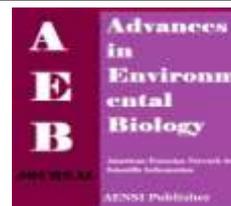




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Pisoptera: Oil Palm Empty Fruit Bunch (EFB) With Active Ingredient (Imidacloprid) As Artificial Bait For Subteranean Termite

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ABSTRACT

Empty fruit bunches (EFB) has become the serious solid waste problem in Malaysia's agricultural sector. In the other hand, termites damage to building also another serious problem in worldwide. This study is to create effective artificial bait for termite using EFB with additional active ingredient (Imidacloprid). For in-situ experiment, there are two experiments. For the first experiment of different concentrations with and without skin, the concentrations used are 0.2%, 0.4%, 0.6%, 0.8% and 1.0% and control with moisture content of 65%. EFB fiber is soaked into the solution and oven-dried in 100°C for an hour. The samples are placed at the sampling houses. For the second experiment of different concentrations with and without skin, the concentrations used are 0.001% and 0.01% and control with moisture content of 65%. It then was oven-dried in 100°C for an hour. Result from that, there was no successfully result shown for the two experiments. For laboratory experiment, there are two experiments. For the soaking method with and without skin, the EFB fiber soaked into the Imidacloprid solution with 0.001%, 0.005% and 0.01% and control for 15 minutes with EFB with and without skin condition. EFB fiber is air-dried until the moisture content is 65%. 10 termites are placed into the sample. The suitable results are 0.001% and 0.005% with condition of EFB fiber with skin. For spraying method with and without skin, EFB fiber sprayed in Imidacloprid solution of 0.001%, 0.005%, 0.01% and air-dried until moisture content is 65%. 10 termites are also placed in the samples. The result is 0.005% of EFB fiber with skin condition. Microscopic analysis use electron microscope with camera PAXcam ARC, magnifical 40 xs and resolution 1280 x 1024. It shows that the dyed Imidacloprid had soaked into the EFB fiber thoroughly. From the comparison of the result, it concludes that the result used is 0.005% in the condition of EFB with skin by using spraying method.

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INTRODUCTION

Oil palm plantation is one of the important plantations in agriculture sector of Malaysia. In 2004, Malaysia produced 14 million tons of palm oil from more than 38,000 square kilometres of land, making it the largest exporter of palm oil in the world. But, EFB is used as mulching material, fertilizer after been incinerated or just thrown on ground. Since there has no effective way to solve the problem, EFB is abandoned or threw on the ground as large amount of solid waste in agricultural sector.

Many cases of termite damage to the buildings are reported not only in Malaysia but other countries as well. Residents have to spend a lot of money to repair their house but yet the problem still not solved. They forced to move from the building since the building is no longer safe to be staying [5]. In China, the workers at Forbidden City of China found out that the wooden structure of the 700-year-old building is rotten by termites [1]. Distances of one hundred yards (thirty metres) may be traveled by the small workers with their loads of wood [4]. It shows that human is very difficult to detect the presence of termites in the building until there is a noticeable damage. Premise (Imidacloprid) is different from other termiticide soil treatment products which are

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designed to repel or keep termite away from treated zone. It works by killing termites, not repelling them. Other repellent termite control products rely on complete barrier to be effective. Furthermore, termites cannot detect the Premise chemical as it has no odor, taste or smell to termites [3]. If a termite contacts even a very small amount of imidacloprid it will become lethargic and forget to eat and feed other termites. It will also forget to groom itself so it soon becomes infested with soil fungi. The termite eventually dies as a result of these indirect symptoms of Imidacloprid exposure [6].

Research shows that the oil palm empty fruit bunch can attract the attention from termites in three days since the EFB still contain the cellulose which is the main food for termites [2]. Chia also proved that the empty fruit bunch work perfectly in without shredded condition. So, empty fruit bunch may become the natural raw material as artificial bait for termites after chemical treatment.

