in sandy soils, others in clay or wetlands. Some need a lot of fertilizer, others very little. Nothing does well surround by weeds that compete for light, fertility and water and often harbor insects and diseases.

When selecting annuals, perennials, shrubs, trees, and turf we will make sure the soil and light conditions support the plant's needs. Strong healthy vegetation is much less susceptible to attacks by insects or disease. Species are chosen that are selected to the environment here. Monitoring flowers, vegetables and landscape plantings for damage every week during the growing season helps reduce pesticide use.

## Preventive Cultural Methods

Cultural methods are essentially preventative measures which block or reduce the extent of pest problems and focus on turf health. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Examples of cultural methods are as follows:

- Aeration, topdressing, thatch removal, and over-seeding to promote a healthy turfgrass environment;
- Hand-pull or spot treat weeds growing in small patches;
- Select native or pest-resistant trees, shrubs, and ornamentals in landscape beds. Select turfgrass cultivars adapted to local climatic conditions;
- Conserve native grass species or establish diverse grass species where possible;



- Incorporate organic amendments (such as peat moss, compost or straw) in areas where organic content of the soil is low to improve water and nutrient-holding capacity, enhance drainage, and promote aeration;
- Aerate compacted soil and provide good drainage;
- Raise mowing height and reduce mowing frequency;
- Mow with sharp blades;
- Return grass clippings to grass areas wherever possible;
- Use high quality seed stock/varieties that are disease-free and disease-resistant;
- Manage soil fertility, weed control, and irrigation to help maintain a strong, healthy grass stand and increase disease resistance;
- Schedule early-morning irrigation in areas that are susceptible to disease;
- Minimize shade in areas susceptible to disease;
- Till exposed soil to kill growing weeds;
- Prevent the spread of disease and weeds by equipment;
- Use outside contractors for mammal control;
- Use tree guards to control damage by rabbits and porcupines; and
- Use mechanical methods for removing vegetation, taking care to remove roots and plant debris.

### Preventive Non-Cultural Methods

Non-cultural methods utilize either biological controls or pesticides for pest control.

- Biological controls involve the use of specific organisms (e.g., weed-eating fish, snails, etc.) to control the pests. Other control organisms include bacteria, predatory insects, bats and birds. Given that the use of biological controls is relatively new, combined with the potential adverse consequences of introducing new species into the local environment, we consult with a biologist prior to implementing any of these control options.
- Chemical controls are used to ensure a plants survival or to prevent and outbreak of pest.
  - Insecticides are used on our trees to prevent the spread of Dutch Elm Disease, Elm Yellows, Emerald Ash Borer, and Hemlock Woolly Adelgid. Without these preventative control methods, the host trees will die. Timing for these applications is based on Growing Degree Days.
  - Pre-emergent herbicides are used in some shrub beds and lawn areas on campus to prevent those areas from being overrun with weeds. Timing for these applications is based on growing season and weather.

### Controls

Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, the IPM program then evaluates the proper control method both for effectiveness and risk.

Effective, lower risk pest controls will be chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further

monitoring, identification, and action thresholds indicate that these lower risk controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spreading of non-specific or non-selective pesticides is a last resort.

### Physical Controls

If preventative measures fail to prevent pest problems, a second strategy is to use mechanical trapping devices, natural predators including various insects and birds, insect growth regulators, pheromones, or other mating disruption substances. Some pests can be removed by hand, or by using a strong jet of water; other physical practices, including pruning, raking, and regular mulching also help. Using physical controls will mean taking a more active role in pest management, without spending time and money on pesticide treatments that may harm the environment.

### Horticultural Controls

Horticultural practices such as planting pest-resistant trees and shrubs and composting decayed plant material and using it to improve soil quality, also help control pest populations safely and effectively while protecting the environment from chemical overuse.

### Biological Controls

Biological controls are another safe way to manage pests without the use of chemicals. The most common natural enemies include predators, parasites, and pathogens. Predators, including various insects, birds, bats, and moles, help consume and eliminate large numbers of pests. Ladybugs, for example, help control aphids. These methods are mainly employed within the greenhouses and are the major form of pest control in these areas. See Appendix V for specific biological controls and pests.

