Technical Information - Pests

Least Toxic Methods of Cockroach Control

Introduction

Controlling a cockroach infestation is not simply a matter of aesthetics. Large indoor cockroach populations are one of the leading causes of allergies, asthma and other bronchial disorders in humans. Additionally, cockroaches are capable of carrying disease organisms and bacteria on their bodies and in their fecal material. The presence of cockroach populations in and around urban structures is an indication that cockroach food, moisture and harborage resources are present. These conditions allow pests to proliferate and lead to cockroach population explosions.

Until recently, efforts to suppress cockroach populations in the urban environment have relied almost exclusively on repeated applications of synthetic pesticides. Surveys have shown that more than 1/3 of all the pesticides used in the U.S. are applied in urban environments and most of these pesticides are applied in the home. However, the chemical approach to cockroach control has become increasingly less popular. This is primarily due to the development of multi-chemical resistance among German cockroach populations and increased public concern about pesticide exposure in their living environment. These two issues have greatly emphasized the need for a more holistic and less toxic approach to cockroach management.

The Principal Cockroach Species

In order to deal with any particular infestation it is important that the cockroach pest be properly identified so that most appropriate and least toxic control methods can be applied. There are 41 cockroach species present in the state of Florida, of these only about six are considered pests. These pest species can have very distinct behavior and habitat preferences.

The predominant pest cockroach species in New York (and the world) is the **German cockroach**, *Blattella germanica*. German cockroaches are small with adults less than 0.75 inches (1.5 cm) in length. They are gold in color and have two dark longitudinal bands on their pronotum near the head. Immature German cockroaches, or nymphs, are smaller than adults, wingless and dark brown in color.

German cockroaches are primarily indoor pests and do not have "wild" populations. They have strict moisture requirements so they are usually found in kitchen and bathroom areas. Adults live about six months, and during this time the female produces from four to eight egg cases (oothecae). The female carries the egg case throughout embryonic development (three to four weeks) often releasing it from her body only hours before the nymphs hatch. Each female produces an average of 28 nymphs from each egg case. German cockroaches are the most prolific pest species and therefore the most difficult to control.

Cockroach Prevention: Exclusion and Sanitation

Long term prevention of cockroach infestation is the best means of ensuring a cockroach free environment. This is most easily accomplished by means of exclusion (preventing cockroach entry) and sanitation (elimination of cockroach resources). Not only will these measures prevent a future infestation, they will also help to reduce an existing cockroach problem.

Exclusion

Prevent Cockroach Entry:

- Cockroaches migrate easily through multi-unit dwellings via plumbing and electrical connections. Sealing gaps around plumbing, wall outlets and switch plates will prevent cockroaches from migrating from infested units to others.
- Keep doors and windows closed and screened. Also, caulk cracks and gaps that may allow peridomestic (outdoor) cockroaches to invade from outdoors.
- Fiberglass window screen over vent pipes on the roof will prevent cockroaches from migrating up from sewer connections and gaining access to attics and windows.
- Groceries, produce and other packaged food products may have been stored in infested locations before they were purchased. Make an effort to visibly scan all grocery items for cockroach evidence before putting them away.
- Children can transport cockroaches from school to home in book bags and lunch pails. Inspect these items on a regular basis.
- Guests (adults and children) can often transport cockroaches from their infested home to yours either on themselves or in packages. Limit guest access to specific areas of your home and inspect these areas after they depart.

Sanitation

Elimination of Food Resources:

German cockroaches can remain alive for approximately two weeks with no food or water and for 42 days if only water is available. Therefore it is important to realize that cockroaches can survive on tiny amounts of food such as crumbs, grease or food residue.

- Indoor trash containers should be emptied frequently, kept clean both inside and out. Plastic bags lining trash containers can be kept closed with twist ties. This will prevent cockroaches from being attracted to the garbage area.

