*Proceedings of the Fifth International Conference on Urban Pests*
*Chow-Yang Lee and William H. Robinson (editors), 2005.*
*Printed by Perniagaan Ph'ng @ P&Y Design Network, Malaysia.*

# FIELD TRIALS IN THAILAND ON THE EFFICACY OF SOME SOIL TERMITICIDES TO PREVENT SUBTERRANEAN TERMITES

**[1]C. VONGKALUANG, [2]K. CHAROENKRUNG AND [2]Y. SORNNUWAT**

[1]Advisor, Royal Forest Department, 61 Phaholyathin Road, Bangkok 10900, Thailand
[2]Forest Management and Forest Products Research Office, Royal Forest Department, 61 Phaholyathin Road, Bangkok 10900, Thailand

**Abstract** Study on the efficacy of some soil termiticides available in Thailand market was made in order to evaluate their effectiveness to prevent the invasion of subterranean termites living underneath the buildings. Two methods representing construction practices widely used in the country were experimented, Modified Ground Board Test (MGB) for houses with slabs on ground and Stake Test (ST) for houses with high posts. The study started in 1991 in the north east followed by the second test site in the central plain and the third and fourth in the south and the east accordingly. Synthetic pyrethroids are the majority termiticides used in this study (Permethrin, Cypermethrin, Alphacypermethrin, Deltamethrin, Bifenthrin and Fenvalerate). The Organophosphate group are Chlorpyrifos and Fenobucarb while the relatively newly-promoted products are Fipronil, Imidacloprid and Chlorfenapyr. Persistent organochlorine pesticides (POP) used for key comparison are Aldrin, Chlordane and Dieldrin. Results of the continuous yearly observations were tabulated and further discussed in detail.
**Key Words** Subterranean termite, Termiticide, Termiticidal efficacy, Prevention.

## INTRODUCTION

Soil treatment in Thailand can be dated back only until early 1960's (Vongkaluang, 1990). Before that, termite damage to buildings was considered less important because of many reasons, the most obvious were type of buildings and the durability of timber used as construction materials. In those days, homes and buildings were one storeyed with high post and timber used were highly durable species such as teak, ebony, rose wood, ects. Changing of construction design later to slabs on ground and replacement of durable to non-durable timber started termite infestation in buildings and prevention of termite damage then started to attract attention. Soil treatment was recommended and chemicals for the treatment were mostly insecticides for agricultural crops such as aldrin, dieldrin and chlordane (Vongkaluang, 2004). The organophosphate group entered into practice about a decade later followed by synthetic-pyrethroids in late 1980's. By that time, the chemicals used for soil treatment for termite management were switched from agricultural insecticides to termiticides which were readily available in the market. With various termiticides newly introduced into the country, it was necessary to evaluate the efficacy in order to recognize which will be suitable in the country. Field trials of the efficacy of soil termiticides were then initiated in the northeast and later in the north before permanent plots were set up in 1989 using standard methods applicable to represent the nature of construction practices of the country, the Stake Test and Modified Ground Board Test.

## MATERIALS AND METHODS

### Termiticides

Various concentrations of commercial soil termiticides belonging to 4 chemical groups were applied in 4 permanent plots designated by Royal Forest Department. The common name of the products used were: Synthetic pyrethroid: α-Cypermethrin 1.5 EC, α-Cypermethrin 10 EC, α-Cypermethrin 4 SC, α-Cypermethrin 8 SC, Cypermethrin 25 EC, Cypermethrin 0.25, Cypermethrin 0.5, Cypermethrin 10 MC, Permethrin 38.4, Permethrin 25 EC, Permethrin 30 EC, Permethrin 380 EC, Bifenthrin 2.5 EC, Bifenthrin 3 EC, Bifenthrin 240 EC, Deltamethrin 2.5 EC, Deltamethrin 5 EC, Deltamethrin 12.5 EC, Deltamethrin 25 SC, ϕ-Cyhalothrin, Fenvalerate. Organophosphates: Chlorpyrifos 40 EC, Chlorpyrifos 48 EC, Chlorpyrifos 75 WV, Fenobucarb 15 MC. Others group: Imidacloprid 350 SC, Silafluofen, Fipronil 25 EC, Chlorfenapyr 240 SC. Chlorinated-hydocarbon: Chlordane 72 EC, Aldrin, Lindane 20 EC.