The main objective of the study is to create effective artificial bait for termite using oil palm empty fruit bunch with additional active ingredient (Imidacloprid). The specific objectives of the study are to determine the concentration of active ingredient (Imidacloprid) need to add in EFB as artificial bait to kill termite and study the effectiveness of the artificial bait.

Methodology:

In this research, the fiber used will without shredded. For this research, some of the EFB fiber will be taken off the skin and some will remain the skin. The fiber will be cut manually into small pieces with equal length. Imidacloprid need to be dilute into different concentrations required before been used in treatment of EFB fiber. In this research, the sampling method is dividing to two that are in-situ experiment and laboratory experiment. For In-situ experiment, there are two experiments undertaken. For in-situ experiment, the samples are prepared to test the effectiveness of bait in sampling points. It will help to determine the concentration of Imidacloprid should add in EFB fiber as effective artificial bait. Laboratory experiment also has two experiments. For laboratory experiment, the samples are prepared to test the effectiveness of bait in an enclosed environment. This can make the experiment can undergo without affected by other factors especially the environmental condition.

First Experiment of Different Concentration With and Without Skin:

In this experiment, the Imidacloprid will be dilute into five concentrations which are 0.2%, 0.4%, 0.6%, 0.8% and 1.0% respectively. The both EFB fiber with and without skin will be soaked into the Imidacloprid with the five concentrations respectively for about 15 minutes. After that, the EFB fiber is taken out from solution and weighed. The EFB fiber is dried using oven by 100°C and weighed frequently so that the moisture content of EFB fiber is maintain about 65%. Then, EFB fiber treated with different concentrations with and without skin is put into the container and labeled. The containers are covered with black paper since termites prefer dark and damp places. The control sample is also prepared for comparison. So, the total samples need to prepare is 12. The samples are placed at the sampling houses. Result is taken every two days for about three weeks.

Second Experiment of Different Concentration With and Without Skin:

In this experiment, the Imidacloprid will be dilute into five concentrations which are 0.01% and 0.001% respectively. The both EFB fiber with and without skin will be soaked into the Imidacloprid with the five concentrations respectively for about 15 minutes. After that, the EFB fiber is taken out from solution and weighed. The EFB fiber is dried using oven by 100°C and weighed frequently so that the moisture content of EFB fiber is maintain about 65%. Then, EFB fiber treated with different concentrations with and without skin is put into the container and labeled. The containers are covered with black paper since termites prefer dark and damp places. The control sample is also prepared for comparison. So, the total samples need to prepare is 6. The samples are placed at the sampling houses. Result is taken every two days for about three weeks.

Soaking Method With and Without Skin:

In this experiment, the concentrations of Imidacloprid used are 0.001%, 0.005% and 0.01% respectively. The EFB fiber with and without skin is cut and soaked into the different solution for about 15 minutes. Then, the EFB fiber is taken out from the solution and weighed. EFB fiber will be dried using air dry method and re-weighed frequently until the moisture content of EFB fiber is 65%. The EFB fiber is placed into the container. Termites are to be collected at sampling house. 10 termites are placed in each sample. All the containers will be put inside an enclosed box to provide the dark and room temperature environment. The result is observed every day in which the numbers of termites alive are calculated.

Spraying Method With and Without Skin:

In this experiment, the concentrations of Imidacloprid used are 0.001%, 0.005% and 0.01% respectively. The EFB fiber with and without skin is cut and sprayed with different solution. Then, the EFB fiber will be

weighed and dried using air dry method and re-weighed frequently until the moisture content of EFB fiber is 65%. The EFB fiber is placed into the container. Termites are to be collected at sampling house. 10 termites are placed in each sample. All the containers will be put inside an enclosed box to provide the dark and room temperature environment. The result is observed and calculated every day.

Microscopic Analysis:

The EFB fiber is observed under electron microscope which is under MeijiTechno Company before and after soaking the Imidacloprid solution to make sure the solution is effectively coating and treating the EFB fiber. The camera in electron microscope used is PAXcam ARC. The magnification is meiji 40x and the resolution is 1280 x 1024. The Imidacloprid solution will be dyed with Toluidine blue for easier observation.