- Filled indoor garbage containers should be removed from the dwelling immediately and placed in outdoor containers with tight fitting lids or dumpsters.
- Keeping the area around dumpsters or other outdoor garbage storage areas clean and free of debris will also prevent peridomestic cockroach infestations in the area.
- Frequent emptying of sink strainers and running of the garbage disposal and will prevent food build up in the sink drain.
- Washing dishes immediately after a meal will eliminate prevent cockroaches from consuming food residue on dishes. Unwashed dishes are a major source of food for German cockroaches.
- Kitchen appliances (toasters, toaster ovens, microwaves, ovens, stoves, and refrigerators) should be kept clean and free of food particles and grease. Additionally, the areas underneath and behind these appliances should be kept grease and crumb free.
- If pets are present, dry food should be kept in re-sealable containers. Do not leave food and water out all the time.
- Feed your pet at particular times and clean up after every meal.
- All foods products should be resealed after opening, stored in plastic snap-lid containers or kept in the refrigerator.
- Regular sweeping/vacuuming of floors and furniture where people eat (i.e. kitchen table or in the living room in front of T.V.) help to eliminate cockroach food sources.
- Regular cleaning of food storage areas and shelves not only eliminates spilled or scattered food but disrupts cockroach populations that may be using the area as a harborage.
- Vacuum up roaches, they will die in the vacuum.

<u>Elimination of Water Resources:</u>

The single most important factor in determining cockroach survival is availability of water. German cockroaches live less than two weeks when there is no supply of free water even if food is abundant. It is therefore important to eliminate all sources of moisture that contribute to cockroach survival.

- Tightening loose pipes, patch plumbing leaks and replace used washers in the kitchen sink and bathroom areas. Outdoor water spigots and sprinklers should also be checked for drips and leaks.

- Water left in the sink or bathtub after dish washing or bathing also provides moisture for cockroaches. These sources are eliminated by drying out sinks and bathtubs after use.

- A common source of moisture is condensation under the refrigerator. This area should be frequently wiped dry or, if possible, have a pan should be placed under the appliance to collect water. The collection pan should be emptied frequently. Condensation on pipes (under the sink or in wall voids) is also a problem. Insulate these pipes if possible.

- Pet drink dishes and aquariums are also sources of moisture. Empty pet water dishes at night when cockroaches are foraging but the pet is indoors or asleep. Aquariums should have tight fitting lids or screens to prevent cockroach entry.

- Be careful not to over-water indoor plants, because excess water is available to cockroaches.

- Glasses, cups and soda cans containing water or liquid residue are common sources of moisture for cockroaches. Be not to leave these containers in bedrooms, sinks, on counter tops or other areas. Rinse an invert cups and glasses to dry immediately after use and dispose of soda cans in trash containers.

- Steps should be taken to eliminate places where water collects outdoors (tires, cans, tree holes etc.). This will not only eliminate cockroach moisture sources but also mosquito breeding habitat.

<u>Elimination of Harborage Resources:</u>

The third critical element for cockroach survival is harborage. By nature, cockroaches avoid open, well lit areas with frequent air movement. They prefer dark, warm cracks and crevices. Excess clutter provides numerous locations suitable for cockroach habitation. The elimination of these harborages (clutter) is important in controlling infestations.

- Adult cockroaches can fit into cracks only 1.6 mm wide (about 1/16 of an inch). Any small gap or hole that leads to a void is a prime cockroach harboring area. Cracks and crevices of this kind should be sealed with a tube of caulking.

- Removing clutter (boxes, bags, clothing, toys, food, books, papers etc.) eliminates cockroach harborages and breeding areas. It is essential to keep all areas of the home, especially the kitchen and bathroom, uncluttered and free of useless debris.

- Outside, remove debris and trash from around the house.

Least Toxic Cockroach Management Strategies

After exclusion and sanitation measures have been taken the next step is to decide on a treatment strategy. The most effective cockroach management strategies rarely eliminate the use of pesticides altogether but try to reduce the need for pesticide treatments by employing other less toxic methods. Many of these methods are currently being used in structures across the country. The following is a discussion of some of the non-chemical and reduced chemical control methods currently available for indoor and outdoor cockroach control.

The most recent technological advances in reduced toxic and non-toxic cockroach control have been in bait formulations, and insect growth regulators. Other currently used non-toxic measures include desiccating dusts, traps and biological controls. Each of these treatment methods will be discussed in detail including how they may be incorporated into a complete urban cockroach management program.

Note: Ultrasonic devices are frequently advertised as a non-toxic method of cockroach control. However, extensive research has shown that these devices neither kill nor repel cockroaches so they are not included in the following discussion.

Cockroach Baiting

Cockroach baits consist of a toxicant mixed with a food source. Some baits also contain attractants or feeding stimulants that are supposed to make the bait more attractive to cockroaches than the other food sources that may be available in the immediate area.

Current indoor bait formulations are applied as dusts, pastes, gels or bait stations. The bait station is one of the more popular application methods for cockroach baits. This is because the stations are easy to put out, safe around children and pets and have residual activity.

