

Integrated Pest Management and Assessment-Based Programs for German Cockroach Control in Multi-Unit Housing

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Abstract

This article presents a comprehensive review and practical guidance on the use of Integrated Pest Management (IPM) and Assessment-based Pest Management (APM) programs for controlling German cockroach (*Blattella germanica*) infestations in multi-unit housing environments. The purpose of the article is twofold: first, to underscore the importance of IPM as a long-term solution and addressing the root causes of infestations; and second, to highlight the effectiveness of APM as a rapid, simplified approach that can serve as a precursor to a broader IPM strategy. The article also explains how APM diverges from traditional IPM by focusing exclusively on infestation-level assessment to guide bait application and not requiring tenant participation or additional interventions. Studies and field examples are used to demonstrate the high efficacy of APM in quickly reducing and eliminating infestations. However, we also emphasize that while APM is effective for immediate control, it lacks mechanisms to prevent future infestations. Therefore, transitioning from APM to a full IPM strategy is essential for long-term cockroach management. A hybrid approach is also proposed, which blends the rapid responsiveness of APM with select IPM interventions such as sealing harborage points and controlling moisture early in the treatment process.

The Importance of IPM in Multi-Unit Housing

Integrated Pest Management (IPM) is a system-based strategy for pest control that focuses on prevention rather than relying primarily on pesticides. IPM incorporates a combination of biological control, physical control, habitat modification, and targeted pesticide use to minimize risks to human health and the environment. IPM programs for German cockroaches (*Blattella germanica*) in multi-unit housing include regular monitoring, sealing entry points, moisture control, and harborage reductions to keep populations from becoming established and growing (Brenner et al., 2003; Williams et al., 2006; Miller, Black, and Wang, 2021).

Studies show that IPM programs in these environments

reduce the need for frequent pesticide applications, making it a more sustainable and cost-effective approach over time (Brenner et al., 2003; Wang and Bennett, 2009; Sutherland and Kitagawa, 2023). Such programs for German cockroaches have also shown their effectiveness in reducing cockroach allergens in residential environments (Wang and Bennett, 2009; Nalyanya et al., 2009), which are a significant public health concern (Kramer and Brenner, 2009). By focusing on prevention and long-term solutions, property owners and managers can avoid costly infestations that require repeated treatments while also enhancing the overall health and safety of buildings.

For property managers who already have an IPM program in place, pest populations are recognized and managed early or prevented entirely. However, if a building lacks such a strategy and an infestation has been

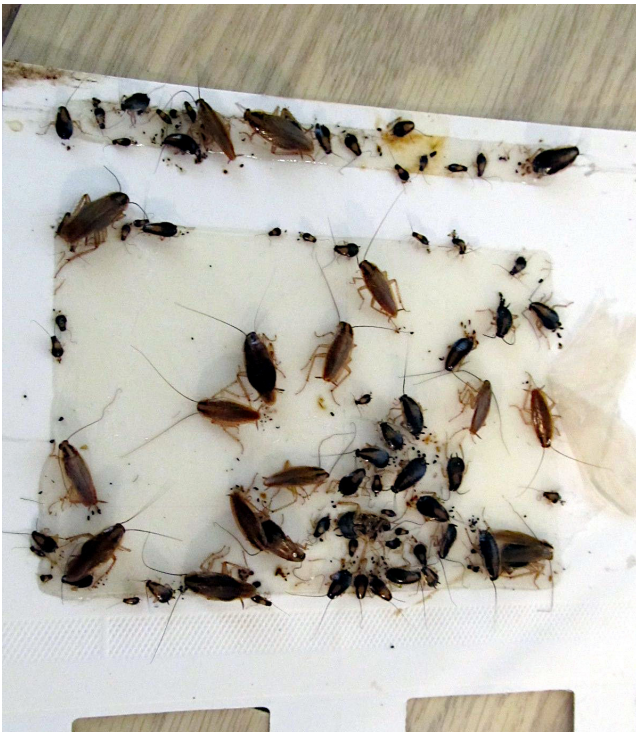


Figure 1. Sticky traps are a critical tool in assessment-based and IPM programs. They help quantify infestation levels, determine treatment needs, and track populations over time. Photo credit: Herb Field

identified, immediate action is needed. Multiple studies have demonstrated that IPM programs can control existing German cockroach infestations (Wang and Bennett, 2006; Wang and Bennett, 2009) and that they are significantly superior to traditional spray programs that are calendar or complaint-based (Miller and Meek, 2004; Wang and Bennett, 2009). Still, starting with a program focused on evaluating infestation levels and then treating accordingly (often with more bait than traditionally applied), can eliminate the existing population more quickly than a traditional IPM program. Once the infestation is controlled, transitioning to a well-designed and comprehensive IPM program will ensure early detection and reduce the cockroaches' ability to thrive should they return.

