Mole Cricket IPM Guide for Florida[1]

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The purpose of this guide is to help people identify mole cricket infestations and manage them effectively and economically while minimizing environmental side effects. It can be used against pest mole crickets in sites such as landscapes, golf courses, athletic fields, sod farms, pastures, and vegetable fields. The first step in determining if you have a mole cricket problem at a site is to compare the existing damage to photographs of known mole cricket infestations. If the damage is likely caused by mole crickets, specimens should be obtained and the pest identified. You then must determine if the number of mole crickets is great enough to cause an unacceptable level of damage and decide what control measures should be used. Eventually, a long-term, sustainable integrated pest management (IPM) program must be established (Figure 1).

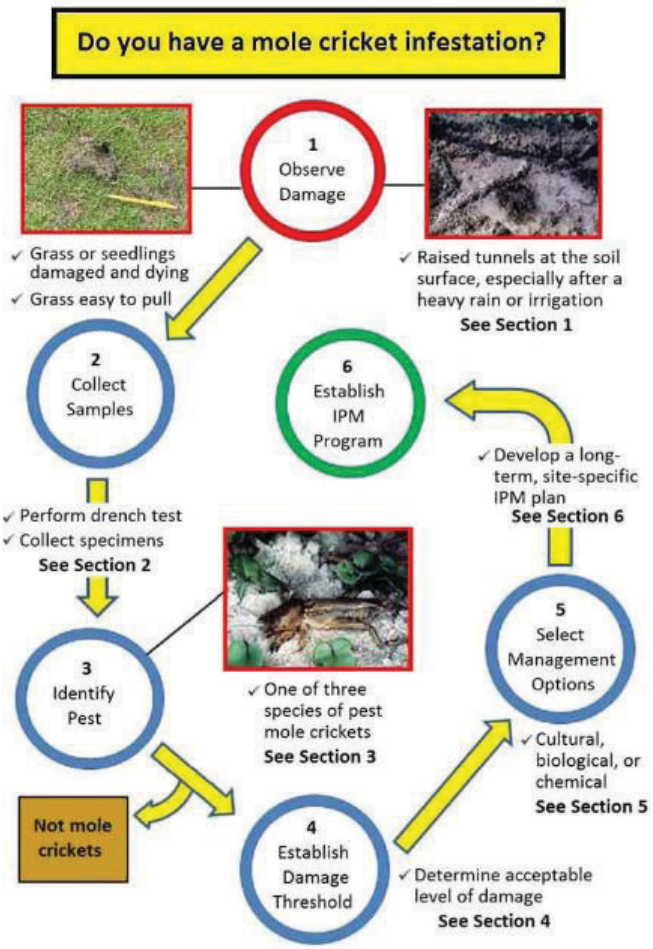

Figure 1. Pest mole cricket management: observe damage, collect samples, identify specimens, establish a damage threshold, select management options, and develop a long-term IPM program.

Section 1: Observe Damage

Plants Affected

Mole crickets are most often thought of as pests of grasses, such as bahiagrass, bermudagrass, centipedegrass, seashore paspalum, St. Augustinegrass, and zoysiagrass. However, other plants that can be damaged by mole crickets include but are not limited to beet, cabbage, cantaloupe, carrot, cauliflower, chrysanthemum, chufa, coleus, collard, eggplant, gypsophila, kale, lettuce, onion, peanut, pepper, potato, rice, spinach, strawberry, sugarcane, sweet potato, tobacco, tomato, and turnip (Worsham and Reed 1912).

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Damage Caused

Mole cricket feeding and tunneling can damage or kill the affected plants, especially during warm and moist summer months when the nymphs are rapidly developing. Feeding on the underground plant parts can cause an overall decline, dead patches, and little to no root mass. In pastures, mole-cricket-infested grass may be uprooted by feeding livestock, rendering the grass unavailable for additional grazing. When mole crickets tunnel in the upper ten inches of the soil surface, plants can become dislodged or have limited water uptake. Moreover, tunneling can create raised surface ridges that disrupt ball roll on golf courses (Figure 2). It may be a symptom of mole cricket activity when plants appear drought-stricken even after sufficient irrigation (Figure 3). Vegetables and other plants are also affected through underground feeding on roots or tubers, and above-ground feeding on foliage or stems, along with their tunneling activity. Above-ground feeding often results in girdling around the base of the stem, or at times the entire plant may be chewed off and taken into a tunnel as food and consumed. This girdling is especially common in seedlings. Flying adult mole crickets are attracted to lights at night, and they often burrow into moist soil nearby to mate and lay eggs. An initial adult mole cricket infestation thus may be localized around outdoor light sources and/or sprinkler heads. After egg hatch and as the next-generation nymphs mature and disperse, greater areas become damaged.

Figure 2. Characteristic mole cricket tunnels.
Credits: N. Leppla, UF/IFAS

Figure 3. Dead patches caused by mole crickets feeding on turfgrass.
Credits: E. Buss, UF/IFAS

Section 2: Collect Samples

Sampling is a critical part of a well-designed IPM program; it is important to know which pests are present and roughly how many. A soap drench can bring mole cricket nymphs and adults to the soil surface, so their species and age can be determined. How many insects emerge from the soil may provide an idea of the extent of an infestation, but tunneling severity within a defined area may be more useful for decision-making. Below is a simple drench test for collecting specimens to be identified and for estimating mole cricket population densities. In this procedure, several 4 ft^2 samples are taken from soil that must be moist:

1. Mix ¾ oz. (1.5 tablespoons) of liquid dishwashing soap in a container with 1 gallon of water.

2. Mark out a 2 ft. × 2 ft. area where mole cricket activity is suspected.

3. Evenly pour the soap solution over the marked area.

4. Observe the area for 3 minutes; count and collect the mole crickets that emerge.

5. In many cases, control actions are justified if two or more mole crickets surface during the 3-minute sampling period. See Section 4, "Establishing Damage Threshold," for more information to help you determine whether to take action.

Section 3: Identify Pest

Three non-native pest species of mole crickets occur in Florida: the shortwinged mole cricket, *Neoscapteriscus abbreviatus* Scudder; the southern mole cricket,

Neoscapteriscus borellii Giglio-Tos; and the tawny mole cricket, *Neoscapteriscus vicinus* Scudder. All three are believed to have been unintentionally transported into the southeastern United States around 1900. It is necessary to distinguish the native, non-pest mole cricket, genus *Neocurtilla*, from the invasive mole crickets in the genus *Neoscapteriscus*. Native mole crickets have four prominent dactyls (claws) on the forelegs and the pest mole crickets have two (Figure 4).