### Chemical Controls

Our chemical applications are integrated into our program based on recommendations from Penn State faculty and other experts. We've moved away from primarily using non-selective herbicides to more targeted pesticides, both by plant and by area. We apply materials as spot treatment more often than entire beds.

Turfgrass areas are more likely to receive broadcast applications compared to flower/shrub beds. Turf areas get a pre-emergent application for summer annual weeds and then get spot treatment for weeds as the season progresses. We try to get our pre-emergent out early for turf to allow for seeding in the fall. Shrub beds will get a pre-emergent and then get spot treated for weeds. Post-emergent herbicides are used in shrub beds, sidewalks/hardscape and lawn areas on campus to spot treat for weeds in those areas to control outbreaks and prevent weeds from establishing. Timing for these applications are based on growing season, number of weeds and weather.

Insecticides are used to control insect population to reduce damage. Timing for these applications is based on thresholds set for acceptable damage or insect counts.

We don't use the boom sprayer during busy times on campus to prevent exposure. We use small capacity sprayers during these periods, where there is less chance of drift and more precise application.

Wind speeds are lower in the morning and pollinators are less active, so this is when we perform applications as often as possible.

We follow all PA Department of Agriculture regulations and manufacturer's labels. All applicators are certified individuals and receive continuing education at Penn State to maintain their licenses. We receive instructions from professors performing the latest research on these.

The Pennsylvania Department of Agriculture (PDA) has instituted a pesticide hypersensitivity registry. All persons listed on the registry are provided with information about pesticide applications that will occur within 500 feet of their residence/office/work area prior to the application. At University Park, a "courtesy" list is also maintained which includes those students, faculty, and staff that are not on the registry but desire notification of pesticide applications in or around their buildings due to health issues associated with these materials. Anyone with health issues related to pesticides is encouraged to register with the PDA, however if they would like to be included on the courtesy list that can contact the IPM Coordinator; notification of a pesticide application is usually made by email. Appendix VII contains a sample hypersensitivity notification form.

## APPENDIX I – IPM Committee Contact Information

<b>Title</b>	<b>Name</b>	<b>Email</b>	<b>Phone</b>
IPM Coordinator	Lysa Holland	LJH17@PSU.EDU	814/863-3844
Manager Grounds and Equipment	Ryan McCaughey	RDM25@PSU.EDU	814/867-4311
Director of Horticulture	Shari Edelson	SKE13@PSU.EDU	814/865-8080
Facility Supervisor, Landscape Services	Matt Wolf	MKW144@PSU.EDU	814/865-1514
Facility Supervisor, Landscape Services	Brian Phiel	BGP103@PSU.EDU	814/865-2775
Facility Supervisor, Landscape Services	Todd Zook	TAZ109@PSU.EDU	814/865-3516
OPP Communications	Susan Bedsworth	SJB5001@PSU.EDU	814/863-9620
Associate Professor of Turf Grass Science	Ben McGraw	BAM53@PSU.EDU	814/865-1138
Insect Identification Lab Director	Michael Skvarla	MXS1578@PSU.EDU	814/865-3256
Plant Science Greenhouse Manager	Scott DiLoreto	DSD134@PSU.EDU	814/867-2965
Coordinator Plant Disease Clinic	Sara May	SRM183@PSU.EDU	814/865-2204
Plant Science Research Support Associate	Art Gover	AEG2@PSU.EDU	814/863-9904

