Anti-termitic activities of plant extracts against *Heterotermes indicola* in District Swat, Khyber Pakhtunkhwa, Pakistan

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Abstract

Termites are the most destructive pests for agriculture crops and other commodities throughout Pakistan. Current, experiment was conducted for ecofriendly management of termites. Different specimens of termite *(Heterotermes indicola*) both worker and soldier caste were collected from various localities of district Swat. Specimens were identified based on the morphometric characters of soldier caste. For the management of termites total six different species of plants (*Cannabis sativa, Teucrium royleanum, Solanum dulcamara, Lepidium penatifidum, Andrachne cordifolia, Zanthoxylum armatum*) at concentrations 5000 ppm, 8000 ppm, and 10,000 ppm were evaluated by using direct contact application and was used to determine their efficacy as termiticidal agent against *H. indicola*. Toxicity of various plant extracts was checked after 72 hours treatment. *Cannabis sativa* and *Tencrium royaleanum* were highly efficient against *H.indicola* and caused significant mortality. *C. sativa* at conc 5000 ppm, 8000 ppm, and 10,000 showed 4%, 12% and 68% mortality respectively at third day and *T. royleanum* at concentration 5000 ppm, 8000 ppm, and 10,000 showed 84%, 100%, 100% mortality respectively at third day of experiment. It was concluded that different dosages of *T. royleanum* can be used as an effective control agent followed by *Cannabis sativa*.

Key words: Termites, botanical extracts, Swat.

1. INTRODUCTION

1.1. Biology of termites

Termites are the social insects and distributed worldwide (Thorne and Carpenter, 1992). Termites are present mostly in that soil which are having organic rich materials, on clump and rotten wood. They feed on cellulose rich items but they are incapable to digest it. For this purpose, they have symbiotic endomicrobes (protozoans, fungi and bacteria) in their hind gut which manufacture an enzyme named as cellulases which can change cellulose into organic materials taken by termites as carbon source and energy (Stingl et al., 2005; Ikeda et al., 2007). Termites have an important economic role in economic entomology, with the rate of damage to the buildings, especially in different prosperous countries in America and Asia, amounting to many millions of pounds. Damage to houses by termites can, in some countries, exceed that caused by natural disasters and fires in a single year. In developing countries, they have even more impact, destroying local huts and crops of poor subsistence farmers. Villages in India and Egypt have been destroyed by termites and the inhabitants forced to move to other areas. In Asia, ancient temples have also been attacked (Pearce 1997). There are about 2,600 known termites of species, among these only 40 species have been recognized in the (US) United States (Kambhampati and Eggleton, 2000) and 53 species of termites are reported in Pakistan but only 11 species out of them were found to cause damage (Naeem and Shafqat, 2013).

1.2. Systematic position of termites

The systematic position of termites is (Phylum Arthropoda, Sub phylum mandibulata, Class Insecta [hexapoda], Group ectogntha, Sub phylum pterygota, infra class Exopterygota, order isoptera) There are seven families in order isoptera including Rhinotermitidae, Hodotermitidae, Termopsidae, Termitidae, kalotermitidea, Mastotermitidae and Semitermitidae (Noirat, 1992; Abe et al., 2000). *Heterotermes indicola* (Wasmann) belonging to order Isoptera and family Rhinotermitidae are considered to be one of the most destructive termites by attacking on wood in urban and Agricultural areas (Manzoor et al., 2010).

1.3. Termites as a destructive organism

Termites are most unnecessary pests of wood because they have the ability to spoil wooden structures. But they take part in a in recycling of plant materials and wood, changing the soil conditions. It modifies structure of soil and productivity by rising organic matter in soil, as they are competent decomposer of cellulose (Sugimoto et al., 2000). They also supply food for other animals (Lee and Wood, 1971). Termites are considered as the dangerous for domestic materials and is a pest

of cultivated crops. They are the chief pests of crops and wood made things in tropical areas. As termites are more efficient in utilization of various types of food and this capacity helped them to become the standing crops pest and wood and some can affect cabinets and furniture also (Akutse and Owusu, 2012).

