# New Turf Insecticides and IRAC Classifications (2021)

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## Using Insecticides Preventively in an IPM Program for Turf

There are many components to an IPM program, including monitoring for pest activity, establishing tolerance levels, and considering cultural and biological control strategies. IPM supports the use of insecticides when a pest population exceeds a predetermined threshold level. Turf insecticides differ in efficacy against pests, residual duration, whether the insecticide is a contact or systemic (mode of action, MOA). For managing white grubs, care must be taken to ensure that the insecticides, such as imidacloprid (Merit) or chlorantraniliprole (Acelepryn), are applied when the grubs are in the most susceptible stage. Incertain instances, however, preventive pesticide applications may be preferred to the alternative of waiting until a problem develops, especially when a problem occurred in the same area the previous year.

For example, several turf insecticides, including the neonicotinoids and chlorantraniliprole (Acelepryn), provide preventive protection against white grubs and are much less toxic than the older organophosphate s that were used for many years. There are not many cultural practices or effective biological control agents that provide reliable control of white grub populations. To be justified in an IPM plan, preventive insecticide applications must be based on scouting or other documentation of the potential for damaging populations from the previous season or seasons.

## Insecticide Resistance

There are several chemical classes of insecticides available to turf managers. Recently the annual bluegrass weevil (ABW) has developed resistance to the pyrethroid class of insecticides. ABW has developed resistance to pyrethroids insome locations, particularly between Hartford, CT and metropolitan NY and south. One of the most effective ways to delay the development of resistance is to avoid using insecticides with the same mode of action. The Insecticide Resistance Action Committee (www.irac-online.org) has assigned IRAC numbers for each chemical class, and many chemical companies are putting these numbers on labels to make it easier for turf managers to incorporate this information into their decisions on chemical inventories.

For example, any insecticide in the neonicotinoid class (e.g., Merit or Meridian or Arena) will have a black box with a white “4A” indicating the IRAC chemical subgroup. Carbamates (class 1A) and organophosphates (class 1B) are in the same group but listed separately because while the chemistry of the two classes of insecticides is different, the mode of action (cholinesterase inhibition) is the same. Most are “older” chemicals and, as cholinesterase inhibitors, tend to bemore acutely toxic to vertebrates than some of the newer insecticides. There is a lot of variation in field characteristics: Some are soluble in water while others are not; some are systemic while some are not; some are quite persistent while some are not. For example, trichlorfon (Dylox) and acephate (Orthene) are very soluble in water and can break down quickly when water pH is above 7.5. Neither is very persistent in field conditions.

Every pyrethroid available for use on turf is virtually insoluble in water and is bound quickly to organic matter. As a result, pyrethroids are effective against insects that are active in the thatch, such as annual bluegrass weevil adults, black turfgrass ataenius adults, bluegrass billbug adults, caterpillars, chinchbugs, and European crane fly. Most pyrethroids begin working three to five days after application and remain active for three to five weeks. Most pyrethroids are toxic to cats, fish, and aquatic invertebrates and some are also toxic to bees that are exposed to direct treatments on flowering crops and weeds. Many pyrethroids are no longer covered by patents, so there are many other products available with different trade names.

There are four neonicotinoids (thiamethoxam, imidacloprid, dinotefuran, and clothianidin) currently available in turf, and all of them are systemic through the roots. Even though imidacloprid has been on the turf market for more than 10 years, there have been no reports of resistance in any turf insects yet. Care should be taken when using any neonicotinoid to avoid applications when honeybees are foraging, such as when clover or Creeping Charlie is in bloom. In addition, some labels indicate products are toxic to aquatic invertebrates.

Some products are now available for commercial applicators that combine a neonicotinoid and a pyrethroid, but in a lower percent of active ingredient. The combination provides protection against soil insects (neonicotinoid) and surface feeders (pyrethroid). Optimal timing of application depends on what the primary insect target is at a given site. For example, if white grubs are the primary target, applications should be made just as adults become active and start laying eggs. If billbugs are the primary target, applications could be made in late May or early June to target adults as they become active. Triple Crown (FMC) contains bifenthrin, zeta-cypermethrin and imidacloprid. Triple Crown works through contact, translaminar and systemic activity. It controls ants, ticks, white grubs, annual bluegrass weevils, billbugs, cutworms, sodwebworms, chinch bugs, leafhoppers, and mites.

Indoxacarb is in the oxadiazine class, which has very low mammalian toxicity and a new mode of action. It works by blocking the movement of sodium ions into nerve cells. Product labels have the same precautionary language as pyrethroids regarding toxicity to cats, fish, and aquatic invertebrates, as well as foraging honeybees. Indoxacarb is particularly effective against caterpillars and is most effective when applications are made targeting eggs and small caterpillars.

