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Effect of Different Plant Extracts on Termite Species (*Heterotermis indicola*)

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**EFFECT OF DIFFERENT PLANTS EXTRACTS ON TERMITE SPECIE
(*HETEROTERMIS INDICOLA*)**

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ABSTRACT

This study was carried out to find the effect of some commonly present plant products on termite species (*Heterotermis indicola*) which are a major threat worldwide. Three different concentrations (20%, 10%, 5%) of various solutions consisting of garlic, Neem and tobacco was used in hot and cold water. Hot and cold water results showed that a high concentration treatment of the garlic (20%) solution caused 100% mortality after 48 hours, but in the case of the tobacco concentration (20%) of the solution in only cold water resulted in 100% mortality. As the concentration become lower, the efficiency becomes slower. 100% mortality in the 10% & 5% solutions of garlic and tobacco occurred in different days. In case of Neem, both hot and cold water was found less effective as compared to garlic and tobacco. The mortality occurred using Neem was significantly less than garlic and tobacco.

Keywords: Termite, Hot and Cold Water, percent mortality, days, different Concentrations

INTRODUCTION

Termites are a group of insects (Isoptera) consisting of 2500 species, of which 300 are considered pests. Termites are social insects found in a wide range of terrestrial environments distributed throughout the world. Termites feed on the decomposition of organic wastes like leaves, animal dung, and living or dead wood. Approximately 2600 species and 281 genera have been described. (Kambhampati and Eggleton, 2000).

Termites are the one of the most damaging pests in the tropics and cause

considerable problems in housing, agriculture and forestry. Termites have families, including sub-families. Some have nests underground, others in wood. For example, some termites hollow out trees and some build mounds. The most difficult types of termites in agriculture are termites on fungal growth, residues of crops and other organic material used for feeding, like mulches and organic soil matter (humus). However, they also feed on the material of live plants when they don't find their required food, including crops such as groundnuts, millets and maize (Zaheer *et al.* 1998.).

Arid and semi-desert areas are the best place for Harvester termites. They build underground nests that can be difficult to locate. They live in the collection of green plants and cause material damage to living grasses, crops and seedlings. Harvester termites will attack weak plants that are wilting or damaged. Subterranean termites are well established pests to wood in service in Portugal, namely to historical timber structures or structural elements. It has been estimated that termites cause over 3 billion dollars of wooden structural damage in a whole year in the United States, with at least 80% of that attributable to subterranean termites. Termites are polymorphic social insects living in colonies that comprise of reproductive, soldier and worker termites. Both winged and wingless individuals occur in a colony. The queen is much bigger than the king. Mouth parts are a chewing type and metamorphosis is simple. Of all the insects, only the termites have workers and soldiers of both sexes. (Donald *et al.* 1979).

Termites found in Pakistan, especially in NWFP. They are either soil or wood inhabiting termites (Chaudhry *et al* 1972). The climate of NWFP is most favorable for the production of different fruits, food and sugar crops. Among fruits, peaches, apricot, citrus, guava, plum, apple and persimmon are grown and attacked by different insects, however, termites are the most serious and inflict huge losses, both to the farming community and the government exchange (Salihah *et al.*, 1988).

Various scientists (Zaheer *et al.* 1998, Lin and Wang 1988, Haung *et al.* 1990, Parihar 1981 and Hutchins *et al.* 1997, Chen *et al.* 1986, Jalees *et al.* 1993) have studied different plant extracts for their toxicity, repellency and attractancy of termites and insect species against a variety of natural

products. (Haung *et al.*, 1990).

Neem Tree (*Azadirachta indica*) extracts used for pest control currently occurs in more than 55 countries. Products of Neem have been used in different parts of Asia, such as Burma and India, for over 2,500 years. The growing world-wide demand is for clean food and better ecological approaches to pest control.

The objectives of this study were to screen out the different plant extracts for control of the termites and to find eco-friendly techniques for the control of termites.