There are two types of field test which can be undergone separately and independently. The results of each test comparably reveal the effectiveness of test chemical for soil treatment.

**Stake Test (ST)**

This test is preferably used in field conditions of buildings with high posts, electricity poles or fence posts. The methods are: install 1x1x 2 $m^3$ concrete block on prepare plot; fill the concrete plot with river sand used for concrete mix. Compact by using construction tool; mix chemical to required concentration, and evenly spray test chemical on the surface of the prepared soil, 5 litre to 1 plot. There is a half-buried 5 x 5 x 50 $cm^3$ rubberwood stake in the middle of the ditch. Examine the stake 6 months and 12 months after treatment, and every 12 months thereafter. Comparatively evaluate the result on the stake in treated soil and the untreated (control) soil.

**Modified Ground Board Test (MGB)**

This test represents field condition of buildings with slabs on ground. Test methods are: install 1 x 1 x 2 $m^3$ concrete block on prepare plot; fill the concrete plot with river sand used for concrete mix. Compact sand by using a construction tool. Mix chemical to required concentration, and evenly spray test chemical on the surface of the prepared soil, 5 litre to 1 plot. Put PVC sheet on the surface of treated soil. Pour concrete 8 cm thick on PVC sheet leaving only 10 cm hole around the PVC pipe in the middle of the ditch. Cut out the PVC sheet inside the PVC pipe. Put one block of wood inside the PVC pipe. Cover the pipe. Comparatively evaluate the results on the stake in treated soil and the untreated (control) soil.

**Test Sites**

The experiment was located at four locations: Kon Khaen Province (KK) in northeastern of the country at Forest Land-Used Management Unit 1, Sri Chompoo District; Saraburi Province (SB) in the central plain, at Charcoal Research Center, Chalermprakiat District; Phuket Province (PK) in the south, at Bang Kanoon Plantation, Talang District; Cholburi Province (CB) in the east, at Nong Ta Yoo Forest Plantation, Sri Racha District.

## RESULTS AND DISCUSSION

Table1 shows the results of the efficacies of tested chemicals as soil termiticides versus the application time of the Stake Test and Modified Ground Board Test. Number of years shown in the Figures for each chemical were the longest period of time those chemicals still actively prevent the invasion of termites in at lease one permanent plot.

From the results as shown in Table 1 and Figures 1 and 2, it is quite obvious that soil termiticides used in this field evaluation did not perform as well when they were subjected to Stake Test as Modified Ground Board Test. The condition of Stake Test was naturally more severe than Modifed Ground Board Test because the treated soil was subjected to sunlight and rain. Chemicals in the organophosphate group reveal shorter preventive role than other chemical groups. However, it was suspected that the formulation of the termiticide may probably effected the degradation of termiticide applied to the soil. Chlorpyrifos 40 EC and 48 EC lasted only 1-3 years while fenobucarb which was formulated as fenobucarb 15 MC at the concentration of 0.3 % lasted 5 years and at 0.5 % is still active after 8 years which is the longest record collected so far. Fipronil revealed the next longest record at 7 years. The concentration of fipronil seemed not to effect the service life in this experiment because all four concentration of this chemical breakdown at the same time within 7 years. Other termiticides in this project hardly passed 5 years. Chlorfenapyr perform well after 4 years. In the Modified Ground Board Test, every termiticide in the tests performed better than the Stake Test. For some chemicals such as alphacypermethrin, cypermethrin, chlorpyrifos and imidacloprid, the concentration of solution played an important role on the performance in preventing termite penetration.

The record of observation shown in Table 1 revealed that results from different test site varied. Factors such as soil type, annual rainfall, pH of soil and land utilization are all account for the variation of results from place to place. Anyhow, chlorinated-hydrocarbons are still most effective in term of preventing termite penetration even though they are not allow to be used anymore. All other termiticides used in the project are now registered and labeled to be capable of preventing the penetration of termite up to 3 years or over. Taking into consideration the discussion given above, the factors involve in selection of termiticide for soil treatment can be summarized as: chemical, formulation, concentration, and location.

