

First evaluation of baits as a preventative tool to control *Coptotermes termites* in Vietnam

by

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Abstract

This research was conducted in construction sites to illustrate the effectiveness of bait in controlling subterranean termites as a preventative tool. Bait was applied around three houses that were under *Coptotermes* attack in urban areas. The houses represented different design styles, and they were monitored over 1- year period. As a result, termite colonies were declined gradually after 18- 24 weeks, after about 12 to 17 weeks foraging in the bait stations containing only wood attractant blocks. The bait stations would also be maintained to monitor concealed entry of termites into the structures. Overall, this finding is considered as the initial research that confirmed protective function of Vietnam termite baits used to protect structures under infection of subterranean termites.

Introduction

Subterranean termites, particularly the genus *Coptotermes*, are one of the most important pests for constructions in Vietnam. They are widely distributed in different regions but abundant in urban areas (Nguyen Duc Kham 2007, Trinh V. Hanh et al., 2010). According to recent studies, there are two *Coptotermes* species causing serious damage to structures in the North part of Vietnam, including *Coptotermes gestroi* and *Coptotermes formosanus* (Nguyen Duc Kham et al 1985, Trinh Van Hanh et al. 2014). The cost of termite control and repairs was reported at about \$1.7 million USD for only private houses (WIP, unpublished data, 2011). Hence, preventing subterranean termites for houses under construction can significantly reduce economic losses as well as environmental problems and human health issues related to frequent use of pesticides.

Fortunately, termite bait was evaluated as an effective tool in termite control. The use of the termite baits has been improved over 20 years (Buczowski 2014), and incessantly developed in association with understanding termite foraging behavior and social activities (Wang & Henderson 2012). However, termite bait treatment in Vietnam was not well published to the world, particularly as a function of a preventative barrier for new building construction. There are several reports about bait application for structures with the active ingredient hexaflumuron including an assessment of BDM, made in Vietnam, used to treat termites infesting buildings at a resort (Hanh et al. 2014). While demand for innovative bait applications are increasing in Vietnam in relation to environment concerns, understanding and enhancing bait effectiveness has become a priority. To promote a wide use of domestic termite bait in Vietnam, it is necessary to design field trials to show the advantage of baits to protect structures from termite attack.

Materials and Methods

Materials

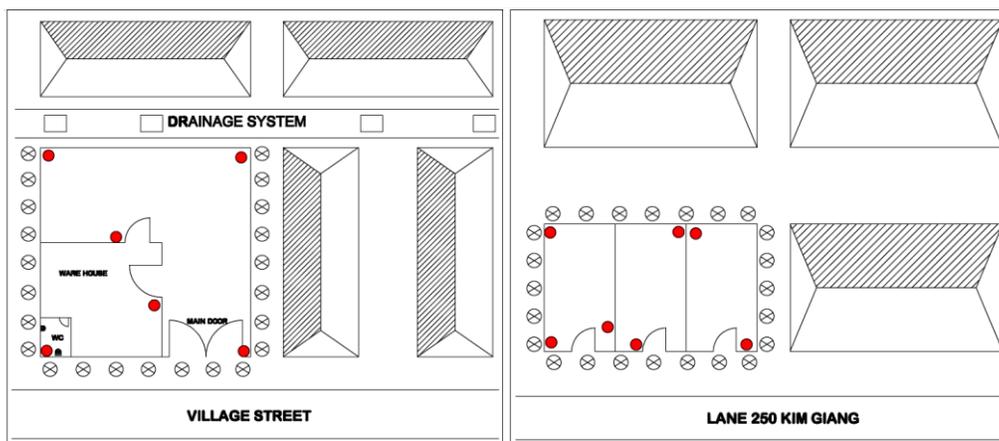
There were two termite bait components used in this study: i) bait stations containing, on average, 15 pine blocks 20cm x1.5cm x1.5cm in size treated with an attractant to lure termite foragers, ii) termite bait, named Mobahex, supplied by WIP containing the active ingredient hexaflumuron.