## APPENDIX II - Campus Plant Diseases

Disease	Description
<b>Anthracnose</b>	Trees most likely to be affected are ash, dogwood, elm, hickory, maple, oak, sycamore, and walnut.
<b>Bacterial leaf spot on Hedera</b>	While affecting the cosmetic appearance of the plant, leaf spot does not generally harm healthy plants.
<b>Diplodia on Austrian pine (Pinus nigra)</b>	Common of stressed conifers with needles in bunches of 2's and 3's. Austrian Pine ( <i>Pinus nigra</i> ) is the most susceptible host, although the following pines are also susceptible: Scots Pine ( <i>Pinus sylvestris</i> ), Red Pine ( <i>Pinus resinosa</i> ), Mugo Pine ( <i>Pinus mugo</i> ), Ponderosa Pine ( <i>Pinus ponderosa</i> ) and occasionally Eastern White Pine ( <i>Pinus strobus</i> ). The disease sometimes attacks other conifers such as Douglas Fir ( <i>Pseudotsuga menziesii</i> ), Norway Spruce ( <i>Picea abies</i> ), Colorado Blue Spruce ( <i>Picea pungens</i> ), American Larch ( <i>Larix laricina</i> ), Noble Fir ( <i>Abies procera</i> ), Silver Fir ( <i>Abies alba</i> ), some true Cedars ( <i>Cupressus</i> spp.), Arborvitae ( <i>Thuja</i> spp.), and Junipers ( <i>Juniperus</i> spp.). Except for young seedlings, the disease rarely attacks trees under 15 years of age and most severely damages trees that are older than 30 years.
<b>Dogwood Anthracnose</b>	A major disease problem on Flowering Dogwood ( <i>C. florida</i> ), dogwood anthracnose differs from other anthracnose diseases in that it can kill trees, rather than merely disfigure them.
<b>Dutch Elm Disease</b>	A fungal disease that kills elm trees. The fungus cannot move by air or water to infect new trees but rather is carried by beetles or transmitted through grafted (connected) roots.
<b>Elm Yellows</b>	Phytoplasma infection is spread by leafhoppers or by root grafts. Elm yellows, also known as elm phloem necrosis, is very aggressive, with no known cure.
<b>Fire blight</b>	Apple and Crabapple ( <i>Malus</i> ), Cotoneaster ( <i>Cotoneaster</i> ), Hawthorn ( <i>Crataegus</i> ), Mountain Ash ( <i>Sorbus</i> ), Pear ( <i>Pyrus</i> ), Pyracantha ( <i>Pyracantha</i> ), Quince ( <i>Chaenomeles</i> ), Rose ( <i>Rosa</i> ), and Spirea ( <i>Spiraea</i> ).
<b>Ganoderma root rot</b>	Attack the lower heartwood, and at advanced stages damage the structural integrity of the host tree, often resulting in windthrow (the potential to be uprooted or broken by wind). Maples, Oaks and Honey Locusts are particularly susceptible, although Ashes, Elms and many other deciduous trees and some conifers can be attacked. By the time the conks are noticed, it is too late to reverse the infection. The rate of decay can lead to death in as little as 3 to 5 years from the time of infection, and appears to be determined by tree vigor, which is often influenced by environmental stresses
<b>Inonotus root rot on oak (Quercus)</b>	Trees may topple before any obvious symptoms are noted. Infected trees often have branch dieback and fewer than normal leaves that are yellowed. Although the root rot begins well out on the root system, the fungus eventually reaches the butt of the tree where it forms large, tough, irregularly shaped, light- to dark-brown shelves at or just above the soil line. With age, these become very rough and dark brown to black. Cutting the shelf reveals a reddish-brown center. The underside of the shelf is brown with tiny pores in which the spores are formed. A sure sign of severe damage to the tree is the presence of the fruiting structures. Infected trees should be removed immediately.