**Table 1.** Number of years that termiticides have been effective against subterranean termites in Modified Ground Board (MGB) and Stake Test (ST) field tests.

| Termiticides | Concentration (%AI[3]) | Site (Year initiated) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SB[1] | | KK[1] | | CB[1] | | PK[1] | |
| | | MGB[2] | ST[2] | MGB[2] | ST[2] | MGB[2] | ST[2] | MGB[2] | ST[2] |
| Synthetic pyrethroid | | | | | | | | | |
| 1. α-Cypermethrin 1.5 EC | 0.05 | 4* | - | 4* | - | - | - | - | - |
| | 0.1 | 7* | - | 4* | - | - | - | - | - |
| | 0.2 | 8* | - | 9* | - | - | - | - | - |
| 2. α-Cypermethrin 10 EC | 0.05 | 3* | - | 4* | - | - | - | - | - |
| | 0.1 | 5* | 1* | 8* | - | - | - | - | - |
| | 0.2 | 8* | 1* | 11* | - | - | - | - | - |
| | 0.3 | 8* | 1* | - | - | - | - | - | - |
| 3. α-Cypermethrin 4 SC | 0.1 | 9+(94) | - | 9+(95) | - | 2+(01) | - | 3+(01) | - |
| 4. α-Cypermethrin 8 SC | 0.1 | 9+(94) | - | 9+(95) | - | 2+(01) | - | 3+(01) | - |
| | 0.2 | - | - | 8+(96) | 7* | - | - | - | - |
| 5. Cypermethrin 25 EC | 0.125 | 3* | 2* | 4* | - | - | - | - | - |
| | 0.25 | 7* | 2* | 5* | - | - | - | - | - |
| | 0.5 | 7* | 2* | 9* | - | - | - | - | - |
| 6. Cypermethrin 0.25 | 0.25 | - | - | - | - | 4* | - | - | - |
| 7. Cypermethrin 0.5 | 0.5 | - | - | - | - | 4+(99) | - | - | - |
| 8. Cypermethrin 10 MC | 0.125 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| | 0.25 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| 9. Permethrin 38.4 | 0.5 | 5* | 1* | - | - | - | - | - | - |
| | 1 | 9* | 2* | - | - | - | - | - | - |
| | 2 | 11* | 2* | - | - | - | - | - | - |
| 10. Permethrin 25 EC | 0.25 | 7* | - | - | - | - | - | - | - |
| 11. Permethrin 30 EC | 0.5 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| | 0.75 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| 12. Permethrin 380 EC | 0.48 | 3* | - | 8* | - | 5+(99) | 3* | 7+(97) | - |
| | 0.72 | 3* | - | 9* | - | 5+(99) | 2* | 7+(97) | - |
| | 0.96 | 8* | - | - | - | 5+(99) | 3* | 7+(97) | - |
| | 1.2 | 8* | - | - | - | 5+(99) | 3* | 7+(97) | - |
| 13. Bifenthrin 2.5 EC | 0.025 | 5* | 2* | - | - | - | - | - | - |
| | 0.05 | 8* | 2* | - | - | - | - | - | - |
| | 0.1 | 11* | 4* | - | - | - | - | - | - |
| 14. Bifenthrin 3 EC | 0.05 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| | 0.06 | - | - | - | - | 2+(01) | - | 3+(01) | - |
| 15. Bifenthrin 240 EC | 0.06 | 9+(95) | - | 9+(95) | - | 5+(99) | 3* | 7+(97) | - |
| | 0.072 | 9+(95) | - | 9+(95) | - | 5+(99) | 3* | 7+(97) | - |
| | 0.09 | 9+(95) | - | 9+(95) | - | 5+(99) | 3* | 7+(97) | - |
| | 0.12 | 9+(95) | - | 9+(95) | - | 5+(99) | 3* | 7+(97) | - |
| 16. Deltamethrin 2.5 EC | 0.005 | 2* | 1* | - | - | - | - | - | - |
| | 0.01 | 1* | 1* | - | - | - | - | - | - |
| | 0.02 | 2* | 1* | - | - | - | - | - | - |
| | 0.05 | - | - | - | - | 4+(00) | - | - | - |
| | 0.0625 | - | - | - | - | 4+(00) | - | - | - |
| | 0.075 | - | - | - | - | 4+(00) | - | - | - |
| 17. Deltamethrin 5 EC | 0.05 | - | - | - | - | 4+(00) | - | - | - |
| | 0.0625 | - | - | - | - | 4+(00) | - | - | - |
| | 0.075 | - | - | - | - | 4+(00) | - | - | - |
| 18. Deltamethrin 12.5 EC | 0.0625 | 3* | - | 3* | - | - | - | - | - |
| | 0.075 | - | - | 3* | - | - | - | - | - |
| | 0.1 | 5* | - | 2* | - | - | - | - | - |
| | 0.125 | 5* | - | 3* | - | - | - | - | - |
| | 0.175 | 5* | - | 4* | - | - | - | - | - |
| 19. Deltamethrin 25 SC | 0.075 | 5* | - | 2* | - | - | - | - | - |
| | 0.125 | 7* | - | 6* | - | - | - | - | - |
| | 0.175 | 5* | - | 4* | - | - | - | - | - |
| | 0.25 | 8+(94) | - | 5* | - | - | - | - | - |