Investigation of termite damage status

Prior to conducting field trials and to gain data for quantifying control, investigation of termite damage status was undertaken in three local areas of Hanoi using questionnaires and face-to-face interviews. They included A1 block (Hoang Mai district), A13 block (Thanh Xuan district) and homes on the campus of University of Trade Union (Dong Da district) and Hanoi Open University (Hai Ba Trung district) for a total of 320 houses, averaging 80 apartments per area or block. Households used in the interviews were selected randomly and investigated based on a SPSS survey (2004) combined and improved with actual situations like: House type? Having termite or not? etc.

Field trials of termite bait treatment

Wood stations, containing no bait, were installed as a field trial control around the houses. These stations found strong *Coptotermes* activity after for 12 weeks. These houses included a private modern house with dynamic decoration style, an antique house used as a church by one family with a big wooden altar in the left-hand-side room and wood decorations inside, and a small building having 4 floors with the ground floor used as a garage and storage place. The wood blocks, 20cm × 1.5cm × 1.5cm in size, used were pine treated through a cycle of submersion and drying then compressed to increase attractive capacity to *Coptotermes* species (Mo 2014). Wood stations were placed at 2m intervals and 0.3 – 0.5m from structural food depending on the house design and mapped for each construction site (Fig.1). The monitoring interval of this phase was 1 week and lasted for 12 weeks. The time period of termite observation was from March 2014 to June 2014 and considered as pre-treatment phase (Su 2007). Wood consumption rate was estimated based on number of wood blocks infected by termite foragers per station (WIP, unpublished data).



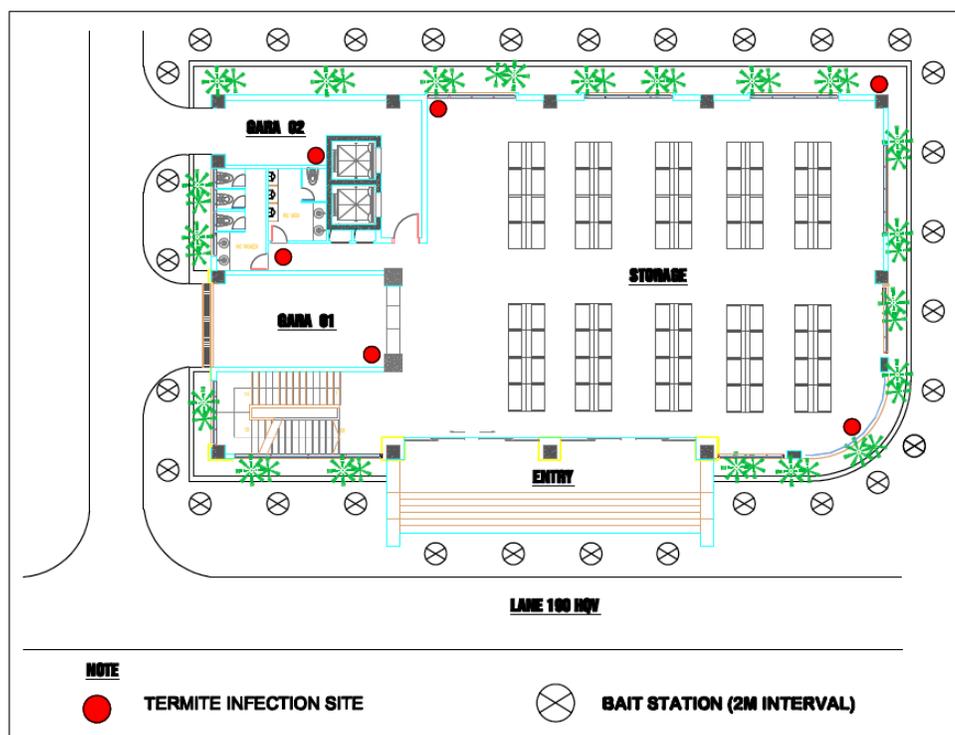


Fig 1. Treatment of in-ground monitoring stations around structures (scale 1:250);
Top left- private house installed 23 stations, top right- antique house installed 24 bait stations and small building installed 32 bait stations.