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<b>Disease</b>	<b>Description</b>
<b>Oak anthracnose (Quercus)</b>	During wet weather, young leaves are blighted as bud break occurs or large dead areas form between the leaf veins primarily on lower branches. Winter twig dieback may occur. Slightly raised, brown dots (fungal fruiting structures) form on the lower surface of leaves and on dead twigs.
<b>Oak Wilt</b>	All oaks are susceptible to oak wilt. However, the Red Oak subgenus (red, black, Hill's, pin, and scarlet) is more susceptible to oak wilt than the White Oak subgenus (white, bur, English, swamp white, and chinkapin)
<b>Powdery Mildew</b>	Some of the more susceptible trees and shrubs include Alder ( <i>Alnus</i> ), Azalea ( <i>Rhododendron</i> ), Birch ( <i>Betula</i> ), Bittersweet ( <i>Celastrus</i> ), Catalpa ( <i>Catalpa</i> ), a few Crabapple cultivars ( <i>Malus</i> ), Dogwood ( <i>Cornus</i> ), Elm ( <i>Ulmus</i> ), Euonymus ( <i>Euonymus</i> ), Holly ( <i>Ilex</i> ), Lilac ( <i>Syringa</i> ), Magnolia ( <i>Magnolia</i> ), Oak ( <i>Quercus</i> ), Privet ( <i>Ligustrum</i> ), and Viburnum ( <i>Viburnum</i> ). Powdery mildews are also common on certain herbaceous plants, such as Chrysanthemums, Dahlias, Delphiniums, Phlox, Snapdragons, and Zinnas.
<b>Botrytis Blight - Greenhouse</b>	One of the most common fungal disease of greenhouse crops. The disease is often referred to as gray-mold because it produces a crop of gray fuzzy-appearing spores on the surface of infected tissues. A variety of plants including ornamentals, vegetables and herbs are susceptible.

## APPENDIX III – Grass and Broadleaf Weeds

### Grass Weeds

Annual Bluegrass ( <i>Poa annua</i> )	Large Crabgrass ( <i>Digitaria sanguinalis</i> )
Bermudagrass ( <i>Cynodon dactylon</i> )	Orchardgrass ( <i>Dactylis glomerata</i> )
Creeping Bentgrass ( <i>Agrostis palustris</i> )	Quackgrass ( <i>Elytrigia repens</i> )
Giant Foxtail ( <i>Setaria faberi</i> )	Rough Bluegrass ( <i>Poa trivialis</i> )
Goosegrass ( <i>Elusine indica</i> )	Tall Fescue ( <i>Festuca arudinacea</i> )
Green Foxtail ( <i>Setaria viridis</i> )	Yellow Foxtail ( <i>Setaria glauca</i> )

### Broadleaf Weeds

Birdsfoot Trefoil ( <i>Lotus corniculatus</i> )	Orange Hawkweed ( <i>Hieracium aurantiacum</i> )
Black Medic ( <i>Medicago lupulina</i> )	Perennial Sowthistle ( <i>Sonchus arvensis</i> )
Broadleaf Plantain ( <i>Plantago major</i> )	Poison Ivy ( <i>Toxicodendron radicans</i> )
Buckhorn Plantain ( <i>Plantago lanceolata</i> )	Prostrate Knotweed ( <i>Polygonum aviculare</i> )
Bull Thistle ( <i>Cirsium vulgare</i> )	Prostrate Pigweed ( <i>Amaranthus blitoides</i> )
Canada Thistle ( <i>Cirsium arvense</i> )	Prostrate Spurge ( <i>Euphorbia maculata</i> )
Carolina Geranium ( <i>Geranium carolinianum</i> )	Purple Deadnettle ( <i>Lamium purpureum</i> )
Chicory ( <i>Cichorium intybus</i> )	Red Sorrel ( <i>Rumex acetosella</i> )
Common Chickweed ( <i>Stellaria media</i> )	Redroot Pigweed ( <i>Amaranthus retroflexus</i> )
Common Lambsquarters ( <i>Chenopodium album</i> )	Shepherd's Purse ( <i>Capsella bursa-pastoris</i> )
Common Mallow ( <i>Malva neglecta</i> )	Silvery Thread Moss ( <i>Bryum argenteum</i> )
Common Milkweed ( <i>Asclepias syriaca</i> )	Smooth Crabgrass ( <i>Digitaria ischaemum</i> )
Common Mullein ( <i>Verbascum thapsus</i> )	White Clover ( <i>Trifolium repens</i> )
Common Purslane ( <i>Portulaca oleracea</i> )	Wild Carrot ( <i>Daucus carota</i> )
Corn Speedwell ( <i>Veronica arvensis</i> )	Wild Strawberry ( <i>Fragaria virginiana</i> )
Creeping Speedwell ( <i>Veronica filiformis</i> )	Wild Violet ( <i>Viola papilionacea</i> )
Creeping Woodsorrel ( <i>Oxalis corniculata</i> )	Yarrow, Common ( <i>Achillea millefolium</i> )
Curly Dock ( <i>Rumex crispus</i> )	Yellow Hawkweed ( <i>Hieracium pratense</i> )
Dandelion ( <i>Taraxacum officinale</i> )	Yellow Nutsedge ( <i>Cyperus esculentus</i> )
English Daisy ( <i>Bellis perennis</i> )	Yellow Rocket ( <i>Barbarea vulgaris</i> )
Field Bindweed ( <i>Convolvulus arvensis</i> )	Yellow Woodsorrel ( <i>Oxalis stricta</i> )
Field Horsetail ( <i>Equisetum arvense</i> )	
Germander Speedwell ( <i>Veronica chamaedrys</i> )	
Ground Ivy ( <i>Glechoma hederacea</i> )	
Heal All ( <i>Prunella vulgaris</i> )	
Henbit ( <i>Lamium amplexicaule</i> )	
Mouseear Chickweed ( <i>Cerastium vulgatum</i> )	
Nimblewill ( <i>Muhlenbergia schreberi</i> )	

