

Integrated Pest Management (IPM) and Pesticide Management BMPs

EPA defines IPM as “an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices.” The primary objective of an IPM program is to reduce the total pesticide load on the turfgrass area by using a combination of tactics to control or manage pests. This approach considers all strategies to reduce pest damage to acceptable levels in the most economical means, while simultaneously accounting for impacts on humans, property, and the environment.

An IPM process should first incorporate the use of regular monitoring and recordkeeping to identify pest problems, analyze the conditions that can lead to pest problems, and determine appropriate threshold or tolerance levels for pests. Strategies to prevent or discourage pest issues should be part of the process. If damage thresholds are met or exceeded, a number of control and management strategies should be considered: biological, physical, mechanical, and chemical. In many cases, the use of chemical pesticides may be delayed until after other IPM strategies have been considered or used.

Regulations

Federal

EPA regulates pesticide distribution, sale, and use under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and its amendments. Among other requirements, FIFRA prohibits the use of any pesticide inconsistent with its labeling and requires all pesticides used in the U.S. to be registered by EPA. Registration assures that pesticides are properly labeled and that when used in accordance with the label, the pesticides do not cause unreasonable harm to the environment. The use of registered pesticides is dictated by the label, which includes legal application sites and situations. Pesticides classified as restricted use pesticides (RUPs) can only be applied by certified applicators. A number of other federal regulations impact pesticide users, including the Superfund Amendments and Reauthorization Act (SARA) Title III (42 CFR 103), also known as the Emergency Planning and Community Right-to-Know Act, and the Resource Conservation and Recovery Act (RCRA). In some cases, SARA Title III requires the Local Emergency Planning Committee (LEPC)¹ to be notified of spills. Any spill that could enter groundwater or surface water must be reported to EPA under the authority of the Clean Water Act.

State

Pesticide applicators must be certified by the state in which they are making applications. Check the state’s requirements for information regarding registered pesticide products, pesticide business licenses, and permits for safe and effective control of pests. Within your state, check if specific counties have special regulations or pesticide bans.

BMPs Monitoring

- Monitor the presence and development of pests, or the conditions that are conducive for pest outbreak throughout the year.
- Train personnel to observe and document turfgrass conditions regularly (daily, weekly, or monthly, depending on the pest), noting which pests are present, so intelligent decisions can be made regarding how damaging they are and what control strategies are necessary.
- Train personnel to determine the pest’s life cycle and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Look for signs of the pest. These may include mushrooms, animal damage, insect frass, or webbing.

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- Identify the symptoms of the pest. Look for symptoms such as chlorosis, dieback, growth reduction, defoliation, mounds, or tunnels.
- Document when the damage occurred. Note the time of day, year, and flowering stages of nearby plants.
- Map pest outbreak locations to identify patterns and susceptible areas for future target applications and ultimate pesticide reductions.
- Train personnel to determine whether corrective actions actually reduce or prevent pest populations, are economical, and minimize risks. Record and use this information when making similar decisions in the future.
- Correct conditions that produce stressful environments for the turfgrass (for example, improve airflow and drainage, reduce or eliminate shade.)
- As part of the overall IPM strategy, preventively apply appropriate fungicides where diseases are likely to occur and when conditions favor disease outbreaks.
- Record and map disease outbreaks and identify trends that can help guide future treatments and focus on changing conditions in susceptible areas to reduce disease outbreaks.

Diseases

- Know which diseases are likely to be active based on grass species, time of year, site conditions, and environmental conditions.
- Understand the potential diseases for a given species or cultivar and environmental conditions associated with it.



Brown Patch – Photo courtesy of Cale Bigelow, Ph.D. and Gregg Munshaw, Ph.D.

- Properly identify the disease to choose the correct management practices or products for treatment.
- Ensure that proper cultural practices (i.e. mowing, fertilization, irrigation) that reduce turfgrass stress are used.

Insects

- Determine the pest's life cycle, and know which life stage to target, i.e. egg, larva/nymph, pupa, or adult.
- Manage insects based on timing, insect threshold, suggested detection and monitoring methods, and biological and cultural control recommendations.
- Record and map insect infestations to help identify site specific issues and preventative actions.