RESULT AND DISCUSSION

First Experiment of Different Concentration With and Without Skin:

Table 1 shows the result of the detection of termites consuming the bait in Sampling House 1 for the five different concentrations and control. For Sampling House 2, the result showing the number of termites consume the bait is shown in Table 2. From the observation, it clearly seen that there was no termite interested in any bait of the five different concentrations. No any bait was consumed by termites where the EFB fiber in the container was still in the original state as the first day been placed at the location in sampling house. This condition was same for the control sample. This happened to the both sampling houses.

Table 1: Detection of Termites in Sampling House 1

Day	Number of Termite in Concentration (%)											
	With Skin						Without Skin					
	0	0.2	0.4	0.6	0.8	1	0	0.2	0.4	0.6	0.8	1
0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Label: ND - Not Detected

D - Detected

Table 2: Detection of Termites in Sampling House 2

Day	Number of Termite in Concentration (%)											
	With Skin						Without Skin					
	0	0.2	0.4	0.6	0.8	1	0	0.2	0.4	0.6	0.8	1
0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Label: ND - Not Detected

D - Detected

For the both sampling houses, it can make the assumption that the concentration of the Imidacloprid solution added into the EFB fiber which are 0.2%, 0.4%, 0.6%, 0.8% and 1.0% respectively may be not suitable. The concentration used may be too high. The assumption made is that once the Imidacloprid solution is adding into the EFB fiber with high concentration, the chemical substance in the Imidacloprid may be will react with the structure of the cellulose in EFB fiber and eventually change the elements in cellulose structure to form another new form of chemical structure. Since the cellulose already been changed to other form, the cellulose in EFB fiber is no longer been interested by the termite's colonies. So, the EFB fiber in any sample was not ate by termites.

Beside that, the method of drying the sample may be also one of the factors. The samples are dried using oven-dry in 100°C. The assumption is that the heating temperature may influence the alternation of the structure of Imidacloprid solution added in EFB fiber during drying. When the structure of Imidacloprid is change, it will become another form of unknown structure. The reaction between the Imidacloprid solution and EFB fiber will be change and affect the physical and chemical characteristics of the EFB fiber. By this, EFB fiber cannot remain in the original state before adding the Imidacloprid solution. EFB fiber may not have the good aroma and taste as good as before finally fail to attract the termite's attention. More importantly, the heat temperatures will rotten the EFB fiber faster than usual as like biomass energy production process. By this, the aroma is totally changed.

The moisture content in EFB fiber is difficult to maintain to 65%. When the moisture content is let reduced to 65%, the moisture content of EFB fiber will still continually reduce to lower since the heat from the drying process is trapped inside the fiber causes the moist is keep evaporate into the air itself. Once the EFB fiber is been cooled down, the moisture content in the fiber is no longer 65% but reduced drastically. When the sample was placed at the sampling houses, the moisture content of the EFB fiber will decreased in the period of time until the moisture content become 0% which is totally dried. If that occurs, the taste and good aroma of EFB fiber will be disappear. Leading of that, termites that prefer damp, sugary food are not interested in the EFB fiber anymore. So, oven-drying may cause in the affect of physical and chemical characteristics of EFB fiber and moisture content in fiber.

Not only that, the existing food source at the sampling house is another factor leads to failure attraction of termites towards the samples. For Sampling House 1, the termites obtain the food from the paper cardboard gathered in the store. Almost all the cardboard is been consumed by the termites and moreover, the termites already built their trail and mud tube on the cardboard. They even built their nest beneath the cardboard. Cardboard is made of paper which is rich in cellulose that as favourite food for termites. Termites also will find their food at the regular trail passing and fix food source unless the food source is been destroyed. Since they already find the rich food source that can provide them the cellulose they need, they may not go out and search another food source nearby the nest because the cardboard is more nearer to them.