After that, baits containing active ingredient were introduced into the wood stations. The monitoring interval was longer than the pre-treatment phase, 2 weeks. After bait elimination, bait stations were maintained and monitored for 13 weeks (approximately every 3 months) until June 2015 to test re-infestation of termites. Effectiveness of the in-ground termite bait was evaluated based on the decline of termite activity around the houses, following the method of Grace and Su (2001) and Su (2007).

Statistical analysis

Data was processed using SPSS (ver 2.0) (<http://www-01.ibm.com/software/analytics/spss/>) to analyze current status of termite pests in urban areas of Vietnam, while bait effectiveness was assessed through statistical analysis using Excel 2011. The output data was collected and saved for general evaluation system at WIP, Vietnam.

Result and discussion

Investigation of termite infection in urban areas

Termites were found in over 25% of the 320 structures investigated. However, this rate was not equal in the different house types, with a high rate of termite appearance in private houses and old houses compared to new and antique houses of the Old Quarter in Hanoi. This rate in the private houses and old houses are 8.07 and 8.38, respectively (Fig.2). When analyzed under cross tabulation, there is a significant difference in the percentage of new houses and old houses ($P = 0.0001 < 0.05$), indicating a preference of termite pests to house types that use a high portion of cellulosic materials to construct or decorate. The reason could be that the old style of structural design generates a humid environment around footing areas, especially ground pavement. Also, a low ceiling and old construction materials, such as carton, lime mortar, might create attraction for termites. Surprisingly, this result was not the

same for antique houses, with a very low infestation rate, 4.97%. To explain for this result, the city council in this area implemented annually several area-wide control programs to preserve the antique view for the Old Quarter tourism. Therefore, the percentage of termite damage decreased. However, to understand the preference trends of termite with different types of construction, there is a need to investigate more houses in wider areas in future. Additionally, the percentage of houses under attack by termites only indicates the incidence of termite infestations, not the damage level. According to Grace & Su (2001), whenever termites are found, they set these structures under threat or a zero tolerance action threshold. These results could be an initial part of integrated pest management programs, being a first step to designing appropriate solutions and gaining public awareness based on actual situations in Viet Nam.