Assessment-Based Programs

Monitoring has long been recognized as a critical component of an IPM program because it provides the data necessary to make informed decisions about pest presence, population size, and treatment needs. In multi-unit housing, some IPM strategies for German cockroach control have recommended the use of monitoring devices as a primary means for determining infestation levels since at least 1993 (Koehler, 1999).

For many years, manufacturers of cockroach gel baits

have recommended the use of sticky traps (Fig. 1) to assess infestation levels before and after treatments, but these recommendations were typically made as part of a broader IPM strategy. Despite this guidance, trap monitoring was not consistently implemented as a tool by technicians to determine the amount of bait to apply. And unfortunately, based on the authors' experience, pest management professionals (PMPs) who rely solely on visual inspections often under-apply bait, sometimes well below label recommendations. This is likely because German cockroaches tend to remain hidden during daylight hours, making infestations appear less severe than they are.

To our knowledge, the earliest study to use cockroach trap counts to guide bait placement and quantity, without incorporating additional interventions like cleaning or tenant education, was conducted by Sever et al. (2007). Additionally, the treatment protocol they tested involved applying larger quantities of bait than was typical practice at the time. The results showed that these protocols provided excellent control of existing German cockroach populations within just 90 days. The study also demonstrated that more traditional calendar-based programs were far less effective, even though bait was incorporated into those treatments. In the 2010s, the practice of using sticky trap data to guide bait application areas and amounts gained more widespread use. Rather than combining these data with multiple IPM interventions, more PMPs began using higher volumes of gel bait as the primary, and sometimes sole, method of treatment. Part of this change was likely due to manufacturers encouraging the use of greater amounts of bait. Bayer Environmental Science, for example, began promoting a 0.05% fipronil cockroach gel bait as a clean-out option that was superior to traditional flushing agent plus residual applications, provided that the high label rate of bait was applied. While promotions such as this urged PMPs to use more bait per site, there was no formal recommendation to solely use sticky traps for measuring populations to determine how much to apply.

The broader shift to using monitors alone to determine bait application amount was largely driven by the work of Dr. Dini Miller, who coined the term "assessment-based" pest management (APM) to emphasize the importance of evaluating infestation severity prior to treatment (Oiet al., 2017). APM marked a simplification of traditional IPM protocols by minimizing or eliminating the need for sanitation efforts, exclusion measures, or tenant involvement.

Notably, monitoring remains essential to both IPM and APM. While IPM is a broad, multifaceted strategy that includes sanitation, exclusion, education, and targeted pesticide use, APM is a focused approach that uses the infestation data to guide bait placement and quantity. APM therefore can function as a rapid-response approach for active infestations and may serve as a precursor or

component of a larger IPM program.

APM: A Simpler Way to Elimination

Miller and Smith (2019) evaluated the effectiveness of an APM strategy over a 15-month period in low-income public housing. Their approach relied exclusively on monitoring to assess infestation severity, which in turn determined the amount of gel bait applied in each unit. No resident preparation, sanitation, or additional interventions were involved. Across three housing authorities, the program led to an average reduction in cockroach populations of over 90%, and complete elimination was achieved in 75% of the units. The success of this method reinforced earlier findings that targeted baiting based on infestation level is effective even in the absence of resident cooperation. Importantly, unlike reactive treatments that rely on tenant complaints and focus only on the units reporting issues, assessment-based programs (like IPM programs) take a comprehensive building-wide approach to eradication. These programs ensure success by evaluating infestation levels throughout a building and tailoring treatments accordingly. Key components of an assessment-based approach include:

- Conducting a building-wide evaluation to determine infestation levels in each unit
- Performing treatments based on infestation severity
- Ensuring that cockroaches are eliminated in all affected units, not just the ones reporting issues

Transitioning to IPM for Long-Term Control

An assessment-based treatment with no other interventions can effectively eliminate active infestations, but it does not address the underlying conditions that support infestations. If cockroaches are reintroduced, these conditions can allow them to establish and spread more quickly. Therefore, once cockroaches are eradicated, transitioning to an IPM-based strategy is necessary for long-term control.

Whether starting with an assessment-based treatment or immediately diving fully into an IPM program, the use of a HEPA-filter vacuum is recommended. This practice not only helps quickly remove both live and dead cockroaches but also significantly reduces allergen exposure by safely capturing their fecal matter and shed skins.

