SYSTEMATIC TERMITE CONTROL^{SM} : A TERMITE (ISOPTERA: RHINOTERMITIDAE) IPM PROGRAM FOR THE PEST CONTROL PROFESSIONAL

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Abstract - Systematic Termite Control^{SM} (STC) is a program developed by FMC Corporation to provide the professional pest control industry with a new, integrated strategy for the control of subterranean termite populations. The objective of STC is structural protectio,n, i.e., to control termite activity within the structure and or suppress termite populations around the structure. The elements of the STC program are: inspection, moisture management, food source management, liquid termiticide, termiticide foam, and termite bait. The pest control operator (PCO), using the results of the inspection, customizes a control strategy to provide structural protection for the customer. The elimination of conditions conducive to termite infestation, moisture and food sources is an important part of the treatment program. A new element of the STC program, termite bait, provides the PCO with an opportunity to suppress termite populations and to eliminate termite activity in and around structures. Above ground bait stations are attached directly onto active termite mud tubes. Termite monitoring stations are installed in the soil in areas around structures conducive to termite attack. When the monitor is infested by termites, the monitor is removed and a bait station is installed. Whether above ground or in ground, bait stations are replaced as the termites continue to feed until termite activity ceases. Monitor stations are then maintained and inspected periodically for as many years as the termite contract is in force. Information, such as: the graph of the structure, the location of conditions conducive to termite infestation, the location of termites and termite damage, the details of the termiticide used, and the results of baiting efforts, are all collected and stored on a hand held computer. Desk top computers are used to organize customer service routes and for the long term management of customer information.
Key words - subterranean termites, control strategy, baits, termiticides, IPM

INTRODUCTION

Since the 1940's, the pest control industry in the United States has relied upon organochlorine based termiticides as the basis for the protection of structures from subterranean termite infestation. This defensive strategy was effective and inexpensive but protection was not achieved by reducing termite populations. By the 1990's, organochlorine based termiticides had been replaced by organophosphate and pyrethroid termiticides which still provided the same defensive barrier against termites. Customers had also begun to change as a growing concern was developing over the sole use of termiticides, especially organophosphate termiticides, as the only means to achieve structural protection. Physical barriers composed of uniformly sized, untreated sand have been evaluated (Ballard and Trimm, 1996). French (1996) reported on uniform sized sand, steel mesh barriers, and dust toxicants. Myles (1996) reported on a groomable coating containing a slow acting toxicant directly to the backs of termites.

The development of termite baits to reduce termite populations is not a new concept, the commercialization of termite baits by manufacturers for use by pest control firms in conjunction with termiticides or stand alone is new (Ballard, 1997a). Termite baits, kill large numbers of termites and are a new offensive weapon which can naturally be combined, with other termite control tools, in the development of customized control strategies for structures. The concept of a systems approach for the control of subterranean termite populations around structures has been recommended by many workers (Forschler, 1998; Gold, 1999; Henderson, 1999; and Rust, 1999). A formalized, organized systems approach for the protection of structures from attack by subterranean termites called Systematic Termite Control^{SM} (STC) has been developed.

The objective of this presentation is to describe the elements of the STC program, to describe some of the research which was conducted at many universities and private laboratories to test components

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of the program, to indicate how the elements are used by PCO firms to form a program that they can use to protect the structures, and to identify the less obvious benefits of using the STC program.

SYSTEMATIC TERMITE CONTROL

Structural protection is the appropriate goal of the STC program. The following elements constitute the STC program: Inspection; Moisture Management; Food Source; Management; Liquid Termiticides; Termiticide Foam; and Termite Bait.

Inspection

The objective of an inspection is to identify termite infestation or signs of previous infestation. A graph is drawn to represent the structure under contract. An important part of the process is the identification and recording of conditions conducive to termite infestation. These conducive conditions are either moisture, food, or construction related. The correction of these conducive conditions should result in reduced risk of termite infestation.