Grub Life Stages (Northern Masked Chafer) – Photo courtesy of David Shetlar, Ph.D.

Weeds

- Identify weeds so proper control measures can be implemented.
- Identify the problem that limits growth, density, and competitiveness of the desirable turfgrass. A high-quality turfgrass outcompetes seedling weeds for light, water, and nutrients, and prevents them from establishing large weed stands that decrease turfgrass playability and aesthetics. Simply killing weeds is not enough. If the underlying problem that has allowed weeds an opportunity for invasion is not fixed, new weeds will invade the area after the current weeds are controlled.

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- Select appropriate turfgrass species or cultivars that are adapted to the prevalent environmental conditions to reduce weed encroachment.
- Adopt or maintain cultural practices that protect turfgrass from environmental stresses such as shade, drought, and extreme temperatures.
- Address improper turfgrass management practices, such as the misuse of fertilizers and chemicals, improper mowing height or mowing frequency, and improper soil aeration, and physical damage and compaction from excessive traffic.
- Properly fertilize to sustain desirable color, growth density, and vigor.
- Avoid scalping. Determine the appropriate recommended mowing height for the turfgrass variety and utilize the 1/3 rule.
- Address damage from turfgrass pests such as diseases, insects, nematodes, and animals to prevent density/canopy loss to broadleaf weeds.
- Record and map weed infestations to help identify site specific issues for preventative actions.



Physical Removal of Weeds - Photo courtesy of Doug Linde, Ph.D.

Control Options

- Manage turfgrasses to reduce disease, insect, and weed pressure. Use cultural, mechanical, or physical methods to prevent problems from occurring. Proper mowing, fertilization, aeration and irrigation keep turfgrass plants healthy and actively growing to outcompete weeds and better withstand insect and disease infestations.
- Select an appropriate turfgrass cultivar or species for site specific conditions, management needs and tolerance to diseases or insect infestations common to the region.
- Control weeds through physical or mechanical removal.
- Use biological controls when possible. Biological control makes use of nonpathogenic microorganisms (bacteria, fungi, and nematodes) to reduce damage from pests.
- Use bio-pesticides, such as insect growth regulators (IGR), to control insect populations.
- Identify areas that can be modified to attract natural predators, provide habitat for them, and protect them from pesticide applications.
- Reduce pest habitat by practicing good sanitation, pruning and dethatching.
- Install flowering plants that can provide parasitoids with nectar, or sucking insects (aphids, mealybugs, or soft scales) with nectar or honeydew source.
- Release insect-parasitic nematodes to naturally suppress mole crickets and white grubs.
- Consider lures, baits, and pheromones as alternatives to insecticides for pest management.
- Observe and document turfgrass conditions regularly (daily, weekly, or monthly, depending on the pest), noting which pests are present, so intelligent decisions can be made regarding how damaging the pests are and what control strategies are necessary.
- Determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.

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- Utilize pesticides only when necessary. IPM does not exclude the use of pesticides, but rather promotes the use of the least toxic and most selective pest management alternatives available.
- Use available pest thresholds to guide pesticide application decisions. Choose the product most appropriate for the problem or pest. Select the least toxic pesticide with the lowest exposure potential.
- Use properly timed preventive chemical applications only when your professional judgment indicates they are likely to control the target pest effectively, while minimizing the economic and environmental costs.
- When making curative applications of pesticides, consider spot treating only the areas with the pests rather than a blanket treatment.
- Keep a detailed record of IPM strategies. This provides the turfgrass manager and staff with a working reference document that can also be used to inform stakeholders (such as owners, regulators, athletes, users, and the public) regarding the IPM strategies and practices at the facility.
- Develop a facility emergency response plan which includes procedures to control, contain, collect, clean-up and store spilled materials.
- Personnel should be trained to follow the emergency response plan before an emergency occurs. Emergency preparedness includes having appropriate and readily accessible PPE, SDSs on all pesticides used and stored onsite, and reporting notification information. In the case of an emergency, call CHEMTREC at (800) 424-9300. CHEMTREC is a service of the Chemical Manufacturers Association and can provide emergency response information.
- Prominently post 'Important Telephone Numbers' including CHEMTREC, for emergency information on hazards or actions to take in the event of a spill.
- Pesticide labels provide minimum PPE requirements, which must be followed according to federal and state requirements and put on before opening pesticide containers.
- Provide adequate PPE for all employees who work with pesticides (including equipment technicians who service pesticide application equipment).