For Sampling House 2, the termites built the mud tube around the wooden beam and column outside the house. They eat the wood until the wood become hollow inside and some of the termites stay inside the hollow wood to consume the wood and feed the other termites in colony. Wood is also one of the items which rich in cellulose as food and provides the good shelter place which is in damp, dark and moist environment when the

wood becomes hollow inside. By this, they already have the food source surrounding them. They do not need to search other food source anymore. Like Sampling House 1, the termites do not treat EFB fiber as their food source.

Location of the bait may affect the result of the research. The samples were placed randomly at the sampling houses. Termites may not move towards the area of the placement of the samples. The location of the samples may be cannot attract the termite's attention.

Second Experiment of Different Concentration With and Without Skin:

Table 3 is showing the result of the detection of termites consuming the bait in Sampling House 2 for the two different concentrations and control under two conditions of EFB that are with skin and without skin.

For this experiment, there is no sample attracting the termites to consume and die. Even though the concentration of the sample already reduced to 0.01% and 0.001% respectively, but still the result of experiment remain the same with the first experiment. The result is also same to control sample.

Termites may not interest on EFB fiber because of the taste and aroma is different from the food consumed regularly. They already have the fix food sources that are wooden beam and column at the house. As so, they do not need to find another food source and moreover the sample is very foreign to them. From the observation, the species of the termites studied from the previous research that is same as Sampling House 1 is not same with the termites at Sampling House 2. The termites at Sampling House 1 are white in colour and the size of body is smaller whereas for the termites at Sampling House 2, the termites are in brown colour and have larger size of body compare to those in Sampling House 1. The behaviour and characteristics of both species of termites may be different. So, the termites at Sampling House 1 will like the EFB fiber and bring the satisfactory result in previous research but may be the termites at Sampling House 2 do not like it and not interest to take it as food. They do not treat EFB fiber as thing that can eat and rather choose back the existing food as primary food source.

Like as first experiment, the oven-dry method may affect the physical and chemical characteristics of Imidacloprid and the cellulose structure in EFB fiber. Once the characteristics are change, these two substances will become other substances without notice. Not only that, the moisture content of the EFB fiber will lessen drastically using this method since it will evaporate the moisture content into the air when leave cool down. It will make the EFB fiber dried up with low moisture content. This method also fastens the rate of rotten of the EFB fiber.

Table 3: Detection of Termites in Sampling House 2

Day	Concentration (%)			
	With Skin		Without Skin	
	0.001	0.01	0.001	0.01
0	ND	ND	ND	ND
1	ND	ND	ND	ND
2	ND	ND	ND	ND
3	ND	ND	ND	ND
4	ND	ND	ND	ND
5	ND	ND	ND	ND
6	ND	ND	ND	ND
7	ND	ND	ND	ND
8	ND	ND	ND	ND
9	ND	ND	ND	ND
10	ND	ND	ND	ND

Label: ND - Not Detected

D - Detected

At the sampling house, there are other ant species which will also act as the competitors to termite's colony. They will compete in space, food and other necessarily materials for survive. As like termites, ant also like food rich in sugar and good aroma of the food will definitely attract their attention to consume the food. The assumption is that if the ants trying to consume the EFB fiber, they become the great competitor to termites in obtaining the EFB fiber as food source. In animal kingdom, two different species or colonies of animal cannot share the same space and food source. So in this case, if the ants become the competitor to termite, these two colonies will definitely fight each other in order to obtain the goal that is the food source. Termites must win in this competition in order to consume the EFB fiber sample. For this, may be the termites lost in the competition and let the ant colony monopoly the EFB fiber so the termites may not consume any EFB fiber placed nearby the mud tube.

Since the samples placed at the same sampling house area in first experiment, the termites already recognize the samples and treat them as same as the samples in first experiment. They may identify the samples as “unwelcome” items around the environment. They have no interest in the samples any more. Even though the concentration of the samples is reduced, but the termites may not try any of the samples. The control sample is getting the same result assuming is that due to this same reason.