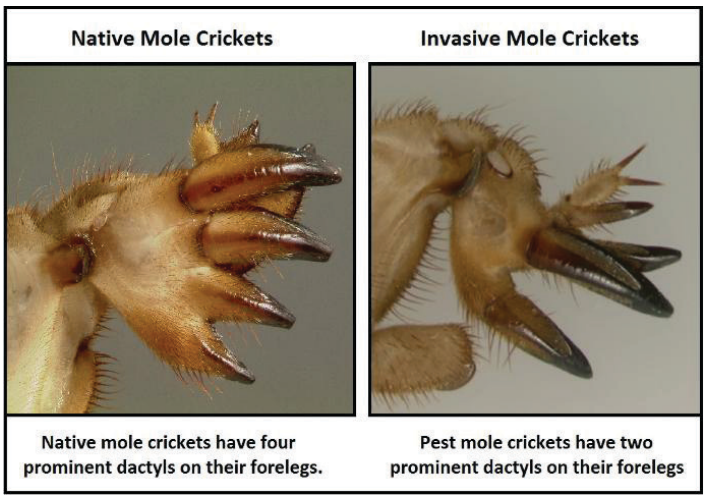

Figure 4. Differences in dactyls between native and non-native pest mole crickets.
Credits: L. Buss, UF/IFAS

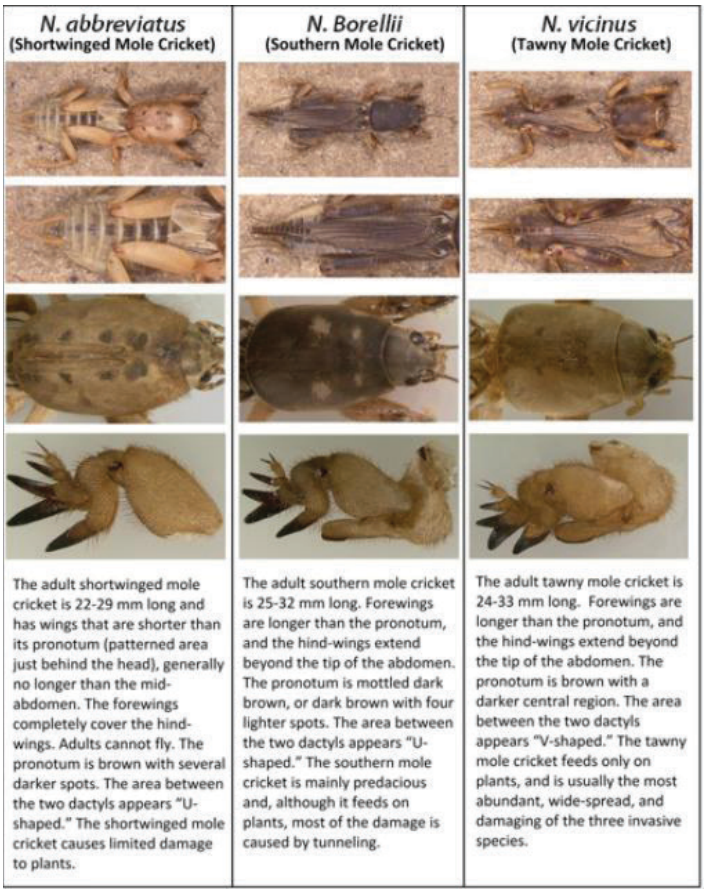

Figure 5. Identification of pest mole cricket species.
Credits: L. Buss, UF/IFAS

Mole Cricket Life Cycle

Eggs

(Figure 6): The female builds a circular egg chamber in the soil near one of the tunnels. The 3- to 4-cm-diameter chambers are placed 5–30 cm below the soil surface. Eggs are deposited in a cluster within the egg chamber, each mass containing 25–60 eggs. Eggs are gray to brownish and roughly oval, measuring about 3 mm long and 1.7 mm wide when fresh. Through the absorption of water, the eggs reach a final size of about 3.9 mm long and 2.8 mm wide. Egg development requires 10–40 days, depending on the soil temperature. A female produces 2–5 egg masses in a lifetime.

Figure 6. Shortwinged mole cricket eggs close to hatching.
Credits: L. Buss, UF/IFAS

Nymphs

(Figure 7): Recently hatched nymphs, called first instars, are whitish but darken to their mature color during the first 24 hours. First instars may consume the egg shell or cannibalize siblings; however, they soon leave the egg chamber and burrow to the soil surface. Nymphs and adults are similar in appearance, except nymphs have underdeveloped external wings called wing-pads. Development time of nymphs varies, requiring 23–38 weeks during which they go through 8–10 instars before becoming adults.

Adults

(Figure 8): Adult mole crickets are light yellow to dark brown and measure 22–33 mm in length, depending on the species. They have enlarged forelegs with dactyls, blade-like projections used for digging. Their antennae are shorter than the body, and they have two long sensory appendages

called "cerci" at the tip of the abdomen. Tawny and southern mole crickets become active at dusk when each male emits a "song" from its burrow that attracts a female of the same species. They mate within the burrow, after which the female may eject the male and occupy the burrow. Unlike the other two species, the shortwinged mole cricket male produces only a weak pulsing chirp that attracts a female.

Figure 7. Shortwinged mole cricket nymphs (note the lack of adult wings).
Credits: J. Castner, UF/IFAS

Figure 8. Tawny mole cricket adult.
Credits: L. Buss, UF/IFAS

Mole Cricket Seasonal and Geographic Distribution

THE SHORTWINGED MOLE CRICKET

The shortwinged mole cricket occurs mainly in coastal regions, with sandy soils (Figure 9). Because it is flightless, the species has not spread as extensively as the other two pest mole crickets. It currently has a limited geographical range in Florida, but all life-stages can occur year-round.

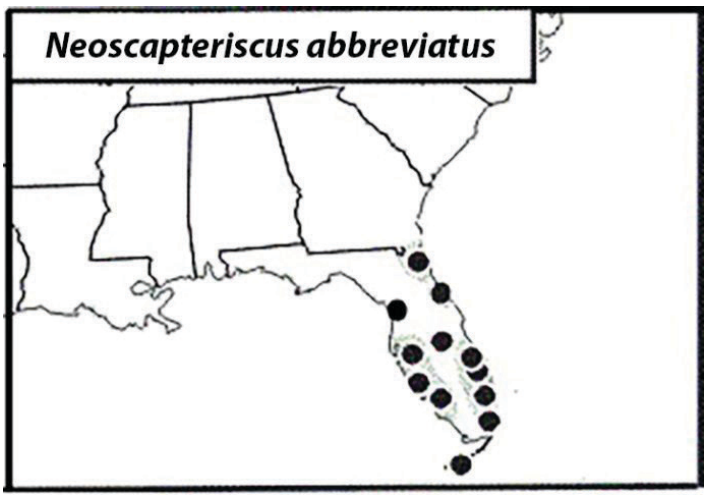

Figure 9. Distribution of the shortwinged mole cricket.
Credits: T. Walker, UF/IFAS

THE SOUTHERN MOLE CRICKET

The southern mole cricket occurs across much of the southeastern United States from southern North Carolina to central Texas (Figure 10). It also has been reported in Yuma, Arizona, and Los Angeles County, California. It is distributed throughout Florida, occurring primarily in moist, sandy areas. This mole cricket usually has one generation per year, but it has two in southern Florida. Peak flights generally occur from April to June, with an additional minor flight around November. However, in south Florida, a second major flight usually occurs in July.

