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Research Article

Efficacy of Biflex in Controlling Termites in Two Different Soil Types in Lahore

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Abstract

Termites are causing drastic economical loss as they attack on building, crops and wooden products. The reason of study was to evaluate the effects of biflex, commonly used pesticides in Pakistan to control the termite's population. A comprehensive survey of laboratory was conducted using biflex, commonly used pesticide to control termites. The results regarding barrier efficacy of biflex in different soil. The aim of this research was to see how effective Biflex (Bifenthrin) termiticides are against a common termite species in the lab. Soil was taken from various locations and after analysis classified as sandy loam soil (SL) or clay loamy soil (CL). In laboratory bioassays, mortality and LC_{50} values in treated soil were determined after 8 hours and after one month, depending on soil type and the result showed that Sandy loam soil (SL) are more effective than clay loamy soil (CL). Biflex was shown to be more persistent in both soils. Based on these results and the benefits of specific chemical could be effectively used for effective control of termites.

Keywords: Toxicity; Repellency; LC_{50}; Persistence; Biflex; Termites; Lahore

Introduction

Termites are extremely sociable small insects (Isoptera: Termitidae) that make up ten percent of all biomass (Van Huis, 2017) and are predominantly found in tropical and semi-tropical sections of the biosphere (Bonachela et al., 2015). Termites are a kind of colonial insect that lives in colonies (Brune, 2014). Termites are sometimes referred to as "white ants," however they are not the same as ants since real ants belong to the order Hymenoptera, while termites belong to the order Isoptera (Grimaldi and Engel, 2005). A soil animal is one that spends a significant portion of its life cycle in or on the soil. Lots of these creatures have minimal impact on soil qualities due to their trophic level, short time or tiny size that are used to soil. Termites and their interaction with soils, unlike many other soil animals, have a significant impact on a variety of soil parameters. Soil scientists demonstrated a great attention in termite action and its implications on soil qualities since 18th century, very likely prompted by the view of massive above soil nests, notably in Australia and Africa (Smeathman, 1781).

Bifenthrin is a prominent termiticides used for termite control all over the globe. The majority of synthetic pesticides kill the target insects by affecting four distinct target sites: hormone activity, respiration, cuticle creation, and nervous system function. Pyrethroid insecticides include bifenthrin (Ahmed and Qasim, 2011). It mostly affects insects' nervous systems. Even with the most advanced chemicals and methods in the post-chlordane era, termite management seems to be very difficult to achieve (Potter, 2001). A lot of research have looked at the proficiency of new insecticides which control Formosan termites (Shelton and Grace, 2003). Pesticide toxicity to *H. indicola*, on the other hand, is little understood (Wasmann). The toxicity and mechanism of action of insecticides, as well as termite sensitivity to insecticides, soil qualities (e.g. soil type, pH, particle size, compactness and organic matter), formulation utilized and application procedure, all have a role in their efficacy against termites (Osbrink and Lax, 2001).

Termites are eusocial arthropod decomposers, and improve soil fertility, crop yield, and also are used by humans for their benefits across the world. However, some species of termites are becoming a threat to the farming community as they are directly and indirectly causing major losses to the agricultural system (Ahmad et al., 2021).Termite infestation causing loss of wood, wood structures, vegetation, agriculture and standing trees. As Pakistan is an agricultural country, Agriculture and forest products provide a significant portion of a community's income and provide pasture for animals. Termites' extensive ground cover denudation, particularly during the dry season, results in a lack of food for animals, which is a source of worry for many. It will be critical to have a thorough understanding of termites in order to restore the situation.

As long-lasting and cost-effective approaches, liquids termiticides treated soil, termite feeding areas treated with dusts, and baiting systems have been deployed (Delgarde et al., 2002). Many pesticides from various organizations have been tested in the field in Pakistan, but without a solid scientific foundation or assessment under a specific set of soil types, termite species, and agroecosystem conditions (Ahmed and Riaz, 2004).

Materials and Methods

Site or location of experimentation

The present study was conducted in university of Lahore in Institute of Molecular Biology and Biotechnology (IMBB) department research laborite with the main objective to evaluate effectiveness of biflex in controlling termites in two different soils at Lahore. Proposed study was conducted at university of Lahore.

Soil for Bioassay

The soil samples were taken from Thokar Niaz Baig Lahore's surrounding districts. Sandy loam soil (SL) and clay loam soil (CL) were the soil types studied (CL). Sieving was used to remove lumps, straws, and stones from the soil. The obtained sieve soil sample was oven dried for 24 hours at (70-80^{0}C) to kill all forms of fungal spores and other pollutants after screening. Incubated soil was maintained in glass jars with a lid made of foil paper (Manzoor and Mir, 2010).