Although the two colonies of termite are different and located at different area, but the study state that termite colony is actually communicate with other colony at nearby neighbourhood. The colony can move from a place to another place in far distance which is 30 metres in order to find food source and suitable habitat. The assumption is made as that the termites at Sampling House 1 already alert of the Imidacloprid solution added in the EFB fiber because of the previous research. So, they do not consume the sample this time. And yet, they move from their nest and communicate with the termite’s colony at Sampling House 2 since the distance between these two locations is just about 5m. The termites at Sampling House 1 warned the termites at Sampling House 2 about the dangerous of the “foreign item” nearby their nest. Therefore, the termites at Sampling House 2 already alert to those samples even though they never contact with the samples a year ago. Eventually, they did not consume the samples and tried to escape from them.

Soaking Method With and Without Skin:

Figure 1 shows the number of termites still alive after period of time for soaking method under the condition of EFB fiber with skin. For the EFB fiber without skin, the result is shown in Figure 2.

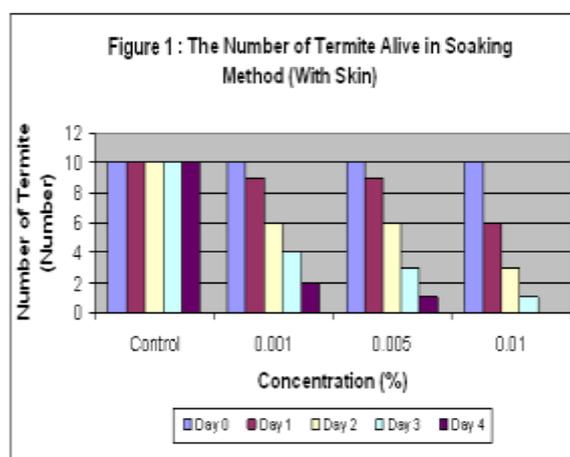


Figure 1 : The Number of Termite alive for Soaking Method (With Skin)

The reason why the rate of mortality of termites in EFB fiber with skin condition is lower than in without skin condition has many assumptions. One of the assumptions is the skin of the EFB fiber had act as barrier to prevent the Imidacloprid solution been soaked into the EFB fiber thoroughly. When soaking the EFB fiber into the Imidacloprid solution, some of the solution had been soaked at the bottom of the fiber and only little of it been soaked through the surface of fiber because of the skin. It can say that the solution is not soaked equally and thoroughly. But for EFB fiber without the skin, the fiber is soaked thoroughly in the Imidacloprid solution. Every fiber has the Imidacloprid chemical substance coat at the surface. So, the EFB fiber without skin may kill the termites effectively.

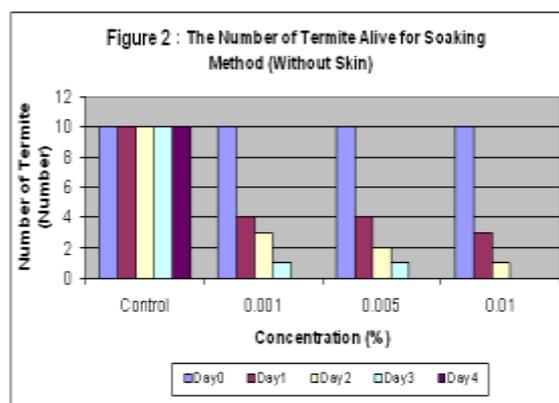


Figure 2 : The Number of Termites alive for Soaking Method (Without Skin)

