

Ivermectin Dust for the Control of *Coptotermes formosanus* in Residential Areas

by

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ABSTRACT

Coptotermes formosanus Shiraki is an important termite severely damage wood components of housing construction and old living trees in residential areas in south of China. The 70% mirex dust was one of important chemical products to control this termite damage. As the completely elimination of mirex in May 2009 in China, one of key works for Chinese researchers on termite control is to find the alternatives of mirex product. In present study, we evaluated the effect of 3% ivermectin dust to eliminate the colonies of *C. formosanus* in residential areas of Hangzhou city, Zhejiang province, China from April 2010 to May 2012. The results indicated that when 20-30 grams of 3% ivermectin dust were applied onto the body of termites feeding in four monitor devices at 18-80 meter far from the *C. formosanus* nests, the termite colonies would be eliminated completely within three and half to eight months. This means 3% ivermectin dust was a good alternative of 70% mirex dust and could be used for subterranean termite control through the method of dusting in the monitor devices.

Keywords: *Coptotermes formosanus*, ivermectin dust, colony, dusting technolog

Y.INTRODUCTION

The Formosan subterranean termite, *Coptotermes formosanus* Shiraki, is a native species of termites to China (Kistner 1985), and causes worldwide over 2 billion U.S. dollars in damage and control costs each year (Potter 1997). Before May 2009, mirex dust and mirex bait are main products for control-

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ling the damage of *C. formosanus* in China. As the completely elimination of mirex in Chinese termite control industry, ivermectin becomes a potential alternative of mirex. Some researches found that ivermectin had good lethal and sublethal effects on termites (Mo *et al.* 2005; Mo *et al.* 2006; Wang *et al.* 2007). When termites in monitor-controlling devices were treated with ivermectin dust and bait, damage of termites could be inhibited greatly (Mo *et al.* 2006; Wang *et al.* 2007; Jiang *et al.* 2011). However, it is not clear whether ivermectin dust could eliminate completely the colony of *C. formosanus* when it was applied in the monitor devices far to termite nest until now. Thus, the objective of this study is to evaluate the feasibility of 3% ivermectin dust to eliminate the *C. formosanus* colonies by means of monitor devices.

MATERIALS & METHODS

Chemical

The 3% ivermectin dust was provided by Deqing Institute of Termite Control, Zhejiang Province, China.

Monitor-controlling device

The monitor-controlling devices for this study were provided by the Hangzhou Changlian Pest Control Technology Co., Ltd. (Hangzhou, China). This device was hollow cuboid and was 8 cm in length, 8 cm in width and 18 cm in height. There were eight pine wooden blocks in its inner wall and empty cavity.

Test sites

The termite colonies tested was locating at the residential area of Hangzhou city, Zhejiang province and totally five *Coptotermes formosanus* colonies were tested.

Test procedures

Firstly, some monitor devices were installed in the area near to the nest of *C. formosanus* in the reason of termite activity of 2010. When most of monitor devices were infested by termites, all termites in two monitor devices 50 cm far to the termite nest were collected and labeled with filter papers treated by 0.5% neutral red solution in laboratory. Then labeled termites were released into original two monitor devices. After that, the monitor devices were checked every week within one month. During check, if dyed termites in

a monitor devices were found, and the position of the monitor device was marked on the map.

After the activity territory of termite colony was determined, application of dust was done. For each treated colony, only foraging worker termites feeding in four monitor devices farthest to the termite nest were treated by dust (5-10 grams of dust was applied to each device and totally 20-30 grams of dust for one colony were applied) and other monitor device with termite infestation were left for the observation of termite activity. Then the termite activity in untreated and treated monitor devices was checked every month. During check, if the woods were all consumed by termites, new woods would be added continuously into the monitor devices. When termite activities in untreated and treated monitor devices were not found within at least six continuing months in termite activity seasons, the test was ended.

RESULTS

Colony one

Totally 40 monitor devices was installed in the place near to the Formosan subterranean nest located in the Zhijiang Community of Hangzhou City on April 5, 2010 (Fig. 1). Termite invasion was found in 10 monitor devices near to the nest on April 25. There was termite invasion in 22 monitor devices on June 9. Termite individuals dye labeled test showed that the termites within these monitor devices belonged to the same colony. Termites in four monitor devices were treated with about 25 grams of 3% ivermectin dust on July 11, 2010. The distance from the farthest devices treated to the termite nest was 24 m. When check on August 15, no termite was found in four devices treated but there were still some termites to be found in other untreated devices. When check on October 25, 2010, no termite activity was found in all devices with originally termite infestation. There was still no termite activity to be observed in these monitor devices from April 2011 to May 2012. (termite nest; monitor device with termite infestation; monitor device without termite infestation; monitor device treated with 3% ivermectin dust)