Data management is accomplished by graphing the structure and notes concerning conducive conditions and other findings during the initial inspection. The back side of the form contains an area for recording the results of monitoring termite bait stations or monitoring stations. The SMARTRAK™ Software allows the PCO to inspect and graph the structure on a hand held computer and later download the hand held computer to a desktop computer in the office which stores all the information on the accounts. When the PCO goes back to the structure, the hand held computer has the last graphs for the properties being inspected which are then updated. The software has icons for moisture and food conducive conditions, termiticide application, bait and monitor station placement and monitoring results.

Moisture management

Because termites lose water so easily through their thin cuticle, water is probably their most important resource. Termites obtain water from the soil and any other moisture source within or near the structure. It is important to reduce moisture related conducive conditions as much as possible and to direct water away from the structure. Control programs attempt to reduce moisture as much as possible to prevent moisture from becoming a long term termite attractant.

Food source management

Managing food around structures is also important. Identify and try to eliminate food in contact with soil. Also important is the placement of rigid foam insulation and foam backed stucco into the soil as termites tunnel through the foam and infest the structure above. If termites locate a food source imbedded in the soil, they will feed upon that food source below the soil surface. If the food source in on the soil surface, the termites will construct mud tubing to the food.

Liquid application

The direct application of termiticide liquids are usually delivered as a discrete amount of liquid or foam termiticide to a specific infested or critical area of a structure. The value of a termiticide application is the rapid installation of a pesticide barrier which can protect the structure immediately. The use of a repellent termiticide is also important because termiticide barriers are not perfect and contain areas where the soil has a variable concentration of termiticide and where the treated soil is thick or thin. Since pyrethroid soil barriers repel termites at low ppm concentrations (Su and Scheffrahn, 1990), and the termites tend not to penetrate the repellent termiticide barriers, then the actual concentration or thickness of the barrier is not as important. If non-repellent termiticides are used, termites may penetrate the barrier to some degree, and if the barrier is weak or thin, the termites may get through.

Forschler (1994) reported that termites do not follow or build exploratory tunnels along repellent termiticide barriers. Kard (1999) reported bifenthrin had the longest residual among commercially available termiticides.

Termiticide foam

Aqueous foam is usually used as a directed foam treatment to treat a void that is thought to contain active termite mud tubes. In most cases, the foam contacts and enters the mudtube and control is achieved. The value of foam is its ability to move in all directions and to treat all surfaces in a void. Foam also allows for the treatment of slab areas using fewer holes in the slab. Hardy (1994) reported that PCO firms that use foam have better treatment results than those firms that do not use foam.

Termite bait

Commercial termite baits and monitors have been developed using a termite behavior directed model. Bait stations contain cardboard treated with a 100 ppm concentration of the toxicant sulfluramid. Termites eat the cardboard and die slowly over several weeks. Bait repellency or shyness has not been noted up to 1000 ppm treated bait. According to Thorne (1998), trophallaxis is variable in the spread of a bait toxicant among termites. Termite colonies consist of either concentrated colonies, i.e., mound colonies, or dispersed colonies, such as those of subterranean termites where their is no visible evidence of a colony above ground. Because a subterranean termite colony does not lend itself to inspection and because colony population estimation techniques produce wildly variable results, colony elimination is not provable (Evans *et al.*, 1998; Forschler and Townsend, 1996). Other difficulties associated with control strategies directed at the primary queen include the inability of chitin inhibitors to kill the queen because the queen does not molt (Pawson and Gold, 1996). Thorne (1998) reported that if the queen were killed, supplementary reproductives would develop and termite colony growth would continue.

THE TERMITE BAIT STATIONS

FirstLine™ Termite Bait Station

Laboratory research indicated that termites rebuild mud tubes 3.7 times faster than the amount of time taken to build them initially (Porter, 1996). Using termite mud tube construction behavior, an above ground bait station was developed. It consists of a transparent plastic box, 2.5 cm thick and about 10 cm square. It is mounted at the advancing broken edge of an active termite mud tube. The termites rebuild their mud tube up the edge of the station and into the rigid foam base of the station into the treated cardboard above. Once in the cardboard, the termites seal the open corrugations of the cardboard (food modification) and begin to feed upon the cardboard. This station has the ability to kill about 50,000 termites. The number of stations required depends upon the size of the termite population involved. Ballard (1997a) reported the proper angle for the ramp on the baseplate of the station so that *Coptotermes* and *Reticulitermes* termites would enter the station and not build mud tubes around it.