During the drying process, the EFB fiber is dried by air-dry method where the fiber is letting to dry on a piece of paper. The paper will absorb the excessive Imidacloprid solution from the fiber. When the EFB fiber with skin is let air-dry, the paper will absorb the solution from it and most of them are from skin. The Imidacloprid solution is trapped inside the fiber within the skin. The skin is dry or less Imidacloprid solution content. It makes the Imidacloprid content at skin is lower than in fiber. Even though the EFB fiber without skin is also dried using air-dry method, but because the Imidacloprid solution is been soaked fully inside the fiber; the air-dry method may only decrease the Imidacloprid content in fiber with about 35% of it. 65% of the solution is still trapped inside the fiber. When the termites consume the EFB fiber in with skin condition, the termites may ate the skin first before entering the partially wet fiber. Therefore, at the beginning of the experiment, the rate of mortality is small since the contact between Imidacloprid and termites is low. But, after the termites consumed the skin and started to consume the fiber inside, the termites started to die gradually due to the reaction from Imidacloprid solution towards the termite's body. For the EFB fiber without skin, the termites directly contact with the Imidacloprid solution in fiber and consumed it, so they will die faster. The rate of mortality of termites is higher even at the beginning of the experiment.

When the EFB fiber is keep for a period of time, the aroma and the taste will be gone and the moisture content will also lost gradually. It will not same as when the fiber just taken back from factory. The samples may lost those characteristics and decrease its quality slowly for the few days. The EFB fiber with skin may decrease the moisture content and aroma slower than the EFB fiber without skin since the skin is preventing the loss directly. Termites should prefer the food that rich in cellulose and the aroma and moisture content of the food will be the elements that attract their attention. By this, the termites may prefer the EFB fiber with skin and would like to consume it. The termites may be do not like the EFB fiber without skin and never consume it. It means that the termites died may be not because of the Imidacloprid solution in EFB fiber but because of hunger and no suitable food. Therefore, the EFB fiber without skin is not suitable to use as material for the bait.

In this experiment, the method of drying the EFB fiber is air-dry. This method is choose because as discussed in in-situ experiment, the oven-dry method will decrease the moisture content of the EFB fiber drastically until the fiber is dry. The termites may not want to consume it as food. If using air-dry method, the moisture content will not reduced fast and some of the moisture content will still be trapped inside the fiber during the experiment. Then, termites can still interest on the fiber even the experiment last for few days. Compare to oven-dry method, the EFB fiber will not been rotten so easily using air-dry. If the fiber not rots, the aroma, taste and texture of the fiber will not change. The termites still can identify the fiber as nice food and trying to consume it after few days been taken back from factory. As so, this condition of EFB fiber may not affect the result of the experiment. One more thing is, when using oven-dry method, the temperature of heating is determined by own self. The appropriate temperature to use is difficult to determine since the characteristic of the chemical structure of Imidacloprid and EFB fiber are unknown. The wrong applied temperature may destroy the structure of Imidacloprid and EFB fiber during the drying process and eventually affect the reaction between the two materials. If using air-dry method, the temperature used is same as room temperature. The temperature is natural and no heat energy involve in the drying process. The impact on the reaction between the Imidacloprid and EFB fiber can be reduced.

As conclusion, the concentrations choose in this method are 0.001% and 0.005% with the condition of the EFB fiber with skin.

Spraying Method With and Without Skin:

Figure 3 and Figure 4 represent the number of termites alive for spraying method as for EFB fiber with skin and EFB fiber without skin respectively.

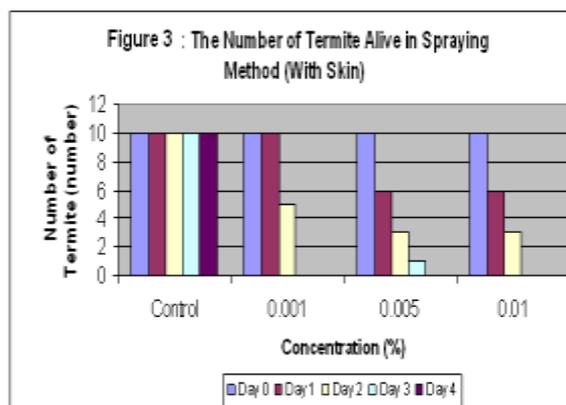


Figure 3 : The Number of Termite Alive for Spraying Method (With Skin)

