Proceedings of the Ninth International Conference on Urban Pests
Matthew P. Davies, Carolin Pfeiffer, and William H Robinson (editors) 2017
Printed by Pureprint Group, Crowson House, Uckfield, East Sussex TN22 1PH UK

CRYPTOTERMES BREVIS (ISOPTERA: KALOTERMITIDAE) CONTROL METHODOLOGY ON A HISTORIC BAROQUE CHURCH

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Abstract The aim of this study is to present a methodology for *Cryptotermes brevis* control in such a fragile, old building environment. The described treatment was undertaken at Igreja Matriz Nossa Senhora da Candelária, a church built in 1780 at Itu city, São Paulo. Its presbytery is made of cedar and was being attacked by *Cryptotermes brevis*. It was decided to treat the structure by using a wettable granules formulation (Optigard LT® - thiamethoxam 25%) sprayed by an aerosol generator, with a needle injector. The application was made by using the holes made by the termites themselves. The product used dosage was 7g/1L of water and the insecticide solution reached about 1 meter distance into termites´ galleries. Twenty litres of insecticide solution were used to treat the infested area, showing that this is also an economic methodology. The used technic provided 100% *C. brevis* control after 2 years. This methodology, using thiamethoxam WG in an aerosol machine, showed effectiveness against drywood termites.

Key words Historic buildings, thiamethoxam.

INTRODUCTION

The West Indian drywood termite, *Cryptotermes brevis* (Isoptera: Kalotermitidae), infestation in historic buildings, mainly the ones from the baroque period, has been long known by the researches, as it is pointed by some authors: "Among the several threats to the historic built heritage, termite is one of the most harmful ones, as it was pointed by Paulo Duarte (1938) and Germain Bazil (1956/58). These insects reach the wood structures, wattle and daub and rammed earth walls, retables, altars, stairs and other wood pieces and many times is only noticed when the damages caused are greatly extended, often there are damages of large extension, frequently compromising the structural stability of the building itself." (Fontes and Filho, 1998).

Most of the infestation occurs due to negligence or lack of knowledge of owners and managers about the Isoptera. (Fontes and Filho, 1998). In Brazil, there is not enough reliable statistics regarding the degradation of cultural property caused by termite. However, a board presented on ICUP 2011, in Ouro Preto, showing a survey performed in baroque churches within the Serro area, in Minas Gerais, pointed that 83% of these buildings were attacked by termites (Silva et al., 2011).

Igreja Matriz de Nossa Senhora da Candelária, completed in 1780 in the city of Itu – the place where this work was developed – represents the social-economic and cultural development of prosperous cities in the colonial period in Brazil.

Since treatments that use toxic gases such as methyl bromide and aluminum phosphide are prohibited under the law, West Indian drywood termite control is done exclusively by means of application of insecticides solutions in Brazil. There are also the aerosol insecticides, marketed in the retail market, which can be also applied for termite control. However, all these techniques are limited as they present low productivity.

In baroque churches, the most difficult part in treating wood for controlling termite attacks has always been choosing the methodology and chemicals properly. Besides the difficulties for reaching 100% of structures, due to barriers and inaccessible confined spaces that limits the application and fast volatilization of insecticide solutions - and extremely high fire hazards due to the use of flammable products in pieces extremely dry and scarified by termites, which significantly increase the combustibility of wood pieces - there is also the enormous risks of damaging paintings, art elements made with natural pigment-based paints, and water and gliding made with the application of thin gold layers. Those factors impaired the use of treatment solutions formulated with oil solvents because they can stain or even remove the finishing. Even in little quantities, as in insecticide formulations of emulsifiable concentrates, which contain oil derivatives in their compositions, solvents can seriously damage paintings and ornaments, which also restricts the use of this type of compound.