Other components of an IPM program in multi-unit housing include:

- Regular monitoring – Consistent, building-wide monitoring is essential for evaluating the success of an IPM program and detecting new infestations before they spread. Miller, Black, and Wang (2021)



Figure 2. A moisture meter being used to detect hidden leaks in a kitchen. Access to moisture is crucial for German cockroach survival, making routine inspections essential for effective IPM programs in multi-unit housing. Photo credit: Herb Field

emphasize that, “for apartment buildings, a building-wide inspection, using sticky traps, should be conducted every six to 12 months.” Pest population levels should be documented both before and after treatments to ensure effective treatment, and identify any potential problem areas. Monitoring with sticky traps also helps correctly identify the cockroach species present, such as German vs. American cockroaches, which is critical because each species requires different treatment strategies and product selection for successful control.

- Moisture control – Addressing leaks and eliminating water sources are critical as cockroach access to moisture is more important than access to food (Reiersen, 1995). It is strongly recommended that units be inspected annually with a moisture meter (Fig. 2) to look for slow or hidden leaks. Cockroaches can only survive a few days without water but can live for weeks without food, making moisture control a top priority. Additionally, excess moisture can lead to mold, which can be a food source for cockroaches.
- Maintain units in good repair – Structural deterioration (Fig. 3) can contribute to persistent infestations. Research has shown that deteriorating housing conditions are positively associated with higher cockroach allergens (Rauh, Chew, and Garfinkel, 2002). Degrading materials, such as peeling laminate or rotting particleboard, create harborage and even nutritional opportunities for cockroaches.
- Structural modifications – Sealing cracks and crevices (Fig. 4) plays a crucial role in cockroach prevention by impacting their ability to aggregate and reproduce optimally. Sealing plumbing points helps prevent cockroaches from being harbored in voids and potentially gaining access to moisture



Figure 3. Structural deterioration plays a significant role in contributing to cockroach infestations. Damaged cabinetry, such as this decaying particle board, should be replaced or repaired. Photo credit: Josh Shoemaker



Figure 4. Unsealed gaps and cracks, like this cabinet corner, provide ideal harborage and travel routes for German cockroaches. Properly sealing these areas is a critical step in preventing infestations. Photo credit: Josh Shoemaker

from slow leaks or sweaty pipes. Studies show that without shelter to congregate, cockroaches experience slower growth, lower reproductive success, and increased environmental stress (Izutsu, Ueda, and Ishii, 1970; Gemenio, Williams, and Schal, 2011).

- Isolation of units – To the degree possible, units should be isolated from each other to prevent cockroaches from traveling between them. In addition to restricting pests from voids, sealing plumbing and other utility points helps prevent cockroaches from migrating to other units. Access points such as electrical boxes (Fig. 5) where an effective seal often cannot be maintained should be treated with insecticidal dust or other measures to prevent cockroach migration. Doors and windows should also be adequately sealed to prevent pest entry.
- Resident education – Informing residents about the importance of reducing clutter and maintaining good sanitation practices can help keep populations from growing as quickly. Tenants should also be instructed not to apply personal pesticide treatments as they may interfere with the IPM program, and put them at risk from misapplications.

As with assessment-based programs, cockroach gel baits should be used when cockroaches are discovered, with these guidelines followed:

- Appropriate bait application – Apply an appropriate amount of bait based on the infestation level in each infested unit to ensure effective control. Do not use spray materials. Sprays may drive cockroaches to other units. Additionally, sprays, even non-repellent materials, may negatively impact the performance of baits.
- Bait rotation – German cockroaches have a history of developing resistance to insecticide applications. To prevent resistance, it is generally recommended that cockroach bait products be rotated quarterly.

Finally, the following practices can aid an IPM program:

- Dusting void areas – Applying dust in voids, including those around cabinets, creates a long-lasting barrier that discourages harborage and provides ongoing control. Properly applied dust can kill or repel cockroaches that come into contact with the treated areas, reducing their ability to re-establish.
- Using Insect Growth Regulators (IGRs) – Incorporating IGRs into a treatment program disrupts the cockroach life cycle by interfering with development. These compounds prevent nymphs from molting into adults, reducing future population growth. Additionally, exposure to IGRs can cause gravid (egg-carrying) German cockroach females to emerge from their hiding places in search of food, increasing the chances that they will encounter and consume bait.
- Using cockroach bait stations – Some cockroach populations may begin to avoid a specific bait matrix after repeated exposure. In addition to bait rotation, offering different formulations of bait can reduce the likelihood of the population becoming bait averse.

Incorporating IPM Principles into Assessment-Based Treatments for Faster Control

While transitioning from an assessment-based program to a complete IPM strategy is essential for long-term cockroach prevention, there is also evidence that incorporating certain IPM elements earlier in the process can accelerate infestation control. By addressing harborage, moisture issues, and structural issues alongside a data-driven baiting program, it may be possible to achieve elimination more rapidly while helping to ensure long-term sustainability.