Chlorantraniliprole (Acelypryn) is in the diamide class and has low mammalian toxicity and a new mode of action. Acelypryn works through contact, translaminar and systemic activity from soil to plant. The EPA did not require a signal wordon the label. The label describes chlorantraniliprole as toxic to aquatic invertebrates, but it is relatively insoluble, so it is less likely to move to surface water than some other products. It is not toxic to bees, ants, or wasps. It is extremely effective against all white grub species but should be applied before early-to-mid June to achieve maximum effectiveness against grubs. Spring applications of chlorantraniliprole will not affect grubs that are present in the spring. Acelypryn controls white grubs, annual bluegrass weevils, billbugs, cutworms, sod webworms, and chinch bugs. It has extremely low toxicity to most non-target animals including birds, fish, and bees.

Another newer class is the spinosyns and the active ingredient spinosad (Conserve), which is derived from a soil actinomycete. The label describes it as highly toxic to bees and to mollusks. It is effective against many caterpillars, including sod webworms, cutworms, and armyworms, as well as caterpillars in the landscape.

For ant control in Minnesota use the Advion Fire Ant Bait (indoxacarb, Syngenta, available in MN) and Maxforce Professional Insect Control Granule Insect Bait or Maxforce Complete Brand Granular Insect Bait (hydramethylnon, Clorox Co., available inMN). Note that a similarly named product, Advance Granular Ant Bait, was not as effective in trials in Kentucky. Neither bait isspecifically marketed to the golf industry, but their labeling does allow use on golf courses. Spot-treating with bait allows selective control, while preserving beneficial ants in fairways and roughs. Baits should NOT be watered in after application.

## Table 1. Synthetic Insecticide Development History

| 1950 | 1960 | 1970 | 1980 | 1990 | 2000 |
|---|---|---|---|---|---|
| **DDT - Sodium Channel** | | | | | |
| **Cyclodienes - chloride channel** | | | | | |
| | **Organophosphates - Acetylcholinesterase** | | | | |
| | **Carbamate - Acetylcholinesterase** | | | | |
| | | **Sodium channel - photostable Pyrethroids** | | | |
| | | | | **Nicotinic acetylcholine receptors - Neonicotinoids** | |
| | | | | **Ecdysone agonist - Diacylhydrazines** | |
| | | | | **GABA chlorine channel - Phenylpyrazoles (fipronil)** | |
| | | | | **Nicotinic acetylcholine allosteric activator - Spinosyns** | |
| | | | | **Sodium channel - Oxadiazines** | |
| | | | | | **Ryanodine receptors - Anthranilic Diamides** |

## Table 2. Common Turf Insecticides Listed by IRAC Classification, Chemical Classes or MOA

| IRAC Group | Mode of Action | Chemical Classes | Active Ingredient | Trade Name[1] |
|---|---|---|---|---|
| **1A** | Acetylcholine esterase inhibitors | Carbamates | carbaryl | Sevin |
| | | | methiocarb | Mesurol |
| **1B** | | Organophosphates | acephate | Orthene |
| | | | chlorpyrifos | Dursban |
| | | | trichlorfon | Dylox |
| **2B** | GABA-gated chloride channel antagonists | Fipronil | fipronil | Chipco Choice, Chipco TopChoice |
| **3** | Sodium channel modulators | Pyrethroids | bifenthrin | Allectus, Aloft, Onyx, Talstar |
| | | | cyfluthrin | Tempo |
| | | | cypermethrin | Demon |
| | | | deltamethrin | Deltagard |
| | | | lambda-cyhalothrin | Lambda, Battle, Demand, Scimitar |
| | | | permethrin | Astro |
| **4A** | Nicotinic acetylcholine receptoragonists/antagonists | Neonicotinoids | clothianidin | Arena, Aloft |
| | | | dinotefuran | Zylam |
| | | | imidacloprid | Allectus, Imidacloprid, Merit, Mallet, etc. |
| | | | thiamethoxam | Meridian |
| **5** | Nicotinic acetylcholine allosteric activator | Spinosyns | spinosad | Conserve, Justice Fire Ant Bait |
| **6** | Chloride channel activators | Avermectins | abamectin | Affirm, Varsity Fire Ant Bait |
| **7A** | Juvenile hormone mimics | Junevile hormone analogues | s-methoprene | Firestrike, Extinguish, Extinguish Plus |
| **7B** | | Fenoxycarb | fenoxycarb | Award Fire Ant Bait |
| **7C** | | Pyriproxyfen | pyriproxyfen | Distance Fire Ant Bait |
| **11B1** | Microbial disruptors of insect midgut membranes | *Bacillus thuringiensis* | *B.t.* var. *aizawai* | Xentari |
| **11B2** | | | *B.t.* var. *kurstaki* | Biobit, Crymax, Dipel, Juvelin, Lepinox |
| **18A** | Ecdysone agonists.molting disruptors | Diacylhydrazines | halofenozide | Mach 2 |
| **20** | Mitochondrial complex III electron transport inhibitors (Coupling Site II) | Hydramethylnon | hydramethylnon | Amdro Firestrike, Extinguish Plus, SiegePro |
| **22A** | Voltage-dependent sodium channel blockers | Indoxacarb | indoxacarb | Advion, Provaunt |
| **28** | Ryanodine receptor modulator | Diamides | chlorantraniliprole | Acelypryn |
| **Un** | Unknown MOA | Dicofol | dicofol | Kelthane |
| **UC** | Unclassified: Pathogens | Bacteria | *Bacillus popillae* | Milky spore powder |
| | | Nematodes | *Steinernema* and *Heterorhabditis* spp. | Millenium, BioVector, Nemashield |
| | | Fungi | *Beauveria bassiana* | Botanigard, Naturalis |

