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Thirty years after the commercial launching of the first bait product for subterranean termites: introduction

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A symposium titled "Development and Application of Baits for Subterranean Termite Control in the Last Three Decades" was held from 25 to 30 August 2024, at the XXVII International Congress of Entomology in Kyoto, Japan. This event provided a platform to discuss the advancements in termite bait technologies across different regions over the past 30 years. This special collection features reports from symposium speakers, highlighting the effects of chitin synthesis inhibitor baits on termite colonies, the evolution of termite bait technology, impacts on the termite control industry in the United States and Southeast Asia, area-wide projects, and examples of innovations in bait technology.

Keywords: chitin synthesis inhibitor, *Coptotermes*, *Reticulitermes*, area-wide project

Introduction

The introduction of the first commercial bait product for subterranean termites in 1995 marked a significant milestone in termite control, creating a new category of solution for the industry. Since then, numerous advancements have been made to enhance baiting technologies which have changed the landscape of the termite control industry. Additionally, interest in the biology of subterranean termites in relation to bait applications has spurred studies on termite ecdysis, foraging behavior, and effects of baits on termite colonies. Termite baits have been deployed for area-wide (AW) projects in several regions, but not all were successful or have been properly documented. This special collection is an attempt to review the evolution of bait technology and its impact on the industry in the past 3 decades and to highlight some of the studies that have been absent in the literature.

Effects of CSI Baits on Termite Colony

As reviewed by Su (2025, this collection), a significant development in our understanding of how chitin synthesis inhibitors (CSIs) eliminate termite colonies was the discovery that subterranean termite workers return to the central nest to molt (Kakkar et al. 2017). A follow-up study (Kakkar et al. 2018) demonstrated that after feeding on CSI baits in an extended arena, pre-molt workers returned to the central nest near the reproductives, eggs, and brood. These workers died there when they failed to complete an ecdysis. The royal pairs migrated to other parts of the arena to escape the carcasses, and they were accompanied by workers transporting eggs and brood. However, over time, a new batch of dead workers would accumulate near the royal pairs, forcing them to migrate again. This cycle of 'death chase' may occur several times before the entire colony collapses. This observation explains why only CSI baits are capable of colony elimination and why all current commercial baits for subterranean termites contain CSIs as the active ingredient.

Chouvenc (2025, this collection) explored the underlying biological and ecological mechanisms affecting the effectiveness of CSI baits in eliminating subterranean termite colonies. CSI baits leverage termite molting biology, trophallactic behavior, and colony demographics to achieve gradual, colony-wide mortality with minimal environmental impact. The review synthesizes recent research on how termites' asynchronous molting, centralization of molting activity, and the spread of toxicant through trophallaxis and cannibalism drive colony collapse within 90 days. Factors such as termite species, environmental conditions, and bait station placement can influence baiting success.

Evolution of Termite Baits

Hexaflumuron was the CSI used in the first commercial bait, the Sentricon system (Corteva Agriscience, Indianapolis, IN), and its efficacy in eliminating field colonies of subterranean termites has been documented in numerous studies (Su 2023). As of 2025, other CSIs such as noviflumuron, diflubenzuron, and novaluron are also used in commercial bait products in the United States. Chlorfluazuron is the active ingredient in Requiem baits (Ensystex Australia, Auburn, Australia), while bistrifluron is used in Xterm baits (Sumitomo Chemical Co., Ltd., Tokyo, Japan). Lee and Lee (2025, this collection) reported faster colony elimination by bistrifluron baits compared to hexaflumuron or chlorfluazuron baits in Southeast Asia.

Dhang (2025, this collection) described studies demonstrating the efficacy of chlorfluazuron baits in eliminating termite colonies, including the challenging Termitidae species, in several countries across the Asia-Pacific region. Problems associated with CSI bait efficacy against termitids are also reported by Chiu and Li (2025, this collection).

The first commercial bait, the Recruit bait of the Sentricon system, used sawdust as the bait matrix. The Requiem baits (Exterra) use a paste-like mixture of cellulose powder and water, while compressed cellulose tablets are used by Xterm baits and the Trelona baits of the Advance system (BASF Corp., Florham Park, NJ). Recruit baits of the Sentricon system have undergone several developments, including a paper-towel matrix, compressed cellulose briquettes, and the durable bait, Recruit HD, which is comprised of polymer and noviflumuron-impregnated cellulose. With Recruit HD, only an annual on-site inspection is required. Due to the reduced labor costs from less frequent on-site visits compared to the traditional monitoring-baiting protocol, the number of termite control firms adopting durable baits has increased in recent years.