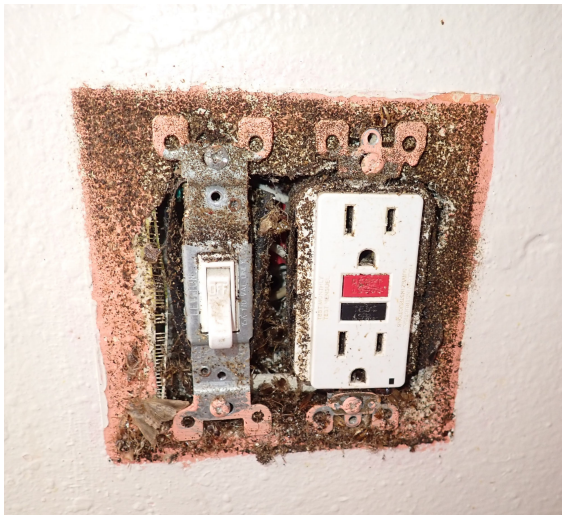


Figure 5. Electrical outlet boxes like this one allow cockroaches to travel in wall voids and between units, as well as harbor inside the voids themselves. To prevent movement and infestation, insecticidal dust or other control materials should be applied inside these voids. Photo credit: Josh Shoemaker

One such approach was developed by one of the authors, Herb Field. This method blends the precision and speed of assessment-based baiting with select IPM interventions to eliminate infestations. Additionally, while assessment-based programs typically use infestation levels to determine the precise amount of bait applied in a single treatment, this program takes a slightly different approach. Instead of adjusting the bait quantity per treatment, the infestation assessment is primarily used to determine service intervals, with each visit applying a generally consistent amount of bait according to product labels. This hybrid method emphasizes population assessment and treatment frequency while simultaneously addressing two critical IPM components, sealing plumbing access (Fig. 6) and harborage removal (Fig. 7).

By integrating key IPM tools earlier in the process, this method expedites cockroach population declines by placing the populations under stress. It also sets the stage for a smoother transition into a complete IPM program, reducing the likelihood of reinfestation. The approach was successfully implemented in 2012 at a 64-unit apartment complex in Concord, CA, that was part of a legal matter involving severe pest infestations (Herb Field, personal observation). While no peer-reviewed publication exists, the events were documented through legal proceedings and pest control service records. The property had a long-standing history of German cockroach problems, with every unit actively infested at the start of treatment. Most units had over 100 cockroaches based on sticky trap counts. These were defined as severe infestations. The remaining units had 50 to 100 cockroaches each,



Figure 6. An unsealed plumbing entry point with visible German cockroach fecal material. Gaps like this provide cockroaches easy access to water, harborage, and migration routes between units, allowing them to thrive and reproduce. Photo Credit: Josh Shoemaker

which were defined as moderate infestations. Sanitation levels ranged from fair to poor.

To combat the infestation, the following protocols were instituted and performed by a Pest Management Professional:

- Plumbing entry points and harborage areas were sealed.
- Sticky traps were placed to monitor each unit to determine infestation levels.
- Gel baits were applied according to infestation severity, with the following service intervals:
 - Severely infested units received weekly treatments.
 - Moderately infested units were treated every two weeks.
 - Light infested units (fewer than 50 cockroaches per unit) were treated monthly.
- Treatment frequency continued to be adjusted based on ongoing monitoring until the infestations in all units were eliminated.

Notably, tenant education and sanitation improvements were not part of the program, yet complete elimination of German cockroaches across all units was achieved within eight weeks.

Rapid and Sustainable Cockroach Control in Multi-Unit Housing

German cockroach infestations in multi-unit housing present unique challenges that require a structured



Figure 7. Unsealed gaps at the back of kitchen countertops, like the one shown here, provide cockroaches with easy access to hidden voids where they can shelter and reproduce. Additionally, trapped food debris and moisture within these crevices create ideal conditions for cockroach survival and can interfere with the effectiveness of bait treatments. Photo credit: Josh Shoemaker

and strategic approach for effective control. While assessment-based programs have been shown to be a rapid way to effectively eliminate infestations, they do not address the underlying conditions that allow cockroaches to thrive and spread. Therefore, transitioning to an IPM program after initial elimination is critical for long-term control and prevention.

IPM programs provide a sustainable, cost-effective, long-term solution by reducing conducive conditions, limiting reinfestation risks, and eliminating excessive pesticide applications. They incorporate monitoring, exclusion, moisture control, and structural modifications, all of which help prevent cockroach populations from re-establishing.

Research and field experience suggest that integrating certain IPM elements earlier in the process, alongside an assessment-based baiting program, can enhance treatment effectiveness and accelerate control. The hybrid approach further lays the foundation for long-term IPM success.

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