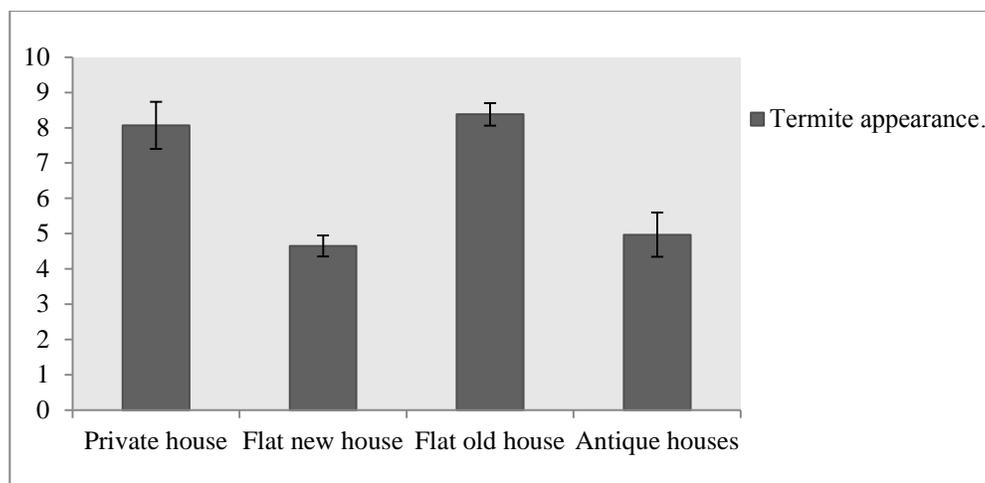


Fig.2. Percentage of house found to be attacked by subterranean termites

Effectiveness of bait treatment as protective tools

Wood consumption rate. There was a general pattern of increasing consumption of the wood blocks during 3 months in all three houses. Termites were first found in bait stations around the modern house, after 3 weeks, then the antique house and lastly the ground floor of the building. However, the wood consumption rate in the antique house was highest at week 12, with 20% of wood blocks consumed, and steadily increased over time. The same pattern was illustrated in the small building, except a slightly stability in weeks 7 and 8, whereas the consumption rate in the modern house increased very slowly and reaching over 6% of the wood blocks consumed by week 12th. This result might be due to internal conditions around the modern house where there was a convenience store on the ground floor with noise from a number of visitors everyday. Also, the store contained a number of big carton boxes, which could serve as an alternative food source for termites (Baker & Weeks 2006). Compared to previous studies on different termite bait systems, termites were found in monitoring stations of Sentricon bait after 1 month (4 weeks) at rate from 8 – 27% (Grace et al. 1996) and termites first foraged to Firstline and SentriconR bait stations at 8.7 weeks and 3.7 weeks, respectively (Glenn et al. 2008). Hence, the time period of 4.3 ± 1.5 on average to attract *Coptotermes* is short and the consumption rate of Mobahex bait is within the reported range. This finding might be attributable to seasonal conditions in Vietnam, when termites are at their most active. In addition, the density of termite bait around the house could be another reason for the successful attraction because wood volume can increase termite recruitment (Lenz & Evans, 2002)

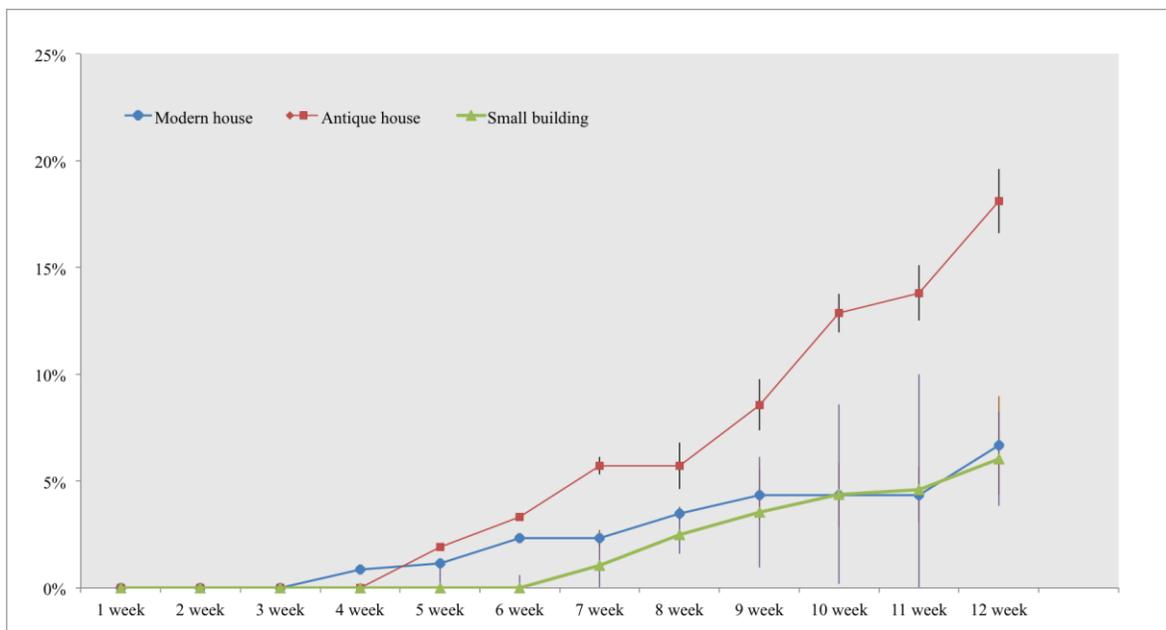


Fig. 3. Wood consumption rate per station of *Coptotermes* genus over 12 weeks in control sites.