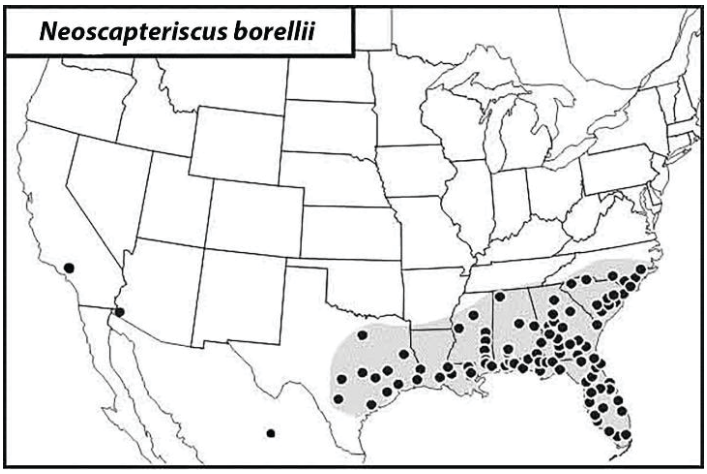

Figure 10. Distribution of the southern mole cricket.
Credits: T. Walker, UF/IFAS

THE TAWNY MOLE CRICKET

The tawny mole cricket occurs within several miles of the Atlantic and Gulf coasts from North Carolina to eastern Texas (Figure 11). However, it is distributed throughout Florida and primarily inhabits well-drained, moist, sandy

areas. This mole cricket has one full generation per year with a peak flight generally occurring in March–May, with an additional flight in the fall. Egg hatch occurs in April–June, after which nymphs develop for five months and become adults as early as September.

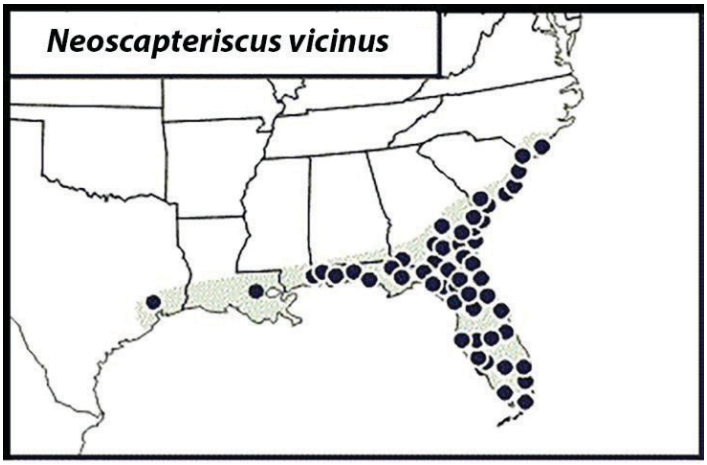

Figure 11. Distribution of the tawny mole cricket.
Credits: T. Walker, UF/IFAS

SECTION 4: ESTABLISH DAMAGE THRESHOLD

The amount of plant damage a homeowner or site manager determines as tolerable is called the "damage threshold." It varies with the site and expectations for plant quality. On athletic fields and golf courses, the more intensive management practices, lower cutting heights, and esthetic standards may dictate lower thresholds. In vegetable production, on the other hand, acceptable levels of damage may be low during the seedling stage but higher as the plants mature. Thresholds are highly subjective and vary with the condition of the plants.

The damage mole crickets cause is related to the species, stage, and number of mole crickets that infest the site. Tawny mole crickets, for instance, cause a relatively high degree of destruction, and a range of 2-4 adult mole crickets per 4 ft^2 is a general upper limit warranting management action for turf, though most managers set the damage threshold somewhat higher for pastures. The plant damage nymphs cause increases as they grow and disperse. Continue sampling and re-evaluating thresholds throughout the mole crickets' life cycle to watch for increases both in the number of mole crickets and the damage they are causing. Ultimately, the severity of a mole cricket infestation and the associated damage threshold will dictate which control options will be most effective and economical.

Section 5: Select Management Options

Options for managing mole crickets in turfgrass include cultural, biological, and chemical control. Properly integrating several options will provide the greatest level of long-term control. After verifying the species, stage, and relative abundance of mole crickets, and deciding on a reasonable action threshold, select management practices from the following options.

Cultural Control

Cultural controls are steps taken in the management of a site that can make it less attractive or supportive for mole crickets. Steps may include selecting tolerant plant cultivars, altering soil moisture, reducing attractive lighting, and changing various growing practices. Cultural controls, such as lighting, may be implemented individually or used in conjunction with other methods.

TOLERANT CULTIVARS

No turfgrass species or cultivar is completely resistant to mole cricket damage, although centipedegrass, St. Augustinegrass, and zoysiagrass are considered the least frequently injured. Bahiagrass, bermudagrass, and seashore paspalum tend to be the most susceptible to damage caused by mole crickets. Table 1 in the appendix describes some susceptible and tolerant turfgrass cultivars.

SOIL MOISTURE

Soil moisture can affect mole crickets, significantly increasing plant damage at irrigated sites. Mole crickets remain closer to the soil surface when the soil is moist but tunnel deeper when the soil is dry. Rain after a long dry period causes an increase in the number of mole crickets in flight and may increase the number attracted to lights. During periods of egg-laying, females prefer to lay more eggs in irrigated areas than in non-irrigated ones. Egg survival decreases under drought conditions. Long-term control of soil moisture generally is not an option because it would disrupt plant growth, but the response of mole crickets to soil moisture can be used to time pest management practices. For example, insecticides could be more effective if applied after irrigation that brings mole crickets closer to the soil surface. Alternatively, flooding can drown the mole crickets or force them to move to higher ground where insecticides can be applied as spot treatments.

LIGHTING

Mole crickets fly at dusk for 1-2 hours during which they are attracted to light, especially ultraviolet and

mercury-vapor lamps. To limit the incidence of mole crickets in turfgrass, lights should be turned off at a site during times of peak flight. Conversely, lights can be used to attract mole crickets for spot treatment with insecticides. If lights are necessary, yellow bulbs or filters can be used to minimize attraction of mole crickets.

TILLAGE

The objective of tilling is to expose mole crickets to predation or desiccation and kill them mechanically. Feeding by birds may be promoted by tilling, for example. In addition to exposing or damaging the insects, tilling can destroy their burrows and cause them to relocate. Tilling generally is not used on turfgrasses but can be effective on agricultural sites. Till when eggs and young nymphs are present because these life stages are more palatable to birds and less able to resist desiccation, so they are more likely to be killed than adults.

PLANT HEALTH

The plant's health can affect its tolerance to damage by mole crickets. Maintaining proper fertilization, irrigation, and soil conditions is important. For turfgrasses, leaving sufficient shoot growth after mowing is important because cutting too close increases stress on the grass. Mowing height recommendations are given in Table 2 in the appendix. For pastures, overgrazing should be avoided as this can cause significant stress to the grass.

RECORD KEEPING

Areas that historically have been infested by mole crickets are likely to be re-infested. It therefore is important to document and map these preferred mole cricket habitats. Monitor these areas intensively so that you can implement control measures quickly before damage thresholds are exceeded.

Biological Control

Biological control is the use of living natural enemies to control pests. Natural enemies can be predators, parasites, pathogens, or competitors. Populations of some natural enemies may be enhanced by habitat manipulation. In some cases, natural enemies can be produced in large quantities and released at sites that have too few established natural enemies to effectively limit pest populations, keeping them below the damage thresholds. For pest mole crickets in Florida, widespread applications have been made of the entomopathogenic mole cricket nematode, Steinernema scapterisci, in addition to releases of the *Larra* wasp, *Larra bicolor*, and Brazilian red-eyed fly, *Ormia depleta*. These non-native natural enemies were imported, tested for safety and released by the UF/IFAS Mole Cricket Biological Control Program (Mhina et al. 2016). All are currently present in Florida, but none are available commercially. Specifics on the importation and introduction of these three natural enemies are described by Frank and Walker (2006).

MOLE CRICKET NEMATODE

This nematode (Figure 12) was introduced from South America and widely applied across Florida as a biopesticide until 2012. It infects large nymphs and adults, reproducing inside them to yield additional generations of nematodes. These parasites are not normally observed outside the host; they are spread throughout an area by the infected mole crickets.