MATERIALS AND METHODS

Collection of termites

This experiment was carried out at the Nuclear Institute for Food and Agriculture (NIFA) during 2009. First, all of the NIFA-TERMPAS were checked out to find the infested ones. The old infested bundles of NIFA-TERMPAS were replaced by new ones. The chosen infested NIFA-TERMPAS were brought into the research lab through different sieves. Plastic tubes were used, through which debris, soil, and the termites were passed. Blotting paper trapped the active termites after a few minutes. Plastic tubs held the inverted Petri-dishes that were placed to put the remaining termites with soil and soil debris.

Preparation of different plants extracts

This particular study was related to three different plants, the details of which are below:

Allium sativum (Garlic)

The garlic was cleaned and chopped in a new pestle and mortar. 125 g of the chopped material was taken and covered with muslin cloth. 625 ml of distilled water (hot and cold) was taken and the sample

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with the muslin cloth was kept in distilled water for 24 hours. After 24 hours, the extracts from the 125 g sample was extracted and filtered with muslin cloth. The 125 ml of garlic juice was mixed with 250 ml of hot water, and 62.5 ml of garlic juice with 250 ml of cold water. Each treatment repeated three times. The blotting papers were dipped in both types of water and then poured into petri dishes for the purpose of the experiment.

***Azadirachta indica* (Neem)**

Neem extract was prepared by adding 125 g of grinded Neem in 250 ml of hot and cold water and kept for 24 hours. The same method was used after filtering the material.

***Nicotiana tabacum* (Tobacco)**

The tobacco extract was prepared by adding 125 g of grinded tobacco in 250 ml of hot and cold water and kept for 24 hours. The same method for garlic and Neem was used (mentioned above).

RESULTS

Different extracts of plants were used to check their effectiveness against the termite species *heterotermis indicola* at the Nuclear Institute for Food and Agriculture (NIFA), Tarnab Peshawar. The results on the effect of cold water plant extracts are presented in Table 1, and the hot water plant extracts are presented in Table 2.

On the 3rd day, mortality reached 36% using the garlic 10% solution, which was significantly different from the other treatments. The garlic 5% solution caused 0.00% mortality, the Neem 20% solution 8.00% mortality, the Neem 10% solution had zero percent mortality, and the Neem 5% also had 0.00% mortality. The tobacco 10% solution had 24.00% mortality, and the

tobacco 5% solution caused 0.00% mortality. These treatment results are non-significant with each other.

On the 4th day, the mortality increased to 60% using the garlic 10% solution, which was significantly higher than the other treatments. The mortality of the garlic 5% solution was 12.00%, the Neem 20% solution was 24.00%, the Neem solution 10% solution having 4.00%, and the Neem 5% solution had a mortality rate of 0.00%. The tobacco 10% solution had 48% mortality, and the tobacco 5% solution caused 12.00% mortality. the treatments result is non-significant with each other.

On the 5th day mortality, was 72%, which then increased to 100% on the 6th day of using the garlic 10% solution. This result was significantly different from other treatments on day 5, as well as on day 6. Mortality using the garlic 5% solution was 48.00%, the Neem 20% solution caused 41.33% mortality, the Neem 10% solution had a mortality rate of 12.00%, and the Neem 5% solution had a 0.00% mortality rate. The tobacco 10% solution caused 80.00% mortality, and the tobacco 5% solution caused 48.00% mortality. These results were also non-significant with one another (Table 1).

On the 7th day, the garlic 5% garlic 5% solution mortality was 79%, which was significant from the other treatments in mortality. The Neem 20% solution mortality was 45.40%, the Neem 10% solution had a mortality rate of 19.70%, and the Neem 5% caused 2.84% mortality. The tobacco 10% solution had a 98.60% mortality rate, and the tobacco 5% solution mortality rate was 58.04% (Table 1).