1.4. Control methods of termites

Biological control is one of the ways that involve the use of compounds which are active biologically for termite control. This biologically active compounds of plants for termite control is very cheap, easy to handle and its effect on environment is very less. presently there is an increasing worldwide attention in developing compounds which are biologically active and can be used in place of synthetic chemical compound to control pests of remedial and commercial worth importance because these compounds can be simply degraded, harmless and are not detrimental as synthetic pesticides are (Moretti et al., 2002; Ojewole et al., 2000; Sosan et al., 2001; Sharma et al., 1998 Cetin and Yanikogh, 2006).

2. MATERIALS AND METHODS

2.1. Termites collection:

Different samples of termites species named as (*H.Indicola)* were collected from different localities of tehsil Kabal which is located in District Swat in the month of June, July 2015. These termites were collected by using a collection trap unit as described by (Sornnuwat et al., 1996) with some modifications and identified with the help of taxonomic keys (Akhtar, 1983). Specimens were preserved in 70% ethanol for their morphological identification.

2.2. Identification of termites:

Termites were identified and recognized by their morphometric analysis. Specimens from the samples were selected randomly and calculated under stereoscopic binocular microscope. This microscope was built in magnification changer. Calibrated ocular micrometer was used for measurements.

2.3. Extraction method:

The shoots of six different plants were splashed with water to eliminate the associated organisms and attached salts. After that the leaves were dried in oven at 37 Celsius and crumpled with the help of electric grinder. 40 and 60 mesh retained substances was carefully chosen. For experiments 30g grinded shoot of that plants were used and extracted in 300ml of solvents.

3. RESULTS AND DISCUSSION

3.1. Morphometric analysis of *Heterotermes indicola*

Morphometry is the measurement of different body part of an organism. It is essential for the identification of an organism. (*Heterotermis indicola)* specie was identified by their morphometric analysis of its mouth parts. Different specimens from the samples were selected up randomly and calculated under stereoscopic binocular microscope with built in magnification changer. Measurements were taken with the aid of calibrated ocular micrometer.

3.2. Collected plants diversity.

Plants which were collected for extraction from different locations of tropical region. These plants were reported to have toxic activity against microbes. The different plants were *Solanum dulcamara, Lepidium pinnatifidium, Cannabis sativa, Andrachne cordifolia, Zanthoxylum armatum* and *Teucrium royleanum.*

3.3. Termiticidal activity of plant extracts

Different extracts were made from these collected plants individually and was applied on the selected specie of termites (*H. Indicola*) to test their insecticidal activity. The mortality of termites, *H. indicola*, exposed to to different plant extracts at different concentrations prepared in water as a solvent and up to 3 days its activity was recorded. Among these 6 plant extracts *T. royleanum* extracts showed good termiticidal activity against *H. indicola* followed by *C. sativa* plant extracts.

3.3.1. Insecticidal activity of *Solenum dulcamara*:

The workers of *H. indicola* fed on the extract of *S. dulcamara* plant at concentrations 5000 ppm, 8000 ppm and 10,000 ppm showed 24%, 28%, 32% of mortality rate respectively. On the first day of experiment no significant mortality was observed. After 72 hours or 3rd day of the experiment. The extract of this plant at different concentration showed comparable fewer toxic effects on the workers of this species of termite. The high concentration of this plant extracts was found to be the most toxic as compared to less concentration. (Table.1).The data obtained from the control groups showed no mortality of termites during the period of experimentation.

3.3.2. Insecticidal activity of *Cannabis sativa*:

The second plant extract was taken from *C. sativa* for the conducted experimentation. The concentrations taken from this plant extract was taken in small ppm and also the stock solution was tested to test its

activity against termites as 5000, 8000 and 10,000 ppm. The mortality showed by these concentrations was 4%, 12%, and 68% respectively after 72 hours from the start of experiment. (Table.2)

3.3.3. Insecticidal activity of *Andrachne cordifolia*:

The third extract was taken from the *A.cordifolia* plant. The concentrations taken from this plant extract was 5000, 8000, and 10,000 ppm showed mortality as 10%, 13% and 20% respectively after three days from the start of experiment (table.3). The result of this plant extracts showed that *H.indicola* termite's specie is very resistant to different concentrations of this plant. Because their percentage mortality was less as compared to other plant extracts.