Figure 12. *Steinernema scapterisci* nematodes emerging from an adult mole cricket in the laboratory.
Credits: L. Buss, UF/IFAS

LARRA WASP

This wasp (Figures 13 and 14) was introduced from South America into south Florida in 1981, and again into north Florida in 1988, to control pest mole crickets. It parasitizes only *Neoscapteriscus* spp. and does not sting people, so it was safe to release. The wasp is black with a red abdomen, and its wings are clear to smoky dark blue. A female usually lays one egg on each mole cricket it finds. The egg hatches in 6–7 days, the larva feeds on the mole cricket for 10–11 days and kills it, then pupates in a cocoon in the soil. A new adult emerges roughly 6 weeks later during the warmer months, but those that pupate in the fall may not become adults until the following Spring. Larra wasps lay eggs only on mole cricket adults and medium to large nymphs.

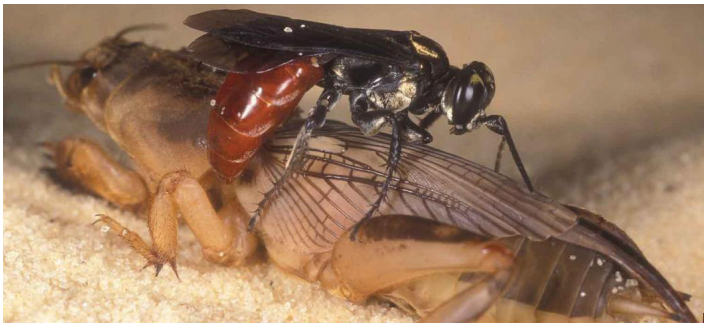

Figure 13. Larra wasp laying an egg onto a tawny mole cricket adult.
Credits: L. Buss, UF/IFAS

Figure 14. Larra wasp larva feeding on a tawny mole cricket adult.
Credits: L. Buss, UF/IFAS

Larra wasps require a nectar source for their survival. The shrubby false buttonweed, *Spermacoce verticillata* (a.k.a. larraflower), is the preferred nectar source (Figure 15). White flowered pentas, *Pentas lanceolata*, and partridge pea, *Chamaechrista fasciculata*, are alternative nectar sources. If either of these plants or other nectar sources are available, larra wasps will appear and forage at least 200 yards from them to locate mole crickets. Larraflower can be invasive, so it should be contained. Partridge pea may be toxic if consumed by livestock.

Figure 15. Larra wasp feeding on *S. verticillata* nectar.
Credits: L. Buss, UF/IFAS

By the end of 2008, the larra wasp had spread into much of north and central Florida and had penetrated into parts of south Florida (Figure 16). It also expanded its range into southern and eastern Georgia and coastal areas of Alabama and Mississippi. More recently it has been reported from eastern South Carolina and southeastern North Carolina. In northern Florida, larra wasp adults are active from late April until the first hard frost; in southern Florida, activity may persist year-round, offering even greater mole cricket suppression.

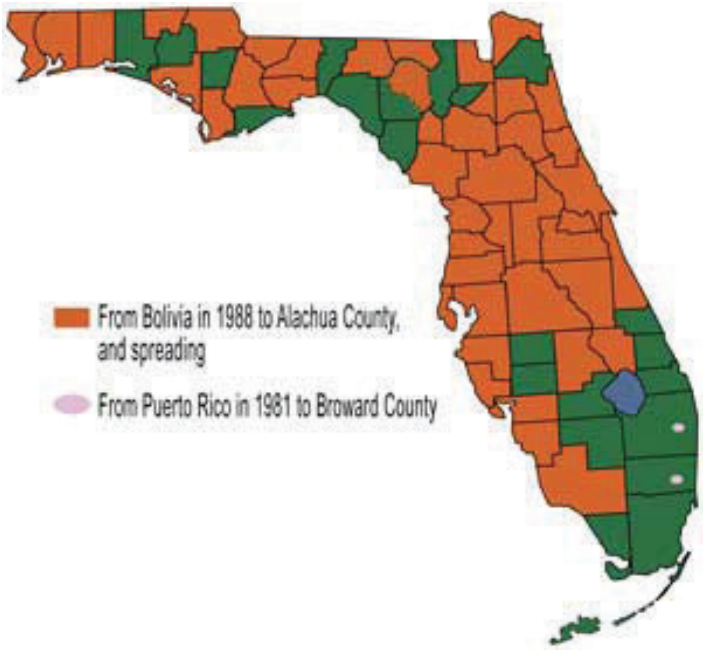

Figure 16. Distribution of larra wasp in Florida.
Credits: J. H. Frank, UF/IFAS

BRAZILIAN RED-EYED FLY

This tachinid fly was introduced from South America to suppress invasive mole crickets. The Brazilian red-eyed fly is distributed in the southern and central parts of Florida with the northern boundary reaching Alachua County (Figure 17). The fly parasitizes a pest mole cricket adult by depositing a larva nearby, the larva finds the adult, develops inside it, and kills it. Golf courses inhabited by the Brazilian red-eyed fly have considerably less damage than those without the fly.

MOLE CRICKET PREDATORS

Naturally occurring predators of mole crickets include raccoons, opossums, armadillos, birds, spiders, tiger beetles, and many other insectivorous animals. Unfortunately, foraging by some of these predators, especially armadillos, can cause considerable damage to turfgrass.

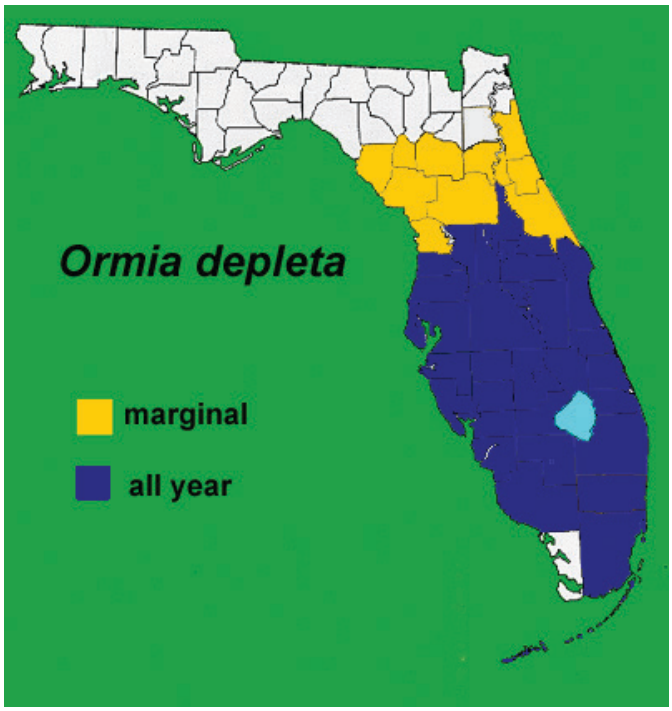

Figure 17. Distribution of Brazilian red-eyed fly in Florida.


Figure 18. Brazilian red-eyed fly pupa next to a mole cricket.
Credits: L. Buss, UF


Figure 19. Brazilian red-eyed fly.
Credits: L. Buss, UF

Chemical Control

Mole cricket IPM includes the use of insecticides when necessary; however, applications can be expensive and disruptive to biological control. Apply an insecticide only when the plant damage threshold is met or exceeded, and follow the instructions on the label. Time applications and target them to infested areas, thus reducing costs and environmental risks. On golf courses, for example, it's frequently most effective to apply insecticides only to fairways, greens, and tees, leaving roughs and driving ranges untreated to maintain populations of beneficial organisms. Small mole cricket nymphs feeding and growing during the summer months are more susceptible to insecticides than large nymphs present in late summer and fall.