On the 8th day, the garlic 5% solution mortality was 98%, which then reached 100% on 9th day. The results were

Table 1: The percent mortality of termites in cold water in different concentration of plant extracts.

Days	Garlic 20%	Garlic 10%	Garlic 5%	Neem 20%	Neem 10%	Neem 5%	Tobacco 20%	Tobacco 10%	Tobacco 5%
1	8.00 ^A	4.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	8.00 ^A	0.00 ^B	0.00 ^B
2	100 ^A	12.00 ^B	0.00 ^C	4.00 ^C	0.00 ^C	0.00 ^C	100 ^A	4.00 ^C	0.00 ^C
3	100 ^A	36.00 ^B	0.00 ^C	8.00 ^C	0.00 ^C	0.00 ^C	10 ^A	24.00 ^B	0.00 ^C
4	100 ^A	60.00 ^B	12.00 ^E	24.00 ^D	4.00 ^F	0.00 ^F	100 ^A	48.00 ^C	12.00 ^E
5	100 ^A	72.00 ^B	24.00 ^{DC}	28.00 ^C	12.00 ^{DE}	0.00 ^E	100 ^A	60.00 ^B	26.66 ^{DC}
6	100 ^A	100 ^A	48.00 ^B	41.33 ^B	12.00 ^C	0.00 ^C	100 ^A	80.00 ^A	48.00 ^B
7	100 ^A	100 ^A	79.16 ^B	45.40 ^C	19.70 ^D	2.84 ^D	100 ^A	98.60 ^A	58.04 ^C
8	100 ^A	100 ^A	98.56 ^A	57.14 ^B	35.66 ^C	18.60 ^C	100 ^A	100 ^A	78.56 ^A
9	100 ^A	100 ^A	100 ^A	77.60 ^B	42.74 ^C	21.86 ^D	100 ^A	100 ^A	100 ^A
10	100 ^A	100 ^A	100 ^A	92.44 ^A	55.20 ^B	32.80 ^C	100 ^A	100 ^A	100 ^A

Table 2: The percent mortality of termites using hot water in different concentration of plant extracts.

Days	Garlic 20%	Garlic 10%	Garlic 5%	Neem 20%	Neem 10%	Neem 5%	Tobacco 20%	Tobacco 10%	Tobacco 5%
1	9.33 ^A	4.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B	0.00 ^B
2	100 ^A	12.00 ^B	0.00 ^D	0.00 ^D	0.00 ^D	0.00 ^D	12.00 ^B	4.00 ^C	0.00 ^D
3	100 ^A	36.00 ^B	0.00 ^D	0.00 ^{DC}	0.00 ^D	0.00 ^D	20.00 ^C	4.00 ^{DC}	4.00 ^{DC}
4	100 ^A	60.00 ^C	12.00 ^B	8.00 ^{FE}	4.00 ^{FG}	4.00 ^G	80.00 ^B	24.00 ^D	12.00 ^E
5	100 ^A	71.28 ^B	21.77 ^D	5.44 ^F	5.44 ^F	9.61 ^{EF}	100 ^A	34.22 ^C	17.72 ^{ED}
6	100 ^A	100 ^A	45.83 ^B	12.50 ^D	8.33 ^D	8.33 ^D	100 ^A	45.83 ^B	25.00 ^C
7	100 ^A	100 ^A	79.16 ^B	19.80 ^D	15.52 ^D	15.45 ^D	100 ^A	73.24 ^B	45.04 ^C
8	100 ^A	100 ^A	100 ^A	27.11 ^C	18.54 ^C	18.53 ^C	100 ^A	92.75 ^A	52.84 ^B
9	100 ^A	100 ^A	100 ^A	33.60 ^C	24.84 ^D	16.20 ^E	100 ^A	100 ^A	60.15 ^B
10	100 ^A	100 ^A	100 ^A	46.25 ^C	28.32 ^D	19.38 ^D	100 ^A	100 ^A	77.60 ^B

significant from the other treatments with mortality. The Neem 20% solution had a mortality rate of 57.14%, the Neem 10% solution caused 35.66% mortality, and the Neem 5% had a mortality rate of 18.60%. The tobacco 10% solution had a mortality rate of 100.00%, and the tobacco 5%

solution caused 78.46% mortality. These results were also non-significant with each other (Table 1).