Termites collection

For the collection of termites, traps were stable in the whole locations of The University of Lahore, after conduction of proper survey. Appropriate locations were those with manure, debris, and symptoms of termite infestation. A porthole was excavated in roughly 0.5 feet of dirt at the chosen locations. Inside the window, tissue paper rolls dipped in sugar cane juice was inserted, then covered with dirt. The trap was examined for termite collecting after 6-7 days. Termites were found in large numbers in the traps, which were collected in a plastic box and sent to the Entomology laboratory. Dead termites, any stones, trash, and pebbles, was removed. For the experiment, only active and healthy termites were employed. As a source of humidity and food, active termites were housed in a plastic box with wet filter paper. Termites were maintained in complete darkness until bioassays could be performed (Manzoor and Pervez, 2014).

Insecticides

Termiticides representing one chemical class was selected as follow: Biflex (Bifenthrin) different concentrations. In the experiment stock solution was prepared on six different formulations i.e., 0ppm, 50ppm, 150ppm, 75ppm, 250ppm, and 500ppm. These concentrations are taken in 10g of soil.

Toxicity test

For soil toxicity test, Smith's (1979) method was used. Petri-plates ware washed with methanol before the experimentation. Every petri plate surface covered with Ten gram of treated soil. Six different concentrations of insecticide biflex 0ppm, 50ppm, 75ppm, 150ppm, 250ppm, and 500ppm was used to treat the soil sample during the procedure. Ten active and healthy termite workers were released into each petri-plate. Three replicates of each insecticide concentration were used. Termite mortality data was collected after 1/2 hour, for up to 8 hours. After that dead termites were removed then placed the petri-plate for one month. After one-month same soil was used and again termites added these process was repeated and find the Mortality and LC_{50}.

Repellency test

For repellency test, Smith's (1979) method was used. In this method, thirty-six Petri-plates were wash away and sanitized at 70^0C for a period of 24 hours before the experimentation. Every petri plate surface had covered with 10g of oven dried soil sandy loam and clay loam uniformly divided in two halves with the aid of a glass slide so that one half of the surface of each petri plate was filled with treated soil and the other half with un-treated soil. Ten active and healthy termite workers were free in the middle of each plate to observe their presence on un-treated soil. For every concentration of biflex, three replicates were used. Petri Plates were fully covered the plates with black cloth to lessen impact of light, providing a natural atmosphere and preserving room temperature at $25\text{-}26^0C$ and 80% Relative humidity. The number of termites was observed on a soil treated with water after fifteen minutes for a total of five observations. At all five observation times, a treatment concentration in which 21 or more out of 30 termites was present on the untreated soil was considered as repellent concentration, a treatment concentration in which less than 21 termites were observed on untreated soil was considered as non-repellent.

Calculation of LC_{50} value

LC_{50} value is calculated by using probit analysis.

Persistence of biflex in both soils

The sandy loam soil (SL) and clay loam soil (CL) was studied to check persistence of the biflex against termites.

Result

Table 1 shows the mortality (mean±SEM) of termites at different time intervals and different concertation post treatments up to 8 hours duration. From results it was revealed that mean mortality of termites in Biflex treated SLSsoil was1±0, 0.9667±0.05774, 0.9667±0.05774 and 0.6333±0.05774, 0.5±0.1,0.2667±0.05774 at 1^{st} month treatment, respectively. Similarly mean mortality of termites in Biflex treated CLSsoil was 1±0,0.9667±0.05774,0.9667±0.05774 and 0.6333±0.05774,0.5±0.1,0.2667±0.05774 at 1^{st} month treatment, respectively. From ANOVA two way analysis it was revealed that there were significant differences in the mean mortality at 8 hours intervals as $P< 0.05$, df= 75.

Like Biflex bioavailability was also measured in post-treatment soil bioassay. From the results, it was revealed that mean mortality of termites treated SLS soil was 0.9667±0.057,0.8±0.1,0.7±0.1 and 0.6±0.1,0.5±0.1,0.4±0.1 at 2^{nd} month treatment, respectively. Similarly mean mortality of termites in biflex treated CLS soil was 0.9667±0.057,0.8±0.1,0.7±0.1 and 0.6±0.1,0.5±0.1,0.4±0.1 at 2^{nd} month treatment, respectively. From statistical analysis it was revealed that there was significant difference in the mean mortality at 8 hours' intervals as $P< 0.05$, df= 75. In both soils, mean mortality rate decreased as time increased indicating a decrease in termiticide concentration with time.