Table 3 lists selected insecticide active ingredients for products that are currently registered for use in Florida on pest mole crickets in residential lawns, golf courses and athletic fields, pastures, vegetables, and sod farms. To minimize resistance to insecticides, active ingredients should be rotated based on the Insecticide Resistance Action Committee (IRAC) group numbers. The table and associated appendix in this publication serve as guides only: keep in mind that the information in them can become outdated if insecticide registrations change.

The appendix includes Table 5 that lists registered insecticide products formulated with the active ingredients listed in Table 3. Restricted-use insecticides are to be applied by a licensed applicator. You must read and understand the current product label before applying any insecticide. The label lists all specific sites and pests for which an insecticide may be applied legally. It also displays a signal word indicating the relative toxicity of the product to mammals: slightly toxic (CAUTION), moderately toxic (WARNING), or highly toxic (DANGER).

Section 6: Establish IPM Program

Develop a long-term, site-specific IPM program by combining cultural, biological, and chemical control measures to suppress pest mole crickets to levels that assure plant damage thresholds are not exceeded and that minimize costs and risks to humans and the environment. The program is based on plant selection and growing practices and mole cricket biology and management options.

The following are guidelines for developing an IPM program for turfgrass:

1. Use a tolerant grass cultivar or species, such as centipedegrass or zoysiagrass.

2. Maintain healthy grass with proper irrigation and cutting.

3. Perform routine soil testing and add fertilizer or lime as needed.

4. Reduce watering during winter months; mole crickets require moist soil.

5. Plant a nectar source, such as larraflower or partridge pea, to attract and support *Larra* wasp populations.

6. Eliminate lights from sunset to well past dark during months of peak mole cricket flight.

7. Sample regularly for mole crickets; 2–4 per 4 ft^2 may require management.

8. Apply insecticides at infested sites only if plant damage thresholds are exceeded; evaluate their effectiveness.

9. Target and map areas that become infested.

10. Rotate insecticide active ingredients (IRAC numbers and letters) to delay pesticide resistance.

Acknowledgments

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Appendix

The applicator holds full responsibility in verifying the legal usage and assumes all associated liability when applying any pesticide. Before applying an insecticide, verify your target pest and specific site of application are by consulting the product's label and always wear proper personal protective equipment.

Table 1. Some tolerant and susceptible cultivars of turfgrass species.

Turfgrass	Generally Susceptible Cultivars	Generally Tolerant Cultivars
Bahiagrass	Pensacola, Tifton 9, and Sand Mountain	Argentine and Paraguay 22 (tolerance can be low)
Bermudagrass	Tifdwarf, Tifgreen, Sunturf, Texturf-10 and Texturf-1F	Ormond, Tifsport,Tifeagle, Tifway, Tifton-44
Centipedegrass	Most cultivars generally tolerant	
Seashore Paspalum	Most cultivars generally susceptible	
St. Augustinegrass	Bitterblue	Most cultivars generally tolerant
Zoysiagrass	Royal and Meyer	Diamond, Palisades, Emerald, Cavalier

Table 2. Turfgrass mowing height recommendations.

Turgrass	Recommended mowing height
Bahiagrass	3–4″
Bermudagrass	Cultivar and utility dependent
Centipedegrass	1–1.5″
St. Augustine Dwarfs	2–2.5″
St. Augustine Standards	3.5–4″
Zoysiagrass	2–2.5″
Source: Dr. L. E. Trenholm, UF/IFAS	

Table 3. Selected insecticides for controlling mole crickets (compiled by N. C. Leppla).

Active ingredient products	IRAC Group	Application range total/yr	Reentry interval	Applications product details
Acephate Orthene	1B	GC, 1-2 oz/gal. S, 1 1/3-1 ½ oz/gal.	24 h	GC, S allow 3 d to harvest
Bifenthrin Talstar	3A	0.5-1.0 oz/1000 ft^2 Up to 10 gal/1000 ft2	12 h	RL, GC, V, S water in
Carbaryl Sevin	1A	RL, 0.75-0.9 lbs/ 1000 ft^2, 4 appl./yr	Dry surface	RL, GC, P, V, S RL, water in, 7 d retreat
Chlorpyrifos Lorsban, Dursban	1B	1.5 oz/1000 ft^2 2 lbs AI/acre/yr	24 h	GC, S Apply to wet surface
Clothianidin Arena	4A	0.29 oz (1-5 gal)/ 1000 ft^2, 0.4 lb/acre/yr	Dry surface	RL, S Apply to early instars
Fipronil Chipco Choice	2B	4.6-9.4 oz/1000 ft^2 50 lbs/yr	24 h	RL, GC, S avoid water bodies

RL= Residential lawns, GC= Golf courses and athletic fields, P=Pastures, V=Vegetables, S=Sod farm.

Table 4. Mole cricket stages and partial IPM program for North Central Florida.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Event												
Adult flights			X	X	X	X			X	X	X	
Egg hatch				X	X	X	X	X				
Nymph development	X	X	X			X	X	X	X	X	X	X
Action												
Sample	X	X	X	X	X	X	X	X	X	X	X	X
Reduce watering	X										X	X
Reduce lighting			X	X	X	X			X	X	X	

Table 5. Active ingredients contained in insecticide products registered for residential lawns.

Azadirachtin

SAFER BRAND BIONEEM MULTI-PURPOSE INSECTICIDE & REPELLENT CONCENTRATE
SAFER BRAND GRUB KILLER READY-TO-SPRAY
NEEMIX 4.5

Beauveria bassiana

Botanigard ES
Mycotrol O

beta-Cyfluthrin

BAYER ADVANCED TRIPLE ACTION INSECT KILLER FOR LAWNS
BAYER ADVANCED POWER FORCE MULTI-INSECT KILLER
TEMPO ULTRA GC INSECTICIDE (Restricted Use)

beta-Cyfluthrin & Imidacloprid

BAYER ADVANCED COMPLETE BRAND INSECT KILLER FOR SOIL & TURF
BAYER ADVANCED COMPLETE INSECT KILLER FOR SOIL & TURF
BAYER ADVANCED LAWN COMPLETE INSECT KILLER FOR SOIL & TURF