On the 9th day, the Neem 20% solution mortality reached 77.60%, which was significantly different from the 5% and 10% Neem solutions (Table 1).

On the 10th day, the Neem 20% solution mortality reached to 92.44%, which was significantly different from the 5% and 10% Neem solutions, but non-significant from the 5% tobacco solution (Table 1).

The percentage of termite mortality rates in Table 2 in response to hot water plant extracts showed that during the first day, mortality was the same using all treatments. On the 2nd day, the mortality percentage was up to 100% in the garlic. These solutions have mortality rates of 12.00%, 0.00%, 0.00%, 0.00%, 0.00%, 20.00%, 4.00%, and 0.00% respectively.

On the 3rd day, the mortality reached to 36% in the garlic 10% solution, which was significantly higher from other treatments. The garlic 5% solution, the Neem 20% solution, the Neem 10% solution, the Neem 5% solution, the tobacco 20% solution, the tobacco 10% solution, and the tobacco 5% solution had mortality rates of 0.00%, 4.00%, 0.00%, 0.00%, 20.00%, 4.00% and 4.00% respectively. These treatments results were non-significant with each other.

On the 4th day, mortality was 60% in the garlic solution, the 10% solution was significant from the other treatments (garlic 5% solution, Neem 20% solution, Neem 10% solution, Neem 5% solution, tobacco 20% solution, tobacco 10% solution, and tobacco 5% solution have mortality rates of 12.00%, 8.00%, 4.00%, 4.00%, 80.00%, 24.00%, and 12.00%, respectively. These treatment results are non-significant with each other).

On the 5th day, mortality was 71.28%, and reached to 100% on day 6 using the garlic 10% solution. This result is significantly higher from the other treatments on day 5, as well as on day 6. The mortality rates were 45.83%, 12.50%,

20% solution, which was highly significant from the other treatments, but non-significant to each other. 100% mortality occurred in the garlic 20% solution, followed by the garlic 10% solution, the garlic 5% solution, the Neem 20% solution, the Neem 10% solution, the Neem 5% solution, the tobacco 20% solution, the tobacco 10% solution, and the tobacco 5% solution.

12.50%, 8.33%, 8.33%, 45.83%, and 25.00%. These treatments results are non-significant with each other.

On the 7th day, a 79.00% mortality rate occurred in the garlic 5% solution, which was significantly different from the other treatments. The Neem 20% Neem 10%, Neem 5%, tobacco 10% and tobacco 5% solutions had mortality rates of 19.80%, 15.52%, and 15.45%, 73.24% and 45.04% respectively. These treatment results are non-significant with each other.

On the 8th day, 100% mortality occurred using the garlic 5% solution, which was significantly different from other treatments, i.e., the Neem 20%, Neem 10%, Neem 5%, tobacco 20%, tobacco 10%, and tobacco 5% solutions had mortality rates of 27.11%, 18.54%, 8.53%, 92.75%, and 52.84% respectively. These treatment results are non-significant with each other.

On the 9th day, 33.80% mortality occurred using the Neem 20% solution, which was significantly different from the other treatments. The Neem 5% tobacco, tobacco 5% solution these solution having mortality of 24.84%, 16.20%, 100.00%, and 60.15%. These treatment results are non-significant.

On the 10th day, mortality using the Neem 20% solution reached 46.25%.

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Solutions which were significantly different from the other treatments include the Neem 5% solution and the tobacco 5% solution. These solutions had mortality of rates of 28.32%, 19.38%, and 77.60%. These treatments result non-significant with each other.