## APPENDIX IV – Insect Growing Degree Day Life Stages

<b>GDD for forecasting landscape insect life stages</b>		
<b>Insect</b>	<b>Life stage</b>	<b>GDD</b>
American plum borer	adult flight and egg laying	245-440
American plum borer	2nd generation	1375-1500
Arborvitae leaf miner	larvae in mines; 1st generation	245-360
Arborvitae leaf miner	2nd generation	533-700
Arborvitae leaf miner	3rd generation	1700-2100
Balsam gall midge	adults laying eggs	150-300
Balsam gall midge	galls apparent	550-700
Balsam twig aphid	egg hatch	60-100
Balsam twig aphid	stem mothers present (control target)	100-140
Banded ash clearwing borer	adult emergence	1800-2200
Beech scale	eggs present	800
Beech scale	egg hatch; 1st crawlers	1250
Birch leaf miner	1st adult emergence	175-215
Birch leaf miner	Adults laying eggs	275-375
Birch leaf miner	larvae and pupae	375-500
Birch leaf miner	adults and egg laying; 2nd generation	600-700
Black pine leaf scale	egg hatch	1068
Bronze birch borer	adults; eggs; new grubs	400-600
Cankerworm	young caterpillars	100-200
Cooley spruce gall adelgid	1st adults active - Spruce (control target)	25-120
Cooley spruce gall adelgid	1st galls visible - Spruce	200-310
Cooley spruce gall adelgid	1st adults active - Douglas fir	90-180
Cooley spruce gall adelgid	1st nymphs - Douglas fir (control target)	90-150
Cooley spruce gall adelgid	2nd nymphs - Douglas fir (control target)	600-1000
Cooley spruce gall adelgid	2nd adults active (control target)	1500-1600
Cottony maple scale	adults & yellow crawlers on leaf veins	802-1200
Dogwood borer	adults, eggs, caterpillars	350-850
Eastern pine shoot borer	1st adults active	75-200
Eastern spruce gall adelgid	1st adults active (control target)	25-100
Eastern spruce gall adelgid	egg hatch, galls begin forming	250-310
Eastern spruce gall adelgid	2nd adults active (control target)	1500-1600
Eastern tent caterpillar	egg hatch	45-100
Eastern tent caterpillar	tents apparent	150
Eastern tent caterpillar	pupation	450
Elm leaf beetle	1st generation	400-600
Elm leaf beetle	2nd generation	1300
Elm leaf miner	adult emergence	215-240