Bifenthrin

ACTISHIELD LIQUID INSECTICIDE
BASELINE FLORIDA INSECTICIDE
BASELINE INSECTICIDE
BASIC SOLUTIONS LAWN & GARDEN INSECT KILLER GRANULES
BIFEN I/T INSECTICIDE/TERMITICIDE
BIFEN L/P INSECTICIDE GRANULES
BIFEN XTS
BIFENTHRIN GC GRANULES (Restricted Use)
BISECT G (Restricted Use)
BISECT L
BONIDE EIGHT INSECT CONTROL FLOWER & VEGETABLE ABOVE & BELOW SOIL INSECT GRANULES
BONIDE INSECT & FEED
BROADCIDE FLOWABLE INSECTICIDE GC (Restricted Use)
BROADCIDE GRANULAR INSECTICIDE GC (Restricted Use)
CARPETMAKER X-X-X WITH 0.069 TALSTAR GRANULAR INSECTICIDE
COMPARE-N-SAVE CONCENTRATED INDOOR/OUTDOOR INSECT CONTROL
COMPARE-N-SAVE LAWN INSECT CONTROL GRANULES
FERTILIZER W/TALSTAR 0.069%
FERTILIZER W/TALSTAR 0.096%
FERTILIZER W/TALSTAR 0.2%
FERTI-LOME BROAD SPECTRUM INSECTICIDE
FORTIFY INSECT CONTROL
FORTIFY PHOSPHORUS FREE INSECT CONTROL PLUS LAWN FOOD 18-0-5
GREEN THUMB PREMIUM FERTILIZER + INSECT CONTROL 30-3-4
GREEN THUMB PREMIUM INSECT CONTROL GRANULES
GREEN THUMB SUMMER INSECT CONTROL + LAWN FERTILIZER (25-0-5)
GROWERS FERTILIZER WITH 0.083% BIFENTHRIN
HEAVY WEIGHT MULTI-INSECT & FIRE ANT KILLER GRANULES
HI-YIELD BUG BLASTER BIFENTHRIN 2.4
HI-YIELD BUG BLASTER II TURF INSECT CONTROL GRANULES
HI-YIELD VEGETABLE & ORNAMENTAL INSECT CONTROL GRANULES
HJE BIFENTHRIN PL GRANULAR
HY-END BIFEN S
KGRO READY TO USE HOME PEST INSECT CONTROL
LAWNSTAR GRANULAR INSECTICIDE
LESCO CROSSCHECK 0.069% PLUS FERTILIZER
LESCO CROSSCHECK EZ GRANULAR INSECTICIDE
LESCO CROSSCHECK PL GRANULAR INSECTICIDE
LESCO CROSSCHECK PLUS MULTI-INSECTICIDE
LESCO TALSTAR 0.069% PLUS FERTILIZER

Bifenthrin cont.

LESCO TALSTAR 0.096% PLUS FERTILIZER
MASTERLINE BIFENTHRIN 7.9 TERMITICIDE/INSECTICIDE
MAXXTHOR SC
MAXXTHOR SG
MENACE 7.9% FLOWABLE (Restricted Use)
MOLE CRICKET - CHINCH BUG LAWN SPRAY RTS
MONTEREY TURF & ORNAMENTAL INSECT SPRAY
ONYX INSECTICIDE
ONYXPRO INSECTICIDE (Restricted Use)
ORTHO ANT, FLEA & TICK KILLER FOR LAWNS READY TO USE GRANULES
ORTHO BUG B GON MAX INSECT KILLER FOR LAWNS
ORTHO BUG BGON MAX LAWN & GARDEN INSECT KILLER 1
ORTHO MAX PRO
PRO-MATE BIFENTHRIN
PRO-MATE TALSTAR GC 0.069% WITH FERTILIZER (Restricted Use)
PRO-MATE TALSTAR LG 0.069% WITH FERTILIZER
QUALI-PRO BIFENTHRIN I/T 7.9 F
SCOTTS PROFESSIONAL FERTILIZER X-X-X WITH ORTHO MAX PRO
SENTRYHOME YARD AND PREMISE SPRAY CONCENTRATE
SERGEANT'S YARD & PREMISE SPRAY CONCENTRATE

Bifenthrin & Imidacloprid

ALLECTUS G INSECTICIDE
PRO-MATE ALLECTUS 0.225% PLUS TURF FERTILIZER
THE ANDERSONS TURF PRODUCTS FERTILIZER WITH ALLECTUS INSECTICIDE
LESCO ALLECTUS 0.225 INSECTICIDE PLUS FERTILIZER
SIGNATURE ALLECTUS 0.225 G PLUS TURF FERTILIZER
TURFPRIDE ACCUBLEND FERTILIZER WITH 0.225G ALLECTUS INSECTICIDE
TCS GROWSTAR ALLECTUS 0.225 G PLUS TURF FERTILIZER INSECTICIDE
LESCO ALLECTUS 0.18 G PLUS FERTILIZER
TCS GROWSTAR ALLECTUS 0.18 G PLUS TURF FERTILIZER INSECTICIDE
PRO-MATE ALLECTUS 0.15% PLUS TURF FERTILIZER
TURFPRIDE ACCUBLEND FERTILIZER WITH 0.15G ALLECTUS INSECTICIDE

Bifenthrin & Zeta-Cypermethrin

ORTHO BUG B GON INSECT KILLER FOR LAWNS (2)
TALSTAR XTRA GRANULAR INSECTICIDE
ORTHO BUG B GON INSECT KILLER FOR LAWNS & GARDENS
TALSTAR XTRA GC GRANULAR INSECTICIDE (Restricted Use)
TALSTAR XTRA GRANULAR INSECTICIDE

Bifenthrin, Imidacloprid & Zeta-Cypermethrin

TRIPLE CROWN T&O INSECTICIDE

Carbaryl

CARBAIT 5
SA-50 MOLE CRICKET BAIT

Carbaryl & Bifenthrin

FORTIFY ABOVE & BELOW INSECT & GRUB CONTROL
THE ANDERSONS TURF PRODUCTS DUOCIDE INSECT CONTROL

Clothianidin

CHINCH BUG KILLER WITH ARENA
GREEN LIGHT CHINCH BUG KILLER1 WITH ARENA
GREEN LIGHT GRUB CONTROL WITH ARENA

Clothianidin & Bifenthrin

ALOFT GC G (Restricted Use—not labeled for use in Florida)

Cyfluthrin

BAYER ADVANCED POWER FORCE MULTI-INSECT KILLER
BAYER ADVANCED VEGETABLE & GARDEN INSECT SPRAY
BAYER ADVANCED TRIPLE ACTION INSECT KILLER FOR LAWNS & GARDENS
TEMPO 20 WP GOLF COURSE INSECTICIDE (Restricted Use)

Cypermethrin

CYPER TC INSECTICIDE
CYPER-LO EC
DEMON MAX
UP-CYDE PRO 2.0 EC TERMITICIDE/INSECTICIDE (Restricted Use)

Deltamethrin

DELTAGARD G INSECTICIDE GRANULE
DELTAGARD T&O GRANULAR INSECTICIDE
HI-YIELD IMPORTED FIRE ANT CONTROL GRANULES CONTAINING DELTAMETHRIN
HI-YIELD TURF RANGER INSECT CONTROL GRANULES CONTAINING DELTAMETHRIN
SUSPEND SC INSECTICIDE
TERRO HOME INSECT KILLER

Esfenvalerate

FENVASTAR ECOCAP
ONSLAUGHT MICROENCAPSULATED INSECTICIDE

Fipronil

CHIPCO CHOICE INSECTICIDE (Restricted Use)
QUALI-PRO FIPRONIL 0.1G (Restricted Use)