Impacts of Baits on the Termite Control Industry

As of 2025, 16% of termite control firms in the United States use baits as the primary tool, while another 48% offer both baits and liquid termiticides, totaling 64% of the industry segment that utilized baits (Anonymous 2025). In 2007, 42% of the termite control industry relied exclusively on soil termiticides, and this figure has reduced to 33% in 2025. Combined with the 48% that use both baits and soil termiticides, 81% of the industry in the United States still applies soil termiticides.

In Southeast Asia, however, termite baits have transformed the landscape of the pest management industry (Lee and Lee 2025, this collection). The evolution of termite research in Southeast Asia can be traced back to early studies in plantation agriculture to its current urban focus, primarily driven by regulatory bans on chlordane and the introduction of the Sentricon baiting system. Based on a 2023 survey of pest management professionals in Southeast Asia, termite baiting, particularly above-ground baiting, has become the preferred approach due to construction constraints and low interception rates of in-ground stations for the predominant termite pest, *Coptotermes gestroi* (Wasmann). Bait systems are highly effective in eliminating termite colonies such as *Coptotermes* spp, although their performance may vary depending on the target species and bait formulation. Baiting remains less effective against fungus-growing termites like *Macrotermes gilvus* (Hagen), highlighting the need for improved bait formulations and strategies. Lee and Lee (2025) concluded that termite baiting has reshaped pest management practices in Southeast Asia and elevated professional standards and scientific engagement across the region.

Area-Wide Projects

Due to their ability to eliminate subterranean termite colonies, baits are an ideal tool for AW projects to reduce or eliminate termite populations over large areas. Several experimental AW projects have been conducted in the United States and Chile, with varying degrees of success. Factors contributing to the failures of AW projects included a lack of community cooperation and complex managerial structures (Su 2025, this collection).

Cottone et al. (2025, this collection) revisited the status of bait applications in the French Quarter of New Orleans about a decade after the end of "Operation Full Stop," which was considered a failed AW project due to managerial problems (Su 2025, this collection). Following the conclusion of the AW project in 2012, alate density decreased over time. This reduction was attributed to the continuous use of baiting programs in the French Quarter, with more than half of the structures under a private contractor for bait maintenance. The study suggests that the installation of durable CSI baits (Recruit HD) in more than half of the structures allowed for recurring colony elimination, ultimately leading to an overall lower colony density over time within the area.

The most impressive success story in AW projects is summarized by Mora and Hernández-Teixidor (2025, this collection) who conducted large-scale AW projects in 5 town centers in Spain against *Reticulitermes* species. These commercially executed AW projects represent the largest subterranean termite colony elimination efforts to date. Their AW projects have resulted in a total absence of termite damage in these cities for over a decade. This study is one of the few commercial applications of the core concepts of AW projects that succeeded due to the involvement of residents and local administrations. The authors demonstrated the feasibility of commercial AW projects and provided a template for other municipalities worldwide to emulate, achieving cost-effective termite control for entire areas.

Innovations in Bait Technology

One limitation of CSI baits is the extended time required to eliminate a termite colony. Lee and Su (2025, this collection) explored the potential of using 20-hydroxyecdysone, a molting hormone, as an additive to accelerate termite mortality by inducing premature molting Lee and Su (2025). Another innovation is the development of fluid baits that can be injected directly into active termite infestations (Su 2015, Su et al. 2018). Commercial prototype injectable baits have been successfully field-tested against *C. gestroi* (Su and Mullins 2023).

In summary, this special collection highlights the evolution of termite bait technology over the past 30 years and its significant impact on the termite control industry. It offers valuable insights into the post-AW project in the French Quarter of New Orleans and previously unreported large-scale commercial AW projects in several cities in Spain. This information, which would otherwise be inaccessible to those outside these regions, is made available through this special collection, a result of the symposium held at the XXVII International Congress of Entomology in 2024.

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Author contributions

Nan-Yao Su (Conceptualization [equal], Formal analysis [equal], Writing—original draft [equal]), Thomas Chouvenc (Writing—review & editing [equal]), and Chow-Yang Lee (Writing—original draft [equal], Writing—review & editing [equal])

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