Colony two

Totally 25 monitor devices was installed in the place near to the Formosa subterranean nest located in the Huajiachi Community of Hangzhou City

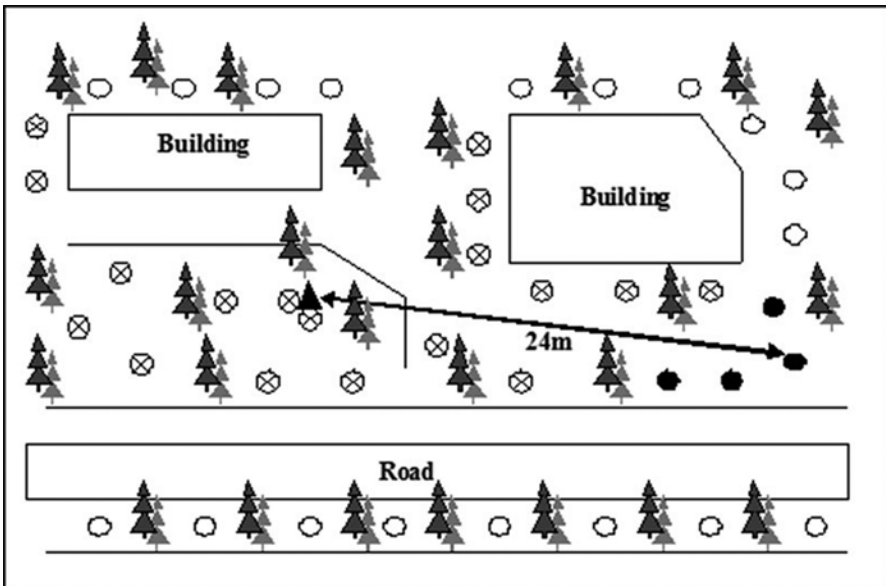


Fig. 1. Sketch map of termite monitor device distribution. \otimes termite nest; \circ monitor device with termite infestation; \circ monitor device without termite infestation; \bullet monitor device treated with 3% ivermectin dust)

on June 11, 2010 (Fig. 2). Termite invasion was found in 22 monitor devices on July 9 and dye labeled test verified that the termites within these monitor devices were from the same colony. After using about 20 grams 3% ivermectin dust to treat the termites feeding in four monitor devices (the farthest one to the nest was 38 m) on August 12, 2010, no termite activity was found in all untreated and treated devices when check on December 16, 2010. Moreover, no termite renewed to invade into these monitor devices during the period from April 2011 to May 2012.

Colony three

Totally 30 monitor devices was installed in the place near to the Formosa subterranean nest located in the Yuquan Community of Hangzhou City on July 14, 2010 (Fig. 3). Of which, 23 monitor devices was invaded by termites up to August 5 and dye labeled test showed that these termites were from the same colony. We used about 25 grams of 3% ivermectin dust to treat the termites feeding in four monitor devices (which the farthest one to the nest was 18 m) on September 10, 2010. Only few termites were found in part of