Table 2 shows lethal concentration of Biflex at different time intervals in SLS and CLS soils. Bioavailability values of the termiticides were determined in post-treatment at the highest concentration (500ppm) of both soils in 4 and 8 hours. LC_{50} values were determined at 1st and 2^{nd} month's intervals. From calculated LC_{50} values it was revealed that lethal concentration increased as time intervals increased. Indicated termiticide efficacy decreased as time increased. By comparison of termiticides it was revealed that Biflex was more persistence in SLS soils compared to CLS. Termiticides showed maximum efficacy in sandy loam soil compared to clay loam soil. Concentration and time both are inversely related to each other.

The results regarding the repellency of biflex demonstrated that at higher concentrations 500pmm, 250ppm, 175ppm of biflex were repellent in both type of soil but high repellent in sandy loam soil and clay loam soil whereas, at all other doses like, 75ppm, 50ppm and 0ppm biflex was non-repellent in both types of soil but less non-repellent in clay loam soil Figs.1 and 2.

Termiticide	***Month***	***Soil***	***Conc.(ppm) / 8 hours***	***Mean±SEM***	***Difference in Mortality between concentrations by ANOVA two way test***
Biflex (Bifenthrin)	***1***	***Sandy loam soil(SLS)***	500	1±0	P<0.000, df= 75
			250	0.9667±0.05774	
			150	0.9667±0.05774	
			75	0.6333±0.05774	
			50	0.5±0.1	
			0	0.2667±0.05774	
		Clay loam soil(CLS)	500	1±0	P<0.000, df= 75
			250	0.9667±0.057	
			150	0.9667±0.057	
			75	0.6333±0.057	
			50	0.5±0.1	
			0	0.2667±0.057	
	2	***Sandy loam soil(SLS)***	500	0.9667±0.057	P<0.000, df= 75
			250	0.8±0.1	
			150	0.7±0.1	
			75	0.6±0.1	
			50	0.5±0.1	
			0	0.4±0.1	
		Clay loam soil(CLS)	500	0.9667±0.057	P<0.000, df= 75
			250	0.8±0.1	
			150	0.7±0.1	
			75	0.6±0.1	
			50	0.5±0.1	
			0	0.4±0.1	

Table 1: Mean±SEM percent mortality of termites in response to different concentrations of Biflex (Bifenthrin) in sandy loam soil and clay loam soil at different concentration at different time intervals (Post treatment).

Month	Time (Hours)	Soil	Regression equation	Significance	X^2	LC_{50}	Lower bound	Upper bound
1	4	Clay loam	-1.283+.401	.000	6.826	3.198	2.649	3.702
	8	Clay loam	-1.377+.672	.000	8.569	2.050	1.604	2.409
2	4	Clay loam	-1.163+.214	.000	7.305	5.425	4.439	7.861
	8	Clay loam	-.688+.336	.000	8.011	2.047	1.059	2.672
1	4	Sandy loam	-1.220+.481	.000	16.646	2.539	1.988	2.980
	8	Sandy loam	-1.043+.502	.000	10.797	2.080	1.474	2.530
2	4	Sandy loam	-.903+.174	.000	5.060	5.195	4.069	8.595
	8	Sandy loam	-.493+-279	.000	10.193	1.772	.325	2.540

Table 2: Lethal concertation (LC50) of Biflex in sandy loam soil and clay loam soil at Different concentration at different time intervals (post treatment).

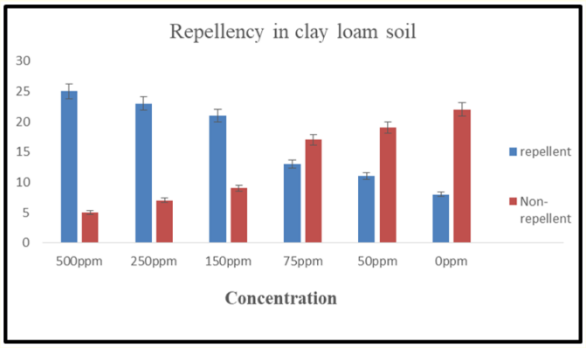

Figure 1: A repellent effect of biflex to termites at different concentration in clay loam soil.