Gel and dust bait formulations are also very safe. They are formulated for injection into cracks and crevices that are harborages for cockroaches but not accessible to people.

Until recently, paste baits were very messy and required application with a putty knife. However, manufactures have improved these products by repackaging the bait material in easy application syringes that are also suitable for bait gun application. This greatly improves bait placement allowing paste baits to be applied into cockroach harborages like the gel and dust formulations.

Almost all baiting products available for indoor use are formulated using one of the following active ingredients: hydramethylnon (Combat, Maxforce); chlorpyrifos (Raid Max); abamectin (Avert). Combat and Maxforce are bait products using injectable gel formulations and the bait station delivery system. Raid Max also available as a bait station. Avert is available as a bait station, a gel aerosol and a flowable bait dust that can be injected into cracks and crevices.

Outdoor baiting products are used primarily for the control of peridomestic cockroaches. Spreadable granular baits containing chlorpyrifos or bait stations with hydramethylnon bait are the most common formulations used for peridomestic cockroach control.

Spreadable baits are usually applied as a perimeter band around a structure. It is difficult to determine the residual longevity of these products particularly in areas where precipitation is frequent. Even "weatherized" baits have difficulty retaining their residual properties where there is heavy rainfall. This is particularly true in the southeastern United States where precipitation can ruin bait effectiveness within a single day.

Insect Growth Regulators

Insect Growth Regulators (IGRs) are a group of compounds which disrupt the normal growth and development of insects. The IGRs are very safe compounds. They generally have very little toxicity to mammals because they act by disrupting the hormonal processes that are specific to insects.

IGRs that mimic the juvenile hormones of insects are called juvenile hormone analogues (JHAs). JHAs are chemical compounds whose structural chemistry is very similar to the hormones that the immature cockroach produces naturally. These hormones function in cockroaches roughly the same way as they do in humans. They send chemical messages throughout the body that regulate physiological changes. These changes facilitate the development of a juvenile into a reproductive adult. Juvenile hormone analogues disrupt this natural process. Specifically, JHAs interfere with the proper development of last instar cockroach nymphs. Instead of the nymphs molting into reproductive adults they molt into "adultoids", which often have twisted wings and are sterile. The JHAs effect on the cockroach population is that as more and more cockroaches are exposed to the JHA, the adultoids begin to predominate. Because the adultoids are unable to reproduce, over time, the cockroach populations begins to decline. JHAs are a very effective method of long term German cockroach control. However, because JHAs eliminate reproduction but do not kill existing, cockroaches they are very slow acting (from four to nine months to achieve control). It is for this reason that JHAs are often combined with residual insecticides. In this manner most of the population can be eliminated quickly by the insecticide, cockroaches that survive the insecticide treatment are then sterilized by the JHA.

Insect Growth Regulators are available in spray formulations or point source dispensers (where the IGR is released on a filter paper contained in a permeable plastic station then transmigrates throughout the infested area). Hydroprene (Gentrol Point Source) is a JHA that is currently available for indoor cockroach control. Pyriproxifen (Nylar, spray formulation) recently joined the market and has shown good control in laboratory and field tests against German cockroaches. At this time there are no IGRs available for peridomestic cockroach control.

Chitin synthesis inhibitors (CSI) are another type of insect growth regulator that is being developed for use in management programs targeting a variety of insect pests. These compounds are faster acting than JHAs and can target a much larger range of sensitive stages in the cockroach life cycle. Exposure to CSIs results in the abnormal molting of nymphs causing them to die during the molting process. CSIs also cause adult cockroaches to form abnormal egg cases and interferes with the hatching process. However, chitin synthesis inhibitors are not yet commercially for cockroach control.

Inorganic Dusts

Inorganic dusts, such as silica gel and boric acid, have been used frequently for indoor cockroach control. The dusts are applied with a squeeze-bulb duster into cracks and crevices under sinks, stoves, behind refrigerators, along baseboards, in electrical outlets, cabinets and wall voids. Silica gel is simply finely ground sand or glass that adheres to and absorbs the protective waxes on the cockroach cuticle resulting in cockroach death from dehydration. Boric acid is a stomach poison that is picked up by cockroaches walking across dusted areas. The boric acid adheres to the cockroach cuticle so when the cockroach grooms itself it ingests the boric acid and soon dies.

Traps

One of the non-chemical tactics available for reducing a cockroach infestation involves the use of traps. Sticky traps (i.e. Roach Motel type) can be purchased and placed, indoors, near the garbage, under the sink, in the cabinets, under and behind the refrigerator, and in the bathroom. Outdoors, sticky traps are not recommended because they tend to capture many non-target animals (snakes, lizards etc.) and are not resistant to weathering.