This way, the challenge for performing these works that are highly specialized – where error margins are almost null – consist of the exact choice of insecticides, solvents, techniques of preparation for the woodwork, dosing and equipment that are able to ensure the efficacy of treatments without causing (minor) damages to wood components. For that, the insecticide shall be solvent-free, extremely efficient on termite elimination, high residual power and preferentially odorless. The solvent shall be completely inert to not damage ornaments, do not cause discomfort due to strong and long lasting odors in treated environments and to avoid the maximization of fire risks. Using water as a vehicle is the most recommended practice, although it has deleterious effects to wood in high doses. This way, treatments shall be suitable to be fully effective against West Indian drywood termite colonies elimination without damaging art or constituent elements.

The aim of this study is to present a methodology for *Cryptotermes brevis* control in such a fragile environment. The described treatment was undertaken at Igreja Matriz Nossa Senhora da Candelária, an ancient baroque church built in 1780 at Itu city, São Paulo. Its presbytery is made of cedar and was being attacked by *Cryptotermes brevis*. There are several old paintings on its walls, so the usage of formulations containing oil solvents is not appropriate.

MATERIALS AND METHODS

Chancel's woodwork comprises cedar wood, contemporary in this Church's construction. The treatments described as follows were performed considering all the aforementioned restrictions, and it was performed on the wood walls of the chancel, main altar, side altars, art and decorative elements and furniture of Igreja de Matriz de Nossa Senhora da Candelária, Itu, São Paulo, Brazil.

These described treatments occurred from June to September, 2014. By the end of the treatment, 10 visits with insecticides applications were done, totalizing 180 hours of work.

Being a building listed by the National Heritage Department, mechanical interventions, like perforation to allow insecticide application were considered aggressive due to the fact the attack was very disseminated through the architectural complex. Taking all considerations presented for this issue, the woodwork treatment by "extra-low volume" application of an insecticide solution of aqueous base and high concentration of active ingredient was selected. The application was made by using the holes made by the termites themselves, to avoid more damage to the wood. To perform this treatment, the pieces were checked, and the holes were previously identified and marked.

Before applying the insecticide, the internal part of the galleries was cleaned by compressed air jet. This procedure aimed to remove fecal granules inside the pieces, cleaning inside the attacked pieces, removing fecal granules, unclogging galleries and allowing the free flow of insecticide solution.

The structure was treated by using a wettable granules formulation (Optigard LT® - Thiamethoxam 25%), at 7g c.p./L dosage (higher than indicated by the manufacturer for subterranean termite control) sprayed by an aerosol generator (Micronizer®), with a needle injector, that allowed extremely low volumes application. The average flow measured for the injection nozzle was 80 ml/ minute. This equipment also works with a low airflow that helps insecticide penetration into the wood.

RESULTS AND DISCUSSION

After treating such woodwork, there was a monitoring period of 24 months to assess the results. During this period, there was no occurrence of attacks by West Indian drywood termites regarding treated pieces. The technique used allowed the full Chancel treatment at Igreja Nossa Senhora da Candelária, and two years after applications, no West Indian drywood termite activity was found in the pieces. Monitoring visits were established every 60 days in the first year and every 90 days in the second year.

The low volume of insecticide solution used for the treatment, about 30 liters, was considered enough for this work, confirming one of the purposes of this test, which was to seek a higher efficacy in treatments and reducing the quantity of chemical agents used. This success is due to the set of methodologies: 1) Using a concentrated aqueous and low volume solution in order to not damage the pieces; 2) Using holes opened by termites as insecticide introduction points to reach the entire internal part of the pieces; 3) Previous clearance of galleries by using compressed air jet; 4) Using the galleries as conduction paths for the insecticide to go inside wood pieces; 5) Simultaneously inoculate both insecticide and compressed air, which enabled the expansion and propagation, and full distribution of insecticides through galleries; 6) Using insecticide with good residual and non-repellent effects.

In December, 2016, a West Indian drywood termite occurrence was diagnosed in one of the chambers of the Chancel. This attack is still under surveillance due to the fact traces are still arising from internal structural timbers of the walls not treated yet.

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