Imidacloprid

AGRISEL IMIDAPRO 2SC INSECTICIDE
ANDERSONS GOLF PRODUCTS TURF FERTILIZER 14-0-14 WITH MERIT
ARMOR TECH IMD 2SC
BAYER ADVANCED LAWN SEASON-LONG GRUB CONTROL
BAYER ADVANCED SEASON LONG GRUB CONTROL
BONIDE SYSTEMIC INSECT SPRAY WITH SYSTEMAXX
CRITERION 0.5 G INSECTICIDE
CRITERION 2F INSECTICIDE
CRITERION 75 WSP INSECTICIDE
DELPHI INSECTICIDE
DOMINION 2L TERMITIICIDE/INSECTICIDE
ENFORCE 0.5G TURF AND ORNAMENTAL INSECTICIDE
ENFORCE 75WSP TURF AND ORNAMENTAL INSECTICIDE
EQUIL ADONIS 2F INSECTICIDE
EQUIL ADONIS 75 WSP INSECTICIDE
FERTILIZER W/MERIT 0.15%
FERTILIZER W/MERIT 0.2%
FERTI-LOME SYSTEMIC INSECT SPRAY
FORTIFY SEASON LONG GRUB CONTROL
GARANT T&O 2F INSECTICIDE
GARANT T&O 75 WSP INSECTICIDE
GORDON'S GRUB NO-MORE GRANULES
GORDON'S PROFESSIONAL TURF & ORNAMENTAL PRODUCTS IMIDIPRO
GRUBEX
GRUBEX II
HI-YIELD GRUB FREE ZONE II
HI-YIELD GRUB FREE ZONE III
HI-YIELD SYSTEMIC INSECT SPRAY
IMIDASTAR 2L T&O
IMIGOLD 0.5 G
IMIGOLD 2 F
IMIGOLD 70 DF TURF, ORNAMENTAL AND GREENHOUSE INSECTICIDE
INVICT BLITZ ANT GRANULES
INVICT XPRESS GRANULAR BAIT

Imidacloprid cont.

KNOCKOUT READY TO USE GRUB KILLER GRANULES
LADA 2F INSECTICIDE
LESCO BANDIT 0.5 G INSECTICIDE
LESCO BANDIT 2F INSECTICIDE
LESCO BANDIT 75 WSP INSECTICIDE
LESCO MERIT 0.2 PLUS TURF FERTILIZER
LESCO MERIT 0.2 PLUS TURF FERTILIZER
LESCO SYSTEMIC INSECTICIDE CONTAINS MERIT
MALICE 0.5G
MALICE 75 WSP
MALLET 7.1% PF INSECTICIDE
MARTIN'S DOMINION TREE & SHRUB
MERIT 0.5 G INSECTICIDE
MERIT 2F INSECTICIDE
MERIT 75 WP INSECTICIDE
MERIT 75 WSP INSECTICIDE
MIDASH 2SC T&O
PHOENIX HAWK-I 75WSP
PHOENIX HAWK-I 2L
PRIMERAONE IMIDACLOPRID 2F INSECTICIDE
PROFESSIONAL TURF SOLUTIONS WITH MERIT FERTILIZER
PROKOZ ZENITH 0.5 G INSECTICIDE
PROKOZ ZENITH 2F INSECTICIDE
PROKOZ ZENITH 75 WSP INSECTICIDE
PRO-MATE MERIT 0.2% PLUS TURF FERTILIZER
PROTHOR SC 2
QUALI-PRO IMIDACLOPRID 0.5G INSECTICIDE
QUALI-PRO IMIDACLOPRID 75 WSB
REGAL MERIT 0.2 PLUS
SCOTTS FERTILIZER X-X-X WITH GRUBEX PRO
SCOTTS PROFESSIONAL FERTILIZER X-X-X WITH GRUBEX
SIGNATURE FERTILIZER WITH 0.2% MERIT
SPECTRACIDE GRUB KILLER CONCENTRATE
SPECTRACIDE TREE & SHRUB INSECT CONTROL
TCS GROWSTAR MERIT 0.2 PLUS TURF FERTILIZER
THE ANDERSONS GRUBOUT DG 0.2% INSECTICIDE
THE ANDERSONS TURF PRODUCTS FERTILIZER WITH 0.2% MERIT INSECTICIDE
TURF PRIDE ACCUBLEND FERTILIZER WITH 0.2% MERIT
TURFTHOR WP
TURFTHOR WSP
XYTECT 2F INSECTICIDE
XYTECT 75WSP INSECTICIDE

Imidacloprid & lambda-Cyhalothrin

LESCO INSECTUS PLUS FERTILIZER
BONIDE DURATURF INSECT & GRUB CONTROL

Indoxacarb

ADVION INSECT GRANULE
PROVAUNT

lambda-Cyhalothrin

BORDER INSECTICIDE
CUTTER BACKYARD BUG CONTROL CONCENTRATE
CYZMIC CS
DEMAND CS INSECTICIDE
DEMAND EZ INSECTICIDE
DEMAND G INSECTICIDE
EQUIL LAMBDA 9.7 CS INSECTICIDE
GRENADE ER
LAMBDA-CY EC INSECTICIDE
LAMBDASTAR 9.7% CS
MARTIN'S CYONARA LAWN & GARDEN INSECT CONTROL

Table 6. Active ingredients contained in insecticide products registered for golf courses and athletic fields.

Acephate

ACEPHATE 90 PRILL
ACEPHATE 90 SP SOLUBLE POWDER
ACEPHATE 90 WDG
ACEPHATE 90 WSP INSECTICIDE
ACEPHATE 97 DF
ACEPHATE 97% PRILLS
ACEPHATE 97UP INSECTICIDE
BRACKET 90 WDG
BRACKET 97
BRACKET 97
CHEMINOVA ACEPHATE 75SP
CHEMINOVA ACEPHATE 90SP
ORTHENE 97
ORTHENE TURF, TREE & ORNAMENTAL 97 SPRAY
ORTHENE TURF, TREE & ORNAMENTAL WSP
TENKOZ ACEPHATE 97 INSECTICIDE
TIDE ACEPHATE 90 WDG

beta-Cyfluthrin

TEMPO ULTRA GC INSECTICIDE (Restricted Use)

Bifenthrin

BIFEN 2 AG GOLD (Restricted Use)
BIFENTHRIN GC GRANULES (Restricted Use)
BISECT G (Restricted Use)
BROADCIDE FLOWABLE INSECTICIDE GC (Restricted Use)
BROADCIDE GRANULAR INSECTICIDE GC (Restricted Use)
FIREBIRD PRO (Restricted Use)
GROWERS FERTILIZER WITH 0.083% BIFENTHRIN
LESCO TALSTAR 0.073% PLUS FERTILIZER (Restricted Use)
MENACE GC 7.9% FLOWABLE (Restricted Use)
ONYXPRO INSECTICIDE (Restricted Use)
PHOENIX FIREBIRD PRO (Restricted Use)
PRO-MATE TALSTAR GC 0.069% WITH FERTILIZER (Restricted Use)
QUALI-PRO BIFENTHRIN GOLF & NURSERY 7.9F (Restricted Use)
TALSTAR GC GRANULAR INSECTICIDE (Restricted Use)
TALSTAR SELECT INSECTICIDE (Restricted Use)
TURF PRIDE ACCUBLEND FERTILIZER WITH 0.069% BIFENTHRIN INSECTICIDE PROFUSION PROCESS
TURF PRIDE ACCUBLEND FERTILIZER WITH 0.096% BIFENTHRIN INSECTICIDE PROFUSION PROCESS
UP-STAR GC GRANULAR INSECTICIDE (Restricted Use)
UP-STAR SC LAWN AND NURSERY INSECTICIDE/MITICIDE (Restricted Use)

Bifenthrin & zeta-Cypermethrin

TALSTAR XTRA GC GRANULAR INSECTICIDE (Restricted Use)

Bifenthrin, Imidacloprid & zeta-Cypermethrin

TRIPLE CROWN GOLF INSECTICIDE (Restricted Use)

Carbaryl & Bifenthrin

ANDERSONS GOLF PRODUCTS DUOCIDE INSECT CONTROL (Restricted Use)