[1]***References to commercial products or trade names are made with the understanding that no discrimination is intended and no product endorsement by the University ofMinnesota Extension is implied. Any use inconsistent with the label is a violation of Federal law***

**Table 3. Insecticides effective against white grubs.**

| Insect | Insecticide | Ideal Timing | Comments |
|---|---|---|---|
| **White Grubs** | carbaryl (Sevin) | when grubs are present | Sometimes inconsistent, sensitive to high pH. Very toxic to honey bees. |
| | chlothianidin (Arena) | when adults are laying eggs | Neonicotinoid May have some curative properties in late summer applications. |
| | chlorantraniliprole (Acelepryn) | mid-April to mid-June | Takes 60 days to be effective against white grubs. |
| | imidacloprid (Merit) | when adults are laying eggs | neonicotinoid Merit went off patent in 2007, many generic forms now available. |
| | thiamethoxam (Meridian) | when adults are laying eggs | neonicotinoid |
| | trichlorfon (Dylox) | when grubs are present | Best option to control grubs in the spring. Can be used into id September in most years. Sensitive to high pH. |
| | Allectus | when adults are laying eggs | combination product – Merit + Talstar |
| | Aloft | when adults are laying eggs | combination product –chlothianidin and bifenthrin. May have some curative properties in late summer applications. |
| **Scouting:** Scout for grubs in early spring or late summer or with soil cores. Check the root/thatch interface for presence of grubs in late July to late August. | | | |
| **Treatment:** If using a neonicotinoid, treat when adults are laying eggs (mid-June to late-August). Treat between mid-August and mid-September if grub population averages at least 5 to 10 grubs per square foot. Water in (at least 0.25") immediately after application but avoid puddling. If population was not controlled in late summer, apply spring control as soon as grubs are near surface, normally in May. Note that some materials have been inconsistent while others have performed consistently well over the years. | | | |

**Table 4. Insecticides effective against cutworms.**

| Insect | Insecticide | Ideal Timing | Comments |
|---|---|---|---|
| **Cutworm** | bifenthrin (Talstar) | when damage appears | |
| | carbaryl (Sevin) | when damage appears | Very toxic to honey bees. Repeat applications may be needed, especially after a heavy rain. |
| | chlorantraniliprole (Acelepryn) | mid May to mid June | Several weeks of protection when applied at high label rate. |
| | chlorpyrifos (Dursban) | when damage appears | Golf Course Only. Generic formulations only. |
| | cyfluthrin (Tempo) | when damage appears | |
| | indoxacarb (Provaunt) | June – July | Often provides several weeks of protection. |
| | spinosad (Conserve) | when damage appears | |
| | Allectus | June to mid July | Combination product: Merit + Talstar |
| | Aloft | June to mid July | Combination product: blend of clothianidin + bifenthrin |
| **Scouting:** Scout for caterpillars (late in the day or early in the morning) with soapy flushes. **Treatment:** Most cutworms are nocturnal, so treatments are most effective if applied late in the day. Water lightly (less than 0.10"). On golf courses inspect aerification holes throughout summer. Damage often becomes most noticeable shortly after aerification, particularly in late summer. | | | |

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