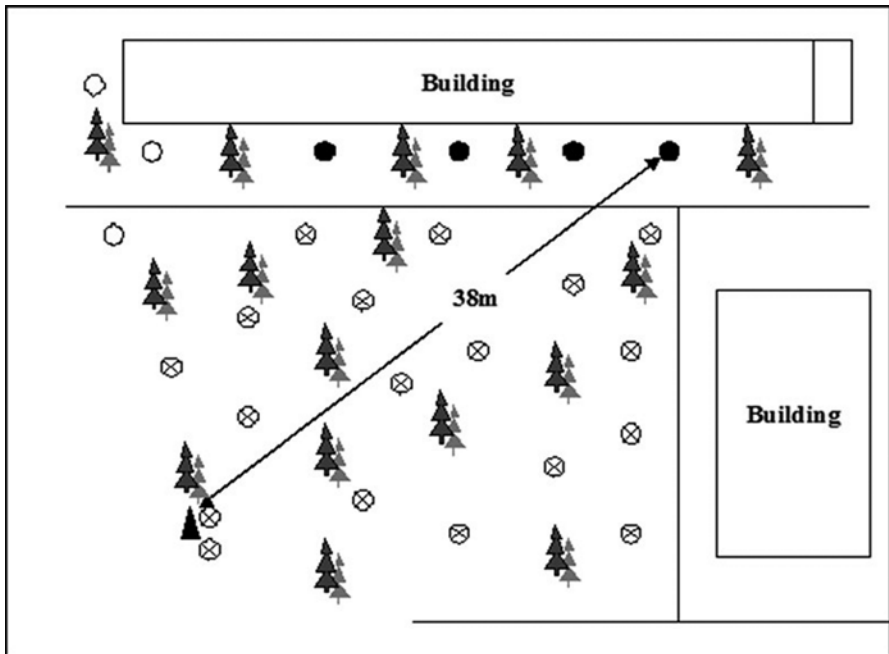
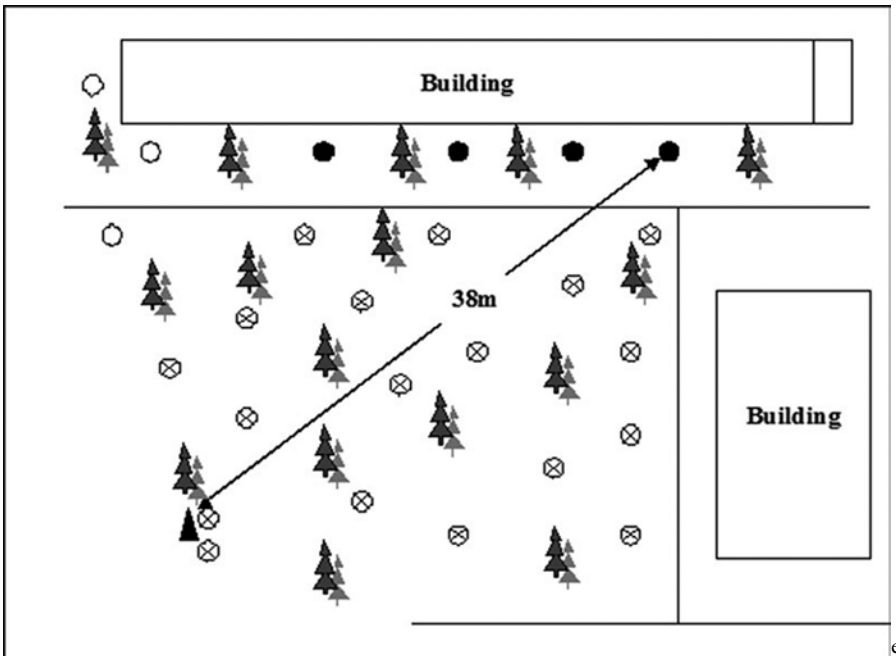


Fig. 2. Sketch map of termite monitor device distribution. \odot termite nest; \odot monitor device with termite infestation; \otimes monitor device without termite infestation; \bullet monitor device treated with 3% ivermectin dust

monitor devices when check on December 2, 2010 and no termite activity was found in all untreated and treated devices when check again on May 10, 2011. Meanwhile, we did not also find any termites in these monitor devices during the period from June 2011 to May 2012.

Colony four

Totally 30 monitor devices was installed in the place near to the Formosa subterranean nest located in the Xixi Community of Hangzhou City on June 18, 2010 (Fig. 4). Among these monitor devices, 19 monitor devices was infested by termites when check on July 6 and dye labeled test showed that these termites were from the same colony. About 30 grams of 3% ivermectin dust were dusted onto the body of termites feeding in four monitor devices (which the farthest one to the nest was 80 m) on August 18. We did not find any termites in all untreated and treated devices when check on December



infestation; monitor device without termite infestation; monitor device treated with 3% ivermectin dust)

20, 2011. In addition, we did not also find any termites to enter into these monitor devices during the period from late April 2011 to late May 2012.

(termite nest; monitor device with termite infestation; monitor device without termite infestation; monitor device treated with 3% ivermectin dust)

Colony five.

Totally 35 monitor devices was installed in the place near to the Formosa subterranean nest located in the Lianhua Community of Hangzhou City on June 21, 2010 (Fig. 5). Consequently, 22 monitor devices detected termite activity up to July 19 and we found the termites in these monitor devices came from the same colony through dye labeled test. About 30 grams of 3% ivermectin dust were applied onto the termites feeding in four monitor devices (which the farthest one to the nest was 41 m) on August 22. Up to November 5, 2010, we did not find any termite activity in all untreated and treated devices. During the check from late April 2011 to late May 2012, no.