Termite elimination by MobaHex. The effectiveness of MobaHex in controlling *Coptotermes* species was demonstrated after 21.3 ± 3.1 weeks (around 5 months) after installing bait stations (Table 2). There were no termites found in the area of the modern house after 18 weeks and in the antique house or the small building after 22 weeks. If considering only time after bait application, the time to elimination ranged from 6 – 10 weeks. Interestingly, despite termite foragers consuming significant wood in the stations around the antique house the elimination was generated later than at the other houses. However, to confirm a persistent control effect of MobaHex, it is necessary to maintain the bait stations over longer time to prevent concealed entry termite into the structures as illustrated by the case of termites appearing in the small building although it was not *Coptotermes* (shown as “+” letter in Table 1). This finding is in agreement with previous studies where termite population elimination by using hexaflumuron in large areas was reported in a relative short period, from 2 – 3 months (approximately 4 – 13 weeks). Furthermore, Osbrink, Conerlius & Lax (2011) asserted that the wide-area control using hexaflumuron bait can be maintained over two years and therefore act as an active barrier. In addition, the time period for MobaHex bait to be effective can also be compared to, for example, chlorfluazuron with over 6- 8 weeks (Sukartana, Sumarni & Broadbent 2009) or by week 12 (Peter & Fitzgerald 2003) on *Coptotermes* termites. Hence, this domestic bait can be recommended to control termites in wide areas.

The time variation reported for the amount of bait considered sufficient to control termites depends on different micro-environmental conditions at bait sites, building design and decoration styles. For instance, the antique house is in a quiet area and easier to install station systems including more favorable internal environment at bait stations. Whereas the surrounding at the small building includes a large garden with a high density of shrubs and trees that created a humid environment to make the bait moldy, which interfered with termite activities. In addition, control activities of the bait are related to population size, as well as more colonies that would require a longer time to elimination. To understand this hypothesis and preventative function of bait under a range of climate conditions, it needs further studies for longer time frames applied in a number of structures.

In comparison to the bait controls, it is clear to see from Table 1 and Fig. 2 that the termite bait killed all termite colonies after 4 months (around 16 weeks) as evidenced by a cessation of bait consumptions.

They also act as an active barrier to deal with termite problems around houses. This finding was first published about bait treatments applied against Formosan subterranean termites in field trials and can be a helpful reference for developing a national standard to protect new buildings under termite threats.

Table 1. Termite elimination of MobaHex bait over time periods

House types	Termite activities per bait stations over time (week- wk)								
	14 wks	16 wks	18 wks	20 wks	22 wks	24 wks	36 wks	48 wks	60 wks
Modern house	3	4	4	0	0	0	0	0	0
Antique house	4	6	7	7	3	0	0	0	0
Small building	4	4	5	4	2	0	0	0	+

Conclusion

The termite bait MobaHex can be used as an alternative barrier to prevent termite attacks into structures. To be effective, it requires a period from 16 to 24 weeks to eliminate all termite colonies around houses and the variation in time to elimination may depend on termite population size. The time of initial attraction to the termite bait stations was around 3 weeks. This is promising to apply bait to control termites in wide areas and developing this method is a key of integrated pest management along with education and public awareness in developing countries like Vietnam. Furthermore, these findings can be considered the first publication of the bait treatment method to prevent subterranean termites for urban structures. In the future further studies of termite bait systems should be tested over longer time periods and under different internal environmental conditions to investigate sustainable maintenance of the barrier.

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