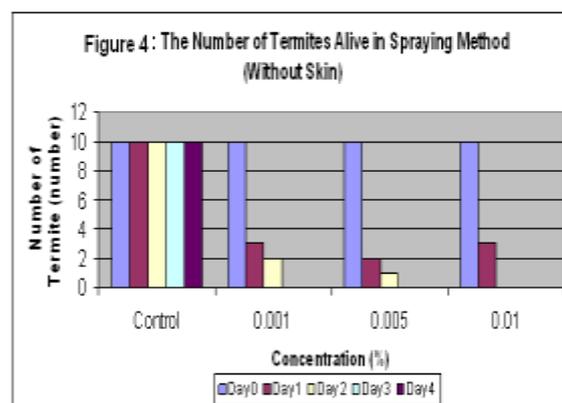


Figure 4 : The Number of Termite Alive for Spraying Method (Without Skin)

The reasons of this phenomenon are almost the same with the soaking method. In this experiment, the drying method of EFB fiber after treating is air-dry method. In this method, the EFB fiber will be leaved to dry in room temperature. For the EFB fiber with skin, the Imidacloprid is only sprayed and leaved on the surface of the skin only. The Imidacloprid do not absorb thoroughly into the fiber so the level of poisoning is very low. When drying, the moisture content will evaporate into the air and some of the Imidacloprid will absorbed as well. By this, the remaining Imidacloprid solution at the surface of the EFB fiber with skin is much lesser. For the EFB fiber without skin, the fiber is directly sprayed by the Imidacloprid and absorbs the solution very well. When drying, the Imidacloprid solution also will be evaporated into the air as well but the level of poisonous in EFB fiber without skin will be higher than in EFB fiber with skin since the fiber absorbs the solution thoroughly. As a result, the rate of mortality in the condition of the EFB fiber without skin is higher than the EFB fiber with skin.

During the drying process, some moisture content will decreased and bring along the good taste and aroma of the EFB fiber. It will happen even though the rate of losing is lower than using the oven-dry method. For the EFB fiber with skin, the skin will act as the barrier between the air and the fiber, eventually some portions of the moisture content only will evaporated into the air and most of the portions are trapped inside the fiber. So, the moisture content and aroma of the EFB fiber with skin can be keeping longer during the experiment. This can attract the attention of the termites to consume the fiber and finally been killed by the Imidacloprid chemical substance. But for the EFB fiber without skin, the aroma and moisture content will loss faster and gradually gone thoroughly after the few days of experiment. Termites may not feel the EFB fiber attractive and choose to not consuming the fiber. Some of them will still eat and some of them may not. If that occurs, some of the termites died because of consuming the fiber but some of them died because of hunger. This make the termites in the condition of EFB fiber without skin is died faster than with skin condition.

The skin of the EFB fiber make the fiber gets less Imidacloprid solution. This makes the EFB fiber with skin less poisonous. When the termites want to eat the fiber, they will climb up the fiber and make the contact with the fiber by their bodies. Imidacloprid shall attach to their bodies and make affect to it. The Imidacloprid

enter into the body under the skin and affect their neurological system and eventually kill them. Unlike the EFB fiber with skin, the EFB fiber without skin will absorb much more Imidacloprid solution and make it more poisonous. So when the termites touch the fiber, the amount of Imidacloprid can enter their bodies is more than in the EFB fiber with skin. That makes them die faster in the condition of EFB fiber without skin.

In this experiment, the concentration and condition used is 0.005% with the condition of the EFB fiber with skin.

Determination of Concentration and Method:

Figure 5 shows the comparison between the three options from both laboratory experiments. The three options are letting the termites die gradually in four days. So, three of them are suitable to be used in making the artificial bait for killing termites. However, one of these options must be choosing as best method. In this case, the economic aspect should be concern. For the soaking and spraying method, the quantity of Imidacloprid solution used is much different. The amount of Imidacloprid solution used in soaking method is more than in spraying method since the EFB need to soak in the solution thoroughly but using spraying method, the Imidacloprid solution just need to spray on the surface of the fiber. If comparing in this aspect, the spraying method is preferred.