Monitor and FirstLine™ GT Termite Bait Station

The station was 2.5 cm in diameter and 11.5 cm long and consisted of a transparent housing containing holes for the termites to enter and it was fitted with a non removable cap. The monitor contained a piece of slotted untreated white pine wood. When the termites entered the station, they constructed mud tubes oriented up the slots (food modification behavior) so that inspection through the cap would reveal whether or not the station was infested. The stations were installed in a triangular pattern in conducive areas around the structure. Henderson *et al.* (1997) reported that termites were more likely to be attacked to stations in conducive locations.

Once a monitor became infested, a pair of GT bait stations were installed very close to the infested monitor. The bait station contained a small roll of treated cardboard. Once the termites entered the bait station, they sealed the top of the cardboard corrugations with mud (food modification behavior) and fed upon the bait. Laboratory arena testing indicated that one bait station could kill at least 10,000 termites. Both monitors and bait stations were inspected monthly with stations replaced as needed. Field use data was obtained from records of Orkin Pest Control usage in the state of Florida in 1997. Based upon several thousand homes where STC was used, damage claims have been fewer when compared to conven-

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tional liquid termiticide applications. When the results of one year (1997) of FirstLine usage was compared to one year (1996) results of a competitive bait program, little difference was noted between the two control systems as reported by (Lewis *et al.*, 1998).

Field trials conducted for one year indicated that termite populations could be suppressed and some structures protected with or without termiticide usage. A full two years was needed to really observe the influence of the control program on many of the structures involved. Seasonality and termite species differences was also apparent in all of the university trials.

Monitor and FirstLine™ GT *Plus* Termite Bait Station

A stake study, completed in NJ in by Mampe (1998), indicated that stakes inserted into the soil at least 17-20 cm were attacked by termites during periods of dry weather. An additional stake study (Granovsky, 1997) and a monitor study (Ballard, 1997b) indicated that locating termites associated with tree roots could be very difficult and that large numbers of stations installed deeper than 6 inches would be needed.

The station is 5 cm in diameter and 20 cm long and installed one per conducive condition area. The station has rows of holes to allow termite entry, and the monitor station contains a piece of slotted untreated spruce wood with a nail protruding from the top. The transparent cap to the monitor was removable so that mud tunneling can be observed but the cap could also be used to lift the wood out of the station for closer inspection. Taking advantage of termite exploratory behavior, the monitor was also fitted with a 17.5 cm diameter, SMARTDISC™ Locator. The Locator allows the pest control operator to easily find the monitor through time, it created a circle of increased moisture around the station, and the bottom of the Locator contained ridges which direct the termites into the monitor through the large holes at the top of the monitor. Laboratory research in arenas containing 10,000 termites indicated that the termites infested the monitors fitted with the Locator 4 times faster than without the Locator as reported by (Porter 1998). Once the monitor was infested, the entire monitor is removed and a GT *Plus* bait station installed in its place. The bait station is transparent and contains a roll of treated cardboard 8 times larger than the smaller GT bait station. This station is fitted with a non removable cap. When the termites infest the bait, the termites seal off the cardboard corrugations at the top of the station (food modification), thus inspection through the cap is relatively easy.

Both monitors and bait stations are replaced as needed during monthly or periodic inspections. Structures are monitored and or baited as long as the contract stays in force.

CONCLUSIONS

Some benefits of the STC program would include: the STC program combines liquid termiticide control; the pest control operator owns the program, equipment and customers; the long term nature of the STC program should result in increased customer and employee retention and pave the way for the development of the professional technician as a career path; reduce the liability to the pest control company because the constant monitoring of the structure is likely to reveal control problems early in the program.

One cause for concern needs to be addressed. Pest control companies that rely on monitoring and bait stations as the primary means of control could face a problem where the technician focuses on the monitors and not the structure. The use of the STC program should provide a proper focus on not only stations, but also on what is going on in and around the structure as captured on the periodic inspection report forms or SMARTRAK Software. At least one annual indoor inspection should be worked into the program.

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