**University Park Campus Landscape Integrated Pest Management Program**

<b>GDD for forecasting landscape insect life stages</b>		
<b>Insect</b>	<b>Life stage</b>	<b>GDD</b>
Elm leaf miner	1st generation larvae	365-530
Emerald ash borer	1st adult emergence	400-500
Emerald ash borer	peak adult activity	1000-1200
Euonymus scale	egg hatch - 1st generation	400-575
Euonymus scale	egg hatch - 2nd generation	1900-1050
European Elm Bark Beetle	Control - 1st generation	300
European Elm Bark Beetle	Control - 2nd generation	1250
European Fruit Lecanium Scale	Egg hatch	1073
European pine sawfly	1st larvae	100-195
European pine shoot moth	1st larvae	50-220
European pine shoot moth	egg hatch	900-1000
European pine shoot moth	adults active	700-800
Fall webworm	egg hatch	850-900
Fall webworm	caterpillars feeding	1200-1800
Fall webworm	tents become apparent	1850-2050
Fletcher scale	egg hatch	850-900
Forest tent caterpillar	egg hatch	125-250
Forest tent caterpillar	pupation	450
Forest tent caterpillar	tachinid parasitic flies abundant	450-550
Golden oak scale	Egg hatch	680-700
Greater peach tree borer	adult emergence	575-710
Gypsy moth	egg hatch, 1st larvae	145-200
Gypsy moth	young caterpillars	450
Gypsy moth	pupation	900-1200
Hawthorn Leaf miner	Adult emergence	180
Elongate hemlock scale	crawlers	360 -700
Hemlock Woolly Adelgid	Larvae emergence	203
Honey locust spider mite	egg hatch	220-250
Honey locust plant bug	egg hatch	220-250
Introduced pine sawfly	1st larvae	400-600
Imported willow leaf beetle	Adults active	120-275
Jack pine budworm	young larvae feeding	300-350
Jack pine budworm	large larvae feeding - defoliation apparent	650-700
Jack pine sawfly	eggs; young larvae	100-200
Jack pine sawfly	larger larvae consuming needles	275-500
Japanese beetle	adults emerge and feed	950-2150
Juniper scale	egg hatch	550-700
Larch casebearer	egg hatch	120-150
Large aspen tortrix	pupation	600-700
Lesser peach tree borer	adult flight	350-375

**University Park Campus Landscape Integrated Pest Management Program**

<b>GDD for forecasting landscape insect life stages</b>		
<b>Insect</b>	<b>Life stage</b>	<b>GDD</b>
Lilac borer	adult flight	325-350
Magnolia scale	egg hatch	1925-1950
Mimosa webworm	egg hatch - 1st generation	850-900
Northern pine weevil	1st adults active	25-100
Northern pine weevil	2nd adults active	1200-1400
Oystershell scale	egg hatch	350-500
Pales weevil	1st adults active	25-100
Pales weevil	2nd adults active	1200-1400
Pine chafer (Anomela beetle)	1st adults active	450-600
Pine engraver (Ips bark beetle)	1st adults active	100-150
Pine needle midge	1st adults active	400-500
Pine needle scale	1st generation egg hatch	250-400
Pine needle scale	1st generation - hyaline stage (control target)	400-500
Pine needle scale	2nd generation egg hatch	1250-1350
Pine needle scale	2nd generation - hyaline stage (control target)	1500
Pine root collar weevil	1st adults active	300-350
Pine root collar weevil	2nd adults active	1200-1400
Pine shoot beetle	new adults emerge; begin shoot-feeding	500-550
Pine shoot beetle	optimal control window	450-500
Pine tortoise scale	egg hatch begins; 1st crawlers	400-500
Pine tortoise scale	egg hatch ends; last of the crawlers	1000-1200
Pine tube moth	adults; egg laying; caterpillars	90-250
Red-headed pine sawfly	1st larvae	400-600
Spruce budscale	egg hatch, 1st crawlers	700-1150
Spruce budworm	1st larvae	200-300
Spruce needleminer	1st larvae	150-200
Spruce spider mite	1st egg hatch	150-175
Striped pine scale	egg hatch	750-800
Turpentine beetle	parent beetles colonizing brood material	300-350
Viburnum Crown Borer	adult emergence / larvae treatment	500 - 648
Walnut caterpillar	egg hatch; caterpillars	1600-1700
White pine weevil	1st adults active	25-220
White pine weevil	2nd adults active	1200-1400
Zimmerman pine moth	1st larvae	25-100
Zimmerman pine moth	adult flight	1700