**Table 1 (continued).** Number of years that termiticides have been effective against subterranean termites in Modified Ground Board (MGB) and Stake Test (ST) field tests.

| Termiticides | Concentration (%AI[3]) | Site (Year initiated) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SB[1] | | KK[1] | | CB[1] | | PK[1] | |
| | | MGB[2] | ST[2] | MGB[2] | ST[2] | MGB[2] | ST[2] | MGB[2] | ST[2] |
| Synthetic pyrethroid | | | | | | | | | |
| 20. ϕ-Cyhalothrin | 0.25 | 7* | - | - | - | - | - | - | - |
| 21. Fenvalerate | 0.5 | 7* | 1* | - | - | - | - | - | - |
| | 1 | 7* | 3* | - | - | - | - | - | - |
| Organophosphate | | | | | | | | | |
| 1. Chlorpyrifos 40 EC | 0.5 | 4* | 1* | - | - | 2+(02) | 2+(02) | 1* | 1* |
| | 1 | 7* | 1* | 6* | - | 2* | 3* | 3* | 2* |
| | 2 | 7* | 1* | 8+(96) | 7* | 2* | 4+(00) | 3* | 3* |
| 2. Chlorpyrifos 75 WV | 0.5 | - | - | - | - | - | - | 4* | |
| | 1 | - | - | - | - | - | - | 4* | 4* |
| | 2 | - | - | - | - | - | - | 4* | 4* |
| 3. Chlorpyrifos 48 EC | 0.5 | - | - | 4* | 3* | - | - | - | - |
| | 1 | - | - | 5* | 3* | - | - | - | - |
| | 2 | - | - | 10* | 3* | - | - | - | - |
| 4. Fenobucarb 15 MC | 0.3 | 8+(96) | 5* | - | - | - | - | - | - |
| | 0.5 | 8+(96) | 8+(96) | - | - | - | - | - | - |
| Others | | | | | | | | | |
| 1. Imidacloprid 350 SC | 0.01 | 3* | - | - | - | - | - | - | - |
| | 0.025 | 4* | - | - | - | - | - | - | - |
| | 0.05 | 5* | - | - | - | - | - | - | - |
| | 0.1 | 5* | - | - | - | - | - | - | - |
| | 0.2 | 6* | - | - | - | - | - | - | - |
| 2. Silafluofen | 0.15 | 3* | - | - | - | - | - | - | - |
| | 0.25 | 3* | - | - | - | - | - | - | - |
| | 0.325 | 3* | - | - | - | - | - | - | - |
| | 0.375 | 3* | - | - | - | - | - | - | - |
| | 0.5 | 3* | - | - | - | - | - | - | - |
| 3. Fipronil 25 EC | 0.0075 | - | - | 8* | 7* | - | - | - | - |
| | 0.015 | - | - | 8* | 7* | - | - | - | - |
| | 0.0225 | - | - | 8* | 7* | - | - | - | - |
| | 0.03 | 8+(96) | 5* | 8* | 7* | - | - | - | - |
| | 0.06 | 8+(96) | 6* | - | - | - | - | - | - |
| | 0.09 | 8+(96) | 7* | - | - | - | - | - | - |
| 4. Chlorfenapyr 2 SC | 0.0625 | - | - | - | - | 1* | 4+(00) | 4+(00) | 4+(00) |
| | 0.125 | - | - | - | - | 4+(00) | 4+(00) | 4+(00) | 4+(00) |
| | 0.25 | - | - | - | - | 4+(00) | 4+(00) | 4+(00) | 4+(00) |
| | 0.5 | - | - | - | - | 4+(00) | 4+(00) | 4+(00) | 4+(00) |
| Chlorinated-Hydrocarbon | | | | | | | | | |
| 1. Chlordane 72 EC | 1 | 13+(92) | 4* | - | - | - | - | - | - |
| | 2 | 13+(92) | - | - | - | - | - | - | - |
| 2. Aldrin | 0.5 | - | - | 14+(91) | - | - | - | - | - |
| 3. Lindane 20 EC | 1 | - | - | - | - | 4* | - | - | - |