A second trapping method is the use of baited jars. Any empty jar (pickle, mayonnaise, peanut butter etc...) with a rounded inside lip will suffice. Coat the inner lip of the jar with a thin film of Vaseline (to keep trapped cockroaches from escaping). The jar should then be baited with a quarter slice of bread soaked in beer (a cockroach favorite). If beer and bread is unavailable try other foods like cookies, dog food, apples etc. The outside of the jar should be wrapped in paper towel so cockroaches have a surface to grasp as they climb up the sides of the jar. To kill trapped cockroaches simply pour dish washing detergent into the jar and add hot water. The cockroaches can then be dumped outside or in the garbage. Wash out the jar and repeat the process every two to three days. Indoor jar traps should be placed in the same locations as those listed for sticky traps.

When trapping outdoors, jars should be placed in trees, tree holes, mulched areas, firewood, near the garbage cans, compost piles, air conditioning units and storage sheds. Covering the jars with a dome shaped piece of aluminum foil taped to the sides will prevent rain from filling the traps. Jar traps are very suitable for outdoor use because they present no danger to non-target organisms and are not easily damaged by weather.

Biological Controls

Almost all animals have natural enemies. Cockroaches are no exception. However, biological control is not always considered when we think of controlling a cockroach infestation. However, natural controls do play an important role in managing cockroach populations. Natural cockroach enemies include wasps, nematodes, spiders, toads and frogs, centipedes, birds, lizards, geckos, beetles, mantids, ants and small mammals (mice). It is very important that these populations of natural enemies be maintained to help keep cockroach populations in check.

Oothecal Parasitoids

Parasitic wasps are the most important natural enemy of cockroaches. The wasps are parasitoids of the cockroach egg case (ootheca) and can have a severe effect on the cockroach reproductive potential. Most species of parasitoid wasps are associated with peridomestic cockroaches. The majority of these wasps are very tiny (1 to 5 mm) and do not sting humans. Peridomestic cockroaches like the American and smokybrown, live in outdoor harborages such as palm trees, tree holes, and woodpiles. The parasitoids live with the cockroaches in the harborage parasitizing their egg cases. When the adult male and female wasps emerge (from previously parasitized cockroach oothecae) they mate immediately. The female then begins to sting other oothecae laying her eggs inside them. The wasp offspring hatch quickly and eat the cockroach embryos inside the ootheca. So when the ootheca hatches, adult wasps emerge instead of cockroach nymphs. This natural system results in 60-70% of all cockroach egg cases being parasitized without any human interference.

Oothecal wasp parasitoids have been tested for potential indoor use. Domestic populations of brownbanded cockroaches were successfully controlled in a California animal rearing facility by these wasps. However, it is doubtful that parasitoid wasps will ever be reared for commercial use. Very few individuals would welcome a population of 200,000 wasps in their home even if they promised to eliminate a severe cockroach infestation.

Note: Wasp parasitoids are extremely susceptible to pyrethroid insecticides. When attempting to eliminate an outdoor cockroach infestation it is important to realize the insecticide applications in peridomestic cockroach harborages may not kill all of the cockroaches but it certainly will eliminate the parasitoids. This can result in future cockroach problems as surviving cockroaches can reproduce unchecked the following year. The application of bait around an infested area is the best way to treat a population of peridomestic cockroaches and preserve the wasp parasitoids.

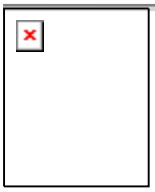
Summary

German cockroaches are the most important pest in the indoor environment. Once the cockroach and its habitat have been determined, the magnitude and location of the population needs to be evaluated. This can be done by performing a thorough inspection in and around the structure and monitoring with traps. The population information should then be used to choose treatment strategies. A combination of

treatments is recommended for a complete approach to cockroach management. Several least toxic treatment choices are available for cockroach control, they include bait products (available for indoor and outdoor use), insect growth regulators (IGRs), inorganic dusts and traps. Oothecal parasitoids occur as a biological control for peridomestic cockroaches. However, these wasps are very sensitive to insecticides and should be protected from outdoor applications, particularly those involving pyrethroids.

Authors:
Dr. Dini Miller, Urban Pest Management, Virginia Polytechnic Institute and State Univeristy;
Dr. Philip Koehler, Urban Pest Specialist, University of Florida

Photos: University of Florida



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