Pesticide Safety

- Always apply pesticides in accordance with label recommendations. County, State and Federal laws prohibit the use of any pesticide inconsistent with its label. Applicators must read, understand, and follow label directions carefully.
- Follow guidelines and advice provided by the Fungicide Resistance Action Committee (FRAC), Herbicide Resistance Action Committee (HRAC), and Insecticide Resistance Action Committee (IRAC).
- Do not apply pesticides to any site not listed on the product label.
- Do not apply materials more often or at rates higher than the label directs.
- Follow all label directions for transport, mixing, loading, application, storage, and disposal of pesticide products and containers.
- Personally ensure spray technician is experienced, licensed, and properly trained.
- Ensure that PPE is sized appropriately for each person using it.
- Make certain that PPE is appropriate for the chemicals used.
- Ensure that PPE meets rigorous testing standards and is not just the least expensive.
- Store PPE where it is easily accessible but not in the pesticide storage area.
- Forbid employees who apply pesticides from wearing facility uniforms home where they may come into contact with children.
- Provide laundering facilities or uniform service for employee uniforms.
- Meet requirements for OSHA 1910.134 Respiratory Protection Program.

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Photo courtesy of Mike Fidanza, Ph.D.

Pesticide Application

- Time pesticide applications based on available scouting methods and thresholds.
- Apply pesticides during the ‘weak link’ in the insect life cycle.
- Apply pesticides according to degree-day programs.
- Do not apply pesticides when pollinators are active. Avoid applying pesticides during bloom season, and cut flowering weeds before application.
- If fungicide application is necessary, for optimal control, apply fungicide preventatively when conditions become favorable for disease development.
- Reapply pesticides only if necessary. Timing depends on active ingredients, product formulation, target pests, environmental conditions, and the product label, which may restrict the number of applications per year or limit the frequency and timing.
- Choose the appropriate herbicide based on time of year and species being controlled. Pre-emergence herbicides kill seedlings as they germinate and are applied in advance of germination. Post-emergence control will control weeds that have already germinated.
- Train employees in proper pest identification and pesticide selection techniques.

- Mix only the quantity of pesticide needed in order to avoid disposal problems, protect non-target organisms, and save money.
- Spot-treat pests whenever appropriate.
- Rotate pesticide modes-of-action to reduce the likelihood of resistance.

Application Equipment

- Keep application equipment in good working order. Equipment must be properly calibrated at the beginning of each season and monthly during the growing period, as well as after equipment modifications.
- Minimize off-target movement by using properly configured application equipment.
- Check equipment daily when in use, including visual confirmation of nozzle delivery.
- Use recommended spray volumes for the targeted pest to maximize efficacy.
- Conduct calibration of walk-behind applicators for each person making the application to take into consideration their walking speed, etc.



Photo courtesy of Brad Fresenburg, Ph.D.