Moreover, the concentration discussed is very low that are 0.001% and 0.005% which is not much different in the usage of Imidacloprid during the dilution process. So, the concentration is not an issue concerned here.

As conclusion, the concentration and method used in making the bait is 0.005% in the condition of EFB with skin by using the spraying method.

Microscope Analysis:

Figure 6 represents the condition of EFB fiber in original state where it is before the Imidacloprid solution been added into the fiber under the microscope. The condition of EFB fiber after adding the colour dyed Imidacloprid solution will be shown in Figure 7.

From the observation, it clearly sees that the colour of the EFB fiber is changes from brownish to blue. The blue colour is due to the dye (Toluidine Blue) added into the Imidacloprid solution. This proves that the Imidacloprid has been absorbed into the fiber physically. The EFB fiber will has the physical reaction with the Imidacloprid chemical substance. So, when the termites eat the fiber, they definitely will eat the Imidacloprid along into their bodies. Then, the Imidacloprid may take affect on the termites and kill them. The whole length of EFB fiber is been dyed showing that the EFB fiber has strong absorbing characteristic where it absorb the solution thoroughly. Physical reaction between the EFB fiber and Imidacloprid solution is said to be successful. A disadvantage of this analysis is the chemical reaction between the EFB fiber and the Imidacloprid solution cannot be observed. Therefore, it is very difficult to confirm that the chemical structure of the chemical elements in EFB fiber has chemically reacted with Imidacloprid and change.

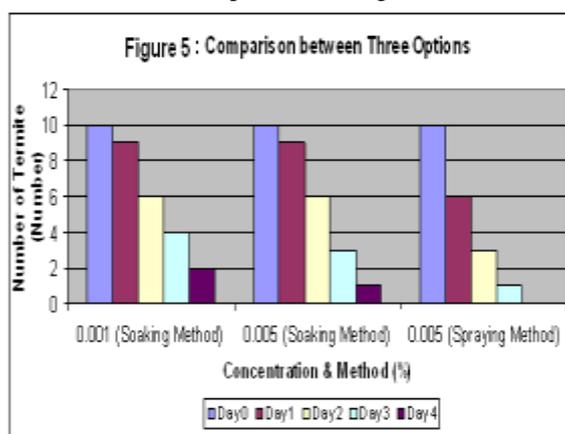


Figure 5 : Comparison between the Three Options



Fig. 6: EFB Fiber Before Adding Imidacloprid.



Fig. 7: EFB Fiber After Adding Imidacloprid.

Conclusion:

For the in-situ experiments, it is considered a failure since no termites were detected to consume the bait and killed in both experiments. For the first experiment, the assumptions of the reasons leading to the failure of this experiment are the concentration of the Imidacloprid solution added into the EFB fiber, the EFB fiber drying method, the moisture content of EFB fiber, the existing food source around the nest of termites, the aroma of the EFB fiber, the detection of the samples when inside the mud tube and the location of the samples. Whereas for the second experiment, the factors causing the experiment to be unsuccessful are the food source nearby the nest, the drying method of the EFB fiber, the moisture content of the EFB fiber, the competition between ant species and termites, the alert existence of samples and the communication between the two colonies of termites.

For the soaking method with and without skin, the concentrations and conditions chosen are 0.001% or 0.005% in EFB fiber with skin condition. The factors that may cause the rate of mortality for the EFB fiber with skin to be lower than the EFB fiber without skin are the characteristic of the EFB fiber skin, the moisture content of the EFB fiber and the drying method of EFB fiber. For the spraying method with and without skin, the factors discussed are the EFB fiber drying method, the moisture content and aroma of the EFB fiber after drying, and the contact between the termites and the Imidacloprid. In this experiment, the concentration and condition used is 0.005% with the condition of the EFB fiber with skin.

Microscopic analysis proves that Imidacloprid has been absorbed into the fiber physically. The EFB fiber will have a physical reaction with the Imidacloprid chemical substance.

As a conclusion, the concentration and method best used in making the bait is 0.005% in the condition of EFB with skin by using the spraying method due to the economic aspect.

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