3.3.4. Insecticidal activity of *Zanthoxylum armatum*:

The fourth plant extrat was taken from the *Z. armatum* which showed no significant difference in the percentage mortality. The different concentrations of the extract were 5000, 8000 and 10,000 ppm showed percentage mortality as 13%, 16%, and 20% respectively after the 72 hours from the start of experiment (Table.4). The data obtained from the control groups showed no mortality of termites during the period of experimentation.

3.3.5. Insecticidal activity of *Lepidium Pinnatifidum*:

L.pennatifidum plant extracts result appeared to be toxic as compared to the result showed by the previous plant extracts in (table 3.6). The same concentrations were taken as 5000 ppm, 8000 ppm, and 10,000 ppm showed %age mortality as 24%, 28% and 36% respectively after three days (72 hrs) from the start of experiment (Table.5). The data obtained from the control groups showed no mortality of termites during the period of experimentation (Table.5).

3.3.6. Insecticidal activity of *Teucrium royleanum* in water solvent:

On the first day of experiment in control group no significant mortality was observed. The extracts taken from the *T.royleanum* plant was found to be the most effective for the biological control of termites because their percentage mortality was on the peak among the six plants extracts used in the study. The different concentrations of this extracts were 5000, 8000 ppm and 10,000 ppm which showed percentage mortality as 84%, 100% and 100% respectively (Table3.8) after three days from the start of experiment (72 hours).

Table 3.1.1 Morphometric analysis of *Heterotermis indicola*.

S.No	Morphometric Parameters	Mean ± SEM (µm)
1	Full body length	57.42 ± 1.1
2	Head length	14.71 ± 0.60
3	Length from mendible tip to head	23.64 ± 0.56
4	Length of mandible	8.28 ± 0.18
5	Length of Prothorax	4.85 ± 0.34
6	Length of Mesothorax	3.14 ± 0.14
7	Length of Metathorax	2.71 ± 0.42
8	Length of Abdomen	2.44 ± 0.92
9	Length of Antennae	11.42 ± 0.71
10	Length of Pronotum	14.85 ± 0.40
11	Width of Pronotum	8.85 ± 0.26
12	Length of Post Mentum	11.57 ± 0.81
13	Width of Post Mentum	3.64 ± 0.17

Table.2. Showing Percentage mortalities of *H.indicola* workers and soldiers feeding on the different concentrations of *C. sativa* plant extract on filter paper on corresponding days.

Extract	Conc. Ppm	Total no of termites	Mortality/72 hours
Cannabis Sativa	5000 ppm	25	4%
	8000 ppm	25	12%
	10,000 ppm	25	68%
	Control group	25	0%

Table.3. Showing Percentage mortalities of *H.indicola* workers and soldiers feeding on the different concentrations of *A. cordifolia* plant extracts on filter paper on corresponding days.

Extract	Conc. Ppm	Total no of termites	Mortality/72 hours
Andrachne Cordifolia	5000ppm	30	10%
	8000ppm	30	13%
	10,000ppm	30	20%
	Control group	30	0%

Table.4. Showing Percentage mortalities of *H.indicola* workers and soldiers feeding on the different concentrations of *Z. armatum* plant extracts on filter paper on corresponding days.

Extract	Conc. Ppm	Total no of termites	Mortality/72 hours
Zanthoxylum Armatum	5000ppm	30	13%
	8000ppm	30	16%
	10,000ppm	30	20%
	Control group	30	0%

Table.5. Showing Percentage mortalities of *H.indicola* workers and soldiers feeding on the different concentrations of *L. pennatifidum* plant extracts on filter paper on corresponding days.

Extract	Conc. Ppm	Total no of termites	Mortality/72 hours
Lepidium Penatifidum	5000ppm	25	24%
	8000ppm	25	28%
	10000ppm	25	36%
	Control group	25	0%

Table.6 Showing Percentage mortalities of *H. indicola* workers and soldiers feeding on the different concentrations of *T. Royleanum* plant extracts on filter paper on corresponding days.

Extract	Conc. Ppm	Total no of termites	Mortality/72 hours
Teucrium Royleanum	5000 ppm	25	84%
	8000 ppm	25	100%
	10,000 ppm	25	100%
	Control group	25	0%

4. Conclusion

From the result of our whole studies, it came to our knowledge that among the six plant extracts the different concentrations of *T.royleanum* were more toxic to termites due to the presence of some toxic components because it showed high mortality rate and may use against termites for their biological control.

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