## APPENDIX V - Current Known Pests and Treatments

### Greenhouse

Insects - Threshold for chemical control varies based on crop

- **Biological Controls- Predatory Insects**
  - Encarsia Formosa - Whitefly
  - Neoseiulus cucumeris - Thrips
  - Aphidius colemani - Aphids
  - Neoseiulus californicus - Spider mites
  - Phytoseiulus persimilis – Spider mites
- **Chemical Controls- Safari Drench or Suff-oil X spray**
  - Whitefly
  - Thrips
  - Aphids
  - Spider mites
  - Mealybugs

Fungal - Threshold for chemical control varies based on crop

- **Botrytis blight - Agri-Mycin/ Manicure**
- **Powdery Mildew – Agri-Mycin/ Manicure**

### Arboretum

Trees - Threshold is preventative chemical control

- **Hemlock**
  - Woolly adelgid – Merit (Imidacloprid) Drench
  - Elongated Scale – Safari Drench
- **Birches**
  - Emerald Ash Borer- Trunk Injection with TreeAge
- **Beech**
  - Phytophthora - Imidacloprid
  - Phytophthora - Agri-Fos/PentraBark
- **Ash**
  - Fire Blight - Argifos
- **Elm**
  - Spanworm - Dipel (Bt var kurstaki)

Shrubs – Threshold when disease or insects are present

- **Fire Blight - Agri-mycin**
- **White Pine Weevil - Prune out**
- **Mugo Pine Weevil - Prune out**
- **Viburnum Crown Borer - Imidacloprid**
- **Pine and Dogwood Sawflies -Permethrin or Insecticidal soap**

Turf - Threshold is 5-10 per square feet or animal feeding

- **White Grubs – Merit Granular or Spray**

Annual – Preventative fungal treatment then containment and disposal after bloom (not composted)

- Tulip Blight – Daconil and Bacillus subtilis

## Campus

Trees - Threshold is preventative chemical control

- Elms – Aerial Spray/ Mist Blower based on Growing Degree Days (300 AND 1350)
  - Dutch Elm and Elm Yellow - Astro-ground and Mavrik Aquaflow-aerial
- Hemlock
  - Woolly adelgid – Merit (Imidacloprid) Drench
  - Elongated Scale – Safari Drench
- Birches
  - Leaf beetle - Imidacloprid
- Fraxinus
  - Emerald Ash Borer- Trunk Injection with TreeAge
- Magnolia
  - Scale - Imidacloprid
- Beech
  - Phytophthora - Imidacloprid
  - Phytophthora - Agri-Fos/PentraBark
- Tulip Poplar
  - Scale – Safari
- Malus, Sorbus, Craetagus
  - Fire Blight – Agri-Mycin
- Gleditsia
  - Webworm- Dipel