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Environmental Impact

- Understand the environmental fate of a pesticide in order to select an effective product with minimal risk of causing environmental problems. Consider the impact of site-specific and pesticide-specific characteristics before application.
- Time applications based on weather and irrigation scheduling. Prolonged heavy rain or irrigation may cause excess water to remain on the soil surface, especially in saturated soils or soils with low infiltration rates, and can lead to surface runoff. If heavy rain is likely, outdoor handling operations should be delayed (such as mixing, loading, application, and disposal).
- Select pesticides with a low runoff and leaching potential.
- Install vegetated buffers to avoid pesticide runoff into surface waters.
- Avoid the potential for surface water contamination by identifying and protecting sensitive areas.
- Do not allow irrigation water containing pesticides to flow into waterways.
- Do not compost or use clippings with pesticide residues as mulch near surface waters.
- Do not apply pesticides under conditions conducive to spray drift. To avoid spray drift, carefully consider equipment selection (nozzle selection for liquid sprays), equipment operation (application rates, volumes, release height), and weather (winds, temperature, and humidity). Tactics to reduce spray particle drift include the following: using properly-configured application equipment, selecting a nozzle that produces coarser droplets without sacrificing the efficacy of the pesticide, increasing application volume by using larger capacity nozzles, operating at the lower end of the nozzle's effective pressure range, reducing release height, spraying when winds are light (3–10 mph and steady), and spraying when wind is moving away from sensitive crops or areas.
- Do not apply pesticides under conditions conducive to vapor drift. Turfgrass pesticides with known volatility should be avoided. Tactics to reduce vapor drift include the following: choosing nonvolatile formulations, avoiding spraying in hot, dry conditions, avoiding spraying when

the air is very calm to avoid temperature inversions.

- Select pesticides with reduced impact on pollinators.
- Select pesticides that, when applied according to the label, have no known effect on endangered species present at the facility.

Recordkeeping

- Keep accurate records of all pesticide use to meet legal requirements, evaluate pest control efforts, and plan future treatments. Records should be kept according to local, state, or federal requirements.
- Recordkeeping information should include:
 - Name, address, and telephone number of the property owner
 - Address or location of the application site, if different
 - Name and certification number of the person making or supervising the application
 - Date and time of application
 - Weather and Site conditions at time of application, such as air temperature, relative humidity, wind speed and direction, rainfall (date, amount), and soil moisture level
 - Target pest
 - Pesticide used – trade name, active ingredient, amount of formulation, EPA product registration number
 - Amount of pesticide concentrate and amount of diluent (such as water) applied by weight or volume, to the area or sites treated
 - Acreage, area, or number of plants or animals treated
 - Type of application equipment used
 - Additional information such as stage of development of the treated turfgrass or plant material, life cycle stage of target pest, severity of infestation, beneficial species present, and previous attempts to control
 - Follow-up to check the effectiveness of the application. Determine whether the corrective actions actually reduced or prevented pest populations, were

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economical, and minimized risks. Record and use this information when making similar decisions in the future.

Pesticide Transportation

- Drivers must know emergency response procedures in case of a spill.
- Ensure emergency contact information travels with pesticide products. Keep information in a binder that includes contacts for police, fire, local environmental department, spill center, etc. Also include the product SDS sheets in case of an accident.
- Equip the vehicle with a spill kit.
- Transport pesticides secured in the back of a truck, preferably in a locked compartment or enclosed cargo box. Steel or plastic-lined beds are the easiest to clean if a spill occurs.
- Inspect containers to ensure that all caps, plugs, and other openings are tightly closed, and no pesticides are present on the outside of containers.
- Ensure pesticide labels are intact, undamaged, and readable.
- Ensure packing or shipping containers are equipped with extra cushioning and paper and cardboard containers are protected from moisture.
- Handle containers carefully to avoid rips or punctures.
- Avoid transport during extreme temperatures (very high or very low air temperatures).
- Place pesticides where they will not come in contact with food, clothing, or other things that people or animals might eat or touch.
- Transport highly volatile pesticides separately from other chemicals.
- Never leave pesticides unattended in an unlocked trunk compartment.
- Follow labeling requirements for containers used for the temporary storage or transportation of pesticide concentrates of end-use dilutions.

Pesticide Storage

- Follow all local requirements regarding pesticide storage.
- Only allow access to pesticide storage area to authorized personnel.
- Consider ease of access and security when choosing a storage area. If possible, locate the storage area near the mixing and loading work site and equipment cleaning area or pad.
- Locate pesticide storage facilities at least 100 feet from wells, springs, sinkholes, and other sites that directly link to groundwater. This buffer distance prevents groundwater contamination from floods, runoff, or firefighting water.
- Ensure the storage area is secure, dry, well lit, well-ventilated, protected from extreme heat and cold. Recommended features include:
 - Impervious shelving (Sturdy plastic or reinforced metal. Wood shelving should never be used because it may absorb spilled pesticides.)
 - A continuous, sealed floor
 - Secondary containment
 - A sump
 - Floor with a continuous sill to retain spilled materials and no drains, although a sump may be included.
 - Automatic exhaust fans
 - Emergency wash area
 - Explosion-proof lighting may be required.
 - Light and fan switches located outside the building, so that both can be turned on before staff enter the building and turned off after they leave the building.