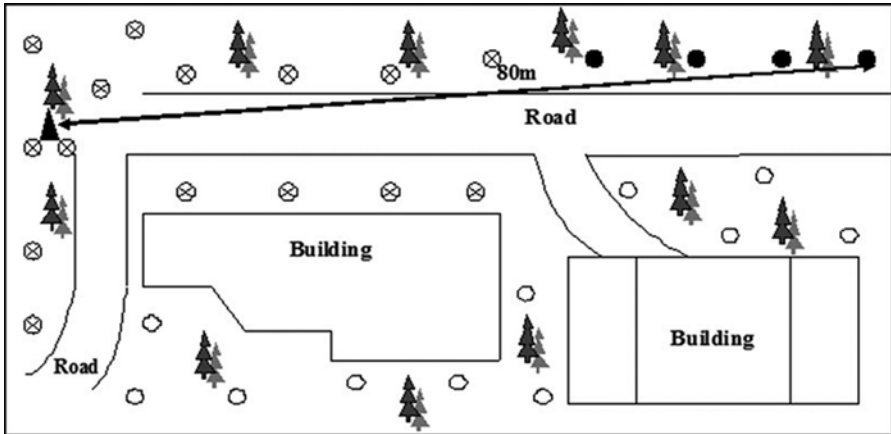
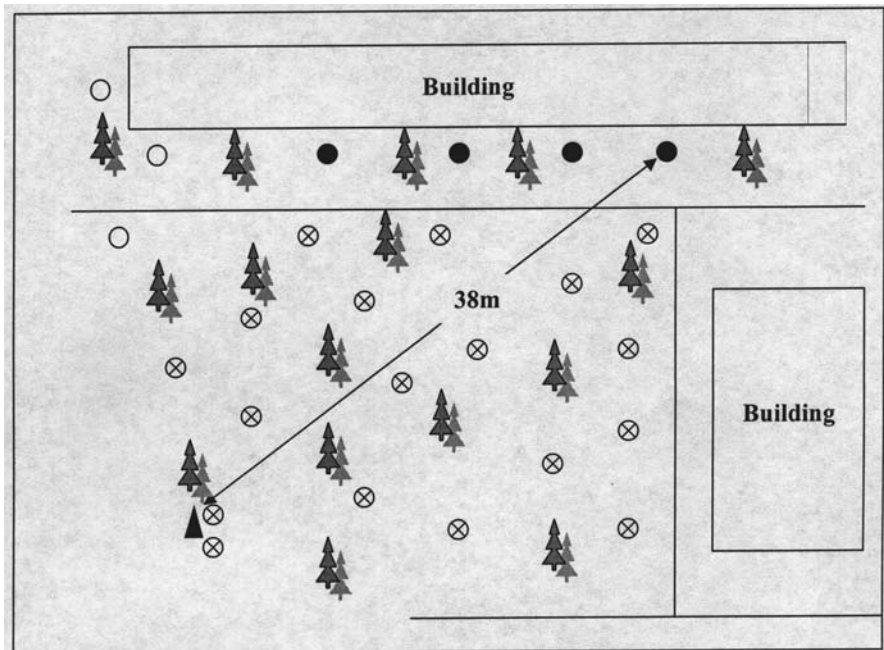


Fig. 4. Sketch map of termite monitor device .with termite distribution. distribution. device distribution termite nest; monitor device with termite infestation; monitor device without termite infestation; monitor device treated with 3% ivermectin dust)



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DISCUSSION

In China, *C. formosanus* locates at the area of north latitude 33.5° and is an amphibious termite which severely damage wood components of housing construction, stored cellulose materials, living trees, and communication facilities. It causes tremendous economic losses every year in China. Therefore, people hope to have better method to control the damage of *C. formosanus*.

At present, there are two potential approaches to the management of subterranean termite colony: exclusion and population suppression (Su 1993). Since the monitoring-baiting station was developed to detect and eliminate foraging population of subterranean termites (Su 1995), this technology has been broadly used in subterranean termite management in China. However, the success of this technology relied greatly on the bait for termite control. Unfortunately, there is no perfect bait in Chinese market until now. In past decades, Chinese termite control operators have been using dusting technology to control termite damage. Under the condition without good baits, after the completely elimination of mirex in May 2009, they hope to have suitable alternatives to be used in the dusting technology. The 3% ivermectin dust was one of alternatives of 70% mirex dust. Our test results indicated that 20~30 grams of 3% ivermectin dust could eliminate completely the Formosan subterranean termite colonies within three and half to eight months when it was dusted onto the body of foraging workers feeding in four monitor devices at 18-80 meter far from the termite nests. Clearly, 3% ivermectin dust could replace completely the 70% mirex dust and be used for subterranean termite control.

Lin *et al.* (2011) reported that when about 30 grams of 0.3% fipronil dust was applied onto termites feeding in a bait box, the whole colony of *C. formosanus* could be extinguished within one month. This means 3% ivermectin dust applied into four monitor devices needs longer time to eliminate completely a *C. formosanus* colony compared with 0.3% fipronil dust applied in a bait box. The reason caused this phenomenon could be that there are more termites in a bait box than in four monitor devices. In the near future, the effect of 3% ivermectin dust and 0.3% fipronil dust to control Formosan subterranean termites feeding in monitor devices should be further evaluated.

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