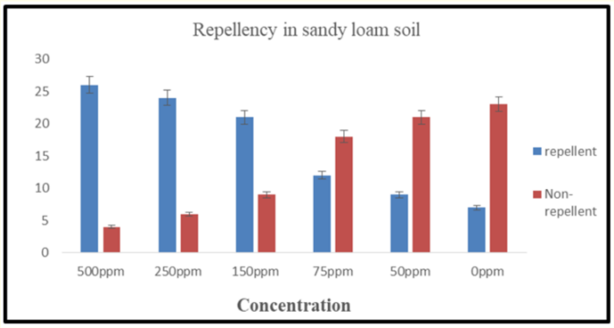

Figure 2: A repellent effect of biflex to termites at different concentration in sandy loam soil.

Discussion

In this study, we investigated the toxicity and repellency of an insecticide biflex having novel mechanism of action against a termite collected from the area of thokar nayaz bag Lahore, Pakistan. Soil toxicity test revealed that by increasing concentration of biflex mortality rate of termites also increase significantly ($P<0.05$). So, biflex is more toxic at high concentrations. Furthermore, it was also noted that a greater LC_{50} of biflex required a greater time to kill a population of termites. The results regarding the repellency of biflex showed that its repellent at higher dose i.e., 500ppm, 250ppm, 150ppm, whereas, its non-repellent at all other concentrations less than 75ppm, 50ppm, 0ppm. This proved that biflex has a fast mechanism of action and also a repellent toxicant. Hence it requires a long period of time for its potential activity.

Ahmed and Qasim (2011) showed a revision on termites scavenging and foraging activity and used chlorpyrifos, imidacloprid, bifenthrin and alphacypermethrin as test termiticide. Chlorpyrifos and alpha Cypermethrin were the most effective termiticides against termites. Collaboration of concentrations and depths of despair of soil has exposed non-significant variance between chlorpyrifos and fipronil. Usually, chlorpyrifos is considered as a repellent termiticides, on the other hand, in case of this study (Smith and Rust, 1990) termites penetrated in the soil treated with it. In the same way, (Spomer et al., 2009) examined in cooperation Small and high quantities of certain insecticides was used to remove insect pests were tested. When evaluating small or high tag used are suitable form a given kind of soil, bioavailability and environmental fate of termiticides in certain soils is a significant factor.

In 2013 Iqbal and Saeed also investigated the toxic effect of latest insecticide which are imidacloprid, fipronil, thiamethoxam, Spinosad and Chlorfenapyr against Microtermes mycophagus. For fipronil and chlorfenapyr, LC_{50} values for termite species Microtermes mycophagus introduced to soil treated with different concentrations of these termiticides were measured and found to be 2.80-3.45ppm for fipronil and 3.72-5.88ppm for chlorfenapyr. The result indicated that imidacloprid is toxic chemical at higher concentrations. Present study results were not consistent with some previous researches about toxicity of chemical.

Saran and Kamble (2008) performed a 6-month research on Nebraska loamy soil to determine the degradation and bioavailability of Bifenthrin, Fipronil, and Imidacloprid in contrast to the Reticuliterme flavipes. A half-life model was used to calculate the rate of deterioration. The rate of degradation was lowermost label rate was faster than the maximum sticky label rate, suggesting that termiticide degradation was concentration dependent. For the evaluation of termiticide bioavailability, laboratory bioassays were performed at 8 hours for every 30 mints, and the same procedure was repeated after one month. Bioavailability decreased as the treated soil aged, according to the findings. The LC_{50} and concentration were shown to have an inverse relationship. Bifenthrin has the strongest effectiveness in greater concentrations than any other termiticide.

Su (2005) also proved the efficacy of Fipronil and found that 2ppm of Fipronil that can fully stop the outcome showed that cadusafos is highly toxic against termites after 8 hours' treatment than Bifenthrin, Fipronil, Chlorfenapyr and Imidacloprid even at lowest concentrations. Bifenthrin was more toxic than Imidacloprid, Chlorfenapyr and Fipronil but less than cadusafos. Imidacloprid, Chlorfenapyr and Fipronil are slow acting insecticides and showed less mortality when compared to Bifenthrin.

Conclusion

The present study indicated that the biflex were toxic to termites in both soils however biflex with mortality and LC_{50} was 500ppm found to be more toxic as compared to Others. Biflex was repellent at higher concentrations and all other non-repellent. These results showed that biflex are long acting and repellent toxic chemical with detain toxicity, making it suitable for long-term control program. Biflex is repellent at higher concentrations i.e. 500ppm, 250ppm, 150ppm and all other concentrations were non-repellent in both types soil Biflex also known as repellent insecticide.

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