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Pesticide Storage – Photo courtesy of Victoria Wallace

- Ensure the storage facility is well organized and laid out so that pesticides may be stored properly. For example: separate areas for herbicides, fungicides, insecticides; large containers on lower shelves; and bags placed where they will not tear or decompose.
- Keep spill cleanup materials in or near the storage facility.
- Install a sloped entrance/exit ramp to allow the use of wheeled handcarts to move material in and out of the storage area safely.
- Display a warning sign and emergency contact information in a prominent place.
- Store PPE directly outside the pesticide storage area.
- Ensure labels are on every package and container and remain properly affixed.
- Mark containers with date of purchase.
- Identify container damage or deterioration, which indicates that a product may no longer be effective, or a leak may result.
- Provide an inventory of all pesticides and an SDS for each product so it is available and accessible in case of emergency.
- Consult inventory when planning and before making purchases.

- Update inventory after pesticide purchase and use.
- Identify and keep a separate inventory of unwanted or unusable materials and store separately from usable pesticides and other materials.
- Avoid purchasing large quantities of pesticides that require storage for greater than six months.
- Adopt the ‘first in–first out’ principle, using the oldest products first to ensure that the product shelf life does not expire.
- Conduct routine inspections of the storage area and building.

Handling

- Follow all pesticide application recommendations, including label requirements, to protect human health and the environment.
- Locate mixing and loading sites at least 100 feet from surface water, direct links to groundwater, and drains to prevent releases from spills, leaks, and overflows. If located near a water source, methods such as dikes, sump pits, and containment pads should be used to keep pesticides from reaching the water.
- Prevent back-siphoning of pesticides into water sources by keeping the water pipe or hose well above the level of the pesticide mixture. An air gap prevents contamination.
- When pumping water directly from the source into a mix tank, a check valve, anti-siphoning device, or backflow preventer to prevent back-siphoning must be used in case of pump failure.
- Load pesticides and mix them with water or oil diluents over an impermeable surface (such as lined or sealed concrete), so surface can easily be cleaned and spills can be collected and managed.

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- Pump the sump dry and clean it at the end of each day. Liquids and sediments should also be removed from the sump and the pad whenever pesticide materials are changed to an incompatible product (that is, one that cannot be legally applied to the same site).
- Apply liquids and sediments from the sump as you would a pesticide, strictly following label instructions.
- Use absorbents as directed to clean up small spills and dispose of according to regulations or instructions.
- Sweep up solid materials and use as intended.
- Collect wash water (from both inside and outside the application equipment) and use it as a pesticide in accordance with the label instructions.
- Rinse emptied pesticide containers by either triple rinsing or pressure rinsing.
- Puncture empty and rinsed pesticide containers and dispose of according to the label.
- Many states offer ‘amnesty’ days in order to eliminate potential public health and environmental hazards from cancelled, suspended, and unusable pesticides that are being stored.

Disposal

- Apply excess mix to a selected site following all label directions (including rate, number, frequency, and timing of applications).
- Apply rinsate as a pesticide (preferred) or store for use as makeup water for the next compatible application.
- Disposal of unwanted or unusable concentrate or product include: legal use; valid label disposal directions; return to point-of-sale or manufacturer/registrant; indemnification; professional waste disposal firm; local, state, or federal waste disposal program; indefinite proper storage.
- Minimize pesticide container disposal efforts using the following practices: choosing low-rate products (which reduces container volume); selecting products packaged in a manner that eliminates the need for container disposal (such as water-soluble packaging); using returnable/refillable containers; recycling or reconditioning containers; choosing products packaged in containers that can be disposed of legally and conveniently.
- Rinse pesticide containers immediately in order to remove the most residue.
- Rinse containers during the mixing and loading process and add rinsate water to the finished spray mix.