Shrubs – Threshold when disease or insects are present

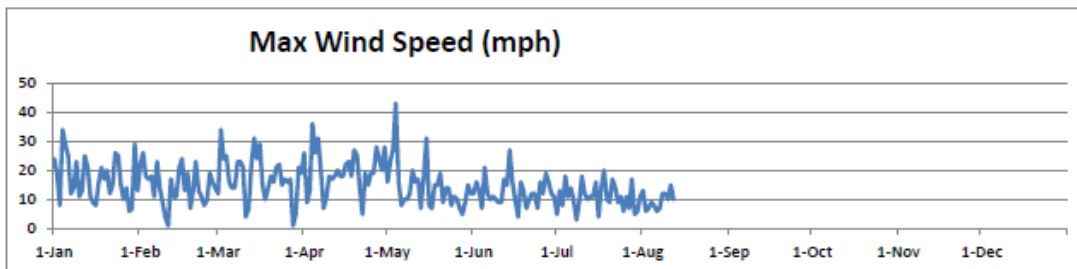
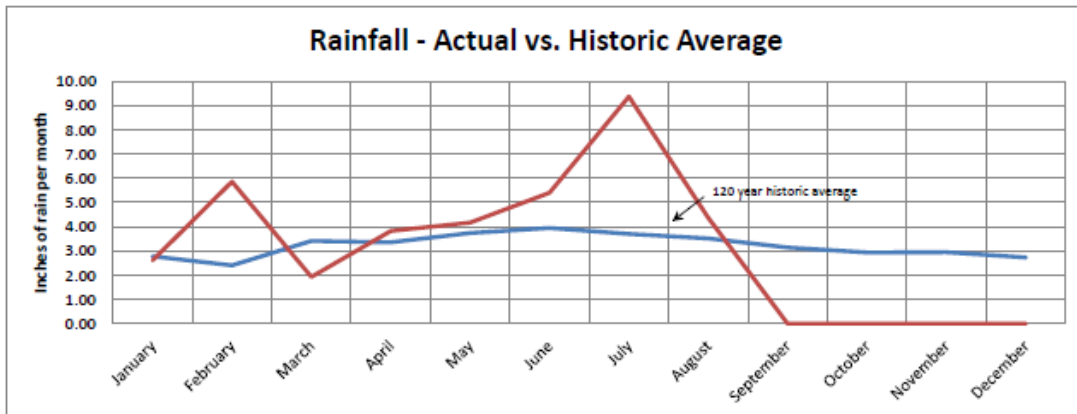
- Fire Blight - Agri-mycin
- White Pine Weevil- Prune out
- Mugo Pine Weevil – Prune out
- Emerald Ash Borer – Imidacloprid

Turf - Threshold is 5-10 per square feet or animal feeding

- White Grubs – Preventative - Merit Granular or Spray; Post-Emergent - Dylox Granular or spray

APPENDIX VI – Sample IPM Report

OPP IPM Report				
<b>Date</b>	<b>Actual GDD</b>	<b>Predicted GDD</b>	Magnolia Scale - (egg hatch - 1938 GDD), Fall Web Worm (larvae emergence 1800 - 2100)	
8/12/2018	2036			
8/13/2018		2056		5 day extended Forecast
8/14/2018		2075.5		5 day extended Forecast
8/15/2018		2101		5 day extended Forecast
8/16/2018		2126.5		5 day extended Forecast
8/17/2018		2150	5 day extended Forecast	
Rainfall Information				
Month	Deficit or surplus vs. 100 yr. ave	Actual Total for Month		
January	-0.17	2.61		
February	3.45	5.86		
March	-1.49	1.93		
April	0.47	3.83		
May	0.43	4.17		
June	1.45	5.40		
July	5.66	9.37		
August	0.85	4.37		
September	-3.15	0.00		
October	-2.94	0.00		
November	-2.95	0.00		
December	-2.74	0.00		



## APPENDIX VII - Sample Hypersensitivity Notification



### Hypersensitivity Notification

#### Penn State University – Office of Physical Plant

**DATE:** 6/4/2018 through 6/8/2018

**TIME:** Generally, Between the hours of 6am to 4:30pm

**LOCATION:** Landscape Areas P-12, P-13, P-1, P-6

[https://opp.psu.edu/sites/opp/files/landscape\\_maintenance\\_areas\\_map.pdf](https://opp.psu.edu/sites/opp/files/landscape_maintenance_areas_map.pdf)

**PRODUCT:** Battleship III

**EPA #:** 226-453-5905

**AI:** Dimethylamine Salt of 2-Methyl-4-Chlorophenoxyacetic Acid,  
1-Methyleptyl Ester of Fluroxypr; ((4-amino-3-5dichloro-6 flouro-2-2pyridinyl)oxy)acetic  
Acid, 1-methylheptyl ester

Triethylamine Salt of 3,5,6-Trichloro-2-Pyridinyloxyacetic Acid

**NAME:** Pollock Landscape Facility – Office of Physical Plant - Penn State University

**TELEPHONE:** 814-865-1514

**CONTACT:** Matthew K. Wolf

**BU #:** 7798

**COMMENTS:** We will be applying broadleaf herbicide to campus turfgrass areas on the dates listed above. Applications will depend of weather. We will be posting signs that read ***Pest Control Product Applied PLEASE KEEP OFF.*** Please obey our signs. If you have any problems accessing the map or you have any questions, please feel free to contact me.