Chlorpyrifos

CHLORPYRIFOS 4E AG (Restricted Use)
DREXEL CHLORPYRIFOS 4E-AG (Restricted Use)
NUFARM CHLORPYRIFOS SPC 1.0% MCB INSECTICIDE
NUFARM CHLORPYRIFOS SPC 2 INSECTICIDE (Restricted Use)
NUFARM CHLORPYRIFOS SPC 2.32% G INSECTICIDE
NUFARM CHLORPYRIFOS SPC 4 INSECTICIDE (Restricted Use)
QUALI-PRO CHLORPYRIFOS 4E (Restricted Use)
SA-50 CHLORPYRIFOS 1% MOLE CRICKET BAIT
VULCAN (Restricted Use)

Cyfluthrin

TEMPO 20 WP GOLF COURSE INSECTICIDE (Restricted Use)

Fipronil

CHIPCO CHOICE INSECTICIDE (Restricted Use)
QUALI-PRO FIPRONIL 0.1G (Restricted Use)

Imidacloprid

AGRISEL IMIDAPRO 2SC INSECTICIDE
ANDERSONS GOLF PRODUCTS TURF FERTILIZER 14-0-14 WITH MERIT INSECTICIDE
ARMOR TECH IMD 2SC
ARMORTECH IMD75
CRITERION 0.5 G INSECTICIDE
CRITERION 2F INSECTICIDE
CRITERION 75 WSP INSECTICIDE
ENFORCE 0.5G TURF AND ORNAMENTAL INSECTICIDE
ENFORCE 75WSP TURF AND ORNAMENTAL INSECTICIDE
EQUIL ADONIS 2F INSECTICIDE
EQUIL ADONIS 75 WSP INSECTICIDE
FERTILIZER W/MERIT 0.15%
FERTILIZER W/MERIT 0.2%
GARANT T&O 2F INSECTICIDE
GARANT T&O 75 WSP INSECTICIDE
GORDON'S PROFESSIONAL TURF & ORNAMENTAL PRODUCTS
IMIDIPRO SYSTEMIC INSECTICIDE
GRUBEX PRO
HAWK-I 2L
HAWK-I 75WSP
HI-YIELD GRUB FREE ZONE
HI-YIELD GRUB FREE ZONE III
IMIDASTAR 2L T&O
IMIGOLD 0.5 G
IMIGOLD 2 F
IMIGOLD 70 DF TURF, ORNAMENTAL AND GREENHOUSE INSECTICIDE
INVICT BLITZ ANT GRANULES
INVICT XPRESS GRANULAR BAIT
LADA 2F INSECTICIDE
LESCO BANDIT 0.5 G INSECTICIDE
LESCO BANDIT 2F INSECTICIDE
LESCO BANDIT 75 WSP INSECTICIDE
LESCO MERIT 0.2 PLUS TURF FERTILIZER
LESCO MERIT 0.2 PLUS TURF FERTILIZER
LESCO SYSTEMIC INSECTICIDE CONTAINS MERIT
MALICE 0.5G
MALICE 75 WSP
MALLET 2F INSECTICIDE
MALLET 75 WSP INSECTICIDE
MERIT 0.5 G INSECTICIDE
MERIT 2F INSECTICIDE
MERIT 75 WP INSECTICIDE
MERIT 75 WSP INSECTICIDE
MIDASH 2SC T&O
PHOENIX HAWK-I 75WSP
PHOENIX HAWK-I 2L
PRIMERAONE IMIDACLOPRID 2F INSECTICIDE
PROFESSIONAL TURF SOLUTIONS WITH MERIT FERTILIZER
PROKOZ ZENITH 0.5 G INSECTICIDE
PROKOZ ZENITH 2F INSECTICIDE
PROKOZ ZENITH 75 WSP INSECTICIDE
PRO-MATE MERIT 0.2% PLUS TURF FERTILIZER
PROTHOR SC 2
QUALI-PRO IMIDACLOPRID 0.5G INSECTICIDE
QUALI-PRO IMIDACLOPRID 75 WSB

Imidacloprid cont.
REGAL MERIT 0.2 PLUS
SCOTTS FERTILIZER 0-0-7 WITH GRUBEX PRO
SCOTTS FERTILIZER 22-0-8 WITH GRUBEX PRO
SCOTTS PROFESSIONAL FERTILIZER 0-0-7 WITH GRUBEX
SCOTTS PROFESSIONAL FERTILIZER 22-0-8 WITH GRUBEX
SIGNATURE FERTILIZER WITH 0.2% MERIT
TCS GROWSTAR MERIT 0.2 PLUS TURF FERTILIZER
THE ANDERSONS GRUBOUT DG 0.2% INSECTICIDE
THE ANDERSONS TURF PRODUCTS FERTILIZER WITH 0.2% MERIT INSECTICIDE 24-0-12
THE ANDERSONS TURF PRODUCTS FERTILIZER WITH 0.2% MERIT INSECTICIDE 22-3-8
TURF PRIDE ACCUBLEND FERTILIZER WITH 0.2% MERIT
TURFTHOR O.5G
TURFTHOR WP
TURFTHOR WSP
XYTECT 2F INSECTICIDE
XYTECT 75WSP INSECTICIDE

Indoxacarb
ADVION INSECT GRANULE
DUPONT ADVION INSECT GRANULE
DUPONT PROVAUNT INSECTICIDE
PROVAUNT

lambda-Cyhalothrin
LAMBDA SELECT (Restricted Use)
LAMBDA-CY EC INSECTICIDE-RUP (Restricted Use)
NUFARM LAMBDA-CYHALOTHRIN 1 EC INSECTICIDE (Restricted Use)
QUALI-PRO LAMBDA GC-O (Restricted Use)

Permethrin
PERMETHRIN 10% RAPID KILL INSECTICIDE CONCENTRATE
PROZAP INSECTRIN X CONCENTRATE

Piperonyl butoxide & Permethrin
FLEX 10-10 INSECTICIDE
KICKER
PYNAMITE SYNERGIZED 10/10 CONCENTRATE
PYRANHA 1-10 PX CONCENTRATE
VECTOR-BAN PLUS MULTI PURPOSE INSECTICIDE

Pyrethrins
MGK EVERGREEN PYRETHRUM CONCENTRATE

Thiamethoxam
MERIDIAN 25WG
MERIDIAN 0.33G

Thiamethoxam & Azoxystrobin
CARAVAN G

Trichlorfon
DYLOX 420 SL TURF AND ORNAMENTAL INSECTICIDE
DYLOX 6.2 GRANULAR INSECTICIDE
DYLOX 80 TURF AND ORNAMENTAL INSECTICIDE

Table 7. Active ingredients contained in insecticide products registered for pastures.

Beauveria bassiana
Botanigard ES
Mycotrol O
Carbaryl
Drexel Carbaryl 5% Bait
Piperonyl butoxide & Pyrethrins
Pyrenone Crop Spray
Pyrethrins
PyGanic Crop Protection EC 5.0II

Table 8. Active ingredients contained in insecticide products registered for vegetables.

Beauveria bassiana
Botanigard ES
Mycotrol O
Bifenthrin
Surrender G
Bonide House Guard
Bonide Eight Insect Control Flower & Vegetable
Vegetable Garden Soil Insecticide
Carbaryl
Drexel Carbaryl 5% Bait
Piperonyl butoxide & Pyrethrins
Pyrenone Crop Spray
Pyrethrins
PyGanic Crop Protection EC 5.0II