[1] SB = Saraburi; KK = Khonkaen; CB = Chonburi; PK = Phuket

[2] MGB = Modified Ground Board; ST = Stake Test

[3] AI = The active ingredient concentration in the termiticide dilution applied to the soil

[4] the number in parentheses is year test initiated

* Evaluations stopped after the overall wood baits destruction of each concentration were more than 50%

+ = Evaluations still in process

- = not tested

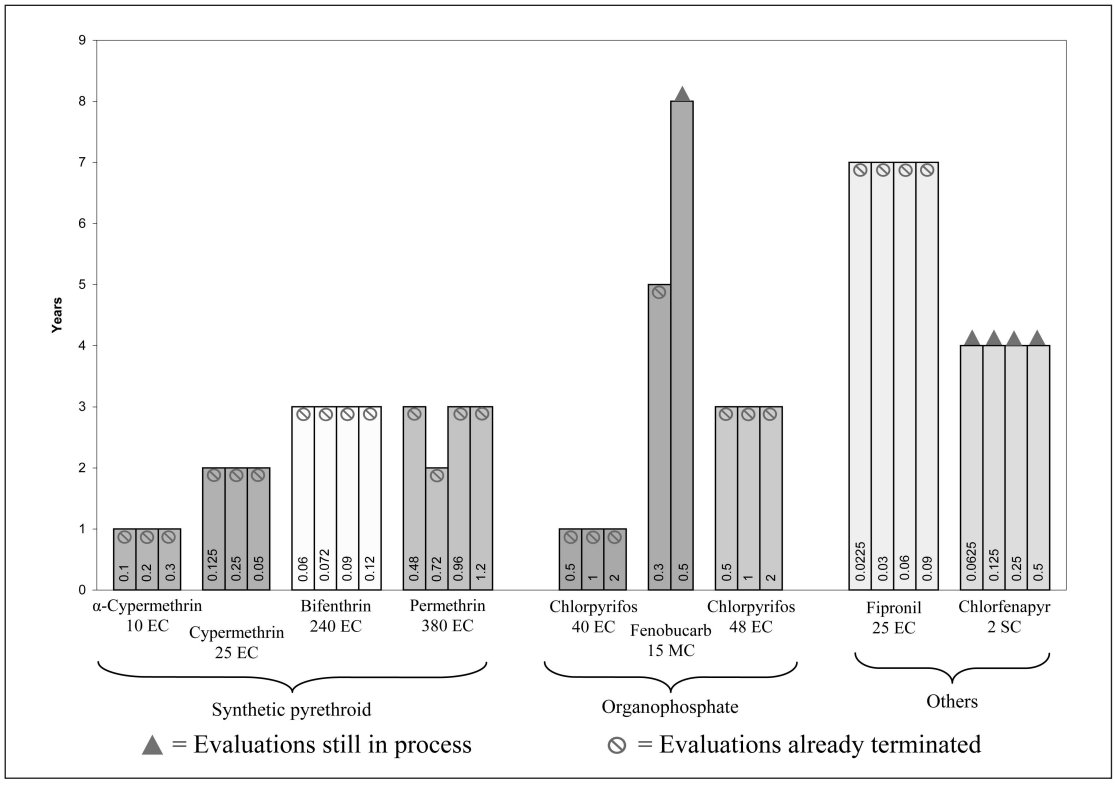


**Figure 1.** Efficacy result (ST) of termiticides at different concentrations within time (years)

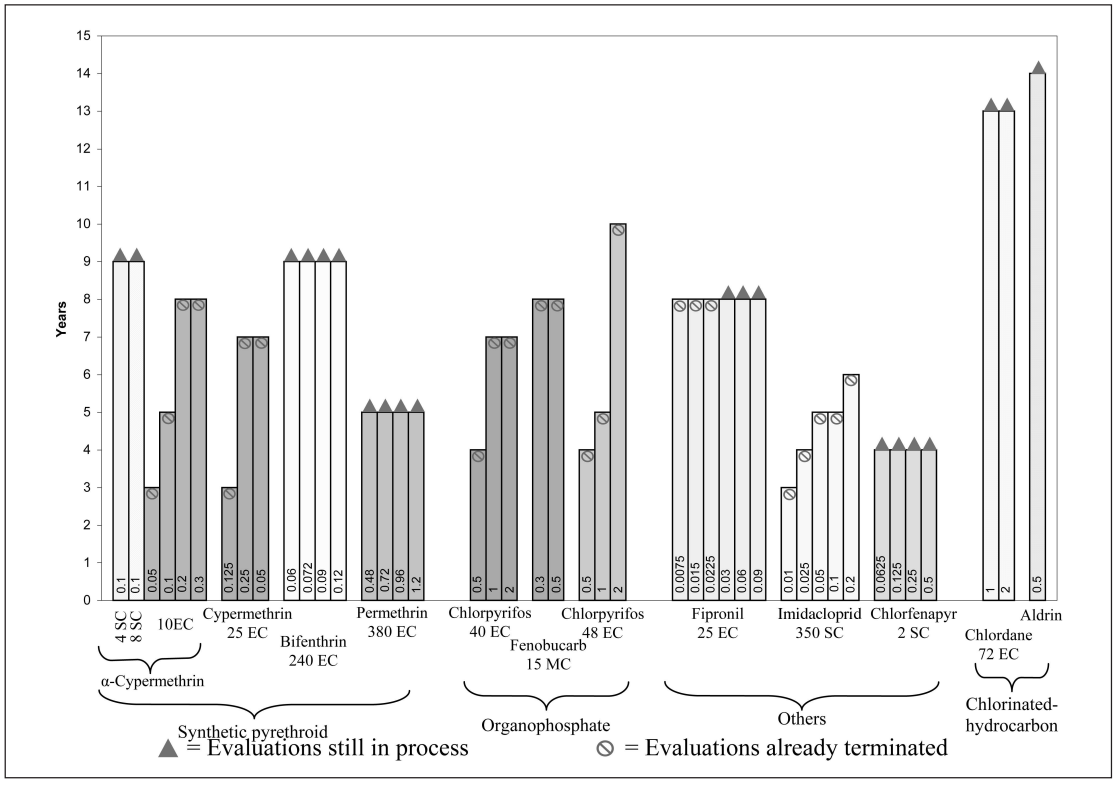


**Figure 2.** Efficacy result (MGB) of termiticides at different concentrations within time (years)

## ACKNOWLEDGMENTS

The authors would like to express our sincere appreciation to the following companies for supplying chemicals and financial for the establishment of the permanent plots for the evaluation: Dow Agrosciences Co., Sherwood Co. Ltd., FMC Co., Bayer Co., BASF Co. and Sumitomo Co.. We would also like to thank the staff of the test sites for their hospitality and helping hands extended to us while we worked in their properties.

## REFERENCES CITED

**Charoenkrung, K., C. Vongkaluang and Y. Sornnuwat. 2003.** The Study on the Efficacy of Termiticides to Prevent the Attack of Subterranean Termites in Thailand. Proceeding of the Sixth National Plant Protection Conference, 24-27 November 2003. Kon Khaen, Thailand.

**Vongkaluang, C. 1996.** Termites. In, Proceeding of the Seminar on Biodiversity-Utilization-Conservation-Research. Kasetsart University, Bangkok, Thailand. 417-429.

**Vongkaluang, C. 2004.** Termite Management in Thailand in Proceeding of First Meeting of Pacific Rim Termite Research Group. Penang, Malaysia. 43-47.