DISCUSSION

Highly effective chemical treatments have been available for many years to prevent subterranean termite attacks and to control infestations. The use of termiticides for control of termites has generated a number of biological and environmental hazards in water, soil, air, and food. In addition to these dilemmas, these treatments are costly and require special equipment. The present study was designed to examine the possibilities of plant (garlic, Neem and tobacco) extracts for their insecticidal properties. The extracts of these plants were made with distilled water.

Garlic was tested against *Heterotermis indicola* in the present study. After only 24 hours, 100 % mortality occurred using this treatment, which is highly significant from the other treatments. Park and Shine (2005) results, who tested garlic oil (3.5 micro litre/liter) against the Japanese termite *Reticulitermes speratus* Kolb with 100% mortality rates after 24 hours of treatment, completely coincide with our results. . Garlic oil shows the most effective anti-termite acidity among the plant essential oils.

Iqram *et al.* (2003) carried out an experiment on ten different plant extracts and antagonistic fungi for the control of *xanthomonas compastris*. He found that garlic gave the best results against this pest, followed by other treatments.

The result of Neem oil was similar to

Serit *et al* (1992), who reported that Neem oil deterred feeding by *Reticulitermes speratus* and added that a methanol extract of the oil was 4-fold more active than the whole oil.

Christos *et al* (2005) also examined the insecticidal effect of the azadirachtin based insecticide, Neem Azal, against adults of *Rhyzopertha dominica* (F), *Sitophilus oryzae* (I) and *Tribolium confusum*. The insecticide was applied at three dose rates, which were equivalent to 50, 100 and 200 ppm of azadirachtin A. We found that in all species and commodities tested, mortality increased with the increase of the dose and exposure interval, except for *T. confuse*, on whole and peeled oats. For *R. dominica*, Neem Azal was more effective on oats than on rye and peeled oats

SUMMARY

Termiticides used for the control of termites has generated a number of biological and environmental hazards in air, water, soil and food. In addition to these dilemmas, these treatment are expensive and require specialized techniques. Increasing concern over environmental contamination and threats to human health by the current termiticides, particularly chlorinated hydrocarbon, has slowly led to a search for new materials and innovative approaches to termites using more sophisticated biological materials.

This study was done to find out the effect of some commonly present plant products on the termites species *Heterotermis indicola*, which is a world-wide problem. Three different concentrations (20%, 10%, 5%) of solutions consisting of garlic, tobacco and Neem in cold, as well as in hot water were tested. Cold water results showed that high concentration treatments of garlic and

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tobacco (20%) solution caused 100% mortality after 48 hours, while as the concentration became lower, the efficiency also become slower. 100% mortality in 10% and 5% solutions of garlic occurred after the 6th and 9th day respectively. In tobacco (10% and 5%) solutions, 100% mortality occurred after the 8th and 9th day respectively. Neem was found less effective as compared to garlic and tobacco. At day 10, 20%, 10% and 5% solutions of Neem, the mortality rate was 92.44%, 55.20% and 32.80% respectively, which is significantly less than garlic and tobacco.

In the hot water treatment, garlic gave the same result as was given in the cold water treatment. 100% mortality in the 20% solution occurred after 48 hours two days of the treatment while in tobacco 20%, 100% mortality occurred after 5 days of treatment. It should be clear that the efficiency of tobacco in hot water decreased. In garlic solutions of 10% and 5%, 100% mortality occurred after the 6th and 8th day respectively. In tobacco, 10% and 5% mortality was found after the 9th day, while in the 5% concentrated solution, the same mortality occurred after 10 days. Mortality was 77.6% in the Neem 20%, 10%, and 5% solutions. Mortality after 10 days was 46.25%, 28.23% and 19.38% respectively. We conclude that the efficiency of garlic was not affected by hot and cold water treatments, while the effect of tobacco and Neem is affected by hot water. Evaporation is an important ingredient to having insecticidal properties, as the solution may become ineffective or evaporate as diluents are hot.

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